



User Guide

AWS Clean Rooms



AWS Clean Rooms: User Guide

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What is AWS Clean Rooms?

AWS Clean Rooms helps you and your partners analyze and collaborate on your collective datasets to gain new insights without revealing underlying data to one another. AWS Clean Rooms is a secure collaboration workspace, where you create your own clean rooms in minutes, and analyze your collective datasets with just a few steps. You choose the partners with whom you want to collaborate, select their datasets, and configure privacy-enhancing controls for those partners.

With AWS Clean Rooms, you can collaborate with thousands of companies already using AWS. Collaboration doesn't require moving data out of AWS or loading it into another cloud services provider. When you run queries or jobs, AWS Clean Rooms reads data from that data's original location and applies built-in analysis rules to help you maintain control over that data.

AWS Clean Rooms provides built-in data access controls and audit support controls that you can configure. These controls include:

- [Analysis rules](#) to restrict SQL queries and provide output constraints.
- [Cryptographic Computing for Clean Rooms](#) to keep data encrypted, even as queries are processed, to comply with stringent data handling policies.
- [Analysis logs](#) to review queries and jobs in AWS Clean Rooms and help support audits.
- [Differential privacy](#) to protect against user-identification attempts. AWS Clean Rooms Differential Privacy is a fully-managed capability that protects the privacy of your users with mathematically-backed techniques and intuitive controls that you can apply in a few steps.
- [AWS Clean Rooms ML](#) to allow two parties to identify similar users in their data without the need to share their data with each other. The first party creates and configures a lookalike model from their training data. Then, seed data is brought to the collaboration to create a lookalike segment that resembles the training data.

The following video explains more about AWS Clean Rooms.

[AWS Clean Rooms](#)

Are you a first-time AWS Clean Rooms user?

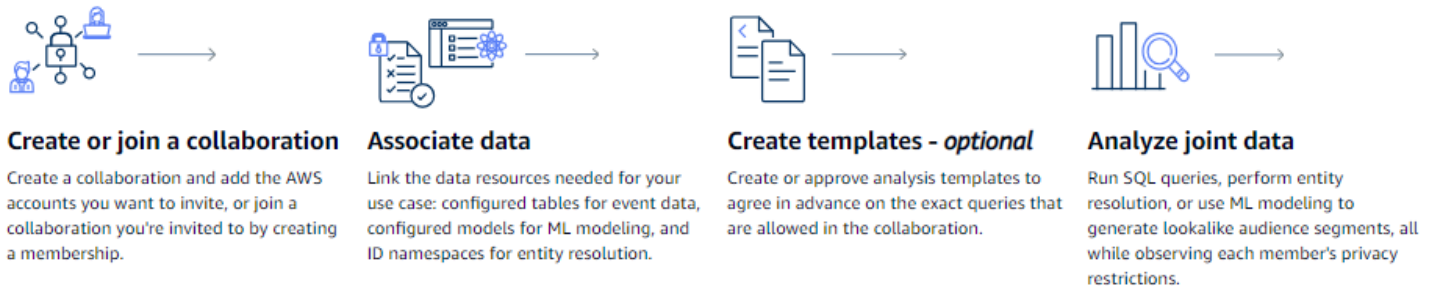
If you are a first-time user of AWS Clean Rooms, we recommend that you begin by reading the following sections:

- [How AWS Clean Rooms works](#)
- [Accessing AWS Clean Rooms](#)
- [Setting up AWS Clean Rooms](#)
- [AWS Clean Rooms Glossary](#)

How AWS Clean Rooms works

In AWS Clean Rooms, you create a collaboration and add the AWS accounts that you want to invite, or create a membership to join a collaboration that you've been invited to. You then link the data resources needed for your use case: configured tables for event data, configured models for ML modeling, or ID namespaces for entity resolution. You have the option to create or approve analysis templates to agree in advance on the exact queries and jobs that you want to allow in a collaboration. Finally, you analyze the joint data by running SQL queries or PySpark jobs on the configured tables, performing entity resolution in ID mapping tables, or using ML modeling to generate lookalike audience segments.

The following diagram shows how AWS Clean Rooms works.



Related services

AWS services

The following AWS services are related to AWS Clean Rooms:

- **Amazon Athena**

Collaboration members can store data that they bring into AWS Clean Rooms as AWS Glue Data Catalog views in Amazon Athena. For more information, see the following topics:

For more information, see the following topics:

[Preparing data tables for queries in AWS Clean Rooms](#)

[Creating a configured table – Amazon Athena data source](#)

[What is Amazon Athena?](#) in the *Amazon Athena User Guide*

- **AWS CloudFormation**

Create the following resources in AWS CloudFormation: collaborations, configured tables, configured table associations, and memberships

For more information, see [Creating AWS Clean Rooms resources with AWS CloudFormation](#).

- **AWS CloudTrail**

Use AWS Clean Rooms with CloudTrail logs to enhance your analysis of AWS service activity.

For more information, see [Logging AWS Clean Rooms API calls using AWS CloudTrail](#).

- **AWS Entity Resolution**

Use AWS Clean Rooms with AWS Entity Resolution to perform entity resolution.

For more information, see [AWS Entity Resolution in AWS Clean Rooms](#).

- **AWS Glue**

Collaboration members can create AWS Glue tables from their data in Amazon S3 for use in AWS Clean Rooms.

For more information, see the following topics:

[Preparing data tables for queries in AWS Clean Rooms](#)

[What is AWS Glue?](#) in the *AWS Glue Developer Guide*

- **Amazon Simple Storage Service (Amazon S3)**

Collaboration members can store data that they bring into AWS Clean Rooms in Amazon S3.

For more information, see the following topics:

[Preparing data tables for queries in AWS Clean Rooms](#)

[Creating a configured table – Amazon S3 data source](#)

[What is Amazon S3?](#) in the *Amazon Simple Storage Service User Guide*

- **AWS Secrets Manager**

Collaboration members can create secrets to access and read data stored in Snowflake.

For more information, see the following topics:

[Create a service role to read data from Snowflake](#)

[Preparing data tables for queries in AWS Clean Rooms](#)

[What is AWS Secrets Manager?](#) in the *AWS Secrets Manager User Guide*

Third-party services

The following third-party service is related to AWS Clean Rooms:

- **Snowflake**

Collaboration members can store data that they bring into AWS Clean Rooms in a Snowflake warehouse.

For more information, see the following topics:

[Preparing data tables for queries in AWS Clean Rooms](#)

[Creating a configured table – Snowflake data source](#)

Accessing AWS Clean Rooms

You can access AWS Clean Rooms through the following options:

- Directly through the AWS Clean Rooms console at <https://console.aws.amazon.com/cleanrooms/>.
- Programmatically through the AWS Clean Rooms API. For more information, see the [AWS Clean Rooms API Reference](#).

Pricing for AWS Clean Rooms

For pricing information, see [AWS Clean Rooms Pricing](#).

Note

For collaboration members who associated data that is stored in Snowflake, you will be charged by their respective data warehouse provider or cloud provider for both data egress and compute each time a query is run that uses data stored in those locations.

Billing for AWS Clean Rooms

AWS Clean Rooms gives the collaboration creator the ability to designate which member is paying for query or job compute costs in the collaboration.

In most cases, the [member who can query](#) and the [member paying for query compute costs](#) are the same. However, if the member who can query and the member paying for query compute costs are different, then, when the member who can query runs queries against their own membership resource, the membership resource of the member paying for query compute costs is billed.

The member paying for query compute costs doesn't see any event for queries being run in their CloudTrail Event history because the payer is neither the one running the queries nor the owner of the resource against which the queries are run. However, the payer does see charges generated on their membership resource for all queries run by the member who can run queries in the collaboration.

For more information about how to create a collaboration and configure the member paying for query compute costs, see [Creating a collaboration](#).

Analytics engine in AWS Clean Rooms

Important

AWS Clean Rooms will end support for the legacy Clean Rooms SQL analytics engine on December 17th, 2025. Before July 16, 2025, you must request a limit increase via AWS Customer Support to create any new Clean Rooms SQL engine-based collaborations.

Starting July 17, 2025, the creation of new Clean Rooms SQL engine-based collaborations will no longer be available.

About the analytics engine

An *analytics engine* is a software component that processes data queries and performs analytical computations within AWS Clean Rooms. The analytics engine interprets SQL commands, executes data processing operations, and returns analysis results.

The following table compares the Spark analytics engine (recommended) with the legacy Clean Rooms SQL analytics engine.

Analytics engine	When would you use it?	Aggregation analysis rule supported ?	List analysis rule supported ?	Custom analysis rule without differential privacy supported ?	Custom analysis rule with differential privacy supported ?	Amazon S3 data source supported ?	Amazon Athena and Snowflake data sources supported ?
Spark analytics engine	- Running Spark SQL queries - Running PySpark jobs - Custom ML modeling	Yes	Yes	Yes	Yes	Yes	Yes
AWS Clean Rooms	Running AWS Clean	Yes	Yes	Yes	Yes	Yes	No

Analytics engine	When would you use it?	Aggregation analysis rule supported?	List analysis rule supported?	Custom analysis rule without differential privacy supported?	Custom analysis rule with differential privacy supported?	Amazon S3 data source supported?	Amazon Athena and Snowflake data sources supported?
SQL analytics engine	Rooms SQL queries						

Additional resources

For information about Spark SQL queries, see the [AWS Clean Rooms Spark SQL Reference](#).

For information about AWS Clean Rooms SQL queries, see the [AWS Clean Rooms SQL Reference](#).

For pricing information for Spark SQL and AWS Clean Rooms SQL, see [AWS Clean Rooms Pricing](#).

Analysis rules in AWS Clean Rooms

As part of enabling a table to use in AWS Clean Rooms for collaboration analysis, the collaboration member must configure an *analysis rule*.

An analysis rule is a privacy-enhancing control that each data owner sets up on a configured table. An analysis rule determines how the configured table can be analyzed.

The analysis rule is an account-level control on the configured table (an account-level resource) and is enforced in any collaboration where the configured table is associated. If there is no analysis rule configured, the configured table can be associated to collaborations but it can't be queried. Queries can only reference configured tables with the same analysis rule type.

To configure an analysis rule, you first select a type of analysis and then specify the analysis rule. For both steps, you should consider the use case you want to enable and how you want to protect your underlying data.

AWS Clean Rooms enforces the more restrictive controls across all configured tables referenced in a query.

The following examples illustrate the restrictive controls.

Example Restrictive control: Output constraint

- Collaborator A has an output constraint on the identifier column of 100.
- Collaborator B has an output constraint on the identifier column of 150.

An aggregation query that references both configured tables requires at least 150 distinct values of identifier within an output row for it to be displayed in the query output. The query output doesn't indicate that results are removed because of the output constraint.

Example Restrictive control: Analysis template not approved

- Collaborator A has allowed an analysis template with a query that references configured tables from Collaborator A and Collaborator B in their custom analysis rule.
- Collaborator B hasn't allowed the analysis template.

Because Collaborator B hasn't allowed the analysis template, the member who can query can't run that analysis template.

Analysis rule types

There are three types of analysis rules: [aggregation](#), [list](#) and [custom](#). The following tables compare the analysis rule types. Each type has a separate section that describes specifying the analysis rule.

Note

There is an analysis rule type called the ID mapping table analysis rule. However, this analysis rule is managed by AWS Clean Rooms and can't be modified. For more information, see [ID mapping table analysis rule](#).

The following sections describe supported use cases and controls for each analysis rule type.

Supported use cases

The following tables show a comparison summary of the supported use cases for each analysis rule type.

Use case	Aggregation	List	Custom
Supported analyses	Queries that aggregate statistics using COUNT, SUM, and AVG functions along optional dimensions	Queries that output row-level lists of the overlap between multiple tables	Any custom analysis as long as the analysis template or the analysis creator have been reviewed and allowed
Common use cases	Segment analysis, measurement, attribution	Enrichment, segment building	First-touch attribution, incremental analyses, audience discovery
SQL constructs	• JOIN statements: INNER JOIN • Aggregate functions: COUNT/COUNT DISTINCT, SUM/SUM DISTINCT, and AVG • Scalar functions: Limited subset	• JOIN statements: INNER JOIN • Scalar functions: None	Majority of SQL functions and SQL constructs available with the SELECT command
Subqueries and common table expressions (CTEs)	No	No	Yes
Analysis templates	No	No	Yes

Supported controls

The following tables show a comparison summary of how each analysis rule type protects your underlying data.

Control	Aggregation	List	Custom
Control mechanism	Control how data in the table can be used in a query <i>(For example, allow COUNT and SUM of column hashed_email.)</i>	Control how data in the table can be used in a query <i>(For example, allow use of column hashed_email only for joining.)</i>	Control what queries are allowed to run on the table <i>(For example, allow only queries defined in analysis templates "Custom query 1".)</i>
Built-in privacy enhancing techniques	• Blind match • Aggregation required • Min aggregation threshold $\geq$ • 2 Pre-defined query structure	• Blind match • Overlap required • Pre-defined query structure • Allowed additional analyses	• Differential privacy • Disallowed output columns
Review query before it can be run	No	No	Yes, using analysis templates

For more information about the analysis rules that are available in AWS Clean Rooms, see the following topics.

- [Aggregation analysis rule](#)
- [List analysis rule](#)
- [Custom analysis rule in AWS Clean Rooms](#)

Aggregation analysis rule

In AWS Clean Rooms, an *aggregation analysis rule* generates aggregate statistics using COUNT, SUM, and/or AVG functions along optional dimensions. When the aggregation analysis rule is added to a configured table, it enables the member who can query to run queries on the configured table.

The aggregation analysis rule supports uses cases such as campaign planning, media reach, frequency measurement, and attribution.

The supported query structure and syntax are defined in [Aggregation query structure and syntax](#).

The parameters of the analysis rule, defined in [Aggregation analysis rule - query controls](#), include query controls and query results controls. Its query controls include the ability to require that a configured table is joined to at least one configured table owned by the member who can query, either directly or transitively. This requirement allows you to ensure that the query is run on the intersection (INNER JOIN) of your table and theirs.

Aggregation query structure and syntax

Queries on tables that have an aggregation analysis rule must adhere to the following syntax.

```
--select_aggregate_function_expression
SELECT
aggregation_function(column_name) [[AS] column_alias ] [, ...]

--select_grouping_column_expression
[, {column_name|scalar_function(arguments)} [[AS] column_alias ]][, ...]

--table_expression
FROM table_name [[AS] table_alias ]
    [[INNER] JOIN table_name [[AS] table_alias] ON join_condition] [...]

--where_expression
[WHERE where_condition]

--group_by_expression
[GROUP BY {column_name|scalar_function(arguments)}, ...]]

--having_expression
[HAVING having_condition]
```

```
--order_by_expression
[ORDER BY {column_name|scalar_function(arguments)} [{ASC|DESC}]] [,...]]
```

The following table explains each expression listed in the preceding syntax.

Expression	Definition	Examples
<i>select_aggregate_function_expression</i>	A comma-separated list containing the following expressions: - select_aggregation_function_expression - select_aggregate_expression	SELECT SUM(PRICE), user_segment
	 Note There must be at least one select_aggregation_function_expression in the select_aggregate_expression .	
<i>select_aggregation_function_expression</i>	One or more supported aggregation functions applied to one or more columns. Only columns are allowed as arguments of aggregation functions.	AVG(PRICE) COUNT(DISTINCT user_id)

Expression	Definition	Examples
	Note There must be at least one <code>select_aggregation_function_expression</code> in the <code>select_aggregate_expression</code> .	
<code>select_grouping_column_expression</code>	An expression that can contain any expression using the following: • Table column names • Supported scalar functions • String literals • Numerical literals Note <code>select_aggregate_expression</code> can alias columns with or without the <code>AS</code> parameter. For more information, see the AWS Clean Rooms SQL Reference.	<code>TRUNC(timestampColumn)</code> <code>UPPER(campaignName)</code>

Expression	Definition	Examples
<i>table_expression</i>	A table, or join of tables, connecting join conditional expressions with <code>join_condition</code> . <code>join_condition</code> returns a Boolean. The <code>table_expression</code> supports: • A specific JOIN type (INNER JOIN) • The equality comparison condition within a <code>join_condition</code> (=) • Logical operators (AND, OR).	<pre>FROM consumer_table INNER JOIN provider_ table ON consumer_table.ide ntifier1 = provider_ table.identifier1 AND consumer_table .identifier2 = provider_table.ide ntifier2</pre>

Expression	Definition	Examples
<i>where_expression</i>	A conditional expression that returns a Boolean. It may be comprised of the following: • Table column names • Supported scalar functions • Mathematical operators • String literals • Numerical literals Supported comparison conditions are (=, >, <, <=, >=, <>, !=, NOT, IN, NOT IN, LIKE, IS NULL, IS NOT NULL). Supported logical operators are (AND, OR). The where_expression is optional.	<pre>WHERE where_condition</pre> <pre>WHERE price > 100</pre> <pre>WHERE TRUNC(timestampColumn) = '1/1/2022'</pre> <pre>WHERE timestampColumn = timestampColumn2 - 14</pre>
<i>group_by_expression</i>	A comma-separated list of expressions that match the requirements for the select_grouping_column_expression .	<pre>GROUP BY TRUNC(timestampColumn), UPPER(campaignName), segment</pre>

Expression	Definition	Examples
<i>having_expression</i>	A conditional expression that returns an Boolean. They have a supported aggregation function applied to a single column (for example, SUM(price)) and are compared to a numerical literal. Supported conditions are (=, >, <, <=, >=, <>, !=). Supported logical operators are (AND, OR). The having_expression is optional.	<pre>HAVING SUM(SALES) > 500</pre>

Expression	Definition	Examples
<i>order_by_expression</i>	A comma-separated list of expressions that is compatible with the same requirements defined in <code>select_aggregate_expression</code> defined earlier. The <code>order_by_expression</code> is optional.  Note <code>order_by_expression</code> permits ASC and DESC parameters. For more information, see ASC DESC parameters in the AWS Clean Rooms SQL Reference.	<pre>ORDER BY SUM(SALES), UPPER(campaignName)</pre>

For aggregation query structure and syntax, be aware of the following:

- SQL commands other than SELECT are not supported.
- Sub-queries and common table expressions (for example, WITH) are not supported.
- Operators that combine multiple queries (for example, UNION) are not supported.
- TOP, LIMIT, and OFFSET parameters are not supported.

Aggregation analysis rule - query controls

With aggregation query controls, you can control how the columns in your table are used to query the table. For example, you can control which column is used for joining, which column can be counted, or which column can be used in WHERE statements.

The following sections explain each control.

Topics

- [Aggregation controls](#)
- [Join controls](#)
- [Dimension controls](#)
- [Scalar functions](#)

Aggregation controls

By using *aggregation controls*, you can define which aggregation functions to allow, and what columns they must be applied to. Aggregation functions can be used in the SELECT, HAVING, and ORDER BY expressions.

Control	Definition	Usage
aggregateColumns	Columns of configured table columns you allow for use within aggregation functions.	aggregateColumns can be used inside an aggregation function in the SELECT, HAVING, and ORDER BY expressions. Some aggregateColumns can also be categorized as a joinColumn (defined later). Given aggregateColumn can't also be categorized as a dimensionColumn (defined later).
function	The COUNT, SUM, and AVG functions you allow for use on top of the aggregate Columns .	function can be applied to an aggregateColumns that is associated to it.

Join controls

A JOIN clause is used to combine rows from two or more tables, based on a related column between them.

You can use *Join controls* to control how your table can be joined to other tables in the `table_expression`. AWS Clean Rooms only supports INNER JOIN. INNER JOIN statements can only use columns that have been explicitly categorized as a `joinColumn` in your analysis rule, subject to the controls that you define.

The INNER JOIN must operate on a `joinColumn` from your configured table and a `joinColumn` from another configured table in the collaboration. You decide which columns from your table can be used as `joinColumn`.

Each match condition within the ON clause is required to use the equality comparison condition (=) between two columns.

Multiple match conditions within an ON clauses can be:

- Combined using the AND logical operator
- Separated using the OR logical operator

Note

All JOIN match conditions must match one row from each side of the JOIN. All conditionals connected by an OR or an AND logical operator must adhere to this requirement as well.

The following is an example of a query with an AND logical operator.

```
SELECT some_col, other_col
FROM table1
  JOIN table2
  ON table1.id = table2.id AND table1.name = table2.name
```

The following is an example of a query with an OR logical operator.

```
SELECT some_col, other_col
FROM table1
  JOIN table2
```

```
ON table1.id = table2.id OR table1.name = table2.name
```

Control	Definition	Usage
joinColumns	The columns (if any) that you want to allow the member who can query to use in the INNER JOIN statement.	A specific joinColumn can also be categorized as a aggregateColumn (see Aggregation controls). The same column can't be used both as joinColumn and dimensionColumns (see later). Unless it has also been categorized as an aggregate Column , a joinColumn can't be used in any other parts of the query other than the INNER JOIN.
joinRequired	Control whether you require an INNER JOIN with a configured table from the member who can query.	If you enable this parameter , an INNER JOIN is required. If you don't enable this parameter, an INNER JOIN is optional. Assuming you enable this parameter, the member who can query is required to include a table they own in the INNER JOIN. They must JOIN your table with theirs, either directly or transitively (that is, join their table to another table, which itself is joined to your table).

Following is an example of transitivity.

```
ON
my_table.identifer = third_party_table.identifier
....
ON
third_party_table.identifier = member_who_can_query_table.id
```

Note

The member who can query can also use the `joinRequired` parameter. In that case, the query must join their table with at least one other table.

Dimension controls

Dimension controls control the column along which the aggregation columns can be filtered, grouped, or aggregated.

Control	Definition	Usage
<code>dimensionColumns</code>	The columns (if any) that you allow the member who can query to use in SELECT, WHERE, GROUP BY, and ORDER BY.	A <code>dimensionColumn</code> can be used in SELECT (<code>select_grouping_column_expression</code>), WHERE, GROUP BY, and ORDER BY. The same column can't be both a <code>dimensionColumn</code>, a <code>joinColumn</code>, and/or an <code>aggregateColumn</code>.

Scalar functions

Scalar functions control which scalar functions can be used on dimension columns.

Control	Definition	Usage
<code>scalarFunctions</code>	The scalar functions that can be used on dimension Columns in the query.	Specifies the scalar functions (if any) that you allow (for example, CAST) to be applied on dimensionColumns . Scalar functions can't be used on top of other functions or within other functions. Arguments of scalar functions can be columns, string literals, or numeric literals.

The following scalar functions are supported:

- Math functions – ABS, CEILING, FLOOR, LOG, LN, ROUND, SQRT
- Data type formatting functions – CAST, CONVERT, TO_CHAR, TO_DATE, TO_NUMBER, TO_TIMESTAMP
- String functions – LOWER, UPPER, TRIM, RTRIM, SUBSTRING
 - For RTRIM, custom character sets to trim aren't allowed.
- Conditional expressions – COALESCE
- Date functions – EXTRACT, GETDATE, CURRENT_DATE, DATEADD
- Other functions – TRUNC

For more details, see the [AWS Clean Rooms SQL Reference](#).

Aggregation analysis rule - query results controls

With the aggregation query results controls, you can control which results are returned by specifying one or more conditions that each output row must meet for it to be returned. AWS Clean Rooms supports aggregation constraints in the form of `COUNT (DISTINCT column) >= X`. This form requires that each row aggregates at least X distinct values of a choice from your configured table (for example, a minimum number of distinct `user_id` values). This minimum threshold is automatically enforced, even if the submitted query itself does not use the specified

column. They are enforced collectively across each configured table in the query from the configured tables from each member in the collaboration.

Each configured table must have at least one aggregation constraint in their analysis rule. Configured table owners can add multiple `columnName` and associated minimum and they are enforced collectively.

Aggregation constraints

Aggregation constraints control which rows in the query results are returned. To be returned, a row must meet the specified minimum number of distinct values in each column specified in the aggregation constraint. This requirement applies even if the column isn't explicitly mentioned in the query or in other parts of the analysis rule.

Control	Definition	Usage
<code>columnName</code>	The <code>aggregateColumn</code> that is used in the condition that each output row must meet.	Can be any column in the configured table.
<code>minimum</code>	The minimum number of distinct values for the associated <code>aggregateColumn</code> that the output row must have (for example, <code>COUNT DISTINCT</code>) for it to be returned in the query results.	The minimum must be at least value of 2.

Aggregation analysis rule structure

The following example shows a predefined structure for an aggregation analysis rule.

In the following example, *MyTable* refers to your data table. You can replace each *user input placeholder* with your own information.

```
{
  "aggregateColumns": [
    {
      "columnNames": [MyTable column names], "function": [Allowed Agg Functions]
    }
  ]
}
```

```

    },
  ],
  "joinRequired": ["QUERY_RUNNER"],
  "joinColumns": [MyTable column names],
  "dimensionColumns": [MyTable column names],
  "scalarFunctions": [Allowed Scalar functions],
  "outputConstraints": [
    {
      "columnName": [MyTable column names], "minimum": [Numeric value]
    },
  ]
}

```

Aggregation analysis rule - example

The following example demonstrates how two companies can collaborate in AWS Clean Rooms using aggregation analysis.

Company A has customer and sales data. Company A is interested in understanding product return activity. Company B is one of Company A's retailers and has returns data. Company B also has segment attributes on customers that are useful to Company A (for example, purchased related products, uses customer service from the retailer). Company B doesn't want to provide row-level customer return data and attribute information. Company B only wants to enable a set of queries for Company A to obtain aggregate statistics on overlapping customers at a minimum aggregation threshold.

Company A and Company B decide to collaborate so that Company A can understand product return activity and deliver better products at Company B and other channels.

To create the collaboration and run an aggregation analysis, the companies do the following:

1. Company A creates a collaboration and creates a membership. The collaboration has Company B as another member in the collaboration. Company A enables query logging in the collaboration, and it enables query logging in their account.
2. Company B creates a membership in the collaboration. It enables query logging in its account.
3. Company A creates a sales configured table.
4. Company A adds the following aggregation analysis rule to the sales configured table.

```

{
  "aggregateColumns": [

```

```
{
  "columnNames": [
    "identifier"
  ],
  "function": "COUNT_DISTINCT"
},
{
  "columnNames": [
    "purchases"
  ],
  "function": "AVG"
},
{
  "columnNames": [
    "purchases"
  ],
  "function": "SUM"
}
],
"joinColumns": [
  "hashedemail"
],
"dimensionColumns": [
  "demoseg",
  "purchasedate",
  "productline"
],
"scalarFunctions": [
  "CAST",
  "COALESCE",
  "TRUNC"
],
"outputConstraints": [
  {
    "columnName": "hashedemail",
    "minimum": 2,
    "type": "COUNT_DISTINCT"
  },
]
}
```

aggregateColumns – Company A wants to count the number of unique customers in the overlap between sales data and returns data. Company A also wants to sum the number of purchases made to compare to number of returns.

joinColumns – Company A wants to use `identifier` to match customers from sales data to customers from returns data. This will help Company A match returns to the right purchases. It also helps Company A segment overlapping customers.

dimensionColumns – Company A uses `dimensionColumns` to filter by the specific product, compare purchases and returns over a certain period of time, ensure the return date is after the product date, and help segment overlapping customers.

scalarFunctions – Company A selects CAST scalar function to help update data type formats if needed based on the configured table Company A associates to the collaboration. It also adds scalar functions to help formatting columns if needed.

outputConstraints – Company A sets minimum output constraints. It doesn't need to constrain the results because the analyst is allowed to see row-level data from their sales table

 Note

Company A doesn't include `joinRequired` in the analysis rule. It provides flexibility for their analyst to query the sales table alone.

5. Company B creates a returns configured table.
6. Company B adds the following aggregation analysis rule to the returns configured table.

```
{
  "aggregateColumns": [
    {
      "columnNames": [
        "identifier"
      ],
      "function": "COUNT_DISTINCT"
    },
    {
      "columnNames": [
        "returns"
      ],

```

```
    "function": "AVG"
  },
  {
    "columnNames": [
      "returns"
    ],
    "function": "SUM"
  }
],
"joinColumns": [
  "hashedemail"
],
"joinRequired": [
  "QUERY_RUNNER"
],
"dimensionColumns": [
  "state",
  "popularpurchases",
  "customerserviceuser",
  "productline",
  "returndate"
],
"scalarFunctions": [
  "CAST",
  "LOWER",
  "UPPER",
  "TRUNC"
],
"outputConstraints": [
  {
    "columnName": "hashedemail",
    "minimum": 100,
    "type": "COUNT_DISTINCT"
  },
  {
    "columnName": "producttype",
    "minimum": 2,
    "type": "COUNT_DISTINCT"
  }
]
}
```

`aggregateColumns` – Company B enables Company A to sum returns to compare to the number of purchases. They have at least one aggregate column because they are enabling an aggregate query.

`joinColumns` – Company B enables Company A to join on `identifier` to match customers from return data to customers from sales data. `identifier` data is particularly sensitive and having it as a `joinColumn` ensures that the data will never be outputted in a query.

`joinRequired` – Company B requires queries on the return data to be overlapped with the sales data. They don't want to enable Company A to query all individuals in their dataset. They also agreed on that restriction in their collaboration agreement.

`dimensionColumns` – Company B enables Company A to filter and group by `state`, `popularpurchases`, and `customerserviceuser` which are unique attributes that could help make the analysis for Company A. Company B enables Company A to use `returndate` to filter output on `returndate` that occurs after `purchasedate`. With this filtering, the output is more accurate for evaluating the impact of the product change.

`scalarFunctions` – Company B enables the following:

- `TRUNC` for dates
- `LOWER` and `UPPER` in case the `producttype` is entered in a different format in their data
- `CAST` if Company A needs to convert data types in sales to be the same as data types in returns

Company A doesn't enable other scalar functions because they don't believe they are required for queries.

`outputConstraints` – Company B sets minimum output constraints on `hashedemail` to help reduce the ability to re-identify customers. It also adds minimum output constraint on `producttype` to reduce the ability to re-identify specific products that were returned. Certain product types could be more dominant based on dimensions of the output (for example, `state`). Their output constraints will always be enforced regardless of output constraints added by Company A to their data.

7. Company A creates a sales table association to collaboration.
8. Company B creates a returns table association to collaboration.

9. Company A runs queries, such as the following example, to better understand the quantity of returns in Company B as compared to total purchases by location in 2022.

```
SELECT
  companyB.state,
  SUM(companyB.returns),
  COUNT(DISTINCT companyA.hashemail)
FROM
  sales companyA
  INNER JOIN returns companyB ON companyA.identifier = companyB.identifier
WHERE
  companyA.purchasedate BETWEEN '2022-01-01' AND '2022-12-31' AND
  TRUNC(companyB.returndate) > companyA.purchasedate
GROUP BY
  companyB.state;
```

- 10 Company A and Company B review query logs. Company B verifies that the query aligns with what was agreed upon in the collaboration agreement.

Troubleshooting aggregation analysis rule issues

Use the information here to help you diagnose and fix common issues when you work with aggregation analysis rules.

Issues

- [My query didn't return any results](#)

My query didn't return any results

This can happen when there are no matching results or when the matching results don't meet one or more minimum aggregation thresholds.

For more information about minimum aggregation thresholds, see [Aggregation analysis rule - example](#).

List analysis rule

In AWS Clean Rooms, a *list analysis rule* outputs row-level lists of the overlap between the configured table that it's added to and the configured tables of the member who can query. The member who can query runs queries that include a list analysis rule.

The list analysis rule type supports uses cases such as enrichment and audience building.

For more information about the predefined query structure and syntax for this analysis rule, see [List analysis rule predefined structure](#).

The parameters of the list analysis rule, defined in [List analysis rule - query controls](#), have query controls. Its query controls include the ability to select the columns that can be listed in the output. The query is required to have at least one join with a configured table from the member who can query, either directly or transitively.

There are no query results controls like there are for the [Aggregation analysis rule](#).

List queries can only use mathematical operators. They can't use other functions (such as aggregation or scalar).

Topics

- [List query structure and syntax](#)
- [List analysis rule - query controls](#)
- [List analysis rule predefined structure](#)
- [List analysis rule - example](#)

List query structure and syntax

Queries on tables that have a list analysis rule must adhere to the following syntax.

```
--select_list_expression
SELECT DISTINCT column_name [[AS] column_alias ] [, ...]

--table_expression
FROM table_name [[AS] table_alias ]
    [[INNER] JOIN table_name [[AS] table_alias] ON join_condition] [...]

--where_expression
[WHERE where_condition]

--limit_expression
[LIMIT number]
```

The following table explains each expression listed in the preceding syntax.

Expression	Definition	Examples
<i>select_list_expression</i>	A comma-separated list containing at least one table column name. A DISTINCT parameter is required.  Note The <code>select_list_expression</code> can alias columns with or without the AS parameter. For more information, see the AWS Clean Rooms SQL Reference.	SELECT DISTINCT segment
<i>table_expression</i>	A table, or join of tables, with <code>join_condition</code> to connect it to <code>join_condition</code>. <code>join_condition</code> returns a Boolean. The <code>table_expression</code> supports: • A specific JOIN type (INNER JOIN) • The equality comparison conditions within a <code>join_condition</code> (=)	<pre>FROM consumer_table INNER JOIN provider_table ON consumer_table.identifier1 = provider_table.identifier1 AND consumer_table.identifier2 = provider_table.identifier2</pre>

Expression	Definition	Examples
	Logical operators (AND, OR).	
<i>where_expression</i>	A conditional expression that returns a Boolean. It can be comprised of the following: - Table column names - Mathematical operators - String literals - Numerical literals Supported comparison conditions are (=, >, <, <=, >=, <>, !=, NOT, IN, NOT IN, LIKE, IS NULL, IS NOT NULL). Supported logical operators are (AND, OR). The <code>where_expression</code> is optional.	<pre>WHERE state + '_' + city = 'NY_NYC'</pre> <pre>WHERE timestampColumn = timestampColumn2 - 14</pre>
<i>limit_expression</i>	This expression must take a positive integer. The <code>limit_expression</code> is optional.	<code>LIMIT 100</code>

For list query structure and syntax, be aware of the following:

- SQL commands other than SELECT are not supported.
- Subqueries and common table expressions (for example, WITH) are not supported
- HAVING, GROUP BY, and ORDER BY clauses are not supported
- OFFSET parameter is not supported

List analysis rule - query controls

With list query controls, you can control how the columns in your table are used to query the table. For example, you can control which column is used for joining, or which column can be used in SELECT statement and WHERE clause.

The following sections explain each control.

Topics

- [Join controls](#)
- [List controls](#)

Join controls

With *Join controls*, you can control how your table can be joined to other tables in the **table_expression**. AWS Clean Rooms only supports INNER JOIN. In the list analysis rule, at least one INNER JOIN is required and the member who can query is required to include a table they own in the INNER JOIN. This means they must join your table with theirs, either directly or transitively.

Following is an example of transitivity.

```
ON
my_table.identifer = third_party_table.identifier
....
ON
third_party_table.identifier = member_who_can_query_table.id
```

INNER JOIN statements can only use columns that have been explicitly categorized as a `joinColumn` in your analysis rule.

The INNER JOIN must operate on a `joinColumn` from your configured table and a `joinColumn` from another configured table in the collaboration. You decide which columns from your table can be used as `joinColumn`.

Each match condition within the ON clause is required to use the equality comparison condition (=) between two columns.

Multiple match conditions within an ON clause can be:

- Combined using the AND logical operator

- Separated using the OR logical operator

Note

All JOIN match conditions must match one row from each side of the JOIN. All conditionals connected by an OR or an AND logical operator must adhere to this requirement as well.

The following is an example of a query with an AND logical operator.

```
SELECT some_col, other_col
FROM table1
  JOIN table2
  ON table1.id = table2.id AND table1.name = table2.name
```

The following is an example of a query with an OR logical operator.

```
SELECT some_col, other_col
FROM table1
  JOIN table2
  ON table1.id = table2.id OR table1.name = table2.name
```

Control	Definition	Usage
<code>joinColumns</code>	The columns that you want to allow the member who can query to use in the INNER JOIN statement.	The same column can't be categorized as both a <code>joinColumn</code> and <code>listColumn</code> (see List controls). <code>joinColumn</code> can't be used in any other parts of the query other than INNER JOIN.

List controls

List controls control the columns that can be listed in the query output (that is, used in the SELECT statement) or used to filter results (that is, used in the WHERE statement).

Control	Definition	Usage
<code>listColumns</code>	The columns that you allow the member who can query to use in the SELECT and WHERE	A <code>listColumn</code> can be used in SELECT and WHERE. The same column can't be used as both a <code>listColumn</code> and <code>joinColumn</code> .

List analysis rule predefined structure

The following example includes a predefined structure that shows how you complete a list analysis rule.

In the following example, *MyTable* refers to your data table. You can replace each *user input placeholder* with your own information.

```
{
  "joinColumns": [MyTable column name(s)],
  "listColumns": [MyTable column name(s)],
}
```

List analysis rule - example

The following example demonstrates how two companies can collaborate in AWS Clean Rooms using list analysis.

Company A has customer relationship management (CRM) data. Company A wants to obtain additional segment data on its customers to learn more about their customers and potentially use attributes as input into other analyses. Company B has segment data comprised of unique segment attributes that they created based on their first party data. Company B wants to provide the unique segment attributes to Company A only on customers that are overlapping between their data and Company A data.

The companies decide to collaborate so that Company A can enrich the overlapping data. Company A is the member who can query, and Company B is the contributor.

To create a collaboration and run list analysis in collaboration, the companies do the following:

1. Company A creates a collaboration and creates a membership. The collaboration has Company B as another member on the collaboration. Company A enables query logging in the collaboration, and it enables query logging in its account.
2. Company B creates a membership in the collaboration. It enables query logging in its account.
3. Company A creates a CRM configured table
4. Company A adds the analysis rule to the customer configured table, as shown in the following example.

```
{
  "joinColumns": [
    "identifier1",
    "identifier2"
  ],
  "listColumns": [
    "internalid",
    "segment1",
    "segment2",
    "customercategory"
  ]
}
```

joinColumns – Company A wants to use `hashedemail` and/or `thirdpartyid` (obtained from an identity vendor) to match customers from CRM data to customers from segment data. This will help ensure Company A matches enriched data for the right customers. They have two `joinColumns` to potentially improve the match rate of the analysis.

listColumns – Company A uses `listColumns` to obtain enriched columns beside an `internalid` they use within their own systems. They add `segment1`, `segment2`, and `customercategory` to potentially limit the enrichment to specific segments by using them in filters.

5. Company B creates a segment configured table.
6. Company B adds the analysis rule to the segment configured table.

```
{
  "joinColumns": [
    "identifier2"
  ],
  "listColumns": [
    "segment3",
```

```

    "segment4"
  ]
}
```

joinColumns – Company B enables Company A to join on `identifier2` to match customers from segment data to CRM data. Company A and Company B worked with the identity vendor to obtain `identifier2` which would match for this collaboration. They didn't add other `joinColumns` because they believed `identifier2` provides the highest and most accurate match rate and other identifiers aren't required for the queries.

listColumns – Company B enables Company A to enrich their data with `segment3` and `segment4` attributes which are unique attributes they have created, collected and aligned on (with customer A) to be a part of data enrichment. They want Company A to obtain these segments for the overlap at a row-level because this is a data enrichment collaboration.

7. Company A creates a CRM table association to the collaboration.
8. Company B creates a segment table association to the collaboration.
9. Company A runs queries, such as the following one to enrich overlapping customer data.

```

SELECT companyA.internalid, companyB.segment3, companyB.segment4
INNER JOIN returns companyB
  ON companyA.identifier2 = companyB.identifier2
WHERE companyA.customercategory > 'xxx'
```

10. Company A and Company B review query logs. Company B verifies that the query aligns with what was agreed upon in the collaboration agreement.

Custom analysis rule in AWS Clean Rooms

In AWS Clean Rooms, a *custom analysis rule* is a new type of analysis rule that allows custom queries to be run on the configured table. Custom SQL queries are still restricted to having only the `SELECT` command but can use more SQL constructs than [aggregation](#) and [list](#) queries (for example, window functions, `OUTER JOIN`, CTEs, or subqueries; see the [AWS Clean Rooms SQL Reference](#) for a complete list). Custom SQL queries don't have to follow a query structure like [aggregation](#) and [list](#) queries.

The custom analysis rule supports more advanced use cases than those that can be supported by the aggregation and list analysis rule such as custom attribution analysis, benchmarking,

incrementality analysis, and audience discovery. This is in addition to a superset of the use cases supported by aggregation and list analysis rule.

The custom analysis rule also supports differential privacy. Differential privacy is a mathematically-rigorous framework for data privacy protection. For more information, see [AWS Clean Rooms Differential Privacy](#). When you create an analysis template, AWS Clean Rooms Differential Privacy checks the template to determine whether it is compatible with the general-purpose query structure for AWS Clean Rooms Differential Privacy. This validation ensures that you don't create an analysis template that isn't allowed with a differential privacy protected table.

To configure the custom analysis rule, data owners can choose to allow specific custom queries, stored in [analysis templates](#), to run on their configured tables. Data owners review analysis templates before adding them to the allowed analysis control in the custom analysis rule. Analysis templates are available and visible only in the collaboration in which they are created (even if the table is associated to other collaborations) and can be run only by the member who can query in that collaboration.

Alternatively, members can choose to allow other members (query providers) to create queries without review. Members add query providers' accounts the allowed query providers control in the custom analysis rule. If the query provider is the member who can query, they could run any query directly on the configured table. Query providers could also create queries by [creating analysis templates](#). Any queries that have been created by the query providers are automatically allowed to run on the table in all collaborations in which the AWS account is present and the table is associated.

Data owners can only allow analysis templates or accounts to create queries, not both. If the data owner leaves it empty, the member who can query can't run queries on the configured table.

Topics

- [Custom analysis rule predefined structure](#)
- [Custom analysis rule example](#)
- [Custom analysis rule with differential privacy](#)

Custom analysis rule predefined structure

The following example includes a predefined structure that shows you how to complete a custom analysis rule with differential privacy turned on. The `userIdentifier` value is the column that uniquely identifies your users, such as `user_id`. When you have two or more tables with differential

privacy turned on in a collaboration, AWS Clean Rooms requires you to configure the same column as the user identifier column in both of the analysis rules to maintain a consistent definition of the users across tables.

```
{
  "allowedAnalyses": ["ANY_QUERY"] | string[],
  "allowedAnalysisProviders": [],
  "differentialPrivacy": {
    "columns": [
      {
        "name": "userIdentifier"
      }
    ]
  }
}
```

You can either:

- Add analysis template ARNs to allowed analyses control. In this case, the `allowedAnalysisProviders` control is not included.

```
{
  allowedAnalyses: string[]
}
```

- Add member AWS account IDs to the `allowedAnalysisProviders` control. In this case, you add `ANY_QUERY` to the `allowedAnalyses` control.

```
{
  allowedAnalyses: ["ANY_QUERY"],
  allowedAnalysisProviders: string[]
}
```

Custom analysis rule example

The following example demonstrates how two companies can collaborate in AWS Clean Rooms using the custom analysis rule.

Company A has customer and sales data. Company A is interested in understanding the sales incrementality of an advertising campaign on Company B site. Company B has viewership data and

segment attributes that are useful to Company (for example, the device they used when viewing the advertising).

Company A has a specific incrementality query they want to run in the collaboration.

To create a collaboration and run a custom analysis in collaboration, the companies do the following:

1. Company A creates a collaboration and creates a membership. The collaboration has Company B as another member on the collaboration. Company A enables query logging in the collaboration, and it enables query logging in its account.
2. Company B creates a membership in the collaboration. It enables query logging in its account.
3. Company A creates a CRM configured table
4. Company A adds empty custom analysis rule to sales configured table.
5. Company A associates sales configured table to the collaboration.
6. Company B creates viewership configured table.
7. Company B adds an empty custom analysis rule to the viewership configured table.
8. Company B associates viewership configured table to the collaboration.
9. Company A views the sales table and viewership table associated to the collaboration and creates analysis template, adding the incrementality query and parameter for campaign month.

```
{
  "analysisParameters": [
    {
      "defaultValue": ""
      "type": "DATE"
      "name": "campaign_month"
    }
  ],
  "description": "Monthly incrementality query using sales and viewership data"
  "format": "SQL"
  "name": "Incrementality analysis"
  "source":
    "WITH labeleddata AS
    (
      SELECT hashedemail, deviceid, purchases, unitprice, purchasedate,
      CASE
        WHEN testvalue IN ('value1', 'value2', 'value3') THEN 0
        ELSE 1
```

```

        END AS testgroup
      FROM viewershipdata
    )
    SELECT labeleddata.purchases, provider.impressions
    FROM labeleddata
    INNER JOIN salesdata
      ON labeleddata.hashedemail = provider.hashedemail
    WHERE MONTH(labeleddata.purchasedate) > :campaignmonth
    AND testgroup = :group
  "
}

```

10 Company A adds their account (for example, 444455556666) to the allowed analysis provider control in the custom analysis rule. They use the allowed analysis provider control because they want to allow any queries they create to run on their sales configured table.

```

{
  "allowedAnalyses": [
    "ANY_QUERY"
  ],
  "allowedAnalysisProviders": [
    "444455556666"
  ]
}

```

11 Company B sees the created analysis template in the collaboration and reviews its contents including the query string and parameter.

12 Company B determines that the analysis template achieves the incrementality use case and meets their privacy requirements for how their viewership configured table can be queried.

13 Company B adds the analysis template ARN to the allowed analysis control in the custom analysis rule of the viewership table. They use the allowed analysis control because they only want to allow the incrementality query to run on their viewership configured table.

```

{
  "allowedAnalyses": [
    "arn:aws:cleanrooms:us-east-1:111122223333:membership/41327cc4-bbf0-43f1-b70c-a160dddceb08/analysistemplate/1ff1bf9d-781c-418d-a6ac-2b80c09d6292"
  ]
}

```

14 Company A runs the analysis template and uses the parameter value 05-01-2023.

Custom analysis rule with differential privacy

In AWS Clean Rooms, the custom analysis rule supports differential privacy. Differential privacy is a mathematically-rigorous framework for data privacy protection that helps you protect your data against re-identification attempts.

Differential privacy supports aggregate analysis such as ad campaign planning, post-ad-campaign measurement, benchmarking in a financial institution consortium, and A/B testing for healthcare research.

The supported query structure and syntax are defined in [Query structure and syntax](#).

Custom analysis rule with differential privacy example

Note

AWS Clean Rooms Differential Privacy is only available for collaborations using AWS Clean Rooms SQL as the analytics engine and data stored in Amazon S3.

Consider the [custom analysis rule example](#) presented in the previous section. This example demonstrates how you can use differential privacy to protect your data against re-identification attempts while allowing your partner to learn business-critical insights from your data. Assume that Company B, who has the viewership data, wants to protect their data using differential privacy. To complete the differential privacy setup, Company B completes the following steps:

1. Company B turns on differential privacy while adding custom analysis rule to the viewership configured table. Company B selects `viewershipdata.hashemail` as the user identifier column.
2. Company B [adds a differential privacy policy](#) in the collaboration to make their viewership data table available for querying. Company B selects the default policy to quickly complete the setup.

Company A, who wants to understand the sales incrementality of an advertising campaign on Company B's site, runs the analysis template. Because the query is compatible with the general-purpose [query structure](#) of AWS Clean Rooms Differential Privacy, the query runs successfully.

Query structure and syntax

Queries containing at least one table that have the differential privacy turned on must adhere to the following syntax.

```

query_statement:
    [cte, ...] final_select

cte:
    WITH sub_query AS (
        inner_select
        [ UNION | INTERSECT | UNION_ALL | EXCEPT/MINUS ]
        [ inner_select ]
    )

inner_select:
    SELECT [user_id_column, ] expression [, ...]
    FROM table_reference [, ...]
    [ WHERE condition ]
    [ GROUP BY user_id_column[, expression] [, ...] ]
    [ HAVING condition ]

final_select:
    SELECT [expression, ...] | COUNT | COUNT_DISTINCT | SUM | AVG | STDDEV
    FROM table_reference [, ...]
    [ WHERE condition ]
    [ GROUP BY expression [, ...] ]
    [ HAVING COUNT | COUNT_DISTINCT | SUM | AVG | STDDEV | condition ]
    [ ORDER BY column_list ASC | DESC ]
    [ OFFSET literal ]
    [ LIMIT literal ]

expression:
    column_name [, ...] | expression AS alias | aggregation_functions |
    window_functions_on_user_id | scalar_function | CASE | column_name math_expression [,
    expression]

window_functions_on_user_id:
    function () OVER (PARTITION BY user_id_column, [column_name] [ORDER BY column_list
    ASC|DESC])
  
```

Note

For differential privacy query structure and syntax, be aware of the following:

- Sub-queries are not supported.
- Common Table Expressions (CTEs) should emit the user identifier column if a table or CTE involve data protected by differential privacy. Filters, groupings, and aggregations should be done at the user level.
- Final_select allows COUNT DISTINCT, COUNT, SUM, AVG, and STDDEV aggregate functions.

For more details about which SQL keywords are supported for differential privacy, see [SQL capabilities of AWS Clean Rooms Differential Privacy](#).

ID mapping table analysis rule

In AWS Clean Rooms, an *ID mapping table analysis rule* isn't a standalone analysis rule. This type of analysis rule is managed by AWS Clean Rooms and is used to join disparate identity data to facilitate querying. It's automatically added to ID mapping tables and can't be edited. It inherits the behaviors of the other analysis rules in the collaboration – as long as those analysis rules are homogeneous.

The ID mapping table analysis rule enforces security on an ID mapping table. It restricts a collaboration member from directly selecting or inspecting the non-overlap population between the two members' datasets using the ID mapping table. The ID mapping table analysis rule is used to protect the sensitive data in the ID mapping table when used in queries with other analysis rules implicitly.

With the ID mapping table analysis rule, AWS Clean Rooms enforces an overlap on both sides of the ID mapping table in expanded SQL. This enables you to do the following tasks:

- Use the overlap of the ID mapping table in JOIN statements.

AWS Clean Rooms allows an INNER, LEFT, or RIGHT join on the ID mapping table if it respects the overlap. To protect sensitive mapping information, the ID mapping table must always be on the "inner" side of any JOIN operation. For example, the following JOIN operations are valid:

- table LEFT JOIN id_mapping_table

- `id_mapping_table RIGHT JOIN table`
- `table INNER JOIN id_mapping_table`

The following JOIN operations are invalid:

- `id_mapping_table LEFT JOIN table`
- `table RIGHT JOIN id_mapping_table`

This prevents exposure of mapping records that don't have corresponding matches in your dataset. Allowing such operations could potentially reveal sensitive information about other collaboration members' data mappings.

- Use the mapping table columns in JOIN statements.

You can't use the mapping table columns in the following statements: SELECT, WHERE, HAVING, GROUP BY, or ORDER BY (unless protections are modified on the source ID namespace association or the target ID namespace association).

- In expanded SQL, AWS Clean Rooms also supports OUTER JOIN, implicit JOIN, and CROSS JOIN. These joins can't satisfy overlap requirements. Instead, AWS Clean Rooms uses `requireOverlap` to specify which columns have to be joined on.

The supported query structure and syntax are defined in [ID mapping table query structure and syntax](#).

The parameters of the analysis rule, defined in [ID mapping table analysis rule query controls](#), include query controls and query results controls. Its query controls include the ability to require overlap of the ID mapping table in JOIN statements (that is, `requireOverlap`).

Topics

- [ID mapping table query structure and syntax](#)
- [ID mapping table analysis rule query controls](#)
- [ID mapping table analysis rule predefined structure](#)
- [ID mapping table analysis rule – example](#)

ID mapping table query structure and syntax

Queries on tables that have an ID mapping table analysis rule must adhere to the following syntax.

```

--select_list_expression
SELECT
provider.data_col, consumer.data_col

--table_expression
FROM provider

JOIN idMappingTable idmt ON provider.id = idmt.sourceId

JOIN consumer ON consumer.id = idmt.targetId

```

Collaboration tables

The following tables represent configured tables that exist in an AWS Clean Rooms collaboration. The **id** column in both the **cr_drivers_license** and **cr_insurance** tables represents a column to match with the ID mapping table.

cr_drivers_license

id	driver_name	state_of_registration
1	Eduard	TX
2	Dana	MA
3	Gweneth	IL

cr_insurance

id	policyholder_email	policy_number
a	eduardo@internal.c ompany.com	17f9d04e-f5be-4426- bdc4-250ed59c6529
b	gwen@internal.company.com	3f0092db-2316-48a8 -8d44-09cf8f6e6c64

c	rosa@internal.company.com	d7692e84-3d3c-47b8-b46d-a0d5345f0601

ID mapping table

The following table represents an existing ID mapping table that matches on the **cr_drivers_license** and **cr_insurance** tables. Not all entries will have IDs for both collaboration tables.

cr_drivers_license_id	cr_insurance_id
1	a
2	null
3	b
null	c

The ID mapping table analysis rule only allows for queries to run on the set of overlapping data, which would look as follows:

cr_driver s_license_id	cr_insura nce_id	driver_name	state_of_ registration	policyhol der_email	policy_nu mber
1	a	Eduard	TX	eduardo@i nternal.c ompany.com	17f9d04e- f5be-4426 -bdc4-250 ed59c6529
3	b	Gweneth	IL	gwen@inte rnal.comp any.com	3f0092db- 2316-48a8 -8d44-09c f8f6e6c64

Example queries

The following examples show valid locations for the ID mapping table joins:

```
-- Single ID mapping table
SELECT
    [ select_items ]FROM
    cr_drivers_license cr_dl
    [ INNER | LEFT ] JOIN cr_identity_mapping_table idmt ON idmt.cr_drivers_license_id
= cr_dl.id
    [ INNER | RIGHT ] JOIN cr_insurance cr_in          ON idmt.cr_insurance_id
= cr_in.id
;

-- Single ID mapping table (Subquery)
SELECT
    [ select_items ]FROM (
    SELECT
        [ select_items ]
    FROM
        cr_drivers_license cr_dl
        [ INNER | LEFT ] JOIN cr_identity_mapping_table idmt ON
idmt.cr_drivers_license_id = cr_dl.id
        [ INNER | RIGHT ] JOIN cr_insurance cr_in          ON idmt.cr_insurance_id
= cr_in.id
    )
;

-- Single ID mapping table (CTE)
WITH
    matched_ids AS (
        SELECT
            [ select_items ]
        FROM
            cr_drivers_license cr_dl
            [ INNER | LEFT ] JOIN cr_identity_mapping_table idmt ON
idmt.cr_drivers_license_id = cr_dl.id
            [ INNER | RIGHT ] JOIN cr_insurance cr_in          ON
idmt.cr_insurance_id      = cr_in.id
        )SELECT
    [ select_items ]FROM
    matched_ids
;

```

Considerations

For ID mapping table query structure and syntax, be aware of the following:

- You can't edit it.
- It's applied to the ID mapping table by default.
- It uses a source and target ID namespace association inside the collaboration.
- The ID mapping table is configured by default to provide default protections for the column that comes from the ID namespace. You can modify this configuration so that the column that comes from the ID namespace (either `sourceID` or `targetID`) can be allowed anywhere in the query. For more information, see [ID namespaces in AWS Clean Rooms](#).
- The ID mapping table analysis rule inherits the SQL restrictions of the other analysis rules in the collaboration.

ID mapping table analysis rule query controls

With ID mapping table query controls, AWS Clean Rooms controls how the columns in your table are used to query the table. For example, it controls which columns are used for joining, and which columns require overlap. The ID mapping table analysis rule also includes functionality that enables you to allow the `sourceID`, the `targetID`, or both, to be projected without requiring a JOIN.

The following table explains each control.

Control	Definition	Usage
<code>joinColumns</code>	The columns that the member who can query can use in the INNER JOIN statement.	You can't use <code>joinColumns</code> in any other parts of the query other than INNER JOIN. For more information, see Join controls .
<code>dimensionColumns</code>	The columns (if any) that the member who can query can use in SELECT and GROUP BY statements.	A <code>dimensionColumn</code> can be used in SELECT and GROUP BY.

Control	Definition	Usage
		A <code>dimensionColumn</code> can appear as <code>joinKeys</code>. You can only use <code>dimensionColumns</code> in the JOIN clause if you specify it in brackets.
<code>queryConstraints:RequireOverlap</code>	The columns in the ID mapping table that must be joined on so the query can run.	These columns must be used to JOIN the ID Mapping table and a collaboration table.

ID mapping table analysis rule predefined structure

The predefined structure for an ID mapping table analysis rule comes with default protections that are applied to the `sourceID` and `targetID`. This means that the column with protections applied must be used in queries.

You can configure the ID mapping table analysis rule in the following ways:

- Both `sourceID` and `targetID` protected

In this configuration, the `sourceID` and `targetID` can't both be projected. The `sourceID` and `targetID` must be used in a JOIN when the ID mapping table is referenced.

- Only `targetID` protected

In this configuration, the `targetID` can't be projected. The `targetID` must be used in a JOIN when the ID mapping table is referenced. The `sourceID` can be used in query.

- Only `sourceID` protected

In this configuration, the `sourceID` can't be projected. The `sourceID` must be used in a JOIN when ID mapping table is referenced. The `targetID` can be used in query.

- Neither `sourceID` or `targetID` protected

In this configuration, the ID mapping table isn't subject to any specific enforcement that can be used in query.

The following example shows a predefined structure for an ID mapping table analysis rule with the default protections applied to the `sourceID` and `targetID`. In this example, the ID mapping table analysis rule only allows an INNER JOIN on both the `sourceID` column and the `targetID` column.

```
{
  "joinColumns": [
    "source_id",
    "target_id"
  ],
  "queryConstraints": [
    {
      "requireOverlap": {
        "columns": [
          "source_id",
          "target_id"
        ]
      }
    }
  ],
  "dimensionColumns": [] // columns that can be used in SELECT and JOIN
}
```

The following example shows a predefined structure for an ID mapping table analysis rule with protections applied to the `targetID`. In this example, the ID mapping table analysis rule only allows an INNER JOIN on the `sourceID` column.

```
{
  "joinColumns": [
    "source_id",
    "target_id"
  ],
  "queryConstraints": [
    {
      "requireOverlap": {
        "columns": [
          "target_id"
        ]
      }
    }
  ],
  "dimensionColumns": [
    "source_id"
  ]
}
```

```
]
}
```

The following example shows a predefined structure for an ID mapping table analysis rule with protections applied to the sourceID. In this example, the ID mapping table analysis rule only allows an INNER JOIN on the targetID column.

```
{
  "joinColumns": [
    "source_id",
    "target_id"
  ],
  "queryConstraints": [
    {
      "requireOverlap": {
        "columns": [
          "source_id"
        ]
      }
    }
  ],
  "dimensionColumns": [
    "target_id"
  ]
}
```

The following example shows a predefined structure for an ID mapping table analysis rule without protections applied to the sourceID or targetID. In this example, the ID mapping table analysis rule allows an INNER JOIN on both the sourceID column and the targetID column.

```
{
  "joinColumns": [
    "source_id",
    "target_id"
  ],
  "queryConstraints": [
    {
      "requireOverlap": {
        "columns": []
      }
    }
  ],
}
```

```
"dimensionColumns": [  
  "source_id",  
  "target_id"  
]  
}
```

ID mapping table analysis rule – example

Rather than writing a long waterfall statement that references Personally Identifiable Information (PII), for example, companies can use the ID mapping table analysis rule to use multi-party LiveRamp transcoding. The following example demonstrates how you can collaborate in AWS Clean Rooms using the ID mapping table analysis rule.

Company A is an advertiser who has customer and sales data, which will be used as a source. Company A also performs transcoding on behalf of the parties in the collaboration, and brings the LiveRamp credentials.

Company B is a publisher who has event data, which will be used as a target.

Note

Either Company A or Company B can provide LiveRamp transcoding credentials and perform the transcoding.

To create a collaboration that enables the ID mapping table analysis in collaboration, the companies do the following:

1. Company A creates a collaboration and creates a membership. It adds Company B, who also creates a membership in the collaboration.
2. Company A either associates an existing ID namespace source or creates a new one in AWS Entity Resolution using the AWS Clean Rooms console.

Company A creates a configured table with their sales data and a column keyed to the `sourceId` in the ID mapping table.

The ID namespace source provides data to transcode.

3. Company B either associates an existing ID namespace target or creates a new one in AWS Entity Resolution using the AWS Clean Rooms console.

Company B creates a configured table with their event data and a column keyed to the `targetId` in the ID mapping table.

The ID namespace target doesn't provide data to transcode, only metadata around the LiveRamp configuration.

4. Company A discovers the two ID namespaces associated to the collaboration and creates and populates an ID mapping table.
5. Company A runs a query across the two datasets by joining on the ID mapping table.

```
--- this would be valid for Custom or List
SELECT provider.data_col, consumer.data_col
FROM provider
  JOIN idMappingTable-123123123123-myMappingWFName idmt
    ON provider.id = idmt.sourceId
  JOIN consumer
    ON consumer.id = idmt.targetId
```

AWS Clean Rooms Differential Privacy

AWS Clean Rooms Differential Privacy helps you protect the privacy of your users with a mathematically-backed technique that is implemented with intuitive controls in a few clicks. As a fully managed capability, no prior differential privacy experience is needed to help you prevent the re-identification of your users. AWS Clean Rooms automatically adds a carefully calibrated amount of noise to query results at runtime in order to help protect your individual-level data.

AWS Clean Rooms Differential Privacy supports a wide range of analytical queries and is a good fit for a wide variety of use cases, where a small amount of error in the query results will not compromise the usefulness of your analysis. With it, your partners can generate business-critical insights about advertising campaigns, investment decisions, clinical research, and more, all without requiring any additional setup from your partners.

AWS Clean Rooms Differential Privacy protects against overflow or invalid cast errors that make use of scalar functions or math operator symbols in a malicious manner.

For more information about AWS Clean Rooms Differential Privacy, see the following topics.

Topics

- [Differential privacy](#)
- [How Differential Privacy in AWS Clean Rooms works](#)
- [Differential privacy policy](#)
- [SQL capabilities of AWS Clean Rooms Differential Privacy](#)
- [Differential Privacy query tips and examples](#)
- [Limitations of AWS Clean Rooms Differential Privacy](#)

Differential privacy

Differential privacy allows only aggregated insights and obfuscates the contribution of any individual's data in those insights. Differential privacy protects the collaboration data from the member who can receive results learning about a specific individual. Without differential privacy, the member who can receive results can attempt to infer individual user data by adding or removing records about an individual and observing the difference in query results.

When differential privacy is turned on, a specified amount of noise is added to the query results to obfuscate the contribution of individual users. If the member who can receive results tries to observe the difference in query results after removing records about an individual from their dataset, the variability in the query result helps prevent the identification of the individual's data. AWS Clean Rooms Differential Privacy uses the [SampCert](#) sampler, a proven correct sampler implementation developed by AWS.

How Differential Privacy in AWS Clean Rooms works

The workflow to turn on differential privacy in AWS Clean Rooms requires the following additional steps when [completing the workflow for AWS Clean Rooms](#):

1. You turn on differential privacy when adding a [custom analysis rule](#).
2. [You configure the differential privacy policy for the collaboration](#) to make your data tables protected with differential privacy available for querying.

After you complete these steps, the member who can query can start running queries on differential privacy protected data. AWS Clean Rooms returns results that comply with the differential privacy policy. AWS Clean Rooms Differential Privacy tracks the estimated number of remaining queries that you can run, similar to the gas gauge in a car that shows you the car's current fuel level. The number of queries that the member who can query can run is limited by

the **Privacy budget** and **Noise added per query** parameters that are set in the [Differential privacy policy](#).

Considerations

When using differential privacy in AWS Clean Rooms, consider the following:

- The member who can receive results can't use differential privacy. They will configure a custom analysis rule with differential privacy turned off for their configured tables.
- The member who can query can't join tables from two or more data providers when both have differential privacy turned on.

Differential privacy policy

The differential privacy policy controls how many aggregation functions the member who can query is allowed to run in a collaboration. The **Privacy budget** defines a common, finite resource that is applied all tables in a collaboration. The **Noise added per query** governs the rate at which the privacy budget is depleted.

A differential privacy policy is required to make your differential privacy protected tables available for querying. This is a one-time step in a collaboration and includes two inputs:

- **Privacy budget** – Quantified in terms of epsilon, the privacy budget controls the level of privacy protection. It is a common, finite resource that is applied for all of your tables protected with differential privacy in the collaboration, because the goal is to preserve the privacy of your users whose information can be present in multiple tables.

The **Privacy budget** is consumed every time a query is run on your tables. When the privacy budget is fully exhausted, the collaboration member who can query can't run additional queries until it is increased or refreshed. By setting a larger privacy budget, the member who can receive results can reduce their uncertainty about individuals within the data. Choose a privacy budget that balances your collaboration requirements against your privacy needs and after consulting with business decision-makers.

You can select **Refresh privacy budget monthly** to automatically create a new privacy budget each calendar month, if you plan to regularly bring new data into the collaboration. Choosing this option allows arbitrary amounts of information to be revealed about rows of the data when repeatedly queried across refreshes. Avoid choosing this if the same rows will be repeatedly queried between privacy budget refreshes.

- **Noise added per query** is measured in terms of the number of users whose contributions you want to obscure. This value governs the rate at which the privacy budget is depleted. A larger noise value reduces the rate at which the privacy budget is depleted, and therefore allows more queries to be run on your data. However, this should be balanced against releasing less accurate data insights. Consider the desired accuracy for collaboration insights when setting this value.

You can use the default differential privacy policy to quickly complete the setup or customize your differential privacy policy as per your use case. AWS Clean Rooms Differential Privacy provides intuitive controls to configure the policy. AWS Clean Rooms Differential Privacy lets you preview the utility in terms of the number of aggregations possible across all queries on your data and estimate how many queries can be run in a data collaboration.

You can use the interactive examples to understand how different values of **Privacy budget** and **Noise added per query** would impact the results for different types of SQL queries. In general, you need to balance your privacy needs against the number of queries you want to permit and the accuracy of those queries. A smaller **Privacy budget** or larger **Noise added per query** can better protect user privacy, but provides less meaningful insights to your collaboration partners.

If you increase the **Privacy budget** while keeping the **Noise added per query** parameter the same, the member who can query can run more aggregations on your tables in the collaboration. You can increase the **Privacy budget** any time during the collaboration. If you decrease the **Privacy budget** while keeping the **Noise added per query** parameter the same, the member who can query can run fewer aggregations. You can't decrease the **Privacy budget** after the member who can query has started analyzing your data.

If you increase the **Noise added per query** while keeping the **Privacy budget** input the same, the member who can query can run more aggregations on your tables in the collaboration. If you decrease the **Noise added per query** while keeping the **Privacy budget** input the same, the member who can query can run fewer aggregations. You can increase or decrease the **Noise added per query** any time during the collaboration.

The differential privacy policy is managed by the privacy budget template API actions.

SQL capabilities of AWS Clean Rooms Differential Privacy

AWS Clean Rooms Differential Privacy uses a general-purpose query structure to support complex SQL queries. Custom analysis templates are validated against this structure to ensure that they can run on tables protected by differential privacy. The following table indicates which functions are supported. See [Query structure and syntax](#) for more information.

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Common alternatives for unsupported SQL constructs

Category	SQL construct	Alternative
Window functions	• LISTAGG • PERCENTILE_CONT • PERCENTILE_DISC	You can use the equivalent aggregate function with GROUP BY.
Mathematical operator symbols	• \$column / 2 • \$column / 2	• CBRT • SQRT

Category	SQL construct	Alternative
	<code>\$column ^ 2</code>	<code>POWER(\$column, 2)</code>
Scalar functions	<code>SYSDATE</code> <code>\$column::integer</code> <code>convert(type, \$column)</code>	<code>CURRENT_DATE</code> <code>CAST \$column AS integer</code> <code>CAST \$column AS type</code>
Literals	<code>INTERVAL '1 SECOND'</code>	<code>INTERVAL '1' SECOND</code>
Row limiting	<code>TOP n</code>	<code>LIMIT n</code>
Join	<code>USING</code> <code>NATURAL</code>	ON clause should explicitly contain a join criterion.

Differential Privacy query tips and examples

AWS Clean Rooms Differential Privacy uses a [general-purpose query structure](#) to support a wide variety of SQL constructs such as Common Table Expressions (CTEs) for data preparation and commonly used aggregate functions such as COUNT, or SUM. In order to obfuscate the contribution of any possible user in your data by adding noise to aggregate query results at run-time, AWS Clean Rooms Differential Privacy requires that aggregate functions in the final SELECT statement are run on user-level data.

The following example uses two tables named `socialco_impressions` and `socialco_users` from a media publisher who wants to protect data using differential privacy while collaborating with an athletic brand with `athletic_brand_sales` data. The media publisher has configured the `user_id` column as the user identifier column while enabling differential privacy in AWS Clean Rooms. The advertiser does not need differential privacy protection and wants to run a query using CTEs on combined data. Since their CTE uses differential privacy protected tables, the advertiser includes the user identifier column from those protected tables in the list of CTE columns and joins the protected tables on the user identifier column.

```
WITH matches_table AS(
  SELECT si.user_id, si.campaign_id, s.sale_id, s.sale_price
  FROM socialco_impressions si
  JOIN socialco_users su
    ON su.user_id = si.user_id
```

```

JOIN athletic_brand_sales s
  ON s.emailsha256 = su.emailsha256
WHERE s.timestamp > si.timestamp

UNION ALL

SELECT si.user_id, si.campaign_id, s.sale_id, s.sale_price
FROM socialco_impressions si
JOIN socialco_users su
  ON su.user_id = si.user_id
JOIN athletic_brand_sales s
  ON s.phonesha256 = su.phonesha256
WHERE s.timestamp > si.timestamp
)

SELECT COUNT (DISTINCT user_id) as unique_users
FROM matches_table
GROUP BY campaign_id
ORDER BY COUNT (DISTINCT user_id) DESC
LIMIT 5

```

Similarly, if you want to run window functions on differential privacy protected data tables, you must include the user identifier column in the `PARTITION BY` clause.

```

ROW_NUMBER() OVER (PARTITION BY conversion_id, user_id ORDER BY match_type, match_age)
AS row

```

Limitations of AWS Clean Rooms Differential Privacy

AWS Clean Rooms Differential Privacy doesn't address the following situations:

1. AWS Clean Rooms Differential Privacy only supports queries with Amazon S3-backed AWS Glue tables. It doesn't support queries with Snowflake or Amazon Athena tables.
2. AWS Clean Rooms Differential Privacy doesn't address timing attacks. For example, these attacks are possible in scenarios where an individual user contributes a large number of rows and adding or removing this user significantly changes the query computation time.
3. AWS Clean Rooms Differential Privacy doesn't guarantee differential privacy when a SQL query can result in overflow or invalid cast errors at run time due to the use of certain SQL constructs.

The following table is a list of some, but not all, SQL constructs that may produce run-time errors and should be verified in analysis templates. We recommend that you approve analysis

templates that minimize the chances of such run-time errors and periodically review query logs to determine if the queries align with the collaboration agreement.

The following SQL constructs are vulnerable to overflow errors:

Category	SQL constructs vulnerable to overflow errors in the Spark SQL analytics engine	SQL constructs vulnerable to overflow errors in the AWS Clean Rooms SQL analytics engine
Aggregate functions	• AVG • SUM/SUM_DISTINCT	• AVG • LISTAVG • PERCENTILE_COUNT • PERCENTILE_DISC • SUM/SUM_DISTINCT
Data type formatting functions	• TO_TIMESTAMP • TO_DATE	• TO_TIMESTAMP • TO_DATE
Date and time functions	• ADD_MONTHS • DATEADD • DATEDIFF	• ADD_MONTHS • DATEADD • DATEDIFF
Math functions	• +, -, *, / • POWER	• +, -, *, / • POWER
String functions	• • CONCAT • REPEAT	• • CONCAT • REPEAT • REPLICATE

Category	SQL constructs vulnerable to overflow errors in the Spark SQL analytics engine	SQL constructs vulnerable to overflow errors in the AWS Clean Rooms SQL analytics engine
Window functions	• AVG • SUM	• AVG • LISTAVG • PERCENTILE_COUNT • PERCENTILE_DISC • RATIO_TO_REPORT • SUM

4. The CAST data type formatting function is vulnerable to invalid cast errors.

You can configure [CloudWatch to create a metric filter for a log group](#) and then [create a CloudWatch alarm](#) on that metric filter to receive alerts if a potential overflow or cast error was encountered.

Specifically, you should monitor for the error codes `CastError`, `OverflowError`, `ConversionError`. The presence of these error codes indicates a potential side-channel attack, but might indicate an erroneous SQL query.

For more information, see [Analysis logging in AWS Clean Rooms](#).

AWS Clean Rooms ML

AWS Clean Rooms ML allows two or more parties to run machine learning models on their data without the need to share their data with each other. The service provides privacy-enhancing controls that allow data owners to safe-guard their data and their model IP. You can use AWS authored models or bring your own custom model.

For a more detailed explanation of how this works, see [Cross-account jobs](#).

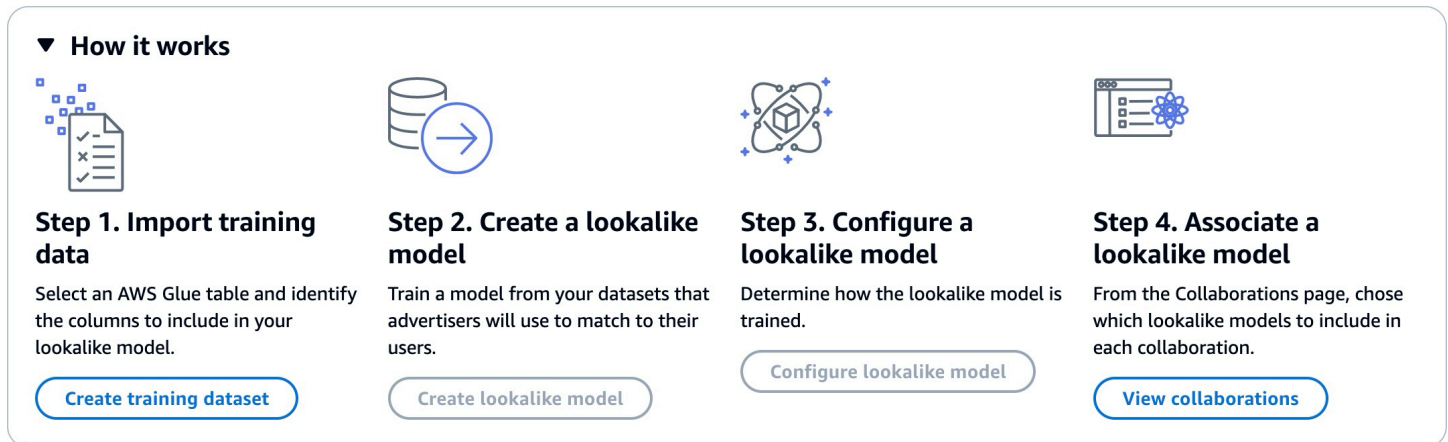
For more information about the capabilities of Clean Rooms ML models, see the following topics.

Topics

- [How AWS Clean Rooms ML works with AWS models](#)

- [How AWS Clean Rooms ML works with custom models](#)
- [AWS models in Clean Rooms ML](#)
- [Custom models in Clean Rooms ML](#)

How AWS Clean Rooms ML works with AWS models



Working with lookalike models requires that two parties, a training data provider and a seed data provider, work sequentially in AWS Clean Rooms to bring their data into a collaboration. This is the workflow that the training data provider must complete first:

1. The training data provider's data must be stored in a AWS Glue data catalog table of user-item interactions. At a minimum, the training data must contain a user ID column, interaction ID column, and a timestamp column.
2. The training data provider registers the training data with AWS Clean Rooms.
3. The training data provider creates a lookalike model that can be shared with multiple seed data providers. The lookalike model is a deep neural network that can take up to 24 hours to train. It isn't automatically retrained and we recommend that you retrain the model weekly.
4. The training data provider configures the lookalike model, including whether to share relevance metrics and the Amazon S3 location of the output segments. The training data provider can create multiple configured lookalike models from a single lookalike model.
5. The training data provider associates the configured audience model to a collaboration that's shared with a seed data provider.

This is the workflow that the seed data provider must complete next:

1. The seed data provider's data can be stored in an Amazon S3 bucket or it can come from the results of query.
2. The seed data provider opens the collaboration that they share with the training data provider.
3. The seed data provider creates a lookalike segment from the Clean Rooms ML tab of the collaboration page.
4. The seed data provider can evaluate the relevance metrics, if they were shared, and export the lookalike segment for use outside AWS Clean Rooms.

How AWS Clean Rooms ML works with custom models

With Clean Rooms ML, members of a collaboration can use a dockerized custom model algorithm that is stored in Amazon ECR to jointly analyze their data. To do this, the *model provider* must create an image and store it in Amazon ECR. Follow the steps in [Amazon Elastic Container Registry User Guide](#) to create a private repository that will contain the custom ML model.

Any member of a collaboration can be the *model provider*, provided they have the correct permissions. All members of a collaboration can contribute training data, inference data, or both to the model. For the purpose of this guide, members contributing data are referred to as *data providers*. The member who creates the collaboration is the *collaboration creator*, and this member can be either the *model provider*, one of the *data providers*, or both.

At the highest level, here are the steps that must be completed to perform custom ML modeling:

1. The collaboration creator creates a collaboration and assigns each member the proper member abilities and payment configuration. The collaboration creator must assign the member ability to either receive model outputs or receive inference results to the appropriate member in this step because it can't be updated after the collaboration is created. For more information, see [Creating and joining the collaboration in AWS Clean Rooms ML](#).
2. The model provider configures and associates their containerized ML model to the collaboration and ensures privacy constraints are set for exported data. For more information, see [Configuring a model algorithm in AWS Clean Rooms ML](#).
3. The data providers contribute their data to the collaboration and ensure their privacy needs are specified. Data providers must allow the model to access their data. For more information, see [Contributing training data in AWS Clean Rooms ML](#) and [Associating the configured model algorithm in AWS Clean Rooms ML](#).

4. A collaboration member creates the ML configuration, which defines where the model artifacts or inference results are exported to.
5. A collaboration member creates an ML input channel that provides input to the training container or inference container. The ML input channel is a query that defines the data to be used in the context of the model algorithm.
6. A collaboration member invokes model training using the ML input channel and the configured model algorithm. For more information, see [Creating a trained model in AWS Clean Rooms ML](#).
7. (Optional) The model trainer invokes the model export job and the model artifacts are sent to the model results receiver. Only members with a valid ML configuration and the member ability to receive model output can receive model artifacts. For more information, see [Exporting model artifacts from AWS Clean Rooms ML](#).
8. (Optional) A collaboration member invokes model inference using the ML input channel, the trained model ARN, and the inference configured model algorithm. The inference results are sent to the inference output receiver. Only members with a valid ML configuration and the member ability to receive inference output can receive inference results.

Here are the steps that must be completed by the *model provider*:

1. Create a SageMaker AI compatible Amazon ECR docker image. Clean Rooms ML supports only SageMaker AI compatible docker images.
2. After you have created a SageMaker AI compatible docker image, push the image to Amazon ECR. Follow the directions in [Amazon Elastic Container Registry User Guide](#) to create a container training image.
3. Configure the model algorithm for use in Clean Rooms ML.
 - a. Provide the Amazon ECR repository link and any arguments necessary to configure the model algorithm.
 - b. Provide a service access role that allows Clean Rooms ML to access the Amazon ECR repository.
 - c. Associate the configured model algorithm with the collaboration. This includes providing a privacy policy that defines controls for container logs, failure logs, CloudWatch metrics, and limits about how much data can be exported from the container results.

Here are the steps that must be completed by the *data provider* to collaborate with a custom ML model:

1. Configure an existing AWS Glue table with a custom analysis rule. This allows a specific set of pre-approved queries or pre-approved accounts to use your data.
2. Associate your configured table with a collaboration and provide a service access role that can access your AWS Glue tables.
3. [Add a collaboration analysis rule](#) to the table that allows the configured model algorithm association to access the configured table.
4. After the model and data are associated and configured in Clean Rooms ML, the member with the ability to run queries provides an SQL query and selects the model algorithm to use.

After model training is finished, that member initiates the export of model training artifacts or inference results. These artifacts or results are sent to the member with the ability to receive trained model output. The results receiver must configure their `MachineLearningConfiguration` before they can receive model output.

AWS models in Clean Rooms ML

AWS Clean Rooms ML provides a privacy-preserving method for two parties to identify similar users in their data without the need to share their data with each other. The first party brings the training data to AWS Clean Rooms so that they can create and configure a lookalike model and associate it with a collaboration. Then, seed data is brought to the collaboration to create a lookalike segment that resembles the training data.

For a more detailed explanation of how this works, see [Cross-account jobs](#).

The following topics provide information on how to create and configure a AWS models in Clean Rooms ML.

Topics

- [AWS Clean Rooms ML terminology](#)
- [Privacy protections of AWS Clean Rooms ML](#)
- [Training data requirements for Clean Rooms ML](#)
- [Seed data requirements for Clean Rooms ML](#)
- [AWS Clean Rooms ML model evaluation metrics](#)

AWS Clean Rooms ML terminology

It is important to understand the following terminology when using Clean Rooms ML:

- *Training data provider* – The party that contributes the training data, creates and configures a lookalike model, and then associates that lookalike model with a collaboration.
- *Seed data provider* – The party that contributes the seed data, generates a lookalike segment, and exports their lookalike segment.
- *Training data* – The training data provider's data, which is used to generate a lookalike model. The training data is used to measure similarity in user behaviors.

The training data must contain a user ID, item ID, and timestamp column. Optionally, the training data can contain other interactions as numerical or categorical features. Examples of interactions are a list of videos watched, items purchased, or articles read.

- *Seed data* – The seed data provider's data, which is used to create a lookalike segment. The seed data can be provided directly or it can come from the results of an AWS Clean Rooms query. The lookalike segment output is a set of users from the training data that most closely resembles the seed users.
- *Lookalike model* – A machine learning model of the training data that is used to find similar users in other datasets.

When using the API, the term *audience model* is used equivalently to lookalike model. For example, you use the [CreateAudienceModel](#) API to create a lookalike model.

- *Lookalike segment* – A subset of the training data that most closely resembles the seed data.

When using the API, you create a lookalike segment with the [StartAudienceGenerationJob](#) API.

The training data provider's data is never shared with the seed data provider and the seed data provider's data is never shared with the training data provider. The lookalike segment output is shared with the training data provider, but never the seed data provider.

Privacy protections of AWS Clean Rooms ML

Clean Rooms ML is designed to reduce the risk of *membership inference attacks* where the training data provider can learn who is in the seed data and the seed data provider can learn who is in the training data. Several steps are taken to prevent this attack.

First, seed data providers don't directly observe the Clean Rooms ML output and training data providers can never observe the seed data. Seed data providers can choose to include the seed data in the output segment.

Next, the lookalike model is created from a random sample of the training data. This sample includes a significant number of users that don't match the seed audience. This process makes it harder to determine whether a user was not in the data, which is another avenue for membership inference.

Further, multiple seed customers can be used for every parameter of seed-specific lookalike model training. This limits how much the model can overfit, and thus how much can be inferred about a user. As a result, we recommend that the minimum size of the seed data is 500 users.

Finally, user-level metrics are never provided to training data providers, which eliminates another avenue for a membership inference attack.

Training data requirements for Clean Rooms ML

To successfully create a lookalike model, your training data must meet the following requirements:

- The training data must be in Parquet, CSV, or JSON format.

Note

Zstandard (ZSTD) compressed Parquet data is not supported.

- Your training data must be cataloged in AWS Glue. For more information, see [Getting started with the AWS Glue Data Catalog](#) in the AWS Glue Developer Guide. We recommend using AWS Glue crawlers to create your tables because the schema is inferred automatically.
- The Amazon S3 bucket that contains the training data and seed data is in the same AWS region as your other Clean Rooms ML resources.
- The training data must contain at least 100,000 unique user IDs with at least two item interactions each.
- The training data must contain at least 1 million records.
- The schema specified in the [CreateTrainingDataset](#) action must align with the schema defined when the AWS Glue table was created.
- The required fields, as defined in the provided table, are defined in the [CreateTrainingDataset](#) action.

Field type	Supported data types	Required	Description
USER_ID	string, int, bigint	Yes	A unique identifier for each user in the dataset. It should be a non-Personally Identifiable Information (PII) value. This might be a hashed identifier or a customer ID.
ITEM_ID	string, int, bigint	Yes	A unique identifier for each item a user interacts with.

Field type	Supported data types	Required	Description
TIMESTAMP	bigint, int, timestamp	Yes	The time when a user interacted with the item. Values must be in the Unix epoch time in seconds format.

Field type	Supported data types	Required	Description
CATEGORICAL_FEATURE	string, int, float, bigint, double, boolean, array	No	Captures categorical data related to the user or the item. This can include things like an event type (such as click or purchase), user demographics (age group, gender - anonymized), user location (city, country - anonymized), item category (such as clothing or electronics), or item brand.

Field type	Supported data types	Required	Description
NUMERICAL_FEATURE	double, float, int, bigint	No	Captures numerical data related to the user or the item. This can include things like user purchase history (total amount spent), item price, number of times an item is visited, or user ratings for items.

- Optionally, you can provide up to 10 total categorical or numerical features.

Here is an example of a valid training data set in CSV format

```
USER_ID,ITEM_ID,TIMESTAMP,EVENT_TYPE(CATEGORICAL FEATURE),EVENT_VALUE (NUMERICAL FEATURE)
196,242,881250949,click,15
186,302,891717742,click,13
22,377,878887116,click,10
244,51,880606923,click,20
166,346,886397596,click,10
```

Seed data requirements for Clean Rooms ML

The seed data for a lookalike model can either come directly from an Amazon S3 bucket or from the results of an SQL query.

Seed data that's provided directly must meet the following requirements:

- The seed data must be in JSON lines format with a list of user IDs.
- The seed size should be between 25 and 500,000 unique user IDs.
- The minimum number of seed users must match the minimum matching seed size value that was specified when you created the configured audience model.

The following is an example of a valid training data set in CSV format

```
{"user_id": "abc"}  
{"user_id": "def"}  
{"user_id": "ghijkl"}  
{"user_id": "123"}  
{"user_id": "456"}  
{"user_id": "7890"}
```

AWS Clean Rooms ML model evaluation metrics

Clean Rooms ML computes the *recall* and *relevance score* to determine how well your model performs. Recall compares the similarity between the lookalike data and training data. The relevance score is used to decide how large the audience should be, not whether the model is well-performing.

Recall is an unbiased measure of how similar the lookalike segment is to the training data. Recall is the percentage of the most similar users (by default, the most similar 20%) from a sample of the training data that are included in the seed audience by the audience generation job. Values range from 0-1, larger values indicate a better audience. A recall value approximately equal to the maximum bin percentage indicates that the audience model is equivalent to random selection.

We consider this a better evaluation metric than accuracy, precision, and F1 scores because Clean Rooms ML doesn't have accurately labeled true negative users when building its model.

Segment-level *relevance score* is a measure of similarity with values ranging from -1 (least similar) to 1 (most similar). Clean Rooms ML computes a set of relevance scores for various segment

sizes to help you determine the best segment size for your data. Relevance scores monotonically decrease as the segment size increases, thus as the segment size increases it can be less similar to the seed data. When the segment-level relevance score reaches 0, the model predicts that all users in the lookalike segment are from the same distribution as the seed data. Increasing the output size is likely to include users in the lookalike segment that aren't from the same distribution as the seed data.

Relevance scores are normalized within a single campaign and should not be used to compare across campaigns. Relevancy scores shouldn't be used as a single-sourced evidence for any business outcome because those are impacted by multiple complex factors in addition to relevance, such as inventory quality, inventory type, timing of advertising, and so on.

Relevance scores should not be used to judge the quality of the seed, but rather if it can be increased or decreased. Consider the following examples:

- All positive scores – This indicates that there are more output users that are predicted as similar than are included in the lookalike segment. This is common for seed data that's part of a large market, such as everybody who has bought toothpaste in the past month. We recommend looking at smaller seed data, such as everybody who has bought toothpaste more than once in the past month.
- All negatives scores or negative for your desired lookalike segment size – This indicates that Clean Rooms ML predicts there aren't enough similar users in the desired lookalike segment size. This can be because the seed data is too specific or the market is too small. We recommend either applying fewer filters to the seed data or widening the market. For example, if the original seed data was customers that bought a stroller and car seat, you could expand the market to customers that bought multiple baby products.

Training data providers determine whether the relevance scores are exposed and the bucket bins where relevance scores are computed.

Custom models in Clean Rooms ML

With Clean Rooms ML, members of a collaboration can use a dockerized custom model algorithm that is stored in Amazon ECR to jointly analyze their data. To do this, the *model provider* must create an image and store it in Amazon ECR. Follow the steps in [Amazon Elastic Container Registry User Guide](#) to create a private repository that will contain the custom ML model.

Any member of a collaboration can be the *model provider*, provided they have the correct permissions. All members of a collaboration can contribute data to the model. For the purpose of this guide, members contributing data are referred to as *data providers*. The member who creates the collaboration is the *collaboration creator*, and this member can be either the *model provider*, one of the *data providers*, or both.

The following topics describe the information necessary to create a custom ML model

Topics

- [Custom ML modeling prerequisites](#)
- [Model authoring guidelines for the training container](#)
- [Model authoring guidelines for the inference container](#)
- [Receiving model logs and metrics](#)

Custom ML modeling prerequisites

Before you can perform custom ML modeling, you should consider the following:

- Determine whether both model training and inference on the trained model is going to be performed in the collaboration.
- Determine the role that each collaboration member will perform and assign them the appropriate abilities.
 - Assign the CAN_QUERY ability to the member who will train the model and run inference on the trained model.
 - Assign the CAN_RECEIVE_RESULTS to at least one member of the collaboration.
 - Assign CAN_RECEIVE_MODEL_OUTPUT or CAN_RECEIVE_INFERENCE_OUTPUT abilities to the member that will receive trained model exports or inference output, respectively. You can choose to use both abilities if they are required by your use-case.
- Determine the maximum size of the trained model artifacts or inference results that you will allow to be exported.
- We recommend that all users have the CleanroomsFullAccess and CleanroomsMLFullAccess policies attached to their role. Using custom ML models requires using both the AWS Clean Rooms and AWS Clean Rooms ML SDKs.
- Consider the following information about IAM roles.

- All data providers must have a service access role that allows AWS Clean Rooms to read data from their AWS Glue catalogs and tables, and the underlying Amazon S3 locations. These roles are similar to those required for SQL querying. This allows you to use the `CreateConfiguredTableAssociation` action. For more information, see [Create a service role to create a configured table association](#).
- All members that want to receive metrics must have a service access role that allows them to write CloudWatch metrics and logs. This role is used by Clean Rooms ML to write all model metrics and logs to the member's AWS account during model training and inference. We also provide privacy controls to determine which members have access to the metrics and logs. This allows you to use the `CreateMLConfiguration` action. For more information see, [Create a service role for custom ML modeling - ML Configuration](#).

The member receiving results must provide a service access role with permissions to write to their Amazon S3 bucket. This role allows Clean Rooms ML to export results (trained model artifacts or inference results) to an Amazon S3 bucket. This allows you to use the `CreateMLConfiguration` action. For more information, see [Create a service role for custom ML modeling - ML Configuration](#).

- The model provider must provide a service access role with permissions to read their Amazon ECR repository and image. This allows you to use the `CreateConfigureModelAlgorithm` action. For more information, see [Create a service role to provide a custom ML model](#).
- The member that creates the `MLInputChannel` to generate datasets for training or inference must provide a service access role that allows Clean Rooms ML to execute an SQL query in AWS Clean Rooms. This allows you to use the `CreateTrainedModel` and `StartTrainedModelInferenceJob` actions. For more information, see [Create a service role to query a dataset](#).
- Model authors should follow the [Model authoring guidelines for the training container](#) and [Model authoring guidelines for the inference container](#) to ensure model inputs and outputs are configured as expected by AWS Clean Rooms.

Model authoring guidelines for the training container

This section details the guidelines that model providers should follow when creating a custom ML model algorithm for Clean Rooms ML.

- Use the appropriate SageMaker AI training-supported container base image, as described in the [SageMaker AI Developer Guide](#). The following code allows you to pull the supported container base images from public SageMaker AI endpoints.

```
ecr_registry_endpoint='763104351884.dkr.ecr.$REGION.amazonaws.com'
base_image='pytorch-training:2.3.0-cpu-py311-ubuntu20.04-sagemaker'
aws ecr get-login-password --region $REGION | docker login --username AWS --password-
stdin $ecr_registry_endpoint
docker pull $ecr_registry_endpoint/$base_image
```

- When authoring the model locally, ensure the following so that you can test your model locally, on a development instance, on SageMaker AI Training in your AWS account, and on Clean Rooms ML.
 - We recommend writing a training script that accesses useful properties about the training environment through various environment variables. Clean Rooms ML uses the following arguments to invoke training on your model code: SM_MODEL_DIR, SM_OUTPUT_DIR, SM_CHANNEL_TRAIN, and FILE_FORMAT. These defaults are used by Clean Rooms ML to train your ML model in its own execution environment with the data from all parties.
 - Clean Rooms ML makes your training input channels available via the /opt/ml/input/data/*channel-name* directories in the docker container. Each ML input channel is mapped based on its corresponding channel_name provided in the CreateTrainedModel request.

```
parser = argparse.ArgumentParser()# Data, model, and output directories

parser.add_argument('--model_dir', type=str, default=os.environ.get('SM_MODEL_DIR',
"/opt/ml/model"))
parser.add_argument('--output_dir', type=str,
default=os.environ.get('SM_OUTPUT_DIR', "/opt/ml/output/data"))
parser.add_argument('--train_dir', type=str,
default=os.environ.get('SM_CHANNEL_TRAIN', "/opt/ml/input/data/train"))
parser.add_argument('--train_file_format', type=str,
default=os.environ.get('FILE_FORMAT', "csv"))
```

- Ensure that you are able to generate a synthetic or test dataset based on the schema of the collaborators that will be used in your model code.
- Ensure that you can run a SageMaker AI training job on your own AWS account before you associate the model algorithm with a AWS Clean Rooms collaboration.

The following code contains a sample Docker file that is compatible with local testing, SageMaker AI Training environment testing, and Clean Rooms ML

```
FROM 763104351884.dkr.ecr.us-west-2.amazonaws.com/pytorch-training:2.3.0-cpu-
py311-ubuntu20.04-sagemaker
MAINTAINER $author_name

ENV PYTHONDONTWRITEBYTECODE=1 \
    PYTHONUNBUFFERED=1 \
    LD_LIBRARY_PATH="${LD_LIBRARY_PATH}:/usr/local/lib"

ENV PATH="/opt/ml/code:${PATH}"

# this environment variable is used by the SageMaker PyTorch container to determine
# our user code directory
ENV SAGEMAKER_SUBMIT_DIRECTORY /opt/ml/code

# copy the training script inside the container
COPY train.py /opt/ml/code/train.py
# define train.py as the script entry point
ENV SAGEMAKER_PROGRAM train.py
ENTRYPOINT ["python", "/opt/ml/code/train.py"]
```

- To best monitor container failures, we recommend exporting logs and debugging for failure reasons. In a `GetTrainedModel` response, Clean Rooms ML returns the first 1024 characters from this file under `StatusDetails`.
- After you have completed any model changes and you are ready to test it in the SageMaker AI environment, run the following commands in the order provided.

```
export ACCOUNT_ID=xxx
export REPO_NAME=xxx
export REPO_TAG=xxx
export REGION=xxx

docker build -t $ACCOUNT_ID.dkr.ecr.us-west-2.amazonaws.com/$REPO_NAME:$REPO_TAG

# Sign into AWS $ACCOUNT_ID/ Run aws configure
# Check the account and make sure it is the correct role/credentials
aws sts get-caller-identity
aws ecr create-repository --repository-name $REPO_NAME --region $REGION
aws ecr describe-repositories --repository-name $REPO_NAME --region $REGION
```

```
# Authenticate Docker
aws ecr get-login-password --region $REGION | docker login --username AWS --password-
stdin $ACCOUNT_ID.dkr.ecr.$REGION.amazonaws.com

# Push To ECR Images
docker push $ACCOUNT_ID.dkr.ecr.$REGION.amazonaws.com$REPO_NAME:$REPO_TAG

# Create Sagemaker Training job
# Configure the training_job.json with
# 1. TrainingImage
# 2. Input DataConfig
# 3. Output DataConfig
aws sagemaker create-training-job --cli-input-json file://training_job.json --region
$REGION
```

After the SageMaker AI job is complete and you are satisfied with your model algorithm, you can register the Amazon ECR Registry with AWS Clean Rooms ML. Use the `CreateConfiguredModelAlgorithm` action to register the model algorithm and the `CreateConfiguredModelAlgorithmAssociation` to associate it to a collaboration.

Model authoring guidelines for the inference container

This section details the guidelines that model providers should follow when creating an inference algorithm for Clean Rooms ML.

- Use the appropriate SageMaker AI inference-supported container base image, as described in the [SageMaker AI Developer Guide](#). The following code allows you to pull the supported container base images from public SageMaker AI endpoints.

```
ecr_registry_endpoint='763104351884.dkr.ecr.$REGION.amazonaws.com'
base_image='pytorch-inference:2.3.0-cpu-py311-ubuntu20.04-sagemaker'
aws ecr get-login-password --region $REGION | docker login --username AWS --password-
stdin $ecr_registry_endpoint
docker pull $ecr_registry_endpoint/$base_image
```

- When authoring the model locally, ensure the following so that you can test your model locally, on a development instance, on SageMaker AI Batch Transform in your AWS account, and on Clean Rooms ML.

- Clean Rooms ML makes your model artifacts from inference available for use by your inference code via the `/opt/ml/model` directory in the docker container.
- Clean Rooms ML splits input by line, uses a `MultiRecord` batch strategy, and adds a newline character at the end of every transformed record.
- Ensure that you are able to generate a synthetic or test inference dataset based on the schema of the collaborators that will be used in your model code.
- Ensure that you can run a SageMaker AI batch transform job on your own AWS account before you associate the model algorithm with a AWS Clean Rooms collaboration.

The following code contains a sample Docker file that is compatible with local testing, SageMaker AI transform environment testing, and Clean Rooms ML

```
FROM 763104351884.dkr.ecr.us-east-1.amazonaws.com/pytorch-inference:1.12.1-cpu-
py38-ubuntu20.04-sagemaker

ENV PYTHONUNBUFFERED=1

COPY serve.py /opt/ml/code/serve.py
COPY inference_handler.py /opt/ml/code/inference_handler.py
COPY handler_service.py /opt/ml/code/handler_service.py
COPY model.py /opt/ml/code/model.py

RUN chmod +x /opt/ml/code/serve.py

ENTRYPOINT ["/opt/ml/code/serve.py"]
```

- After you have completed any model changes and you are ready to test it in the SageMaker AI environment, run the following commands in the order provided.

```
export ACCOUNT_ID=xxx
export REPO_NAME=xxx
export REPO_TAG=xxx
export REGION=xxx

docker build -t $ACCOUNT_ID.dkr.ecr.us-west-2.amazonaws.com/$REPO_NAME:$REPO_TAG

# Sign into AWS $ACCOUNT_ID/ Run aws configure
# Check the account and make sure it is the correct role/credentials
aws sts get-caller-identity
aws ecr create-repository --repository-name $REPO_NAME --region $REGION
```

```
aws ecr describe-repositories --repository-name $REPO_NAME --region $REGION

# Authenticate Docker
aws ecr get-login-password --region $REGION | docker login --username AWS --password-
stdin $ACCOUNT_ID.dkr.ecr.$REGION.amazonaws.com

# Push To ECR Repository
docker push $ACCOUNT_ID.dkr.ecr.$REGION.amazonaws.com$REPO_NAME:$REPO_TAG

# Create Sagemaker Model
# Configure the create_model.json with
# 1. Primary container -
    # a. ModelDataUrl - S3 Uri of the model.tar from your training job
aws sagemaker create-model --cli-input-json file://create_model.json --region $REGION

# Create Sagemaker Transform Job
# Configure the transform_job.json with
# 1. Model created in the step above
# 2. MultiRecord batch strategy
# 3. Line SplitType for TransformInput
# 4. AssembleWith Line for TransformOutput
aws sagemaker create-transform-job --cli-input-json file://transform_job.json --
region $REGION
```

After the SageMaker AI job is complete and you are satisfied with your batch transform, you can register the Amazon ECR Registry with AWS Clean Rooms ML. Use the `CreateConfiguredModelAlgorithm` action to register the model algorithm and the `CreateConfiguredModelAlgorithmAssociation` to associate it to a collaboration.

Receiving model logs and metrics

To receive logs and metrics from custom model training or inference, members must have [created an ML Configuration](#) with a valid role that provides the necessary CloudWatch permissions (see [Create a service role for custom ML modeling - ML Configuration](#)).

System metric

System metrics for both training and inference, such as CPU and memory utilization, are published to all members in the collaboration with valid ML Configurations. These metrics can be viewed as the job progresses via CloudWatch Metrics in the `/aws/cleanroomsm1/TrainedModels` or `/aws/cleanroomsm1/TrainedModelInferenceJobs` namespaces, respectively.

Model logs

Access to the model logs is provided by the privacy configuration policy of each configured model algorithm. The model author sets the privacy configuration policy when associating a configured model algorithm (either via the console or the `CreateConfiguredModelAlgorithmAssociation` API) to a collaboration. Setting the privacy configuration policy controls which members can receive the model logs.

Additionally, the model author can set a filter pattern in the privacy configuration policy to filter log events. All logs that a model container sends to `stdout` or `stderr` and that match the filter pattern (if set), are sent to Amazon CloudWatch Logs. Model logs are available in CloudWatch log groups `/aws/cleanroomsm1/TrainedModels` or `/aws/cleanroomsm1/TrainedModelInferenceJobs`, respectively.

Custom defined metrics

When you configure a model algorithm (either via the console or the `CreateConfiguredModelAlgorithm` API), the model author can provide specific metric names and regex statements to search for in the output logs. These can be viewed as the job progresses via CloudWatch Metrics in the `/aws/cleanroomsm1/TrainedModels` namespace. When associating a configured model algorithm, the model author can set an optional noise level in the metrics privacy configuration to avoid outputting raw data while still providing visibility into custom metric trends. If a noise level is set, the metrics are published at the end of the job rather than in real time.

Cryptographic Computing for Clean Rooms

Cryptographic Computing for Clean Rooms (C3R) is a capability in AWS Clean Rooms that can be used in addition to [analysis rules](#). With C3R, organizations can bring sensitive data together to derive new insights from data analytics while cryptographically limiting what can be learned by any party in the process. C3R can be used by two or more parties that want to collaborate with their sensitive data but are required to only use encrypted data in the cloud.

The C3R encryption client is a client-side encryption tool that you can use to [encrypt](#) your data for use with AWS Clean Rooms. When you use the C3R encryption client, data remains cryptographically protected while in use in an AWS Clean Rooms collaboration. As with a regular AWS Clean Rooms collaboration, the input data is relational database tables, and the computation is expressed as a SQL query. However, C3R only supports a limited subset of SQL queries on encrypted data.

Specifically, C3R supports SQL JOIN and SELECT statements on cryptographically protected data. Each column in the input table can be used in exactly one of the following SQL statement types:

- Columns that are cryptographically protected for use in JOIN statements are called **fingerprint columns**.
- Columns that are cryptographically protected for use in SELECT statements are called **sealed columns**.
- Columns that are not cryptographically protected for use in JOIN or SELECT statements are called **cleartext columns**.

In some cases, GROUP BY statements are supported on fingerprint columns. For more information, see [Fingerprint columns](#). Currently, C3R doesn't support the use of other SQL constructs on encrypted data, such as WHERE clauses or aggregate functions like SUM and AVERAGE, even if they would otherwise be allowed by the relevant analysis rules.

C3R is designed to protect data in individual cells of a table. Using the default configuration for C3R, the underlying data that a customer makes available to third parties through a collaboration remains encrypted while the content is in use within AWS Clean Rooms. C3R uses industry standard AES-GCM encryption for all sealed columns and an industry standard pseudorandom function, known as a Hash-based Message Authentication Code (HMAC), for protecting fingerprint columns.

Although C3R encrypts the data in your tables, the following information might still be able to be inferred:

- Information about the tables themselves, including the number of columns, column names, and the number of rows in your table.
- As with most standard forms of encryption, C3R doesn't try to hide the length of encrypted values. C3R does offer the ability to pad encrypted values to hide the exact length of cleartexts. However, an upper bound on the length of the cleartexts in each column could still be revealed to another party.
- Logging-level information, such as when a particular row was added to an encrypted C3R table.

For more information about C3R, see the following topics.

Topics

- [Considerations when using Cryptographic Computing for Clean Rooms](#)
- [Supported file and data types in Cryptographic Computing for Clean Rooms](#)

- [Column names in Cryptographic Computing for Clean Rooms](#)
- [Column types in Cryptographic Computing for Clean Rooms](#)
- [Cryptographic computing parameters](#)
- [Optional flags in Cryptographic Computing for Clean Rooms](#)
- [Queries with Cryptographic Computing for Clean Rooms](#)
- [Guidelines for the C3R encryption client](#)

Considerations when using Cryptographic Computing for Clean Rooms

Cryptographic Computing for Clean Rooms (C3R) seeks to maximize data protection. However, some use cases might benefit from lower levels of data protection in exchange for additional functionality. You can make these specific tradeoffs by modifying C3R from its most secure configuration. As the customer, you should be aware of these tradeoffs and determine if they are appropriate for your use case. Tradeoffs to consider include the following:

Topics

- [Allowing mixed cleartext and encrypted data in your tables](#)
- [Allowing repeated values in fingerprint columns](#)
- [Loosening restrictions on how fingerprint columns are named](#)
- [Determining how NULL values are represented](#)

For more information about how to set parameters for these scenarios, see [Cryptographic computing parameters](#).

Allowing mixed cleartext and encrypted data in your tables

Having all data be client-side encrypted provides maximum data protection. However, this limits certain kinds of queries (for example, the SUM aggregate function). The risk of allowing cleartext data is that it's feasible that anyone with access to the encrypted tables could infer some information about encrypted values. This could be done by performing a statistical analysis on the cleartext and associated data.

For example, imagine you had the columns of City and State. The City column is cleartext and the State column is encrypted. When you see the value Chicago in the City column, that helps you determine with high probability that the State is Illinois. In contrast, if one column

is `City` and the other column is `EmailAddress`, a cleartext `City` is unlikely to reveal anything about an encrypted `EmailAddress`.

For more information about the parameter for this scenario, see [Allow cleartext columns parameter](#).

Allowing repeated values in fingerprint columns

For the most secure approach, we assume that any fingerprint column contains exactly one instance of a variable. No item can be repeated in a fingerprint column. The C3R encryption client maps these cleartext values into unique values that are indistinguishable from random values. Therefore, it's impossible to infer information about the cleartext from these random values.

The risk of repeated values in a fingerprint column is that repeated values will result in repeated random-looking values. Thus, anyone who has access to the encrypted tables could, in theory, perform a statistical analysis of the fingerprint columns that might reveal information about cleartext values.

Again, suppose the fingerprint column is `State`, and every row of the table corresponds to a US household. By doing a frequency analysis, one could infer which state is California and which is Wyoming with high probability. This inference is possible because California has many more residents than Wyoming. In contrast, say the fingerprint column is on a household identifier and each household appeared in the database between 1 and 4 times in a database of millions of entries. It's unlikely that a frequency analysis would reveal any useful information.

For more information about the parameter for this scenario, see [Allow duplicates parameter](#).

Loosening restrictions on how fingerprint columns are named

By default, we assume that when two tables are joined using encrypted fingerprint columns, those columns have the same name in each table. The technical reason for this result is that, by default, we derive a different cryptographic key for encrypting each fingerprint column. That key is derived from a combination of the shared secret key for the collaboration and the column name. If we try to join two columns with different column names, we derive different keys and we can't compute a valid join.

To address this issue, you can turn off the feature that derives keys from each column name. Then, the C3R encryption client uses a single derived key for all fingerprint columns. The risk is that another kind of frequency analysis can be done that might reveal information.

Let's use the City and State example again. If we derive the same random values for each fingerprint column (by not incorporating the column name), New York has the same random value in the City and State columns. New York is one of a few cities in the US where the City name is the same as the State name. In contrast, if your dataset has completely different values in each column, no information is leaked.

For more information about the parameter for this scenario, see [Allow JOIN of columns with different names parameter](#).

Determining how NULL values are represented

The option available to you is whether to process cryptographically (encrypt and HMAC) NULL values like any other value. If you don't process NULL values like any other value, information might be revealed.

For example, suppose that NULL in the Middle Name column in the cleartext indicates people without middle names. If you don't encrypt those values, you leak which rows in the encrypted table are used for people without middle names. That information might be an identifying signal for some people in some populations. But if you do cryptographically process NULL values, certain SQL queries act differently. For example, GROUP BY clauses will not group fingerprint NULL values in fingerprint columns together.

For more information about the parameter for this scenario, see [Preserve NULL values parameter](#).

Supported file and data types in Cryptographic Computing for Clean Rooms

The C3R encryption client recognizes the following file types:

- CSV files
- Parquet files

You can use the `--fileFormat` flag in the C3R encryption client to specify a file format explicitly. When explicitly specified, file format is not determined by file extension.

Topics

- [CSV files](#)
- [Parquet files](#)

- [Encrypting non-string values](#)

CSV files

A file with a .csv extension is assumed to be CSV formatted and contain UTF-8 encoded text. The C3R encryption client treats all values as strings.

Supported properties in .csv files

The C3R encryption client requires that .csv files have the following properties:

- Might or might not contain an initial header row that uniquely names each column.
- Comma-delimited. (Currently, custom delimiters are not supported.)
- UTF-8 encoded text.

White space trimming from .csv entries

Both leading and trailing white space is trimmed from .csv entries.

Custom NULL encoding for a .csv file

A .csv file can use custom NULL encoding.

With the C3R encryption client, you can specify custom encodings for NULL entries in the input data by using the `--csvInputNULLValue=<csv-input-null>` flag. The C3R encryption client can use custom encodings in the generated output file for NULL entries by using the `--csvOutputNULLValue=<csv-output-null>` flag.

Note

A NULL entry is considered to be *lacking* content, specifically in the context of a richer tabular format like an SQL table. Although .csv doesn't explicitly support this characterization for historical reasons, it's a common convention to consider an empty entry that contains only white space to be NULL. Therefore, that's the default behavior of the C3R encryption client and it can be customized as needed.

How .csv entries are interpreted by C3R

The following table provides examples of how .csv entries are marshalled (cleartext to cleartext for clarity) based on the values (if any) that are provided for the `--csvInputNULLValue=<csv-input-null>` and `--csvOutputNULLValue=<csv-output-null>` flags. Leading and trailing white space outside of quotes is trimmed before C3R interprets any value's meaning.

<csv-input-null>	<csv-output-null>	Input entry	Output entry
None	None	,AnyProduct,	,AnyProduct,
None	None	, AnyProduct ,	,AnyProduct,
None	None	,"AnyProduct",	,AnyProduct,
None	None	, "AnyProdu ct" ,	,AnyProduct,
None	None	,,	,,
None	None	, ,	,,
None	None	, "",	,,
None	None	, " ",	, " ",
None	None	, " " ,	, " ",
"AnyProduct"	"NULL"	,AnyProduct,	,NULL,
"AnyProduct"	"NULL"	, AnyProduct ,	,NULL,
"AnyProduct"	"NULL"	,"AnyProduct",	,NULL,
"AnyProduct"	"NULL"	, "AnyProdu ct" ,	,NULL,
None	"NULL"	,,	,NULL,
None	"NULL"	, ,	,NULL,

<csv-input-null>	<csv-output-null>	Input entry	Output entry
None	"NULL"	, "",	, NULL,
None	"NULL"	, " ",	, " ",
None	"NULL"	, " " ,	, " ",
""	"NULL"	, ,	, NULL,
""	"NULL"	, ,	, NULL,
""	"NULL"	, "",	, "",
""	"NULL"	, " ",	, " ",
""	"NULL"	, " " ,	, " ",
"\""	"NULL"	, ,	, ,
"\""	"NULL"	, ,	, ,
"\""	"NULL"	, "",	, NULL,
"\""	"NULL"	, " ",	, " ",
"\""	"NULL"	, " " ,	, " ",

CSV file without headers

The source .csv file doesn't need to have headers in the first row that uniquely name each column. However, a .csv file without a header row requires a positional encryption schema. The positional encryption schema is required instead of the typical mapped schema that's used for both .csv files with a header row and Parquet files.

A positional encryption schema specifies output columns by position instead of by name. A mapped encryption schema maps source column names to target column names. For more information, including a detailed discussion and examples of both schema formats, see [Mapped and positional table schemas](#).

Parquet files

A file with a .parquet extension is assumed to be in the Apache Parquet format.

Supported Parquet data types

The C3R encryption client can process any non-complex (that is, primitive type) data in a Parquet file that represents a data type supported by AWS Clean Rooms.

However, only string columns can be used for sealed columns.

The following Parquet data types are supported:

- Binary primitive type with the following logical annotations:
 - None if the `--parquetBinaryAsString` is set (STRING data type)
 - `Decimal(scale, precision)` (DECIMAL data type)
 - `String` (STRING data type)
- Boolean primitive data type with no logical annotation (BOOLEAN data type)
- Double primitive data type with no logical annotation (DOUBLE data type)
- `Fixed_Len_Binary_Array` primitive type with the `Decimal(scale, precision)` logical annotation (DECIMAL data type)
- Float primitive data type with no logical annotation (FLOAT data type)
- Int32 primitive type with the following logical annotations:
 - None (INT data type)
 - `Date` (DATE data type)
 - `Decimal(scale, precision)` (DECIMAL data type)
 - `Int(16, true)` (SMALLINT data type)
 - `Int(32, true)` (INT data type)
- Int64 primitive data type with the following logical annotations:
 - None (BIGINT data type)
 - `Decimal(scale, precision)` (DECIMAL data type)
 - `Int(64, true)` (BIGINT data type)
 - `Timestamp(isUTCAdjusted, TimeUnit.MILLIS)` (TIMESTAMP data type)
 - `Timestamp(isUTCAdjusted, TimeUnit.MICROS)` (TIMESTAMP data type)
 - `Timestamp(isUTCAdjusted, TimeUnit.NANOS)` (TIMESTAMP data type)

Encrypting non-string values

Currently, only string values are supported for sealed columns.

For .csv files, the C3R encryption client treats all values as UTF-8 encoded text and makes no attempt to interpret them differently before encryption.

For fingerprint columns, types are grouped into equivalence classes. An equivalence class is a set of data types that can be unambiguously compared for equality via a representative data type.

Equivalence classes allow identical fingerprints to be assigned to the same semantic value regardless of the original representation. However, the same value in two equivalence classes will not result in the same fingerprint column.

For example, the INTEGRAL value 42 will be assigned the same fingerprint regardless of whether it was originally an SMALLINT, INT, or BIGINT. Also, the INTEGRAL value 0 will never match the BOOLEAN value FALSE (which is represented by the value 0).

The following equivalence classes and corresponding AWS Clean Rooms data types are supported by fingerprint columns:

Equivalence class	Supported AWS Clean Rooms data type
BOOLEAN	BOOLEAN
DATE	DATE
INTEGRAL	BIGINT, INT, SMALLINT
STRING	CHAR, STRING, VARCHAR

Column names in Cryptographic Computing for Clean Rooms

By default, the names of columns are important in Cryptographic Computing for Clean Rooms.

If the value of the **Allow JOIN of columns with different names** parameter is **false**, column names are used during the encryption of fingerprint columns. For this reason, by default, collaborators must coordinate in advance and use the same target column names for data that will use JOIN

statements in queries. By default, columns encrypted for JOIN with different names don't successfully JOIN on any values.

If the value of the **Allow JOIN of columns with different names** parameter is **true**, JOIN statements across columns encrypted as fingerprint columns succeed. Encrypting data with this parameter might allow some inference of the cleartext values. For example, if a row has the same Hash-based Message Authentication Code (HMAC) value in both the City column and State column, the value might be New York.

Normalization of column header names

Column header names are normalized by the C3R encryption client. Any leading and trailing white space is removed, and the column name is made lowercase for the transformed output.

Normalization is applied before all other computations, calculations, or other operations which could possibly be impacted by column names. The emitted output file only contains the normalized names.

Column types in Cryptographic Computing for Clean Rooms

This topic provides information about column types in Cryptographic Computing for Clean Rooms.

Topics

- [Fingerprint columns](#)
- [Sealed columns](#)
- [Cleartext columns](#)

Fingerprint columns

Fingerprint columns are columns that are protected cryptographically for use in JOIN statements.

Data from fingerprint columns can't be decrypted. Only data from sealed columns can be decrypted.

Fingerprint columns must only be used in the following SQL clauses and functions:

- JOIN (INNER, OUTER, LEFT, RIGHT, or FULL) against other fingerprint columns:
 - If the value of the `allowJoinsOnColumnsWithDifferentNames` parameter is set to `false`, both fingerprint columns of the JOIN must also have the same name.

- `SELECT COUNT()`
- `SELECT COUNT(DISTINCT )`
- `GROUP BY` (Only use if the collaboration has set the value of the `preserveNulls` parameter to `true`.)

Queries that violate these constraints might yield incorrect results.

Sealed columns

Sealed columns are columns that are protected cryptographically for use in `SELECT` statements.

Sealed columns must only be used in the following SQL clauses and functions:

- `SELECT`
- `SELECT ... AS`
- `SELECT COUNT()`

Note

`SELECT COUNT(DISTINCT )` is not supported.

Queries that violate these constraints might yield incorrect results.

Padding data for a sealed column before encryption

When you specify that a column should be a sealed column, C3R asks you what kind of *padding* to choose. Padding data before encryption is optional. Without padding (a pad type of `none`), the encrypted data's length indicates the size of the cleartext. In some circumstances, the size of the cleartext could expose the plaintext. With padding (a pad type of `fixed` or `max`), all values are first padded to a common size and then encrypted. With padding, the length of the encrypted data provides no information about the original cleartext length, other than giving an upper bound on its size.

If you want padding for a column and the maximal byte length of data in that column is known, use `fixed` padding. Use a `length` value that is at least as large as the byte-length of the longest value in that column.

Note

An error occurs and encryption fails if a value is longer than the provided length.

If you want padding for a column and the maximal byte length of data in that column isn't known, use max padding. This padding mode pads all data to the length of the longest value plus additional length bytes.

Note

You might want to encrypt data in batches, or update your tables with new data periodically. Be aware that max padding will pad entries to the length (plus length byte) of the longest plaintext entry in a given batch. This means that the ciphertext length may vary from batch to batch. Therefore, if you know the maximum byte-length for a column, then you should use fixed instead of max.

Cleartext columns

Cleartext columns are columns that aren't protected cryptographically for use in JOIN or SELECT statements.

Cleartext columns can be used in any part of the SQL query.

Cryptographic computing parameters

Cryptographic computing parameters are available for collaborations using Cryptographic Computing for Clean Rooms (C3R) when [creating a collaboration](#). You can create a collaboration using either the AWS Clean Rooms console or the CreateCollaboration API operation. In the console, you can set values for the parameters in **Cryptographic computing parameters** after you turn on the **Support cryptographic computing** option. For more information, see the following topics.

Topics

- [Allow cleartext columns parameter](#)
- [Allow duplicates parameter](#)

- [Allow JOIN of columns with different names parameter](#)
- [Preserve NULL values parameter](#)

Allow cleartext columns parameter

In the console, you can set the **Allow cleartext columns** parameter when [creating a collaboration](#) to specify if cleartext data is allowed in a table with encrypted data.

The following table describes the values for the **Allow cleartext columns** parameter.

Parameter value	Description
No	Cleartext columns aren't allowed in the encrypted table. All data is cryptographically protected.
Yes	Cleartext columns are allowed in the encrypted table. Cleartext columns are not cryptographically protected and are included as cleartext. You should take note of what your rows' cleartext data might reveal about the other data in the table. To run SUM or AVG on specific columns, the columns must be in cleartext.

Using the CreateCollaboration API operation, for the dataEncryptionMetadata parameter, you can set the value of allowCleartext to true or false. For more information about API operations, see the [AWS Clean Rooms API Reference](#).

Cleartext columns correspond to columns that are classified as cleartext in the table-specific schema. Data in these columns is not encrypted and can be used in any way. Cleartext columns can be useful if the data is not sensitive and/or if more flexibility is needed than an encrypted sealed column or fingerprint column allows.

Allow duplicates parameter

In the console, you can set the **Allow duplicates** parameter when [creating a collaboration](#) to specify if columns encrypted for JOIN queries can contain duplicate non-NULL values.

⚠ Important

The **Allow duplicates**, [Allow JOIN of columns with different names](#), and [Preserve NULL values](#) parameters have separate but related effects.

The following table describes the values for the **Allow duplicates** parameter.

Parameter value	Description
No	Repeated values are not allowed in a fingerprint column. All values in a single fingerprint column must be unique.
Yes	Repeated values are allowed in a fingerprint column. If you need to join columns with repeated values, set this value to Yes . When set to Yes , frequency patterns appearing within fingerprint columns in the C3R table or results might imply some additional information about the structure of the cleartext data.

Using the CreateCollaboration API operation, for the dataEncryptionMetadata parameter you can set the value of allowDuplicates to true or false. For more information about API operations, see the [AWS Clean Rooms API Reference](#).

By default, if encrypted data must be used in JOIN queries, the C3R encryption client requires that those columns have no duplicate values. This requirement is an effort to increase data protection. This behavior can help ensure that repeated patterns in the data are not observable. However, if you want to work with encrypted data in JOIN queries and aren't concerned about duplicate values, the **Allow duplicates** parameter can disable this conservative check.

Allow JOIN of columns with different names parameter

In the console, you can set the **Allow JOIN of columns with different names** parameter when [creating a collaboration](#) to specify if JOIN statements between columns with different names are supported.

For more information, see [Normalization of column header names](#)

The following table describes the values for the **Allow JOIN of columns with different names** parameter.

Parameter value	Description
No	Joins of fingerprint columns with different names are not supported. JOIN statements only provide accurate results on columns that have the same name.  Important The No value provides increased information security but requires collaboration participants to agree previously about column names. If two columns have different names when encrypted as fingerprint columns and Allow JOIN of columns with different names is set to No, JOIN statements on those columns produce no results. This is because no values post-encryption are shared between them.
Yes	Joins of fingerprint columns with different names are supported. For additional flexibility, users can set this value to Yes, which allows JOIN statements on columns regardless of their column name. If set to Yes, the C3R encryption client doesn't consider the column name when protecting fingerprint columns. As a result, common values across different fingerprint columns are observable in the C3R table. For example, if a row has the same encrypted JOIN value in both a City column and a State column, it might be reasonable to infer that value is New York.

Using the CreateCollaboration API operation, for the dataEncryptionMetadata parameter, you can set the value of allowJoinsOnColumnsWithDifferentNames to true or false. For more information about API operations, see the [AWS Clean Rooms API Reference](#).

By default, fingerprint column encryption is affected by the `targetHeader` for that column, set in [Step 4: Generate an encryption schema for a tabular file](#). Therefore, the same cleartext value has different encrypted representations in each different fingerprint column that it's encrypted for.

This parameter can be useful at preventing the inference of cleartext values in some cases. For example, seeing the same encrypted value in fingerprint columns `City` and `State` might be used to reasonably infer the value is New York. However, this parameter's use requires additional coordination in advance, so that all columns to be joined in queries have shared names.

You can use the **Allow JOIN of columns with different names** parameter to loosen this restriction. When the parameter value is set to `Yes`, it allows any columns encrypted for JOIN to be used together regardless of name.

Preserve NULL values parameter

In the console, you can set the **Preserve NULL values** parameter when [creating a collaboration](#) to indicate that there is no value present for that column.

The following table describes the values for the **Preserve NULL values** parameter.

Parameter value	Description
No	NULL values are not preserved. NULL values don't appear as NULL in an encrypted table. NULL values appear as unique random values in a C3R table.
Yes	NULL values are preserved. NULL values appear as NULL in an encrypted table. If you require SQL semantics of NULL values, you can set this value to Yes . As a result, NULL entries appear as NULL in the C3R table, regardless of whether the column is encrypted and regardless of the parameter setting for Allow duplicates .

Using the `CreateCollaboration` API operation, for the `dataEncryptionMetadata` parameter, you can set the value of `preserveNulls` to `true` or `false`. For more information about API operations, see the [AWS Clean Rooms API Reference](#).

When the **Preserve NULL values** parameter is set to **No** for the collaboration:

1. NULL entries in cleartext columns are unchanged.
2. NULL entries in encrypted fingerprint columns are encrypted as random values to conceal their contents. Joining on an encrypted column with NULL entries in the cleartextcolumn doesn't produce any matches for any of the NULL entries. No matches are made because they each receive their own, unique random content.
3. NULL entries in encrypted sealed columns are encrypted.

When the value of the **Preserve NULL values** parameter is set to **Yes** for the collaboration, NULL entries from all columns remain as NULL regardless of whether the column is encrypted.

The **Preserve NULL values** parameter is useful in scenarios such as data enrichment, where you want to share a lack of information expressed as NULL. The **Preserve NULL values** parameter is also useful in fingerprint or HMAC format if you have NULL values in the column you want to JOIN or GROUP BY.

If the value of the **Allow duplicates** and **Preserve NULL values** parameters is set to **No**, having more than one NULL entry in a fingerprint column produces an error and stops encryption. If the value of either parameter is set to **Yes**, no such error occurs.

Optional flags in Cryptographic Computing for Clean Rooms

The following sections describe the optional flags that you can set when you [encrypt data](#) using the C3R encryption client for tabular file customization and testing.

Topics

- [--csvInputNULLValue flag](#)
- [--csvOutputNULLValue flag](#)
- [--enableStackTraces flag](#)
- [--dryRun flag](#)
- [--tempDir flag](#)

--csvInputNULLValue flag

You can use the `--csvInputNULLValue` flag to specify custom encodings for NULL entries in the input data when you [encrypt data](#) using the C3R encryption client.

The following table summarizes the usage and parameters of this flag.

Usage	Parameters
Optional. Users can specify custom encodings for NULL entries in the input data.	User-specified encoding of NULL values in the input CSV file

A NULL entry is an entry which is considered to be lacking content, specifically in the context of a richer tabular format like an SQL table. Although .csv doesn't explicitly support this characterization for historical reasons, it's a common convention to consider an empty entry containing only white space to be NULL. Therefore, that's the default behavior of the C3R encryption client and it can be customized as needed.

--csvOutputNULLValue flag

You can use the `--csvOutputNULLValue` flag to specify custom encodings for NULL entries in the output data when you [encrypt data](#) using the C3R encryption client.

The following table summarizes the usage and parameters of this flag.

Usage	Parameters
Optional. Users can specify custom encodings in the generated output file for NULL entries.	User-specified encoding of NULL values in the output CSV file

A NULL entry is an entry which is considered to be lacking content, specifically in the context of a richer tabular format like an SQL table. Although .csv doesn't explicitly support this characterization for historical reasons, it's a common convention to consider an empty entry containing only white space to be NULL. Therefore, that's the default behavior of the C3R encryption client and it can be customized as needed.

--enableStackTraces flag

When you [encrypt data](#) using the C3R encryption client, use the `--enableStackTraces` flag to provide additional contextual information for error reporting when C3R encounters an error.

AWS doesn't collect errors. If you encounter an error, use the stack trace to troubleshoot the error yourself or send the stack trace to Support for assistance.

The following table summarizes the usage and parameters of this flag.

Usage	Parameters
Optional. Used to provide additional contextual information for error reporting when the C3R encryption client encounters an error.	None

--dryRun flag

The [encrypt](#) and [decrypt](#) C3R encryption client commands include an optional `--dryRun` flag. The flag takes all the user-provided arguments and checks them for validity and consistency.

You can use the `--dryRun` flag to check if your schema file is valid and consistent with its corresponding input file.

The following table summarizes the usage and parameters of this flag.

Usage	Parameters
Optional. Causes the C3R encryption client to parse parameters and check files, but performs no encryption or decryption.	None

--tempDir flag

You might want to use a temporary directory because encrypted files can sometimes be larger than non-encrypted files, depending on their settings. Datasets must also be encrypted per collaboration to work correctly.

When you [encrypt data](#) using C3R, use the `--tempDir` flag to specify the location where temporary files can be created while processing the input.

The following table summarizes the usage and parameters of this flag.

Usage	Parameters
Users can specify the location where temporary files can be created while processing the input.	Defaults to the system temporary directory.

Queries with Cryptographic Computing for Clean Rooms

This topic provides information about writing queries that use data tables that have been encrypted using Cryptographic Computing for Clean Rooms.

Topics

- [Queries that branch on NULL](#)
- [Mapping one source column to multiple target columns](#)
- [Using the same data for both JOIN and SELECT queries](#)

Queries that branch on NULL

To have a query branch on a NULL statement means to use syntax like `IF x IS NULL THEN 0 ELSE 1`.

Queries can always branch on NULL statements in cleartext columns.

Queries can branch on NULL statements in sealed columns and fingerprint columns only when the value of the **Preserve NULL values** parameter (`preserveNulls`) is set to `true`.

Queries that violate these constraints might yield incorrect results.

Mapping one source column to multiple target columns

One source column can map to multiple target columns. For example, you might want to both JOIN and SELECT on a column.

For more information, see [Using the same data for both JOIN and SELECT queries](#).

Using the same data for both JOIN and SELECT queries

If the data in a column is not sensitive, it can appear in a cleartext target column, which allows it to be used for any purpose.

If data in a column is sensitive and must be used for both JOIN and SELECT queries, map that source column to two target columns in the output file. One column is encrypted with the type as a fingerprint column, and one column is encrypted with the type as a sealed column. The interactive schema generation of the C3R encryption client suggests header suffixes of `_fingerprint` and `_sealed`. These header suffixes can be a useful convention for differentiating such columns quickly.

Guidelines for the C3R encryption client

The C3R encryption client is a tool that enables organizations to bring sensitive data together to derive new insights from data analytics. The tool cryptographically limits what can be learned by any party and AWS in the process. Although this is vitally important, the process of securing data cryptographically can add significant overhead both in terms of compute and storage resources. Therefore, it is important to understand the tradeoffs of using each setting and how to optimize settings while still maintaining the desired cryptographic assurances. This topic focuses on the performance implications of different settings in the C3R encryption client and schemas.

All C3R encryption client encryption settings provide different cryptographic assurances. The collaboration-level settings are most secure by default. Enabling additional functionality while creating a collaboration weakens privacy guarantees, allowing activities like frequency analysis to be conducted on the ciphertext. For more information about how these settings are used and what their implications are, see [the section called “Cryptographic computing”](#).

Topics

- [Performance implications for column types](#)
- [Troubleshooting unanticipated increases in ciphertext size](#)

Performance implications for column types

C3R uses three column types: cleartext, fingerprint, and sealed. Each of these column types provide different cryptographic assurances and have different intended uses. In the following sections, the performance implications of the column type are discussed and the performance impact of each setting.

Topics

- [Cleartext columns](#)
- [Fingerprint columns](#)

- [Sealed columns](#)

Cleartext columns

Cleartext columns are not changed from their original format and not cryptographically processed in any way. This column type can't be configured and does not impact storage or compute performance.

Fingerprint columns

Fingerprint columns are meant to be used for joining data across multiple tables. To this end, the resulting ciphertext size must always be the same. However, these columns are impacted by the collaboration-level settings. Fingerprint columns might have varying degrees of impact on the output file size depending on the cleartext contained in the input.

Topics

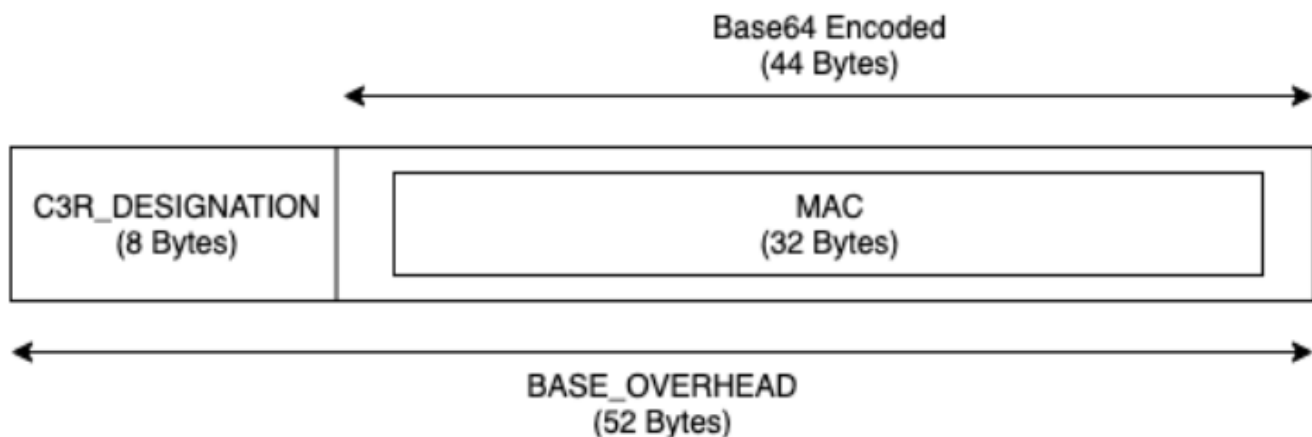
- [Base overhead for fingerprint columns](#)
- [Collaboration settings for fingerprint columns](#)
- [Example data for a fingerprint column](#)
- [Troubleshooting fingerprint columns](#)

Base overhead for fingerprint columns

There is a base overhead for fingerprint columns. This overhead is constant and in place of the size of the cleartext bytes.

Data in the fingerprint columns is cryptographically processed through a Hash-based Message Authentication Code (HMAC) function, which turns the data into a 32 byte message authentication code (MAC). This data is then processed through a base64 encoder, adding roughly 33 percent to the byte size. It is pre-pended with an 8 byte C3R designation to designate the type of column that the data belongs to and the client version that produced it. The final result is 52 bytes. This result is then multiplied by the row count to get the total base overhead (use the number of total non-null values if `preserveNulls` is set to true).

The following image shows how $BASE\_OVERHEAD = C3R\_DESIGNATION + (MAC * 1.33)$



The output ciphertext in the fingerprint columns will always be 52 bytes. This can be a significant storage decrease if the input cleartext data averages more than 52 bytes (for example, full street addresses). This can be a significant storage increase if the input cleartext data averages less than 52 bytes (for example, customer ages).

Collaboration settings for fingerprint columns

preserveNulls setting

When the collaboration-level setting `preserveNulls` is `false` (default), each `null` value is substituted with a unique, random 32 bytes and processed as if it were not `null`. The result is that each `null` value is now 52 bytes. This can add significant storage requirements for tables that contain very sparse data compared to when this setting is `true` and `null` values are passed through as `null`.

If you don't need the privacy assurances of this setting and prefer to retain `null` values within your datasets, enable the `preserveNulls` setting at the time the collaboration is created. The `preserveNulls` setting can't be changed after the collaboration is created.

Example data for a fingerprint column

The following is an example set of input and output data for a fingerprint column with settings to reproduce. Other collaboration-level settings like `allowCleartext` and `allowDuplicates` don't impact the results and can be set as `true` or `false` if trying to reproduce locally.

Example shared secret: `wJa1rXUtnFEMI/K7MDENG/bPxRfiCYEXAMPLEKEY`

Example collaboration ID: `a1b2c3d4-5678-90ab-cdef-EXAMPLE11111`

allowJoinsOnColumnsWithDifferentNames: True This setting doesn't impact performance or storage requirements. However, this setting makes column name choice irrelevant when reproducing the values shown in the following tables.

Example 1

Input	null
preserveNulls	TRUE
Output	null
Deterministic	Yes
Input bytes	0
Output bytes	0

Example 2

Input	null
preserveNulls	FALSE
Output	01:hmac:3lkFjthvV3IUu6mMvFc1a +XAHwgw/Elm0q4p3Yg25kk=
Deterministic	No
Input bytes	0
Output bytes	52

Example 3

Input	empty string
preserveNulls	-

Output	01:hmac:oKTgi3Gba+eUb3JteSz 2EMgXUkF1WgM77UP0Ydw5kPQ=
Deterministic	Yes
Input bytes	0
Output bytes	52

Example 4

Input	abcdefghijklmnopqrstuvxyz
preserveNulls	-
Output	01:hmac:kU/IqwG7FMmzzshr0B9 scomE0UJUEE7j9keTctplGww=
Deterministic	Yes
Input bytes	26
Output bytes	52

Example 5

Input	abcdefghijklmnopqrstuvxyzA BCDEFGHIJKLMNOPQRSTUVWXYZ01 23456789
preserveNulls	-
Output	01:hmac:ks3htnQbw2vdhCRFF6J NzW5LMndJaHG57uvE26mBtSs=
Deterministic	Yes
Input bytes	62

Output bytes	52

Troubleshooting fingerprint columns

Why is the ciphertext in my fingerprint columns several times greater than the size of the cleartext that went into it?

Ciphertext in a fingerprint column is always 52 bytes in length. If your input data were small (for example, the ages of customers), it will show a significant increase in size. This can also happen if the `preserveNulls` setting is set to `false`.

Why is the ciphertext in my fingerprint columns several times smaller than the size of the cleartext that went into it?

Ciphertext in a fingerprint column is always 52 bytes in length. If your input data were large (for example, the full street addresses of customers), it will show a significant decrease in size.

How do I know if I need the cryptographic assurances provided by `preserveNulls`?

Unfortunately, the answer is that it depends. At a minimum, the [the section called "Parameters"](#) should be reviewed for how the `preserveNulls` setting is protecting your data. However, we recommend that you reference your organization's data handling requirements and any contracts applicable to the respective collaboration.

Why do I have to incur the overhead of base64?

To allow for compatibility with tabular file formats such as CSV, base64-encoding is necessary. Although some file formats like Parquet might support binary representations of data, it's important that all participants in a collaboration represent data in the same way to ensure proper query results.

Sealed columns

Sealed columns are meant to be used for transferring data between members of a collaboration. The ciphertext in these columns is non-deterministic and has significant impact on both performance and storage based on how the columns are configured. These columns can be configured individually and often have the greatest impact on the performance of the C3R encryption client and the resulting output file size.

Topics

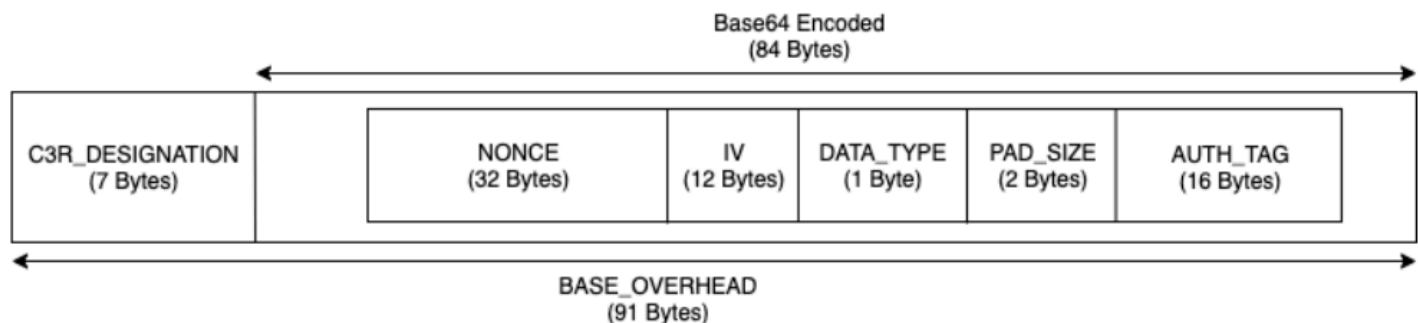
- [Base overhead for sealed columns](#)
- [Collaboration settings for sealed columns](#)
- [Schema settings sealed columns: padding types](#)
- [Example data for a sealed column](#)
- [Troubleshooting sealed columns](#)

Base overhead for sealed columns

There is a base overhead for sealed columns. This overhead is constant and in addition to the size of the cleartext and padding (if any) bytes.

Before any encryption, data in the sealed columns is pre-pended with a 1 byte character designating what type of data is contained. If padding is selected, the data is then padded and appended with 2 bytes stating the pad size. After these bytes are added, data is cryptographically processed by using AES-GCM and stored with the IV (12 bytes), nonce (32 bytes), and Auth Tag (16 bytes). This data is then processed through a base64 encoder, adding roughly 33 percent to the byte size. The data is pre-pended with a 7 byte C3R designation to designate what type of column the data belongs to and the client version used to produce it. The result is a final base overhead of 91 bytes. This result can then be multiplied by the row count to get the total base overhead (use the number of total non-null values if `preserveNulls` is set to true).

The following image shows how $BASE\_OVERHEAD = C3R\_DESIGNATION + ((NONCE + IV + DATA\_TYPE + PAD\_SIZE + AUTH\_TAG) * 1.33)$



Collaboration settings for sealed columns

preserveNulls setting

When the collaboration-level setting `preserveNulls` is false (default), each null value is unique, random 32 bytes and processed as if it were not null. The result is that each null value

is now 91 bytes (more if padded). This can add significant storage requirements for tables that contain very sparse data compared to when this setting is `true` and `null` values are passed through as `null`.

If you don't need the privacy assurances of this setting and prefer to retain `null` values within your datasets, enable the `preserveNulls` setting at the time the collaboration is created. The `preserveNulls` setting can't be changed after the collaboration is created.

Schema settings sealed columns: padding types

Topics

- [Pad type of none](#)
- [Pad type of fixed](#)
- [Pad type of max](#)

Pad type of none

Selecting a pad type of `none` doesn't add any padding to the cleartext and adds no additional overhead to the base overhead described earlier. No padding results in the most space-efficient output size. However, it doesn't provide the same privacy assurances as the `fixed` and `max` padding types. This is because the size of the underlying cleartext is discernible from the size of the ciphertext.

Pad type of fixed

Selecting a pad type of `fixed` is a privacy-preserving measure to hide the lengths of the data contained within a column. This is done by padding all the cleartext to the provided `pad_length` before it is encrypted. Any data exceeding that size causes the C3R encryption client to fail.

Given that the padding is added to the cleartext before it is encrypted, AES-GCM has a 1-to-1 mapping of cleartext to ciphertext bytes. The base64 encoding will add 33 percent. The additional storage overhead of the padding can be calculated by subtracting the average length of the cleartext from the value of the `pad_length` and multiplying it by 1.33. The result is the average overhead of padding per record. This result can then be multiplied by the number of rows to get the total padding overhead (use the number of total non-`null` values if `preserveNulls` is set to `true`).

$$PADDING\_OVERHEAD = (PAD\_LENGTH - AVG\_CLEARTEXT\_LENGTH) * 1.33 * ROW\_COUNT$$

We recommend that you select the minimum `pad_length` that encompasses the largest value in a column. For example, if the largest value is 50 bytes, a `pad_length` of 50 is sufficient. A value larger than that will only add additional storage overhead.

Fixed padding does not add any significant compute overhead.

Pad type of `max`

Selecting a pad type of `max` is a privacy-preserving measure to hide the lengths of the data contained within a column. This is done by padding all the cleartext to the largest value in the column plus the additional `pad_length` before it is encrypted. Generally, `max` padding provides the same assurances as `fixed` padding for a single dataset while allowing for not knowing the largest cleartext value in the column. However, `max` padding might not provide the same privacy assurances as `fixed` padding across updates because the largest value in the individual datasets might differ.

We recommend that you select an additional `pad_length` of 0 when using `max` padding. This length pads all values to be the same size as the largest value in the column. A value larger than that will only add additional storage overhead.

If the largest cleartext value is known for a given column, we recommend that you use the `fixed` pad type instead. Using `fixed` padding creates consistency across updated datasets. Using `max` padding results in each subset of data being padded to the largest value that was in the subset.

Example data for a sealed column

The following is an example set of input and output data for a sealed column with settings to reproduce. Other collaboration-level settings like `allowCleartext`, `allowJoinsOnColumnsWithDifferentNames`, and `allowDuplicates` don't impact the results and can be set as `true` or `false` if trying to reproduce locally. Although these are the basic settings to reproduce, the sealed column is non-deterministic and values will change every time. The goal is to show the bytes in as compared to the bytes out. The example `pad_length` values were chosen intentionally. They show that `fixed` padding results in the same values as `max` padding with the recommended minimum `pad_length` settings or when additional padding is desired.

Example shared secret: `wJa1rXUtnFEMI/K7MDENG/bPxRfiCYEXAMPLEKEY`

Example collaboration ID: `a1b2c3d4-5678-90ab-cdef-EXAMPLE11111`

Topics

- [Pad type of none](#)
- [Pad type of fixed \(Example 1\)](#)
- [Pad type of fixed \(Example 2\)](#)
- [Pad type of max \(Example 1\)](#)
- [Pad type of max \(Example 2\)](#)

Pad type of none

Example 1

Input	null
preserveNulls	TRUE
Output	null
Deterministic	Yes
Input bytes	0
Output bytes	0

Example 2

Input	null
preserveNulls	FALSE
Output	01:enc:bm9uY2UwMTIzNDU2Nzg5MG5vbmNlMDEyMzQ1Njc40TBqfRYZ98t5KU6aWfssGSPbNIJfG3iXmu6cbCUrizuV
Deterministic	No
Input bytes	0
Output bytes	91

Example 3

Input	empty string
preserveNulls	-
Output	01:enc:bm9uY2UwMTIzNDU2Nzg5 MG5vbmNlMDEyMzQ1Njc40TBqfRY Z98t5KU6aWfstGSPeM6qR8DWC2P B2GMlX41YK
Deterministic	No
Input bytes	0
Output bytes	91

Example 4

Input	abcdefghijklmnopqrstuvwxyz
preserveNulls	-
Output	01:enc:bm9uY2UwMTIzNDU2Nzg5 MG5vbmNlMDEyMzQ1Njc40TBqfRY Z98t5KU6aWfsteEE1GKEPiRzyh0 h7t60mWMLTWCv02ckr6pkx9sGL5 VLDQeHzh6DmPpyWNuI=
Deterministic	No
Input bytes	26
Output bytes	127

Example 5

Input	abcdefghijklmnopqrstuvwxyzA BCDEFGHIJKLMNOPQRSTUVWXYZ01 23456789
preserveNulls	-
Output	01:enc:bm9uY2UwMTIzNDU2Nzg5 MG5vbmNlMDEyMzQ1Njc40TBqfRY Z98t5KU6aWfstEE1GKEPiRzyh0 h7t60mWMLTWCv02ckr6plwtH/8t RFnn2rF91bcB9G4+n8GiRfJNmqdP4/ Q0Q3cXb/pbvPcnnohrHIGSX54ua+1/ JfcVjc=
Deterministic	No
Input bytes	62
Output bytes	175

Pad type of fixed (Example 1)

In this example, pad_length is 62 and largest input is 62 bytes.

Example 1

Input	null
preserveNulls	TRUE
Output	null
Deterministic	Yes
Input bytes	0
Output bytes	0

Example 2

Input	null
preserveNulls	FALSE
Output	01:enc:bm9uY2UwMTIzNDU2Nzg5 MG5vbmNlMDEyMzQ1Njc40TBqfRY Z98t5KU6aWfssGSNWfMRp7nSb7S MX2s3JKL0hK1+7r75Tk+Mx9jy48 Fcg1y0PvBqRSZ7oqy1V3UKfYTLEZb/ hCz7oaIneVsrcoNpATs0GzbnLkor4L+/ aSuA=
Deterministic	No
Input bytes	0
Output bytes	175

Example 3

Input	empty string
preserveNulls	-
Output	01:enc:bm9uY2UwMTIzNDU2Nzg5 MG5vbmNlMDEyMzQ1Njc40TBqfRY Z98t5KU6aWfstGSNWfMRp7nSb7S MX2s3JKL0hK1+7r75Tk+Mx9jy48 Fcg1y0PvBqRSZ7oqy1V3UKfYTLE Zb/hCz7oaIneVsrcoLB53l07VZp A60wkuXu29CA=
Deterministic	No
Input bytes	0
Output bytes	175

Example 4

Input	abcdefghijklmnopqrstuvwxyz
preserveNulls	-
Output	01:enc:bm9uY2UwMTIzNDU2Nzg5MG5vbmNlMDEyMzQ1Njc40TBqfRYZ98t5KU6aWfstEE1GKEPiRzyh0h7t60mWMLTWcV02ckr6pkx9jy48Fcg1y0PvBqRSZ7oqy1V3UKfYTLEZb/hCz7oaIneVsrcutBAc0+Mb9tuU2KIIHH31AWg=
Deterministic	No
Input bytes	26
Output bytes	175

Example 5

Input	abcdefghijklmnopqrstuvwxyzA BCDEFGHIJKLMNOPQRSTUVWXYZ01 23456789
preserveNulls	-
Output	01:enc:bm9uY2UwMTIzNDU2Nzg5MG5vbmNlMDEyMzQ1Njc40TBqfRYZ98t5KU6aWfstEE1GKEPiRzyh0h7t60mWMLTWcV02ckr6plwtH/8tRFnn2rF91bcB9G4+n8GiRfJNmqdP4/QOQ3cXb/pbvPcnnohrHIGSX54ua+1/JfcVjc=
Deterministic	No
Input bytes	62

Output bytes	175

Pad type of fixed (Example 2)

In this example, `pad_length` is 162 and largest input is 62 bytes.

Example 1

Input	<code>null</code>
<code>preserveNulls</code>	TRUE
Output	<code>null</code>
Deterministic	Yes
Input bytes	0
Output bytes	0

Example 2

Input	<code>null</code>
<code>preserveNulls</code>	FALSE
Output	<pre> 01:enc:bm9uY2UwMTIzNDU2Nzg5 MG5vbmlmDEyMzQ1Njc4OTBqfRY Z98t5KU6aWfssGSNWfMRp7nSb7S MX2s3JKLOhK1+7r75Tk+Mx9jy48 Fcgl1y0PvBqRSZ7oqy1V3UKfYTLE Zb/hCz7oaIneVsrcnkB0xbLWD7z NdAqQGR0rXoSESdW0I0vpNoGcBf v4cJbG0A3h1DvtkSSVc2B8000Gp pzdDqhrUVN5wFNyn8vgfPMqDaeJk5bn +8o4WtG/ClipNcjDXvXVtK4vfCohcCA6 uwrmwv/xAySX+xcntotL703aBTBb </pre>

Deterministic	No
Input bytes	0
Output bytes	307

Example 3

Input	empty string
preserveNulls	-
Output	01:enc:bm9uY2UwMTIzNDU2Nzg5 MG5vbmNlMDEyMzQ1Njc40TBqfRY Z98t5KU6aWfstGSNWfMRp7nSb7S MX2s3JKL0hK1+7r75Tk+Mx9jy48 Fcgl1y0PvBqRSZ7oqy1V3UKfYTLE Zb/hCz7oaIneVsrcnkB0xbLWD7z NdAqQGR0rXoSESdW0I0vpNoGcBf v4cJbG0A3h1DvtkSSVc2B8000Gp pzdDqhrUVN5wFNyn8vgfPMqDaeJk5bn +8o4WtG/ClipNcjDXvXVtK4vfCohcCA6 uwrmwv84lVaT9Yd+6oQx65/+gdVT
Deterministic	No
Input bytes	0
Output bytes	307

Example 4

Input	abcdefghijklmnopqrstuvwxyz
preserveNulls	-
Output	01:enc:bm9uY2UwMTIzNDU2Nzg5 MG5vbmNlMDEyMzQ1Njc40TBqfRY

	Z98t5KU6aWfsteEE1GKEPiRzyh0 h7t60mWMLTWcV02ckr6pkx9jy48 Fcg1y0PvBqRSZ7oqy1V3UKfYTLE Zb/hCz7oaIneVsrcnkB0xbLWD7z NdAqQGR0rXoSESdW0I0vpNoGcBf v4cJbG0A3h1DvtkSSVc2B8000Gp pzdDqhrUVN5wFNyn8vgfPMqDaeJk5bn +8o4WtG/ClipNcjDXvXVtK4vfCohcCA6 uwrmwT5Hn1+Wyf06ks3QMaRDGSf
Deterministic	No
Input bytes	26
Output bytes	307

Example 5

Input	abcdefghijklmnopqrstuvwxyzA BCDEFGHIJKLMNOPQRSTUVWXYZ01 23456789
preserveNulls	-
Output	01:enc:bm9uY2UwMTIzNDU2Nzg5 MG5vbmNlMDEyMzQ1Njc40TBqfRY Z98t5KU6aWfsteEE1GKEPiRzyh0 h7t60mWMLTWcV02ckr6plwtH/8t RFnn2rF91bcB9G4+n8GiRfJNmqd P4/Q0Q3cXb/pbvPcnkB0xbLWD7z NdAqQGR0rXoSESdW0I0vpNoGcBf v4cJbG0A3h1DvtkSSVc2B8000Gp pzdDqhrUVN5wFNyn8vgfPMqDaeJk5bn +8o4WtG/ClipNcjDXvXVtK4vfCohcCA6 uwrmwjkJXQZ0gPdeFX9Yr/8a1V5i
Deterministic	No

Input bytes	62
Output bytes	307

Pad type of max (Example 1)

In this example, pad_length is 0 and largest input is 62 bytes.

Example 1

Input	null
preserveNulls	TRUE
Output	null
Deterministic	Yes
Input Bytes	0
Output Bytes	0

Example 2

Input	null
preserveNulls	FALSE
Output	01:enc:bm9uY2UwMTIzNDU2Nzg5MG5vbmNlMDEyMzQ1Njc4OTBqfRYZ98t5KU6aWfssGSNWfMRp7nSb7SMX2s3JKLOhK1+7r75Tk+Mx9jy48Fcg1y0PvBqRSZ7oqy1V3UKfYTTLEZb/hCz7oaIneVsrcoNpATs0GzbnLkor4L+/aSuA=
Deterministic	No
Input bytes	0

Output bytes	175

Example 3

Input	empty string
preserveNulls	-
Output	01:enc:bm9uY2UwMTIzNDU2Nzg5MG5vbmNlMDEyMzQ1Njc40TBqfRYZ98t5KU6aWfstGSNWfMRp7nSb7SMX2s3JKL0hK1+7r75Tk+Mx9jy48Fcg1y0PvBqRSZ7oqy1V3UKfYTLEZb/hCz7oaIneVsrrcoLB53l07VZpA60wkuXu29CA=
Deterministic	No
Input bytes	0
Output bytes	175

Example 4

Input	abcdefghijklmnopqrstuvwxyz
preserveNulls	-
Output	01:enc:bm9uY2UwMTIzNDU2Nzg5MG5vbmNlMDEyMzQ1Njc40TBqfRYZ98t5KU6aWfstEE1GKEPiRzyh0h7t60mWMLTWCv02ckr6pkx9jy48Fcg1y0PvBqRSZ7oqy1V3UKfYTLEZb/hCz7oaIneVsrrcutBAc0+Mb9tuU2KIIHH31AWg=
Deterministic	No

Input bytes	26
Output bytes	175

Example 5

Input	abcdefghijklmnopqrstuvwxyzA BCDEFGHIJKLMNOPQRSTUVWXYZ01 23456789
preserveNulls	-
Output	01:enc:bm9uY2UwMTIzNDU2Nzg5 MG5vbmNlMDEyMzQ1Njc4OTBqfRY Z98t5KU6aWfstEE1GKEPiRzyh0 h7t60mWMLTWcV02ckr6plwtH/8t RFnn2rF91bcB9G4+n8GiRfJNmqdP4/ QQQ3cXb/pbvPcnnohrHIGSX54ua+1/ JfcVjc=
Deterministic	No
Input bytes	62
Output bytes	175

Pad type of max (Example 2)

In this example, pad_length is 100 and largest input is 62 bytes.

Example 1

Input	null
preserveNulls	TRUE
Output	null
Deterministic	Yes

Input bytes	0
Output bytes	0

Example 2

Input	null
preserveNulls	FALSE
Output	01:enc:bm9uY2UwMTIzNDU2Nzg5MG5vbmNlMDEyMzQ1Njc40TBqfRYZ98t5KU6aWfssGSNWfMRp7nSb7SMX2s3JKLOhK1+7r75Tk+Mx9jy48Fcg1y0PvBqRSZ7oqy1V3UKfYTLEZb/hCz7oaIneVsrcnkB0xbLWD7zNdAqQGR0rXoSESdW0I0vpNoGcBfv4cJbG0A3h1DvtkSSVc2B8000GppzdDqhrUVN5wFNyn8vgfPMqDaeJk5bn+8o4WtG/ClipNcjDXvXVtK4vfCohcCA6uwrmwv/xAySX+xcntotL703aBTBb
Deterministic	No
Input bytes	0
Output bytes	307

Example 3

Input	empty string
preserveNulls	-
Output	01:enc:bm9uY2UwMTIzNDU2Nzg5MG5vbmNlMDEyMzQ1Njc40TBqfRYZ98t5KU6aWfstGSNWfMRp7nSb7SMX2s3JKLOhK1+7r75Tk+Mx9jy48

	Fcg1y0PvBqRSZ7oqy1V3UKfYTLE Zb/hCz7oaIneVsrcnkB0xbLWD7z NdAqQGR0rXoSESdW0I0vpNoGcBf v4cJbG0A3h1DvtkSSVc2B8000Gp pzdDqhrUVN5wFNyn8vgfPMqDaeJk5bn +8o4WtG/ClipNcjDXvXVtK4vfCohcCA6 uwrmwv84lVaT9Yd+6oQx65/+gdVT
Deterministic	No
Input bytes	0
Output bytes	307

Example 4

Input	abcdefghijklmnopqrstuvwxyz
preserveNulls	-
Output	01:enc:bm9uY2UwMTIzNDU2Nzg5 MG5vbmlMDEyMzQ1Njc4OTBqfRY Z98t5KU6aWfstEE1GKEPiRzyh0 h7t60mWMLTWcV02ckr6pkx9jy48 Fcg1y0PvBqRSZ7oqy1V3UKfYTLE Zb/hCz7oaIneVsrcnkB0xbLWD7z NdAqQGR0rXoSESdW0I0vpNoGcBf v4cJbG0A3h1DvtkSSVc2B8000Gp pzdDqhrUVN5wFNyn8vgfPMqDaeJk5bn +8o4WtG/ClipNcjDXvXVtK4vfCohcCA6 uwrmwX5Hn1+Wyf06ks3QMaRDGSf
Deterministic	No
Input bytes	26
Output bytes	307

Example 5

Input	abcdefghijklmnopqrstuvwxyzA BCDEFGHIJKLMNOPQRSTUVWXYZ01 23456789
preserveNulls	-
Output	01:enc:bm9uY2UwMTIzNDU2Nzg5 MG5vbmNlMDEyMzQ1Njc4OTBqfRY Z98t5KU6aWfstEE1GKEPiRzyh0 h7t60mWMLTWcV02ckr6plwtH/8t RFnn2rF91bcB9G4+n8GiRfJNmqd P4/Q0Q3cXb/pbvPcnkB0xbLWD7z NdAqQGR0rXoSESdW0I0vpNoGcBf v4cJbG0A3h1DvtkSSVc2B8000Gp pzdDqhrUVN5wFNyn8vgfPMqDaeJk5bn +8o4WtG/ClipNcjDXvXVtK4vfCohcCA6 uwrnwjkJXQZ0gPdeFX9Yr/8a1V5i
Deterministic	No
Input bytes	62
Output bytes	307

Troubleshooting sealed columns**Why is the ciphertext in my sealed columns several times greater than the size of the cleartext that went into it?**

This depends on several factors. For one, ciphertext in a Cleartext column is always at least 91 bytes in length. If your input data were small (for example, the ages of customers), it will show a significant increase in size. Second, if `preserveNulls` were set to `false` and your input data contained a lot of `null` values, each of those `null` values will have been turned into 91 bytes of ciphertext. Finally, if you use padding, by definition bytes are added to the cleartext data before it is encrypted.

Most of my data in a sealed column is really small, and I need to use padding. Can I just remove the big values and process them separately to save space?

We don't recommend that you remove large values and process them separately. Doing so changes the privacy assurances that the C3R encryption client is providing. As a threat model, assume that an observer can see both encrypted datasets. If the observer sees that one subset of data has a column padded significantly more or less than another subset, they can make inferences on the size of the data in each subset. For example, assume a `fullName` column is padded to a total of 40 bytes in one file and is padded to 800 bytes in another file. An observer might be able to assume that one dataset contains the world's longest name (747 bytes).

Do I need to provide extra padding when using the max padding type?

No. When using max padding, we recommend that the `pad_length`, also known as the additional padding *beyond* the largest value in the column, is set to 0.

Can I just pick a large pad_length when using fixed padding to avoid worrying if the largest value will fit?

Yes, but the large pad length is inefficient and uses more storage than necessary. We recommend that you check to see how large the largest value is and set the `pad_length` to that value.

How do I know if I need the cryptographic assurances provided by preserveNulls?

Unfortunately, the answer is that it depends. At a minimum, the [Cryptographic Computing for Clean Rooms](#) should be reviewed for how the `preserveNulls` setting is protecting your data. However, we recommend that you reference your organization's data handling requirements and any contracts applicable to the respective collaboration.

Why do I have to incur the overhead of base64?

To allow for compatibility with tabular file formats such as CSV, base64 encoding is necessary. Although some file formats like Parquet might support binary representations of data, it's important that all participants in a collaboration represent data in the same way to ensure proper query results.

Troubleshooting unanticipated increases in ciphertext size

Let's say that you encrypted your data, and the size of the resulting data is surprisingly large. The following steps can help you identify where the size increase occurred and what, if any, actions you can take.

Identifying where the size increase occurred

Before you can troubleshoot why your encrypted data is significantly larger than your cleartext data, you must first identify where the increase in size is. Cleartext columns can safely be ignored because they are unchanged. Look at the remaining fingerprint and sealed columns, and choose one that appears significant.

Identifying the reason the size increase occurred

A fingerprint column or a sealed column might contribute to the size increase.

Topics

- [Is the size increase coming from a fingerprint column?](#)
- [Is the size increase coming from a sealed column?](#)

Is the size increase coming from a fingerprint column?

If the column that's most contributing to the increase in storage is a fingerprint column, this is likely because the cleartext data is small (for example, customer age). Each resulting fingerprint ciphertext is 52 bytes in length. Unfortunately, nothing can be done about this issue on a column-by-column basis. For more information, see [Base overhead for fingerprint columns](#) for details about this column, including how it impacts storage requirements.

The other possible cause of size increase in a fingerprint column is the collaboration setting, `preserveNulls`. If the collaboration setting for `preserveNulls` is disabled (the default setting), all `null` values in fingerprint columns will have become 52 bytes of ciphertext. There is nothing that can be done for this in the current collaboration. The `preserveNulls` setting is set at the time a collaboration is created and all collaborators must use the same setting to ensure correct query results. For more information about the `preserveNulls` setting and how enabling it impacts the privacy assurances of your data, see [the section called "Cryptographic computing"](#).

Is the size increase coming from a sealed column?

If the column that's most contributing to the increase in storage is a sealed column, there are a few details that could contribute to the size increase.

If the cleartext data is small (for example, customer age), each resulting sealed ciphertext is at least 91 bytes in length. Unfortunately, nothing can be done about this issue. For more information, see [Base overhead for sealed columns](#) for details about this column, including how it impacts storage requirements.

The second primary cause for storage increase in sealed columns is padding. Padding adds extra bytes to the cleartext before it's encrypted to hide the size of individual values in a dataset. We recommend that you set padding to the minimum possible value for your dataset. At a minimum, `pad_length` for fixed padding must be set to encompass the largest possible value in the column. Any higher setting than that doesn't add additional privacy assurances. For example, if you know the largest possible value in a column can be 50 bytes, we recommend that you set the `pad_length` to 50 bytes. However, if the sealed column is using max padding, we recommend that you set the `pad_length` to 0 bytes. This is because max padding is referring to the *additional* padding beyond the largest value in the column.

The final possible cause of size increase in a sealed column is the collaboration setting, `preserveNulls`. If the collaboration setting for `preserveNulls` is disabled (the default setting), all `null` values in sealed columns will have become 91 bytes of ciphertext. There is nothing that can be done for this in the current collaboration. The `preserveNulls` setting is set at the time a collaboration is created, and all collaborators must use the same setting to ensure correct query results. For more information about this setting does and how enabling it impacts the privacy assurances of your data, see [the section called "Cryptographic computing"](#).

Setting up AWS Clean Rooms

The following topics explain how to set up AWS Clean Rooms.

Topics

- [Sign up for AWS](#)
- [Set up service roles for AWS Clean Rooms](#)
- [Set up service roles for AWS Clean Rooms ML](#)

Sign up for AWS

Before you can use AWS Clean Rooms, or any AWS service, you must sign up for AWS with an AWS account.

If you don't have an AWS account, complete the following steps to create one.

To sign up for an AWS account

1. Open <https://portal.aws.amazon.com/billing/signup>.
2. Follow the online instructions.

During the sign-up procedure, you'll receive a phone call with a verification code that you'll enter on the phone keypad.

3. When you sign up for an AWS account, an *AWS account root user* is created. The root user has access to all AWS services and resources in the account. As a security best practice, [assign administrative access to an administrative user](#), and use only the root user to perform [tasks that require root user access](#).

Set up service roles for AWS Clean Rooms

The following sections describe the roles needed to perform each task.

Topics

- [Create an administrator user](#)
- [Create an IAM role for a collaboration member](#)
- [Create a service role to read data from Amazon S3](#)

- [Create a service role to read data from Amazon Athena](#)
- [Create a service role to read data from Snowflake](#)
- [Create a service role to read code from an S3 bucket \(PySpark analysis template role\)](#)
- [Create a service role to write results of a PySpark job](#)
- [Create a service role to receive results](#)

Create an administrator user

To use AWS Clean Rooms, you need to create an administrator user for yourself and add the administrator user to an administrators group.

To create an administrator user, choose one of the following options.

Choose one way to manage your administrator	To	By	You can also
In IAM Identity Center (Recommended)	Use short-term credentials to access AWS. This aligns with the security best practices . For information about best practices , see Security best practices in IAM in the <i>IAM User Guide</i> .	Following the instructions in Getting started in the <i>AWS IAM Identity Center User Guide</i> .	Configure programmatic access by Configuring the AWS CLI to use AWS IAM Identity Center in the <i>AWS Command Line Interface User Guide</i> .
In IAM	Use long-term credentials to access AWS.	Following the instructions in Create an IAM user for emergency access in the <i>IAM User Guide</i> .	Configure programmatic access by Manage access keys for IAM users in the <i>IAM User Guide</i> .

Choose one way to manage your administrator	To	By	You can also
(Not recommended)			

Create an IAM role for a collaboration member

A member is an AWS customer who is a participant in a collaboration.

To create an IAM role for a collaboration member

1. Follow the [Creating a role to delegate permissions to an IAM user](#) procedure in the *AWS Identity and Access Management User Guide*.
2. For the **Create policy** step, select the **JSON** tab in the **Policy editor**, and then add policies depending on the abilities granted to the collaboration member.

AWS Clean Rooms offers the following managed policies based on common use cases.

If you want to ...	Then use ...
View the resources and metadata	AWS managed policy: AWSCleanRoomsReadOnlyAccess
Query	AWS managed policy: AWSCleanRoomsFullAccess
Query and run jobs	AWS managed policy: AWSCleanRoomsFullAccess

If you want to ...	Then use ...
Query and receive results	AWS managed policy: <code>AWSCleanRoomsFullAccess</code>
Manage collaboration resources but do not query	AWS managed policy: <code>AWSCleanRoomsFullAccessNoQuerying</code>

For information about the different managed policies offered by AWS Clean Rooms, see [AWS managed policies for AWS Clean Rooms](#),

Create a service role to read data from Amazon S3

AWS Clean Rooms uses a service role to read the data from Amazon S3.

There are two ways to create this service role.

- If you have the necessary IAM permissions to create a service role, use the AWS Clean Rooms console to create a service role.
- If you don't have `iam:CreateRole`, `iam:CreatePolicy` and `iam:AttachRolePolicy` permissions or want to create the IAM roles manually, do one of the following:
 - Use the following procedure to create a service role using custom trust policies.
 - Ask your administrator to create the service role using the following procedure.

Note

You or your IAM administrator should follow this procedure only if you don't have the necessary permissions to create a service role using the AWS Clean Rooms console.

To create a service role to read data from Amazon S3 using custom trust policies

1. Create a role using custom trust policies. For more information, see the [Creating a role using custom trust policies \(console\)](#) procedure in the *AWS Identity and Access Management User Guide*.

2. Use the following custom trust policy according to the [Creating a role using custom trust policies \(console\)](#) procedure.

Note

If you want to help ensure that the role is used only in the context of a certain collaboration membership, you can scope down the trust policy further. For more information, see [Cross-service confused deputy prevention](#).

JSON

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Sid": "RoleTrustPolicyForCleanRoomsService",
      "Effect": "Allow",
      "Principal": {
        "Service": ".amazonaws.com"
      },
      "Action": "sts:AssumeRole"
    }
  ]
}
```

3. Use the following permissions policy according to the [Creating a role using custom trust policies \(console\)](#) procedure.

Note

The following example policy supports the permissions needed to read AWS Glue metadata and its corresponding Amazon S3 data. However, you might need to modify this policy depending on how you've set up your Amazon S3 data. For instance, if you have set up a custom KMS key for your Amazon S3 data, you may need to amend this policy with additional AWS Key Management Service (AWS KMS) permissions.

Your AWS Glue resources and underlying Amazon S3 resources must be in the same AWS Region as the AWS Clean Rooms collaboration.

JSON

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Sid": "NecessaryGluePermissions",
      "Effect": "Allow",
      "Action": [
        "glue:GetDatabase",
        "glue:GetDatabases",
        "glue:GetTable",
        "glue:GetTables",
        "glue:GetPartition",
        "glue:GetPartitions",
        "glue:BatchGetPartition"
      ],
      "Resource": [
        "arn:aws:glue:aws-region:accountId:database/databaseName",
        "arn:aws:glue:aws-region:accountId:table/databaseName/tableName",
        "arn:aws:glue:aws-region:accountId:catalog"
      ]
    },
    {
      "Effect": "Allow",
      "Action": [
        "glue:GetSchema",
        "glue:GetSchemaVersion"
      ],
      "Resource": [
        "*"
      ]
    },
    {
      "Sid": "NecessaryS3BucketPermissions",
      "Effect": "Allow",

```

```

        "Action": [
            "s3:GetBucketLocation",
            "s3:ListBucket"
        ],
        "Resource": [
            "arn:aws:s3:::bucket"
        ],
        "Condition": {
            "StringEquals": {
                "s3:ResourceAccount": [
                    "s3BucketOwnerAccountId"
                ]
            }
        }
    },
    {
        "Sid": "NecessaryS3ObjectPermissions",
        "Effect": "Allow",
        "Action": [
            "s3:GetObject"
        ],
        "Resource": [
            "arn:aws:s3:::bucket/prefix/*"
        ],
        "Condition": {
            "StringEquals": {
                "s3:ResourceAccount": [
                    "s3BucketOwnerAccountId"
                ]
            }
        }
    }
]
}

```

4. Replace each *placeholder* with your own information.
5. Continue to follow the [Creating a role using custom trust policies \(console\)](#) procedure to create the role.

Create a service role to read data from Amazon Athena

AWS Clean Rooms uses a service role to read the data from Amazon Athena.

To create a service role to read data from Athena using custom trust policies

1. Create a role using custom trust policies. For more information, see the [Creating a role using custom trust policies \(console\)](#) procedure in the *AWS Identity and Access Management User Guide*.
2. Use the following custom trust policy according to the [Creating a role using custom trust policies \(console\)](#) procedure.

Note

If you want to help ensure that the role is used only in the context of a certain collaboration membership, you can scope down the trust policy further. For more information, see [Cross-service confused deputy prevention](#).

JSON

```
{  
  
  "Version": "2012-10-17",  
  "Statement": [  
    {  
      "Sid": "RoleTrustPolicyForCleanRoomsService",  
      "Effect": "Allow",  
      "Principal": {  
        "Service": ".amazonaws.com"  
      },  
      "Action": "sts:AssumeRole"  
    }  
  ]  
}
```

3. Use the following permissions policy according to the [Creating a role using custom trust policies \(console\)](#) procedure.

Note

The following example policy supports the permissions needed to read AWS Glue metadata and its corresponding Athena data. However, you might need to modify this

policy depending on how you've set up your Amazon S3 data. For instance, if you've already set up a custom KMS key for your Amazon S3 data, you may need to amend this policy with additional AWS KMS permissions.

Your AWS Glue resources and underlying Athena resources must be in the same AWS Region as the AWS Clean Rooms collaboration.

JSON

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "athena:GetDataCatalog",
        "athena:GetWorkGroup",
        "athena:GetTableMetadata",
        "athena:GetQueryExecution",
        "athena:GetQueryResults",
        "athena:StartQueryExecution"
      ],
      "Resource": [
        "arn:aws:athena:region:accountId:workgroup/workgroup",
        "arn:aws:athena:region:accountId:datacatalog/AwsDataCatalog"
      ]
    },
    {
      "Effect": "Allow",
      "Action": [
        "glue:GetDatabase",
        "glue:GetTable",
        "glue:GetPartitions"
      ],
      "Resource": [
        "arn:aws:glue:region:accountId:catalog",
        "arn:aws:glue:region:accountId:database/database name",
        "arn:aws:glue:region:accountId:table/database name/table name"
      ]
    }
  ]
}
```

```

    {
      "Effect": "Allow",
      "Action": [
        "s3:GetObject",
        "s3:GetBucketLocation",
        "s3:AbortMultipartUpload",
        "s3:ListBucket",
        "s3:PutObject",
        "s3:ListMultipartUploadParts"
      ],
      "Resource": [
        "arn:aws:s3:::bucket",
        "arn:aws:s3:::bucket/*"
      ]
    },
    {
      "Effect": "Allow",
      "Action": "lakeformation:GetDataAccess",
      "Resource": "*"
    },
    {
      "Effect": "Allow",
      "Action": [
        "kms:GenerateDataKey",
        "kms:Decrypt"
      ],
      "Resource": "arn:aws:kms:region:accountId:key/*"
    }
  ]
}

```

4. Replace each *placeholder* with your own information.
5. Continue to follow the [Creating a role using custom trust policies \(console\)](#) procedure to create the role.

Set up Lake Formation permissions

If you query resources protected with Lake Formation permissions, the service role must have **Select** and **Describe** access permissions on the table/view and **Describe** permissions on the AWS Glue database the view is stored in.

For more information, see:

- [Use Athena to query data registered with AWS Lake Formation](#) in the *Amazon Athena User Guide*
- [Onboarding to Lake Formation permissions](#) in the *AWS Lake Formation Developer Guide*

Create a service role to read data from Snowflake

AWS Clean Rooms uses a service role to retrieve your credentials for Snowflake to read your data from this source.

There are two ways to create this service role:

- If you have the necessary IAM permissions to create a service role, use the AWS Clean Rooms console to create a service role.
- If you don't have `iam:CreateRole`, `iam:CreatePolicy` and `iam:AttachRolePolicy` permissions or want to create the IAM roles manually, do one of the following:
 - Use the following procedure to create a service role using custom trust policies.
 - Ask your administrator to create the service role using the following procedure.

Note

You or your IAM administrator should follow this procedure only if you don't have the necessary permissions to create a service role using the AWS Clean Rooms console.

To create a service role to read data from Snowflake using custom trust policies

1. Create a role using custom trust policies. For more information, see the [Creating a role using custom trust policies \(console\)](#) procedure in the *AWS Identity and Access Management User Guide*.
2. Use the following custom trust policy according to the [Creating a role using custom trust policies \(console\)](#) procedure.

Note

If you want to help ensure that the role is used only in the context of a certain collaboration membership, you can scope down the trust policy further. For more information, see [Cross-service confused deputy prevention](#).

JSON

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Sid": "AllowIfSourceArnMatches",
      "Effect": "Allow",
      "Principal": {
        "Service": "cleanrooms.amazonaws.com"
      },
      "Action": "sts:AssumeRole",
      "Condition": {
        "ForAnyValue:ArnEquals": {
          "aws:SourceArn": [

            "arn:aws:cleanrooms:region:accountId:membership/membershipId",

            "arn:aws:cleanrooms:region:queryRunnerAccountId:membership/
            queryRunnerMembershipId"
          ]
        }
      }
    }
  ]
}
```

3. Use one of the following permissions policies according to the [Creating a role using custom trust policies \(console\)](#) procedure.

Permission policy for secrets encrypted with a customer-owned KMS key

JSON

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Action": "secretsmanager:GetSecretValue",
      "Resource":
"arn:aws:secretsmanager:region:secretAccountId:secret:secretIdentifier",
      "Effect": "Allow"
    },
    {
      "Sid": "AllowDecryptViaSecretsManagerForKey",
      "Action": "kms:Decrypt",
      "Resource":
"arn:aws:kms:region:keyOwnerAccountId:key/keyIdentifier",
      "Effect": "Allow",
      "Condition": {
        "StringEquals": {
          "kms:ViaService": "secretsmanager.region.amazonaws.com",
          "kms:EncryptionContext:SecretARN":
"arn:aws:secretsmanager:region:secretAccountId:secret:secretIdentifier"
        }
      }
    }
  ]
}
```

Permission policy for secrets encrypted with an AWS managed key

JSON

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Action": "secretsmanager:GetSecretValue",
      "Resource":
"arn:aws:secretsmanager:region:accountId:secret:secretIdentifier",
```



```

        "Effect": "Allow"
      }
    ]
  }
}

```

4. Replace each *placeholder* with your own information.
5. Continue to follow the [Creating a role using custom trust policies \(console\)](#) procedure to create the role.

Create a service role to read code from an S3 bucket (PySpark analysis template role)

AWS Clean Rooms uses a service role to read code from a collaboration member's specified S3 bucket when using a PySpark analysis template.

To create a service role to read code from an S3 bucket

1. Create a role using custom trust policies. For more information, see the [Creating a role using custom trust policies \(console\)](#) procedure in the *AWS Identity and Access Management User Guide*.
2. Use the following custom trust policy according to the [Creating a role using custom trust policies \(console\)](#) procedure.

JSON

```

{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Principal": {
        "Service": "cleanrooms.amazonaws.com"
      },
      "Action": "sts:AssumeRole",
      "Condition": {
        "ForAnyValue:ArnEquals": {
          "aws:SourceArn": [

```

```

    "arn:aws:cleanrooms:region:jobRunnerAccountId:membership/jobRunnerMembershipId",
    "arn:aws:cleanrooms:region:analysisTemplateAccountId:membership/analysisTemplateOwnerMembershipId"
  ]
}
}
}
]
}

```

3. Use the following permissions policy according to the [Creating a role using custom trust policies \(console\)](#) procedure.

Note

The following example policy supports the permissions needed to read your code from Amazon S3. However, you might need to modify this policy depending on how you've set up your S3 data.

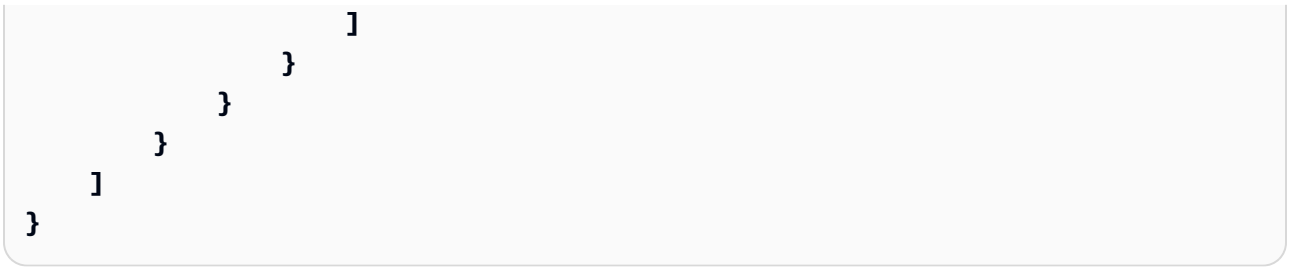
Your Amazon S3 resources must be in the same AWS Region as the AWS Clean Rooms collaboration.

JSON

```

{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "s3:GetObject",
        "s3:GetObjectVersion"
      ],
      "Resource": ["arn:aws:s3:::s3Path"],
      "Condition": {
        "StringEquals": {
          "s3:ResourceAccount": [
            "s3BucketOwnerAccountId"
          ]
        }
      }
    }
  ]
}

```



4. Replace each *placeholder* with your own information:
 - *s3Path* – The S3 bucket location of your code.
 - *s3BucketOwnerAccountId* – The AWS account ID of the S3 bucket owner.
 - *region* – The name of the AWS Region. For example, **us-east-1**.
 - *jobRunnerAccountId* – The AWS account ID of the member who can run queries and jobs.
 - *jobRunnerMembershipId* – The **Membership ID** of the member who can query and run jobs. The **Membership ID** can be found on the **Details** tab of the collaboration. This ensures that AWS Clean Rooms is assuming the role only when this member runs the analysis in this collaboration.
 - *analysisTemplateAccountId* – The AWS account ID of the analysis template.
 - *analysisTemplateOwnerMembershipId* – The **Membership ID** of the member who owns the analysis template. The **Membership ID** can be found on the **Details** tab of the collaboration.
5. Continue to follow the [Creating a role using custom trust policies \(console\)](#) procedure to create the role.

Create a service role to write results of a PySpark job

AWS Clean Rooms uses a service role to write the results of a PySpark job to a specified S3 bucket.

To create a service role to write results of a PySpark job

1. Create a role using custom trust policies. For more information, see the [Creating a role using custom trust policies \(console\)](#) procedure in the *AWS Identity and Access Management User Guide*.
2. Use the following custom trust policy according to the [Creating a role using custom trust policies \(console\)](#) procedure.

JSON

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Principal": {
        "Service": "cleanrooms.amazonaws.com"
      },
      "Action": "sts:AssumeRole",
      "Condition": {
        "ForAnyValue:ArnEquals": {
          "aws:SourceArn": [
            "arn:aws:cleanrooms:region:jobRunnerAccountId:membership/jobRunnerMembershipId",
            "arn:aws:cleanrooms:region:rrAccountId:membership/rrMembershipId"
          ]
        }
      }
    }
  ]
}
```

3. Use the following permissions policy according to the [Creating a role using custom trust policies \(console\)](#) procedure.

 Note

The following example policy supports the permissions needed to write to Amazon S3. However, you might need to modify this policy depending on how you've set up S3. Your Amazon S3 resources must be in the same AWS Region as the AWS Clean Rooms collaboration.

JSON

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "s3:PutObject"
      ],
      "Resource": "arn:aws:s3:::bucket/optionalPrefix/*",
      "Condition": {
        "StringEquals": {
          "s3:ResourceAccount": [
            "s3BucketOwnerAccountId"
          ]
        }
      }
    },
    {
      "Effect": "Allow",
      "Action": [
        "s3:GetBucketLocation",
        "s3:ListBucket"
      ],
      "Resource": "arn:aws:s3:::bucket",
      "Condition": {
        "StringEquals": {
          "s3:ResourceAccount": [
            "s3BucketOwnerAccountId"
          ]
        }
      }
    }
  ]
}
```

4. Replace each *placeholder* with your own information:

- *region* – The name of the AWS Region. For example, **us-east-1**.
- *jobRunnerAccountId* – The AWS account ID in which the S3 bucket is located.

- *jobRunnerMembershipId* – The **Membership ID** of the member who can query and run jobs. The **Membership ID** can be found on the **Details** tab of the collaboration. This ensures that AWS Clean Rooms is assuming the role only when this member runs the analysis in this collaboration.
 - *rrAccountId* – The AWS account ID in which the S3 bucket is located.
 - *rrMembershipId* – The **Membership ID** of the member who can receive results. The **Membership ID** can be found on the **Details** tab of the collaboration. This ensures that AWS Clean Rooms is assuming the role only when this member runs the analysis in this collaboration.
 - *bucket* – The name and location of the S3 bucket.
 - *optionalPrefix* – An optional prefix if you want to save your results under a specific S3 prefix.
 - *s3BucketOwnerAccountId* – The AWS account ID of the S3 bucket owner.
5. Continue to follow the [Creating a role using custom trust policies \(console\)](#) procedure to create the role.

Create a service role to receive results

Note

If you are the member who can only receive results (in the console, **Your member abilities** is only **Receive results**), follow this procedure.

If you are a member who can both query and receive results (in the console, **Your member abilities** is both **Query** and **Receive results**), you can skip this procedure.

For collaboration members who can only receive results, AWS Clean Rooms uses a service role to write results of the queried data in the collaboration to the specified S3 bucket.

There are two ways to create this service role:

- If you have the necessary IAM permissions to create a service role, use the AWS Clean Rooms console to create a service role.
- If you don't have `iam:CreateRole`, `iam:CreatePolicy` and `iam:AttachRolePolicy` permissions or want to create the IAM roles manually, do one of the following:

- Use the following procedure to create a service role using custom trust policies.
- Ask your administrator to create the service role using the following procedure.

Note

You or your IAM administrator should follow this procedure only if you don't have the necessary permissions to create a service role using the AWS Clean Rooms console.

To create a service role to receive results using custom trust policies

1. Create a role using custom trust policies. For more information, see the [Creating a role using custom trust policies \(console\)](#) procedure in the *AWS Identity and Access Management User Guide*.
2. Use the following custom trust policy according to the [Creating a role using custom trust policies \(console\)](#) procedure.

JSON

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Sid": "AllowIfExternalIdMatches",
      "Effect": "Allow",
      "Principal": {
        "Service": "cleanrooms.amazonaws.com"
      },
      "Action": "sts:AssumeRole",
      "Condition": {
        "ArnLike": {
          "sts:ExternalId":
            "arn:aws*:region*:dbuser:*/a1b2c3d4-5678-90ab-cdef-EXAMPLEaaaaa*"
        }
      }
    },
    {
      "Sid": "AllowIfSourceArnMatches",
      "Effect": "Allow",
```

```

        "Principal": {
            "Service": "cleanrooms.amazonaws.com"
        },
        "Action": "sts:AssumeRole",
        "Condition": {
            "ForAnyValue:ArnEquals": {
                "aws:SourceArn": [
                    "arn:aws:cleanrooms:us-
east-1:555555555555:membership/a1b2c3d4-5678-90ab-cdef-EXAMPLEaaaa"
                ]
            }
        }
    }
}

```

3. Use the following permissions policy according to the [Creating a role using custom trust policies \(console\)](#) procedure.

Note

The following example policy supports the permissions needed to read AWS Glue metadata and its corresponding Amazon S3 data. However, you might need to modify this policy depending on how you've set up your S3 data.

Your AWS Glue resources and underlying Amazon S3 resources must be in the same AWS Region as the AWS Clean Rooms collaboration.

JSON

```

{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": [
                "s3:GetBucketLocation",
                "s3:ListBucket"
            ],

```



```

        "Resource": [
            "arn:aws:s3:::bucket_name"
        ],
        "Condition": {
            "StringEquals": {
                "aws:ResourceAccount": "accountId"
            }
        }
    },
    {
        "Effect": "Allow",
        "Action": [
            "s3:PutObject"
        ],
        "Resource": [
            "arn:aws:s3:::bucket_name/optional_key_prefix/*"
        ],
        "Condition": {
            "StringEquals": {
                "aws:ResourceAccount": "accountId"
            }
        }
    }
}
]
}

```

4. Replace each *placeholder* with your own information:

- *region* – The name of the AWS Region. For example, **us-east-1**.
- *a1b2c3d4-5678-90ab-cdef-EXAMPLEaaaa* – The **Membership ID** of the member who can query. The **Membership ID** can be found on the **Details** tab of the collaboration. This ensures that AWS Clean Rooms is assuming the role only when this member runs the analysis in this collaboration.
- *arn:aws:cleanrooms:us-east-1:555555555555:membership/a1b2c3d4-5678-90ab-cdef-EXAMPLEaaaa* – The single **Membership ARN** of the member who can query. The **Membership ARN** can be found on the **Details** tab of the collaboration. This ensures AWS Clean Rooms is assuming the role only when this member runs the analysis in this collaboration.
- *bucket_name* – The **Amazon Resource Name (ARN)** of the S3 bucket. The **Amazon Resource Name (ARN)** can be found on the **Properties** tab of the bucket in Amazon S3.

- *accountId* – The AWS account ID in which the S3 bucket is located.

bucket_name/optional_key_prefix – The **Amazon Resource Name (ARN)** of the results destination in Amazon S3. The **Amazon Resource Name (ARN)** can be found on the **Properties** tab of the bucket in Amazon S3.

5. Continue to follow the [Creating a role using custom trust policies \(console\)](#) procedure to create the role.

Set up service roles for AWS Clean Rooms ML

The roles needed to perform lookalike modeling differ from those needed to use a custom model. The following sections describe the roles needed to perform each task.

Topics

- [Set up service roles for lookalike modeling](#)
- [Set up service roles for custom modeling](#)

Set up service roles for lookalike modeling

Topics

- [Create a service role to read training data](#)
- [Create a service role to write a lookalike segment](#)
- [Create a service role to read seed data](#)

Create a service role to read training data

AWS Clean Rooms uses a service role to read training data. You can create this role using the console if you have the necessary IAM permissions. If you don't have `CreateRole` permissions, ask your administrator to create the service role.

To create a service role to train a dataset

1. Sign in to the IAM console (<https://console.aws.amazon.com/iam/>) with your administrator account.
2. Under **Access management**, choose **Policies**.

3. Choose **Create policy**.
4. In the **Policy editor**, select the **JSON** tab, and then copy and paste the following policy.

 Note

The following example policy supports the permissions needed to read AWS Glue metadata and its corresponding Amazon S3 data. However, you might need to modify this policy depending on how you've set up your S3 data. This policy doesn't include a KMS key to decrypt data.

Your AWS Glue resources and underlying Amazon S3 resources must be in the same AWS Region as the AWS Clean Rooms collaboration.

JSON

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "glue:GetDatabase",
        "glue:GetDatabases",
        "glue:GetTable",
        "glue:GetTables",
        "glue:GetPartitions",
        "glue:GetPartition",
        "glue:BatchGetPartition",
        "glue:GetUserDefinedFunctions"
      ],
      "Resource": [
        "arn:aws:glue:region:accountId:database/databases",
        "arn:aws:glue:region:accountId:table/databases/tables",
        "arn:aws:glue:region:accountId:catalog",
        "arn:aws:glue:region:accountId:database/default"
      ]
    },
    {
      "Effect": "Allow",
      "Action": [
```

```

        "glue:CreateDatabase"
    ],
    "Resource": [
        "arn:aws:glue:region:accountId:database/default"
    ]
},
{
    "Effect": "Allow",
    "Action": [
        "s3:ListBucket",
        "s3:GetBucketLocation"
    ],
    "Resource": [
        "arn:aws:s3::bucket"
    ],
    "Condition": {
        "StringEquals": {
            "s3:ResourceAccount": [
                "accountId"
            ]
        }
    }
},
{
    "Effect": "Allow",
    "Action": [
        "s3:GetObject"
    ],
    "Resource": [
        "arn:aws:s3::bucketFolders/*"
    ],
    "Condition": {
        "StringEquals": {
            "s3:ResourceAccount": [
                "accountId"
            ]
        }
    }
}
]
}

```

If you need to use a KMS key to decrypt data, add this AWS KMS statement to the previous template:

```
{
    "Effect": "Allow",
    "Action": [
        "kms:Decrypt",
    ],
    "Resource": [
        "arn:aws:kms:region:accountId:key/keyId"
    ],
    "Condition": {
        "ArnLike": {
            "kms:EncryptionContext:aws:s3:arn":
                "arn:aws:s3:::bucketFolders*"
        }
    }
}
```

5. Replace each *placeholder* with your own information:

- *region* – The name of the AWS Region. For example, **us-east-1**.
- *accountId* – The AWS account ID in which the S3 bucket is located.
- *database/databases*, *table/databases/tables*, *catalog*, and *database/default* – The location of the training data that AWS Clean Rooms needs to access.
- *bucket* – The **Amazon Resource Name (ARN)** of the S3 bucket. The **Amazon Resource Name (ARN)** can be found on the **Properties** tab of the bucket in Amazon S3.
- *bucketFolders* – The name of specific folders in the S3 bucket that AWS Clean Rooms needs to access.

6. Choose **Next**.

7. For **Review and create**, enter a **Policy name** and **Description**, and review the **Summary**.

8. Choose **Create policy**.

You have created a policy for AWS Clean Rooms.

9. Under **Access management**, choose **Roles**.

With **Roles**, you can create short-term credentials, which is recommended for increased security. You can also choose **Users** to create long-term credentials.

10. Choose **Create role**.

11. In the **Create role** wizard, for **Trusted entity type**, choose **Custom trust policy**.

12. Copy and paste the following custom trust policy into the JSON editor.

JSON

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Sid": "AllowAssumeRole",
      "Effect": "Allow",
      "Principal": {
        "Service": "cleanrooms-ml.amazonaws.com"
      },
      "Action": "sts:AssumeRole",
      "Condition": {
        "StringEqualsIfExists": {
          "aws:SourceAccount": ["accountId"]
        },
        "StringLikeIfExists": {
          "aws:SourceArn": "arn:aws:cleanrooms-ml:region:accountId:training-dataset/*"
        }
      }
    }
  ]
}
```

The SourceAccount is always your AWS account. The SourceArn can be limited to a specific training dataset, but only after that dataset is created. Because you don't yet know the training dataset ARN, the wildcard is specified here.

accountId is the ID of AWS account that contains the training data.

13. Choose **Next** and under **Add permissions**, enter the name of the policy you just created. (You might need to reload the page.)
14. Select the check box next to the name of the policy you created, and then choose **Next**.
15. For **Name, review, and create**, enter the **Role name** and **Description**.

 Note

The **Role name** must match the pattern in the `passRole` permissions granted to the member who can query and receive results and member roles.

- a. Review **Select trusted entities**, and edit if necessary.
- b. Review the permissions in **Add permissions**, and edit if necessary.
- c. Review the **Tags**, and add tags if necessary.
- d. Choose **Create role**.

You have created the service role for AWS Clean Rooms.

Create a service role to write a lookalike segment

AWS Clean Rooms uses a service role to write lookalike segments to a bucket. You can create this role using the console if you have the necessary IAM permissions. If you don't have `CreateRole` permissions, ask your administrator to create the service role.

To create a service role to write a lookalike segment

1. Sign in to the IAM console (<https://console.aws.amazon.com/iam/>) with your administrator account.
2. Under **Access management**, choose **Policies**.
3. Choose **Create policy**.
4. In the **Policy editor**, select the **JSON** tab, and then copy and paste the following policy.

 Note

The following example policy supports the permissions needed to read AWS Glue metadata and its corresponding Amazon S3 data. However, you might need to modify

this policy depending on how you've set up your Amazon S3 data. This policy doesn't include a KMS key to decrypt data.

Your AWS Glue resources and underlying Amazon S3 resources must be in the same AWS Region as the AWS Clean Rooms collaboration.

JSON

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "s3:ListBucket",
        "s3:GetBucketLocation"
      ],
      "Resource": [
        "arn:aws:s3:::buckets"
      ],
      "Condition": {
        "StringEquals": {
          "s3:ResourceAccount": [
            "accountId"
          ]
        }
      }
    },
    {
      "Effect": "Allow",
      "Action": [
        "s3:PutObject"
      ],
      "Resource": [
        "arn:aws:s3:::bucketFolders/*"
      ],
      "Condition": {
        "StringEquals": {
          "s3:ResourceAccount": [
            "accountId"
          ]
        }
      }
    }
  ]
}
```



```

    }
  }
]
}

```

If you need to use a KMS key to encrypt data, add this AWS KMS statement to the template:

```

{
    "Effect": "Allow",
    "Action": [
        "kms:Encrypt",
        "kms:GenerateDataKey*",
        "kms:ReEncrypt*",
    ],
    "Resource": [
        "arn:aws:kms:region:accountId:key/keyId"
    ],
    "Condition": {
        "ArnLike": {
            "kms:EncryptionContext:aws:s3:arn":
                "arn:aws:s3:::bucketFolders*"
        }
    }
}

```

5. Replace each *placeholder* with your own information:

- *buckets* – The **Amazon Resource Name (ARN)** of the S3 bucket. The **Amazon Resource Name (ARN)** can be found on the **Properties** tab of the bucket in Amazon S3.
- *accountId* – The AWS account ID in which the S3 bucket is located.
- *bucketFolders* – The name of specific folders in the S3 bucket that AWS Clean Rooms needs to access.
- *region* – The name of the AWS Region. For example, **us-east-1**.
- *keyId* – The KMS key needed to encrypt your data.

6. Choose **Next**.

7. For **Review and create**, enter a **Policy name** and **Description**, and review the **Summary**.

8. Choose **Create policy**.

You have created a policy for AWS Clean Rooms.

9. Under **Access management**, choose **Roles**.

With **Roles**, you can create short-term credentials, which is recommended for increased security. You can also choose **Users** to create long-term credentials.

10. Choose **Create role**.

11. In the **Create role** wizard, for **Trusted entity type**, choose **Custom trust policy**.

12. Copy and paste the following custom trust policy into the JSON editor.

JSON

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Sid": "AllowAssumeRole",
      "Effect": "Allow",
      "Principal": {
        "Service": "cleanrooms-ml.amazonaws.com"
      },
      "Action": "sts:AssumeRole",
      "Condition": {
        "StringEqualsIfExists": {
          "aws:SourceAccount": ["accountId"]
        },
        "StringLikeIfExists": {
          "aws:SourceArn": "arn:aws:cleanrooms-ml:region:accountId:configured-audience-model/*"
        }
      }
    }
  ]
}
```

The SourceAccount is always your AWS account. The SourceArn can be limited to a specific training dataset, but only after that dataset is created. Because you don't yet know the training dataset ARN, the wildcard is specified here.

13. Choose **Next**.
14. Select the check box next to the name of the policy you created, and then choose **Next**.
15. For **Name, review, and create**, enter the **Role name** and **Description**.

 Note

The **Role name** must match the pattern in the passRole permissions granted to the member who can query and receive results and member roles.

- a. Review **Select trusted entities**, and edit if necessary.
- b. Review the permissions in **Add permissions**, and edit if necessary.
- c. Review the **Tags**, and add tags if necessary.
- d. Choose **Create role**.

You have created the service role for AWS Clean Rooms.

Create a service role to read seed data

AWS Clean Rooms uses a service role to read seed data. You can create this role using the console if you have the necessary IAM permissions. If you don't have CreateRole permissions, ask your administrator to create the service role.

To create a service role to read seed data that is stored in an S3 bucket.

1. Sign in to the IAM console (<https://console.aws.amazon.com/iam/>) with your administrator account.
2. Under **Access management**, choose **Policies**.
3. Choose **Create policy**.
4. In the **Policy editor**, select the **JSON** tab, and then copy and paste one of the following policies.

Note

The following example policy supports the permissions needed to read AWS Glue metadata and its corresponding Amazon S3 data. However, you might need to modify this policy depending on how you've set up your Amazon S3 data. This policy doesn't include a KMS key to decrypt data.

Your AWS Glue resources and underlying Amazon S3 resources must be in the same AWS Region as the AWS Clean Rooms collaboration.

JSON

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "s3:ListBucket",
      ],
      "Resource": [
        "arn:aws:s3:::buckets"
      ],
      "Condition": {
        "StringEquals": {
          "s3:ResourceAccount": [
            "accountId"
          ]
        }
      }
    },
    {
      "Effect": "Allow",
      "Action": [
        "s3:GetObject"
      ],
      "Resource": [
        "arn:aws:s3:::bucketFolders/*"
      ],
      "Condition": {
```

```

        "StringEquals":{
            "s3:ResourceAccount":[
                "accountId"
            ]
        }
    }
}

```

Note

The following example policy supports the permissions needed to read the results of an SQL query and use that as the input data. However, you might need to modify this policy depending on how your query is structured. This policy doesn't include a KMS key to decrypt data.

JSON

```

{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Sid": "AllowCleanRoomsStartQuery",
            "Effect": "Allow",
            "Action": [
                "cleanrooms:GetCollaborationAnalysisTemplate",
                "cleanrooms:GetSchema",
                "cleanrooms:StartProtectedQuery"
            ],
            "Resource": "*"
        },
        {
            "Sid": "AllowCleanRoomsGetAndUpdateQuery",
            "Effect": "Allow",
            "Action": [
                "cleanrooms:GetProtectedQuery",
                "cleanrooms:UpdateProtectedQuery"
            ],

```

```

        "Resource": [
            "arn:aws:cleanrooms:region:queryRunnerAccountId:membership/queryRunnerMembershipId"
        ]
    }
]
}

```

If you need to use a KMS key to decrypt data, add this AWS KMS statement to the template:

```

{
    "Effect": "Allow",
    "Action": [
        "kms:Decrypt",
        "kms:DescribeKey"
    ],
    "Resource": [
        "arn:aws:kms:region:accountId:key/keyId"
    ],
    "Condition": {
        "ArnLike": {
            "kms:EncryptionContext:aws:s3:arn":
                "arn:aws:s3:::bucketFolders*"
        }
    }
}

```

5. Replace each *placeholder* with your own information:

- *buckets* – The **Amazon Resource Name (ARN)** of the S3 bucket. The **Amazon Resource Name (ARN)** can be found on the **Properties** tab of the bucket in Amazon S3.
- *accountId* – The AWS account ID in which the S3 bucket is located.
- *bucketFolders* – The name of specific folders in the S3 bucket that AWS Clean Rooms needs to access.
- *region* – The name of the AWS Region. For example, **us-east-1**.
- *queryRunnerAccountId* – The AWS account ID of the account that will run queries.

- *queryRunnerMembershipId* – The **Membership ID** of the member who can query. The **Membership ID** can be found on the **Details** tab of the collaboration. This ensures that AWS Clean Rooms is assuming the role only when this member runs the analysis in this collaboration.
- *keyId* – The KMS key needed to encrypt your data.

6. Choose **Next**.
7. For **Review and create**, enter a **Policy name** and **Description**, and review the **Summary**.
8. Choose **Create policy**.

You have created a policy for AWS Clean Rooms.

9. Under **Access management**, choose **Roles**.

With **Roles**, you can create short-term credentials, which is recommended for increased security. You can also choose **Users** to create long-term credentials.

10. Choose **Create role**.
11. In the **Create role** wizard, for **Trusted entity type**, choose **Custom trust policy**.
12. Copy and paste the following custom trust policy into the JSON editor.

JSON

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Sid": "AllowAssumeRole",
      "Effect": "Allow",
      "Principal": {
        "Service": "cleanrooms-ml.amazonaws.com"
      },
      "Action": "sts:AssumeRole",
      "Condition": {
        "StringEqualsIfExists": {
          "aws:SourceAccount": ["accountId"]
        },
        "StringLikeIfExists": {
          "aws:SourceArn": "arn:aws:cleanrooms-ml:region:accountId:audience-generation-job/*"
        }
      }
    }
  ]
}
```

```
}  
  }  
    }  
      ]  
        }
```

The `SourceAccount` is always your AWS account. The `SourceArn` can be limited to a specific training dataset, but only after that dataset is created. Because you don't yet know the training dataset ARN, the wildcard is specified here.

13. Choose **Next**.
14. Select the check box next to the name of the policy you created, and then choose **Next**.
15. For **Name, review, and create**, enter the **Role name** and **Description**.

 Note

The **Role name** must match the pattern in the `passRole` permissions granted to the member who can query and receive results and member roles.

- a. Review **Select trusted entities**, and edit if necessary.
- b. Review the permissions in **Add permissions**, and edit if necessary.
- c. Review the **Tags**, and add tags if necessary.
- d. Choose **Create role**.

You have created the service role for AWS Clean Rooms.

Set up service roles for custom modeling

Topics

- [Create a service role for custom ML modeling - ML Configuration](#)
- [Create a service role to provide a custom ML model](#)
- [Create a service role to query a dataset](#)
- [Create a service role to create a configured table association](#)

Create a service role for custom ML modeling - ML Configuration

AWS Clean Rooms uses a service role to control who can create a custom ML configuration. You can create this role using the console if you have the necessary IAM permissions. If you don't have `CreateRole` permissions, ask your administrator to create the service role.

This role allows you to use the [PutMLConfiguration](#) action.

To create a service role to allow creation of a custom ML configuration

1. Sign in to the IAM console (<https://console.aws.amazon.com/iam/>) with your administrator account.
2. Under **Access management**, choose **Policies**.
3. Choose **Create policy**.
4. In the **Policy editor**, select the **JSON** tab, and then copy and paste the following policy.

Note

The following example policy supports the permissions needed to access and write data to an S3 bucket and to publish CloudWatch metrics. However, you might need to modify this policy depending on how you've set up your Amazon S3 data. This policy doesn't include a KMS key to decrypt data.

Your Amazon S3 resources must be in the same AWS Region as the AWS Clean Rooms collaboration.

JSON

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Sid": "AllowS3ObjectWriteForExport",
      "Effect": "Allow",
      "Action": [
        "s3:PutObject"
      ],
      "Resource": [
        "arn:aws:s3:::bucket/*"
      ]
    }
  ]
}
```

```

    ],
    "Condition": {
      "StringEquals": {
        "s3:ResourceAccount": [
          "accountId"
        ]
      }
    }
  },
  {
    "Sid": "AllowS3KMSEncryptForExport",
    "Effect": "Allow",
    "Action": [
      "kms:Encrypt",
      "kms:GenerateDataKey*"
    ],
    "Resource": [
      "arn:aws:kms:region:accountId:key/keyId"
    ],
    "Condition": {
      "StringLike": {
        "kms:EncryptionContext:aws:s3:arn":
        "arn:aws:s3:::bucket*"
      }
    }
  },
  {
    "Sid": "AllowCloudWatchMetricsPublishingForTrainingJobs",
    "Action": "cloudwatch:PutMetricData",
    "Resource": "*",
    "Effect": "Allow",
    "Condition": {
      "StringLike": {
        "cloudwatch:namespace": "/aws/cleanroomsm1/*"
      }
    }
  },
  {
    "Sid": "AllowCloudWatchLogsPublishingForTrainingOrInferenceJobs",
    "Effect": "Allow",
    "Action": [
      "logs:CreateLogGroup",
      "logs:CreateLogStream",
      "logs:DescribeLogStreams",

```

```

        "logs:PutLogEvents"
      ],
      "Resource": [
        "arn:aws:logs:region:account-id:log-group:/aws/cleanroomsml/"
      ]
    },
  ],
}

```

5. Replace each *placeholder* with your own information:
 - *bucket* – The **Amazon Resource Name (ARN)** of the S3 bucket. The **Amazon Resource Name (ARN)** can be found on the **Properties** tab of the bucket in Amazon S3.
 - *region* – The name of the AWS Region. For example, **us-east-1**.
 - *accountId* – The AWS account ID in which the S3 bucket is located.
 - *keyId* – The KMS key needed to encrypt your data.
 6. Choose **Next**.
 7. For **Review and create**, enter a **Policy name** and **Description**, and review the **Summary**.
 8. Choose **Create policy**.
- You have created a policy for AWS Clean Rooms.
9. Under **Access management**, choose **Roles**.
- With **Roles**, you can create short-term credentials, which is recommended for increased security. You can also choose **Users** to create long-term credentials.
10. Choose **Create role**.
 11. In the **Create role** wizard, for **Trusted entity type**, choose **Custom trust policy**.
 12. Copy and paste the following custom trust policy into the JSON editor.

JSON

```

{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",

```

```

    "Principal": {
      "Service": "cleanrooms-ml.amazonaws.com"
    },
    "Action": "sts:AssumeRole",
    "Condition": {
      "StringEquals": {
        "aws:SourceAccount": "accountId"
      },
      "ArnLike": {
        "aws:SourceArn":
          "arn:aws:cleanrooms:region:accountId:membership/membershipID"
      }
    }
  }
]
}

```

The SourceAccount is always your AWS account. The SourceArn can be limited to a specific training dataset, but only after that dataset is created. Because you don't yet know the training dataset ARN, the wildcard is specified here.

13. Choose **Next**.
14. Select the check box next to the name of the policy you created, and then choose **Next**.
15. For **Name, review, and create**, enter the **Role name** and **Description**.

Note

The **Role name** must match the pattern in the passRole permissions granted to the member who can query and receive results and member roles.

- a. Review **Select trusted entities**, and edit if necessary.
- b. Review the permissions in **Add permissions**, and edit if necessary.
- c. Review the **Tags**, and add tags if necessary.
- d. Choose **Create role**.

You have created the service role for AWS Clean Rooms.

Create a service role to provide a custom ML model

AWS Clean Rooms uses a service role to control who can create a custom ML model algorithm. You can create this role using the console if you have the necessary IAM permissions. If you don't have `CreateRole` permissions, ask your administrator to create the service role.

This role allows you to use the [CreateConfiguredModelAlgorithm](#) action.

To create a service role to allow a member to provide a custom ML model

1. Sign in to the IAM console (<https://console.aws.amazon.com/iam/>) with your administrator account.
2. Under **Access management**, choose **Policies**.
3. Choose **Create policy**.
4. In the **Policy editor**, select the **JSON** tab, and then copy and paste the following policy.

Note

The following example policy supports the permissions needed to retrieve the docker image that contains the model algorithm. However, you might need to modify this policy depending on how you've set up your Amazon S3 data. This policy doesn't include a KMS key to decrypt data.

Your Amazon S3 resources must be in the same AWS Region as the AWS Clean Rooms collaboration.

JSON

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Sid": "AllowECRIImageDownloadForTrainingAndInferenceJobs",
      "Effect": "Allow",
      "Action": [
        "ecr:BatchGetImage",
        "ecr:BatchCheckLayerAvailability",
        "ecr:GetDownloadUrlForLayer"
      ]
    }
  ],
}
```

```
        "Resource": "arn:aws:ecr:region:accountID:repository/repoName"
      }
    ]
  }
}
```

5. Replace each *placeholder* with your own information:
 - *region* – The name of the AWS Region. For example, **us-east-1**.
 - *accountId* – The AWS account ID in which the S3 bucket is located.
 - *repoName* – The name of the repository that contains your data.
6. Choose **Next**.
7. For **Review and create**, enter a **Policy name** and **Description**, and review the **Summary**.
8. Choose **Create policy**.

You have created a policy for AWS Clean Rooms.

9. Under **Access management**, choose **Roles**.

With **Roles**, you can create short-term credentials, which is recommended for increased security. You can also choose **Users** to create long-term credentials.

10. Choose **Create role**.
11. In the **Create role** wizard, for **Trusted entity type**, choose **Custom trust policy**.
12. Copy and paste the following custom trust policy into the JSON editor.

JSON

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Principal": {
        "Service": "cleanrooms-ml.amazonaws.com"
      },
      "Action": "sts:AssumeRole"
    }
  ]
}
```

The SourceAccount is always your AWS account. The SourceArn can be limited to a specific training dataset, but only after that dataset is created. Because you don't yet know the training dataset ARN, the wildcard is specified here.

13. Choose **Next**.
14. Select the check box next to the name of the policy you created, and then choose **Next**.
15. For **Name, review, and create**, enter the **Role name** and **Description**.

 Note

The **Role name** must match the pattern in the passRole permissions granted to the member who can query and receive results and member roles.

- a. Review **Select trusted entities**, and edit if necessary.
- b. Review the permissions in **Add permissions**, and edit if necessary.
- c. Review the **Tags**, and add tags if necessary.
- d. Choose **Create role**.

You have created the service role for AWS Clean Rooms.

Create a service role to query a dataset

AWS Clean Rooms uses a service role to control who can query a dataset that will be used for custom ML modeling. You can create this role using the console if you have the necessary IAM permissions. If you don't have CreateRole permissions, ask your administrator to create the service role.

This role allows you to use the [CreateMLInputChannel](#) action.

To create a service role to allow a member to query a dataset

1. Sign in to the IAM console (<https://console.aws.amazon.com/iam/>) with your administrator account.
2. Under **Access management**, choose **Policies**.
3. Choose **Create policy**.

4. In the **Policy editor**, select the **JSON** tab, and then copy and paste the following policy.

 Note

The following example policy supports the permissions needed to query a dataset that will be used for custom ML modeling. However, you might need to modify this policy depending on how you've set up your Amazon S3 data. This policy doesn't include a KMS key to decrypt data.

Your Amazon S3 resources must be in the same AWS Region as the AWS Clean Rooms collaboration.

JSON

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Sid": "AllowCleanRoomsStartQueryForMLInputChannel",
      "Effect": "Allow",
      "Action": "cleanrooms:StartProtectedQuery",
      "Resource": "*"
    },
    {
      "Sid": "AllowCleanroomsGetSchemaAndGetAnalysisTemplateForMLInputChannel",
      "Effect": "Allow",
      "Action": [
        "cleanrooms:GetSchema",
        "cleanrooms:GetCollaborationAnalysisTemplate"
      ],
      "Resource": "*"
    },
    {
      "Sid": "AllowCleanRoomsGetAndUpdateQueryForMLInputChannel",
      "Effect": "Allow",
      "Action": [
        "cleanrooms:GetProtectedQuery",
        "cleanrooms:UpdateProtectedQuery"
      ],
      "Resource": [
```



```

    "arn:aws:cleanrooms:region:queryRunnerAccountId:membership/queryRunnerMembershipId"
  ]
}
]
}

```

5. Replace each *placeholder* with your own information:
 - *region* – The name of the AWS Region. For example, **us-east-1**.
 - *queryRunnerAccountId* – The AWS account ID of the account that will run the queries.
 - *queryRunnerMembershipId* – The **Membership ID** of the member who can query. The **Membership ID** can be found on the **Details** tab of the collaboration. This ensures that AWS Clean Rooms is assuming the role only when this member runs the analysis in this collaboration.
6. Choose **Next**.
7. For **Review and create**, enter a **Policy name** and **Description**, and review the **Summary**.
8. Choose **Create policy**.

You have created a policy for AWS Clean Rooms.

9. Under **Access management**, choose **Roles**.

With **Roles**, you can create short-term credentials, which is recommended for increased security. You can also choose **Users** to create long-term credentials.

10. Choose **Create role**.
11. In the **Create role** wizard, for **Trusted entity type**, choose **Custom trust policy**.
12. Copy and paste the following custom trust policy into the JSON editor.

JSON

```

{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Principal": {
        "Service": "cleanrooms-ml.amazonaws.com"
      }
    }
  ]
}

```

```
    },  
    "Action": "sts:AssumeRole"  
  }  
]  
}
```

The `SourceAccount` is always your AWS account. The `SourceArn` can be limited to a specific training dataset, but only after that dataset is created. Because you don't yet know the training dataset ARN, the wildcard is specified here.

13. Choose **Next**.
14. Select the check box next to the name of the policy you created, and then choose **Next**.
15. For **Name, review, and create**, enter the **Role name** and **Description**.

 Note

The **Role name** must match the pattern in the `passRole` permissions granted to the member who can query and receive results and member roles.

- a. Review **Select trusted entities**, and edit if necessary.
- b. Review the permissions in **Add permissions**, and edit if necessary.
- c. Review the **Tags**, and add tags if necessary.
- d. Choose **Create role**.

You have created the service role for AWS Clean Rooms.

Create a service role to create a configured table association

AWS Clean Rooms uses a service role to control who can create a configured table association. You can create this role using the console if you have the necessary IAM permissions. If you don't have `CreateRole` permissions, ask your administrator to create the service role.

This role allows you to use the `CreateConfiguredTableAssociation` action.

To create a service role to allow creation of a configured table association

1. Sign in to the IAM console (<https://console.aws.amazon.com/iam/>) with your administrator account.
2. Under **Access management**, choose **Policies**.
3. Choose **Create policy**.
4. In the **Policy editor**, select the **JSON** tab, and then copy and paste the following policy.

Note

The following example policy supports the creation of a configured table association. However, you might need to modify this policy depending on how you've set up your Amazon S3 data. This policy doesn't include a KMS key to decrypt data. Your Amazon S3 resources must be in the same AWS Region as the AWS Clean Rooms collaboration.

JSON

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Action": [
        "kms:Decrypt",
        "kms:DescribeKey"
      ],
      "Resource": "KMS key used to encrypt the S3 data",
      "Effect": "Allow"
    },
    {
      "Action": [
        "s3:ListBucket",
        "s3:GetBucketLocation"
      ],
      "Resource": "S3 bucket of Glue table",
      "Effect": "Allow"
    },
    {
```

```

        "Action": "s3:GetObject",
        "Resource": "S3 bucket of Glue table/*",
        "Effect": "Allow"
    },
    {
        "Action": [
            "glue:GetDatabase",
            "glue:GetDatabases",
            "glue:GetTable",
            "glue:GetTables",
            "glue:GetPartitions",
            "glue:GetPartition",
            "glue:BatchGetPartition"
        ],
        "Resource": [
            "arn:aws:glue:region:accountID:catalog",
            "arn:aws:glue:region:accountID:database/Glue database name",
            "arn:aws:glue:region:accountID:table/Glue database name/Glue
table name"
        ],
        "Effect": "Allow"
    },
    {
        "Action": [
            "glue:GetSchema",
            "glue:GetSchemaVersion"
        ],
        "Resource": "*",
        "Effect": "Allow"
    }
]
}

```

5. Replace each *placeholder* with your own information:

- *KMS key used to encrypt the Amazon S3 data* – The KMS key that was used to encrypt the Amazon S3 data. In order to decrypt the data, you need to provide the same KMS key that was used to encrypt the data.
- *Amazon S3 bucket of AWS Glue table* – The name of the Amazon S3 bucket that contains the AWS Glue table that contains your data.
- *region* – The name of the AWS Region. For example, **us-east-1**.
- *accountId* – The AWS account ID of the account that owns the data.

- *AWS Glue database name* – The name of the AWS Glue database that contains your data.
 - *AWS Glue table name* – The name of the AWS Glue table that contains your data.
6. Choose **Next**.
 7. For **Review and create**, enter a **Policy name** and **Description**, and review the **Summary**.
 8. Choose **Create policy**.

You have created a policy for AWS Clean Rooms.

9. Under **Access management**, choose **Roles**.

With **Roles**, you can create short-term credentials, which is recommended for increased security. You can also choose **Users** to create long-term credentials.

10. Choose **Create role**.
11. In the **Create role** wizard, for **Trusted entity type**, choose **Custom trust policy**.
12. Copy and paste the following custom trust policy into the JSON editor.

JSON

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Principal": {
        "Service": "cleanrooms-ml.amazonaws.com"
      },
      "Action": "sts:AssumeRole",
    }
  ]
}
```

The SourceAccount is always your AWS account. The SourceArn can be limited to a specific training dataset, but only after that dataset is created. Because you don't yet know the training dataset ARN, the wildcard is specified here.

13. Choose **Next**.
14. Select the check box next to the name of the policy you created, and then choose **Next**.

15. For **Name, review, and create**, enter the **Role name** and **Description**.

 Note

The **Role name** must match the pattern in the `passRole` permissions granted to the member who can query and receive results and member roles.

- a. Review **Select trusted entities**, and edit if necessary.
- b. Review the permissions in **Add permissions**, and edit if necessary.
- c. Review the **Tags**, and add tags if necessary.
- d. Choose **Create role**.

You have created the service role for AWS Clean Rooms.

Collaborations and memberships in AWS Clean Rooms

A *collaboration* is a secure logical boundary in AWS Clean Rooms in which members can perform analysis on configured tables.

Any member in AWS Clean Rooms can create a collaboration.

The collaboration creator can designate a single member to analyze configured tables and receive results. However, the collaboration creator might want to prevent the member who can run the analysis from having access to the query results. In that case, the collaboration creator can designate one [member to who can query](#) or [one member who can run queries and jobs](#) and another [member who can receive results](#).

In most cases, the member who can query or the member who can query and run jobs is also the [member paying for compute costs](#). However, the collaboration creator can configure a different member to be responsible for paying for the query compute costs.

For information about how to create a collaboration using the AWS SDKs, see the [AWS Clean Rooms API Reference](#).

Topics

- [Creating a collaboration](#)
- [Creating a membership and joining a collaboration](#)
- [Editing collaborations](#)
- [Deleting collaborations](#)
- [Viewing collaborations](#)
- [Inviting members to a collaboration](#)
- [Monitoring members](#)
- [Removing a member from a collaboration](#)
- [Leaving a collaboration](#)

Creating a collaboration

There are three ways to create a collaboration in AWS Clean Rooms.

The most basic form is the collaboration for queries. This collaboration focuses on SQL query analysis and maintains a simple structure with two main roles: one member who can run queries and another who can receive results. This basic collaboration setup works well for simple data analysis tasks.

The second form, collaboration for queries and jobs, extends functionality by incorporating both SQL queries and PySpark jobs and requires Spark as its analytics engine. This collaboration setup maintains the same basic role structure but expands permissions to include job execution. A notable requirement is that the member who creates PySpark analysis templates must also be the one receiving results, ensuring clear accountability in the analysis process.

The third form, collaboration for ML modeling, is built for machine learning workflows and requires Spark as its analytics engine. This collaboration setup adds two more roles: one for users who need the results from trained models, and another for users who need the results from using those models to make predictions. This collaboration setup helps collaboration members work together on complex data projects while keeping everyone's roles and permissions clear.

The following topics explain how to create collaborations for queries, jobs, and ML modeling.

Topics

- [Creating a collaboration for queries](#)
- [Creating a collaboration for queries and jobs](#)
- [Creating a collaboration for ML modeling](#)

Creating a collaboration for queries

In this procedure, you as the [collaboration creator](#) perform the following tasks:

- [Create a collaboration](#).
- Invite one or more [members](#) to the [collaboration](#).
- Assign abilities to members, such as the [member who can query](#) and the [member who can receive results](#).

If the collaboration creator is also the member who can receive results, they specify the results destination and format. They also provide a service role Amazon Resource Name (ARN) to write the results to the results destination.

- Configure which [member is responsible for paying for compute costs in the collaboration](#).

Before you begin, make sure that you have completed the following prerequisites:

-
- You have the name and AWS account ID for each member that you want to invite to the collaboration.
- You have permission to share the name and AWS account ID for each member with all members of the collaboration.

 Note

You can't add more members after you create the collaboration.

For information about how to create a collaboration using the AWS SDKs, see the [AWS Clean Rooms API Reference](#).

To create a collaboration for queries

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with the AWS account that will function as the collaboration creator.
2. In the left navigation pane, choose **Collaborations**.
3. In the upper right corner, choose **Create collaboration**.
4. For **Step 1: Define collaboration**, do the following:
 - a. For **Details**, enter the **Name** and **Description** of the collaboration.

This information will be visible to collaboration members who are invited to participate in the collaboration. The **Name** and **Description** helps them understand what the collaboration is in reference to.

- b. For **Analytics engine**, choose **Spark**.

 Note

AWS Clean Rooms will end support for the legacy Clean Rooms SQL analytics engine on December 17th, 2025. Before July 16, 2025, you must request a limit increase via AWS Customer Support to create any new Clean Rooms SQL engine-based collaborations. Starting July 17, 2025, the creation of new Clean Rooms SQL engine-based collaborations will no longer be available.

If you want to update your collaboration from the AWS Clean Rooms SQL analytics engine to the Spark analytics engine, you can [edit an existing collaboration](#) or re-create the collaboration and select the Spark analytics engine.

c. For **Members**:

- i. For **Member 1: You**, enter your **Member display name** as you want it to appear for the collaboration.

 Note

Your AWS account ID is included automatically for **Member AWS account ID**.

- ii. For **Member 2**, enter the **Member display name** and **Member AWS account ID** for the member that you want to invite to the collaboration.

The **Member display name** and **Member AWS account ID** will be visible to everyone invited to the collaboration. After you enter and save the values for these fields, you can't edit them.

 Note

You must inform the collaboration member that their **Member AWS account ID** and **Member display name** will be visible to all invited and active collaborators in the collaboration.

- iii. If you want to add another member, choose **Add another member**. Then enter the **Member display name** and **Member AWS account ID** for each member who can contribute data that you want to invite to the collaboration.
- d. If you want to enable **Analysis logging**, select the **Enable analysis logging** checkbox.
- Choose the **Logs from queries** checkbox under the **Supported log types**.

You will receive logs generated from SQL queries in your Amazon CloudWatch Logs account.

- e. (Optional) If you want to enable the **Cryptographic computing** capability, select the **Enable cryptographic computing** checkbox.

- i. Choose the following **Cryptographic coverage parameters**:

- **Allow plaintext columns**

Choose **No** if you require fully encrypted tables.

Choose **Yes** if you want cleartext columns allowed in the encrypted table.

To run SUM or AVG on certain columns, the columns must be in cleartext.

- **Preserve NULL values**

Choose **No** if you don't want to preserve NULL values. NULL values won't appear as NULL in an encrypted table.

Choose **Yes** if you want to preserve NULL values. NULL values will appear as NULL in an encrypted table.

ii. Choose the following **Fingerprinting parameters**:

- **Allow duplicates**

Choose **No** if you don't want duplicate entries allowed in a fingerprint column.

Choose **Yes** if you want duplicate entries allowed in a fingerprint column.

- **Allow JOIN of columns with different names**

Choose **No** if you don't want to join fingerprint columns with different names.

Choose **Yes** if you want to join fingerprint columns with different names.

For more information about **Cryptographic computing parameters**, see [Cryptographic computing parameters](#).

For more information about how to encrypt your data for use in AWS Clean Rooms, see [Preparing encrypted data tables with Cryptographic Computing for Clean Rooms](#).

 Note

Verify these configurations carefully before completing the next step. After you create the collaboration, you can only edit the collaboration name, description, and whether the logs are stored in Amazon CloudWatch Logs.

- f. If you want to enable **Tags** for the collaboration resource, choose **Add new tag** and then enter the **Key** and **Value** pair.
 - g. Choose **Next**.
5. For **Step 2: Specify member abilities**, for **Analysis using queries and jobs**, under the **Supported analysis types** leave the **Queries** checkbox selected and take the recommended action, based on your goal.

Your goal	Recommended action
Query the data in the collaboration and receive the results	1. Choose yourself as the member who can Run queries. 2. Choose yourself as member who can Receive results from analyses from the dropdown list.
Query the data in the collaboration and assign a different member to receive results	1. Choose yourself as the member who can Run queries. 2. Select the member who can Receive results from analyses from the dropdown list.
Receive the results of the query in the collaboration and assign a different member to query the data	1. Select the member who can Run queries from the dropdown list. 2. Choose yourself as member who can Receive results from analyses from the dropdown list.
Create and manage the collaboration, assign a different member to query the data, and assign a different member to receive results	1. Select the member who can Run queries from the dropdown list. 2. Select the member who can Receive results from analyses from the dropdown list.

- a. If you are using Clean Rooms ML, for **ML modeling using purpose-built workflows**,

- i. (Optional) Select the member who can **Receive output from trained models** from the dropdown list.
 - ii. (Optional) Select the member who can **Receive output from model inference** from the dropdown list.
 - b. View the member abilities under **ID resolution using AWS Entity Resolution**.
 - c. Choose **Next**.
6. For **Step 3: Configure payment**, for **Analysis using queries**, take one of the following actions based on your goal.

Your goal	Recommended action
Assign the member who can Run queries to be the member who pays for the query compute costs	1. For Analysis using queries, choose the member who will Pay for queries to be the same as the member who can Run queries. 2. Choose Next.
Assign a different member to pay for the query compute costs	1. For Analysis using queries, choose yourself as the member who will Pay for queries. 2. Choose Next.

For **ML modeling using purpose-built workflows**, the **Creator of the configured lookalike model** is the member who will **Pay for lookalike modeling**.

For **ID resolution with AWS Entity Resolution**, the **Creator of the ID mapping table** is the member who will **Pay for ID mapping table**.

7. For **Step 4: Configure membership**, choose one of the following options:

Yes, join by creating membership now

1. For **Results settings defaults**, for **Query results settings**, if you are the member who can **Receive results**,
 - a. For the **Results destination in Amazon S3**, enter the Amazon S3 destination or choose **Browse S3** to select an S3 bucket.

- b. For the query **Result format**, choose either **CSV** or **PARQUET**.
- c. (Spark only) For the **Result files**, choose either **Multiple** or **Single**.
- d. (Optional) For **Service access**, if you want to deliver queries that take up to 24 hours to your S3 destination, select the **Add a service role to support queries that take up to 24 hours to complete** check box.

Large queries that take up to 24 hours to complete will be delivered to your S3 destination.

If you don't select the check box, only queries that complete within 12 hours will be delivered to your S3 location.

- e. Specify the **Service access** permissions by selecting either **Create and use a new service role** or **Use an existing service role**.

If you choose to ...	Then ...
Create and use a new service role	• AWS Clean Rooms creates a service role with the required policy for this table. • The default Service role name is <code>cleanrooms-result-receiver-<timestamp></code> • You must have permissions to create roles and attach policies.

If you choose to ...	Then ...
Use an existing service role	i. Choose an Existing service role name from the dropdown list. The list of roles are displayed if you have permissions to list roles. If you don't have permissions to list roles, you can enter the Amazon Resource Name (ARN) of the role that you want to use. ii. View the service role by choosing the View in IAM external link. If there are no existing service roles, the option to Use an existing service role is unavailable. By default, AWS Clean Rooms doesn't attempt to update the existing role policy to add necessary permissions.

 Note

- AWS Clean Rooms requires permissions to query according to the analysis rules. For more information about permissions for AWS Clean Rooms, see [AWS managed policies for AWS Clean Rooms](#).
- If the role doesn't have sufficient permissions for AWS Clean Rooms, you receive an error message stating that the role doesn't have sufficient permissions for AWS Clean Rooms. The role policy must be added before proceeding.
- If you can't modify the role policy, you receive an error message stating that AWS Clean Rooms couldn't find the policy for the service role.

2. For **Logs settings**, choose one of the following options for **Log storage in Amazon CloudWatch Logs**:

 Note

The **Logs settings** section appears if you chose to enable **Query logging**.

- a. Choose **Turn on** and the query logs relevant to you will be stored in your Amazon CloudWatch Logs account.

Each member can receive only logs for queries that they initiated or that contain their data.

The member who can receive results also receives logs for all queries run in a collaboration, even if their data isn't accessed in a query.

Under **Supported log types**, the **Query logs** checkbox is turned on by default.

 Note

After you turn on **Query logging**, it can take a few minutes for log storage to be set up and start receiving logs in Amazon CloudWatch Logs. During this brief period, the member who can query might run queries that don't actually send logs.

- b. Choose **Turn off** and the query logs relevant to you won't be stored in your Amazon CloudWatch Logs account.
3. If you want to enable **Tags** for the membership resource, choose **Add new tag** and then enter the **Key** and **Value** pair.
4. If you are the member who is paying for **Query compute**, indicate your acceptance by selecting the **I agree to pay for the compute costs in this collaboration** checkbox.

 Note

You must select this checkbox to proceed.

For more information about how pricing is calculated, see [Pricing for AWS Clean Rooms](#).

If you are the [member paying for query compute costs](#) but not the [member who can query](#), it is recommended that you use AWS Budgets to configure a budget for AWS Clean Rooms and receive notifications once the maximum budget has been reached. For more information about setting up a budget, see [Managing your costs with AWS Budgets](#) in the *AWS Cost Management User Guide*. For more information about setting up notifications, see [Creating an Amazon SNS topic for budget notifications](#) in the *AWS Cost Management User Guide*. If the maximum budget has been reached, you can contact the member who can run queries or [leave the collaboration](#). If you leave the collaboration, no more queries will be allowed to run, and therefore you will no longer be billed for query compute costs.

5. Choose **Next**.

Both the collaboration and your membership are created.

Your status in the collaboration is active.

No, I will create a membership later

1. Choose **Next**.

Only the collaboration is created.

Your status in the collaboration is inactive.

8. For **Step 5: Review and create**, do the following:

- a. Review the selections that you made for the previous steps and edit if necessary.
- b. Choose one of the options.

If you have chosen to ...	Then choose ...
Create a membership with the collaboration (Yes, join by creating membership now)	Create collaboration and membership
Create the collaboration, and not to create a membership at this time (No, I will create a membership later)	Create collaboration

After your collaboration has been created successfully, you can see the collaboration details page under **Collaborations**.

You are now ready to:

- [Prepare your data table to be analyzed in AWS Clean Rooms](#). (Optional if you want to analyze your own event data or if you want to query identity data.)
- [Associate the configured table to your collaboration](#). (Optional if you want to analyze your own event data.)
- [Add an analysis rule for the configured table](#). (Optional if you want to analyze your own event data.)
- [Create a membership and join a collaboration](#). (Optional if you've already created a membership.)
- [Invite members to join the collaboration](#).

Creating a collaboration for queries and jobs

In this procedure, you as the [collaboration creator](#) perform the following tasks:

- [Create a collaboration](#).
- Invite one or more [members](#) to the [collaboration](#).
- Assign abilities to members, such as the [member who can run queries and jobs](#) and the [member who can receive results](#).

If the collaboration creator is also the member who can receive results, they specify the results destination and format. They also provide a service role Amazon Resource Name (ARN) to write the results to the results destination.

- Configure which [member is responsible for paying for query and job compute costs in the collaboration](#).

Before you begin, make sure that you have completed the following prerequisites:

- You have the name and AWS account ID for each member that you want to invite to the collaboration.
- You have permission to share the name and AWS account ID for each member with all members of the collaboration.

Note

You can't add more members after you create the collaboration.

For information about how to create a collaboration using the AWS SDKs, see the [AWS Clean Rooms API Reference](#).

To create a collaboration for queries and jobs

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with the AWS account that will function as the collaboration creator.
2. In the left navigation pane, choose **Collaborations**.
3. In the upper right corner, choose **Create collaboration**.
4. For **Step 1: Define collaboration**, do the following:
 - a. For **Details**, enter the **Name** and **Description** of the collaboration.

This information will be visible to collaboration members who are invited to participate in the collaboration. The **Name** and **Description** helps them understand what the collaboration is in reference to.

- b. For **Analytics engine**, choose **Spark**.

Note

AWS Clean Rooms will end support for the legacy Clean Rooms SQL analytics engine on December 17th, 2025. Before July 16, 2025, you must request a limit increase via AWS Customer Support to create any new Clean Rooms SQL engine-based collaborations. Starting July 17, 2025, the creation of new Clean Rooms SQL engine-based collaborations will no longer be available.

If you want to update your collaboration from the AWS Clean Rooms SQL analytics engine to the Spark analytics engine, you can [edit an existing collaboration](#) or re-create the collaboration and select the Spark analytics engine.

- c. For **Members**:

- i. For **Member 1: You**, enter your **Member display name** as you want it to appear for the collaboration.

 Note

Your AWS account ID is included automatically for **Member AWS account ID**.

- ii. For **Member 2**, enter the **Member display name** and **Member AWS account ID** for the member that you want to invite to the collaboration.

The **Member display name** and **Member AWS account ID** will be visible to everyone invited to the collaboration. After you enter and save the values for these fields, you can't edit them.

 Note

You must inform the collaboration member that their **Member AWS account ID** and **Member display name** will be visible to all invited and active collaborators in the collaboration.

- iii. If you want to add another member, choose **Add another member**. Then enter the **Member display name** and **Member AWS account ID** for each member who can contribute data that you want to invite to the collaboration.
- d. If you want to enable **Analysis logging**, select the **Enable analysis logging** checkbox, and then choose the **Supported log types**.
 - If you want to receive logs generated from SQL queries, choose the **Logs from queries** checkbox.
 - If you want to receive logs generated from jobs using PySpark, choose the **Logs from jobs** checkbox.
- e. (Optional) If you want to enable the **Cryptographic computing** capability, select the **Enable cryptographic computing** checkbox.
 - i. Choose the following **Cryptographic coverage parameters**:
 - **Allow plaintext columns**

Choose **No** if you require fully encrypted tables.

Choose **Yes** if you want cleartext columns allowed in the encrypted table.

To run SUM or AVG on certain columns, the columns must be in cleartext.

- **Preserve NULL values**

Choose **No** if you don't want to preserve NULL values. NULL values won't appear as NULL in an encrypted table.

Choose **Yes** if you want to preserve NULL values. NULL values will appear as NULL in an encrypted table.

ii. Choose the following **Fingerprinting parameters**:

- **Allow duplicates**

Choose **No** if you don't want duplicate entries allowed in a fingerprint column.

Choose **Yes** if you want duplicate entries allowed in a fingerprint column.

- **Allow JOIN of columns with different names**

Choose **No** if you don't want to join fingerprint columns with different names.

Choose **Yes** if you want to join fingerprint columns with different names.

For more information about **Cryptographic computing parameters**, see [Cryptographic computing parameters](#).

For more information about how to encrypt your data for use in AWS Clean Rooms, see [Preparing encrypted data tables with Cryptographic Computing for Clean Rooms](#).

 Note

Verify these configurations carefully before completing the next step. After you create the collaboration, you can only edit the collaboration name, description, and whether the logs are stored in Amazon CloudWatch Logs.

- f. If you want to enable **Tags** for the collaboration resource, choose **Add new tag** and then enter the **Key** and **Value** pair.
- g. Choose **Next**.

5. For **Step 2: Specify member abilities**, do the following:

- a. For **Analysis using queries and jobs**, under **Supported analysis types**, choose the **Jobs** checkbox.

The **Queries** checkbox is selected by default.

- i. Select the member who can **Run queries and jobs** from the dropdown list.
- ii. Select the member who can **Receive results from analyses** from the dropdown list.

 Note

The member who creates the PySpark analysis template must also be the member who receives results.

- b. If you are using Clean Rooms ML, for **ML modeling using purpose-built workflows**,
 - i. (Optional) Select the member who can **Receive output from trained models** from the dropdown list.
 - ii. (Optional) Select the member who can **Receive output from model inference** from the dropdown list.
- c. View the member abilities under **ID resolution using AWS Entity Resolution**.
- d. Choose **Next**.

6. For **Step 3: Configure payment**,

- a. For **Analysis using queries and jobs**, choose the member who will **Pay for queries and jobs**.

You can assign the member who can **Run queries and jobs** to be the member who pays for the queries and jobs compute costs.

You can assign a different member to pay for the queries and jobs compute costs.

- b. For **ML modeling using purpose-built workflows**, the **Creator of the configured lookalike model** is the member who will **Pay for lookalike modeling**.
- c. For **ID resolution with AWS Entity Resolution**, the **Creator of the ID mapping table** is the member who will **Pay for ID mapping table**.
- d. Choose **Next**.

7. For **Step 4: Configure membership**, choose one of the following options:

Yes, join by creating membership now

1. For **Results settings defaults**, for **Query results settings**, if you are the member who can **Receive results**,
 - a. Choose the **Set default settings for queries** checkbox. For the **Results destination in Amazon S3**, enter the Amazon S3 destination or choose **Browse S3** to select an S3 bucket.
 - b. For the query **Result format**, choose either **CSV** or **PARQUET**.
 - c. (Spark only) For the **Result files**, choose either **Multiple** or **Single**.
 - d. (Optional) For **Service access**, if you want to deliver queries that take up to 24 hours to your S3 destination, select the **Add a service role to support queries that take up to 24 hours to complete** checkbox.

Large queries that take up to 24 hours to complete will be delivered to your S3 destination.

If you don't select the check box, only queries that complete within 12 hours will be delivered to your S3 location.

- e. Specify the **Service access** permissions by selecting either **Create and use a new service role** or **Use an existing service role**.

If you choose to ...	Then ...
Create and use a new service role	• AWS Clean Rooms creates a service role with the required policy for this table. • The default Service role name is <code>cleanrooms-result-receiver-<timestamp></code> • You must have permissions to create roles and attach policies.

If you choose to ...	Then ...
Use an existing service role	i. Choose an Existing service role name from the dropdown list. The list of roles are displayed if you have permissions to list roles. If you don't have permissions to list roles, you can enter the Amazon Resource Name (ARN) of the role that you want to use. ii. View the service role by choosing the View in IAM external link. If there are no existing service roles, the option to Use an existing service role is unavailable. By default, AWS Clean Rooms doesn't attempt to update the existing role policy to add necessary permissions.

Note

- AWS Clean Rooms requires permissions to query according to the analysis rules. For more information about permissions for AWS Clean Rooms, see [AWS managed policies for AWS Clean Rooms](#).
- If the role doesn't have sufficient permissions for AWS Clean Rooms, you receive an error message stating that the role doesn't have sufficient permissions for AWS Clean Rooms. The role policy must be added before proceeding.
- If you can't modify the role policy, you receive an error message stating that AWS Clean Rooms couldn't find the policy for the service role.

2. For **Job results**,

Example

For example: **s3://bucket/prefix**

- a. Choose the **Set default settings for jobs** checkbox, and then specify the **Results destination in Amazon S3** by entering the S3 destination or choose **Browse S3** to select from a list of available S3 buckets.
 - b. Specify the **Service access** permissions by choosing an **Existing service role name** from the dropdown list.
3. For **Logs settings**, choose one of the following options for **Log storage in Amazon CloudWatch Logs**:

Note

The **Logs settings** section appears if you chose to enable **Query logging**.

- a. Choose **Turn on** and the query logs relevant to you will be stored in your Amazon CloudWatch Logs account.

Each member can receive only logs for queries that they initiated or that contain their data.

The member who can receive results also receives logs for all queries run in a collaboration, even if their data isn't accessed in a query.

Under **Supported log types**, choose from the log types the collaboration creator has chosen to support:

Under **Supported log types**, the **Query logs** and **Job logs** checkboxes are turned on by default.

Note

After you turn on **Analysis logging**, it can take a few minutes for log storage to be set up and start receiving logs in Amazon CloudWatch Logs. During this

brief period, the member who can query might run queries that don't actually send logs.

- b. Choose **Turn off** and the query logs relevant to you won't be stored in your Amazon CloudWatch Logs account.
4. If you want to enable **Membership tags** for the membership resource, choose **Add new tag** and then enter the **Key** and **Value** pair.
5. If you are the member who is paying for **Query compute**, or **Job compute**, or both, indicate your acceptance by selecting the **I agree to pay for the compute costs in this collaboration** checkbox.

 Note

You must select this checkbox to proceed.

For more information about how pricing is calculated, see [Pricing for AWS Clean Rooms](#).

If you are the [member paying for query compute costs](#) but not the [member who can query](#), it is recommended that you use AWS Budgets to configure a budget for AWS Clean Rooms and receive notifications once the maximum budget has been reached. For more information about setting up a budget, see [Managing your costs with AWS Budgets](#) in the *AWS Cost Management User Guide*. For more information about setting up notifications, see [Creating an Amazon SNS topic for budget notifications](#) in the *AWS Cost Management User Guide*. If the maximum budget has been reached, you can contact the member who can run queries or [leave the collaboration](#). If you leave the collaboration, no more queries will be allowed to run, and therefore you will no longer be billed for query compute costs.

6. Choose **Next**.

Both the collaboration and your membership are created.

Your status in the collaboration is active.

No, I will create a membership later

1. Choose **Next**.

Only the collaboration is created.

Your status in the collaboration is inactive.

8. For **Step 5: Review and create**, do the following:

- a. Review the selections that you made for the previous steps and edit if necessary.
- b. Choose one of the options.

If you have chosen to ...	Then choose ...
Create a membership with the collaboration (Yes, join by creating membership now)	Create collaboration and membership
Create the collaboration, and not to create a membership at this time (No, I will create a membership later)	Create collaboration

After your collaboration has been created successfully, you can see the collaboration details page under **Collaborations**.

You are now ready to:

- [Prepare your data table to be analyzed in AWS Clean Rooms](#). (Optional if you want to analyze your own event data or if you want to query identity data.)
- [Associate the configured table to your collaboration](#). (Optional if you want to analyze your own event data.)
- [Add an analysis rule for the configured table](#). (Optional if you want to analyze your own event data.)
- [Create a membership and join a collaboration](#). (Optional if you've already created a membership.)
- [Invite members to join the collaboration](#).

Creating a collaboration for ML modeling

In this procedure, you as the [collaboration creator](#) perform the following tasks:

- [Create a collaboration](#).
- Invite one or more [members](#) to the [collaboration](#).
- Assign abilities to members, such as the
 - [Member who can query](#)
 - [Member who can receive results](#)
 - Member who can receive output from trained models
 - Member who can output from model inference

If the collaboration creator is also the member who can receive results, they specify the results destination and format. They also provide a service role Amazon Resource Name (ARN) to write the results to the results destination.

- Configure which [member is responsible for paying for compute costs, model training, and model inference costs in the collaboration](#).

Before you begin, make sure that you have completed the following prerequisites:

- You have the name and AWS account ID for each member that you want to invite to the collaboration.
- You have permission to share the name and AWS account ID for each member with all members of the collaboration.

 Note

You can't add more members after you create the collaboration.

For information about how to create a collaboration using the AWS SDKs, see the [AWS Clean Rooms API Reference](#).

To create a collaboration for ML modeling

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with the AWS account that will function as the collaboration creator.
2. In the left navigation pane, choose **Collaborations**.
3. In the upper right corner, choose **Create collaboration**.
4. For **Step 1: Define collaboration**, do the following:

- a. For **Details**, enter the **Name** and **Description** of the collaboration.

This information will be visible to collaboration members who are invited to participate in the collaboration. The **Name** and **Description** helps them understand what the collaboration is in reference to.

- b. For **Analytics engine**, choose **Spark**.

- c. For **Members**:

- i. For **Member 1: You**, enter your **Member display name** as you want it to appear for the collaboration.

 Note

Your AWS account ID is included automatically for **Member AWS account ID**.

- ii. For **Member 2**, enter the **Member display name** and **Member AWS account ID** for the member that you want to invite to the collaboration.

The **Member display name** and **Member AWS account ID** will be visible to everyone invited to the collaboration. After you enter and save the values for these fields, you can't edit them.

 Note

You must inform the collaboration member that their **Member AWS account ID** and **Member display name** will be visible to all invited and active collaborators in the collaboration.

- iii. If you want to add another member, choose **Add another member**. Then enter the **Member display name** and **Member AWS account ID** for each member who can contribute data that you want to invite to the collaboration.
- d. If you want to enable **Analysis logging**, select the **Enable analysis logging** checkbox, and then under **Supported log types**, choose **Logs from queries**.
- e. (Optional) If you want to enable the **Cryptographic computing** capability, select the **Enable cryptographic computing** checkbox.
 - i. Choose the following **Cryptographic coverage parameters**:

- **Allow plaintext columns**

Choose **No** if you require fully encrypted tables.

Choose **Yes** if you want cleartext columns allowed in the encrypted table.

To run SUM or AVG on certain columns, the columns must be in cleartext.

- **Preserve NULL values**

Choose **No** if you don't want to preserve NULL values. NULL values won't appear as NULL in an encrypted table.

Choose **Yes** if you want to preserve NULL values. NULL values will appear as NULL in an encrypted table.

ii. Choose the following **Fingerprinting parameters**:

- **Allow duplicates**

Choose **No** if you don't want duplicate entries allowed in a fingerprint column.

Choose **Yes** if you want duplicate entries allowed in a fingerprint column.

- **Allow JOIN of columns with different names**

Choose **No** if you don't want to join fingerprint columns with different names.

Choose **Yes** if you want to join fingerprint columns with different names.

For more information about **Cryptographic computing parameters**, see [Cryptographic computing parameters](#).

For more information about how to encrypt your data for use in AWS Clean Rooms, see [Preparing encrypted data tables with Cryptographic Computing for Clean Rooms](#).

 Note

Verify these configurations carefully before completing the next step. After you create the collaboration, you can only edit the collaboration name, description, and whether the logs are stored in Amazon CloudWatch Logs.

- f. If you want to enable **Tags** for the collaboration resource, choose **Add new tag** and then enter the **Key** and **Value** pair.
- g. Choose **Next**.
5. For **Step 2: Specify member abilities**,
 - a. For **Analysis using queries and jobs**, under the **Supported analysis types**, leave the **Queries** checkbox selected.
 - b. For **Run queries**, choose the member who will initiate the model training
 - c. For **Receive results from analyses**, choose one or more members who will receive the query results.
 - d. For **ML modeling using purpose-built workflows**,
 - i. For **Receive output from trained models**, choose the member who will receive trained model results, including model artifacts and metrics.
 - ii. For **Receive output from model inference**, choose the member who will receive the model inference results.
 - e. View the member abilities under **ID resolution using AWS Entity Resolution**.
6. For **Step 3: Configure payment**, for **Analysis using queries**, take one of the following actions based on your goal.

Your goal	Recommended action
Assign the member who can Run queries to be the member who pays for the query compute costs	1. Choose the member who will Pay for queries to be the same as the member who can Run queries. 2. Choose Next.
Assign a different member to pay for the query compute costs	1. Choose yourself as the member who will Pay for queries. 2. Choose Next.

For **ML modeling using purpose-built workflows**, the **Creator of the configured lookalike model** is the member who will **Pay for lookalike modeling**.

For **ID resolution with AWS Entity Resolution**, the **Creator of the ID mapping table** is the member who will **Pay for ID mapping table**.

7. For **Step 4: Configure membership**, choose one of the following options:

Yes, join by creating membership now

1. For **Results settings defaults**, for **Query results settings**, if you are the member who can **Receive results**,
 - a. For the **Results destination in Amazon S3**, enter the Amazon S3 destination or choose **Browse S3** to select an S3 bucket.
 - b. For the query **Result format**, choose either **CSV** or **PARQUET**.
 - c. (Spark only) For the **Result files**, choose either **Multiple** or **Single**.
 - d. (Optional) For **Service access**, if you want to deliver queries that take up to 24 hours to your S3 destination, select the **Add a service role to support queries that take up to 24 hours to complete** checkbox.

Large queries that take up to 24 hours to complete will be delivered to your S3 destination.

If you don't select the check box, only queries that complete within 12 hours will be delivered to your S3 location.

- e. Specify the **Service access** permissions by selecting either **Create and use a new service role** or **Use an existing service role**.

If you choose to ...	Then ...
Create and use a new service role	• AWS Clean Rooms creates a service role with the required policy for this table. • The default Service role name is <code>cleanrooms-result-receiver-<timestamp></code> • You must have permissions to create roles and attach policies.

If you choose to ...	Then ...
Use an existing service role	i. Choose an Existing service role name from the dropdown list. The list of roles are displayed if you have permissions to list roles. If you don't have permissions to list roles, you can enter the Amazon Resource Name (ARN) of the role that you want to use. ii. View the service role by choosing the View in IAM external link. If there are no existing service roles, the option to Use an existing service role is unavailable. By default, AWS Clean Rooms doesn't attempt to update the existing role policy to add necessary permissions.

 Note

- AWS Clean Rooms requires permissions to query according to the analysis rules. For more information about permissions for AWS Clean Rooms, see [AWS managed policies for AWS Clean Rooms](#).
- If the role doesn't have sufficient permissions for AWS Clean Rooms, you receive an error message stating that the role doesn't have sufficient permissions for AWS Clean Rooms. The role policy must be added before proceeding.
- If you can't modify the role policy, you receive an error message stating that AWS Clean Rooms couldn't find the policy for the service role.

2. For **Job results**,

Example

For example: **s3://bucket/prefix**

- a. Choose the **Set default settings for jobs** checkbox, and then specify the **Results destination in Amazon S3** by entering the S3 destination or choose **Browse S3** to select from a list of available S3 buckets.
 - b. Specify the **Service access** permissions by choosing an **Existing service role name** from the dropdown list.
3. For **Logs settings**, choose one of the following options for **Log storage in Amazon CloudWatch Logs**:

Note

The **Logs settings** section appears if you chose to enable **Query logging**.

- a. Choose **Turn on** and the query logs relevant to you will be stored in your Amazon CloudWatch Logs account.

Each member can receive only logs for queries that they initiated or that contain their data.

The member who can receive results also receives logs for all queries run in a collaboration, even if their data isn't accessed in a query.

Under **Supported log types**, choose from the log types the collaboration creator has chosen to support:

Under **Supported log types**, the **Query logs** checkbox is turned on by default.

Note

After you turn on **Analysis logging**, it can take a few minutes for log storage to be set up and start receiving logs in Amazon CloudWatch Logs. During this brief period, the member who can query might run queries that don't actually send logs.

- b. Choose **Turn off** and the query logs relevant to you won't be stored in your Amazon CloudWatch Logs account.
4. If you want to enable **Tags** for the membership resource, choose **Add new tag** and then enter the **Key** and **Value** pair.
5. If you are the member who is paying for **Query compute**, indicate your acceptance by selecting the **I agree to pay for the compute costs in this collaboration** checkbox.

 Note

You must select this checkbox to proceed.

For more information about how pricing is calculated, see [Pricing for AWS Clean Rooms](#).

If you are the [member paying for query compute costs](#) but not the [member who can query](#), it is recommended that you use AWS Budgets to configure a budget for AWS Clean Rooms and receive notifications once the maximum budget has been reached. For more information about setting up a budget, see [Managing your costs with AWS Budgets](#) in the *AWS Cost Management User Guide*. For more information about setting up notifications, see [Creating an Amazon SNS topic for budget notifications](#) in the *AWS Cost Management User Guide*. If the maximum budget has been reached, you can contact the member who can run queries or [leave the collaboration](#). If you leave the collaboration, no more queries will be allowed to run, and therefore you will no longer be billed for query compute costs.

6. Choose **Next**.

Both the collaboration and your membership are created.

Your status in the collaboration is active.

No, I will create a membership later

1. Choose **Next**.

Only the collaboration is created.

Your status in the collaboration is inactive.

8. For **Step 5: Review and create**, do the following:

- a. Review the selections that you made for the previous steps and edit if necessary.
- b. Choose one of the options.

If you have chosen to ...	Then choose ...
Create a membership with the collaboration (Yes, join by creating membership now)	Create collaboration and membership
Create the collaboration, and not to create a membership at this time (No, I will create a membership later)	Create collaboration

Creating a membership and joining a collaboration

A *membership* is a resource that's created when a member joins a collaboration in AWS Clean Rooms.

You can join a collaboration as a

- [member who can query](#)
- [member who can run queries and jobs](#)
- [member who can receive results](#) of a query or a job
- [member paying for query compute costs](#)
- [member paying for queries and jobs](#)

All members can contribute data.

For information about how to create a membership and join a collaboration using the AWS SDKs, see the [AWS Clean Rooms API Reference](#).

In this procedure, the invited member [joins the collaboration by creating a membership resource](#).

If the invited member is the member who can receive results, they specify the results destination and format. They also provide a service role ARN to write to the results destination.

If the invited member is the member who is responsible to pay for compute costs, they accept their payment responsibilities before joining the collaboration.

To create a membership and join a collaboration

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your member AWS account.
2. In the left navigation pane, choose **Collaborations**.
3. On the **Available to join** tab, for **Collaborations available to join**, choose the **Name** of the collaboration.
4. On the collaboration details page, in the **Overview** section, view the collaboration details, including **Your member details** and a list of the other members.

Verify that the AWS account IDs for each member of the collaboration are the ones with whom you intend to enter in to the collaboration.

5. Choose **Create membership**.
6. On the **Create membership** page, in the **Overview**, view the **Collaboration name**, **Collaboration description**, AWS account ID of the **Collaboration creator**, **Your member details**, and the AWS account ID of the member who will **Pay for queries**.
7. If the collaboration creator has chosen to enable **Analysis logging**, choose one of the following options for **Log storage in Amazon CloudWatch Logs**:

If you choose...	Then ...
Turn on	The logs relevant to you are stored in Amazon CloudWatch Logs. Each member can receive only logs for queries that they initiated or that contain their data. The member who can receive results also receives logs for all analyses run in a collaboration, even if their data isn't accessed in an analysis.

If you choose...	Then ...
	Under Supported log types, choose from the log types the collaboration creator has chosen to support: 1. If you want to receive logs generated from SQL queries, choose the Logs from queries checkbox. 2. If you want to receive logs generated from jobs using PySpark, choose the Logs from jobs checkbox.
Turn off	The query logs relevant to you aren't stored in your Amazon CloudWatch Logs account.

 Note

After you turn on **Analysis logging**, it can take a few minutes for log storage to be set up and start receiving logs in Amazon CloudWatch Logs. During this brief period, the member who can query might run queries that don't actually send logs.

8. If **Your member abilities** includes **Receive results**, for **Results settings defaults**:
 - a. For **Query results**, choose the **Set default settings for queries** checkbox, and then specify the **Results destination in Amazon S3** by entering the S3 destination or choose **Browse S3** to select from a list of available S3 buckets.

Example

For example: **s3://bucket/prefix**

- i. For the **Result format**, choose either **CSV** or **PARQUET**.
- ii. (Spark only) For the **Result files**, choose either **Multiple** or **Single**.
- iii. (Optional) For **Service access**, if you want to deliver queries that take up to 24 hours to your S3 destination, select the **Add a service role to support queries that take up to 24 hours to complete** check box.

Large queries that take up to 24 hours to complete will be delivered to your S3 destination.

If you don't select the check box, only queries that complete within 12 hours will be delivered to your S3 location.

 Note

You must either select an existing service role or have permissions to create a new one. For more information, see [Create a service role to receive results](#).

- iv. Specify the **Service access** permissions by selecting either **Create and use a new service role** or **Use an existing service role**.

Create and use a new service role

- AWS Clean Rooms creates a service role with the required policy for this table.
- The default **Service role name** is `cleanrooms-result-receiver-
<timestamp>`
- You must have permissions to create roles and attach policies.

Use an existing service role

1. Choose an **Existing service role name** from the dropdown list.

The list of roles are displayed if you have permissions to list roles.

If you don't have permissions to list roles, you can enter the Amazon Resource Name (ARN) of the role that you want to use.

2. View the service role by choosing the **View in IAM** external link.

If there are no existing service roles, the option to **Use an existing service role** is unavailable.

By default, AWS Clean Rooms doesn't attempt to update the existing role policy to add necessary permissions.

Note

- AWS Clean Rooms requires permissions to query according to the analysis rules. For more information about permissions for AWS Clean Rooms, see [AWS managed policies for AWS Clean Rooms](#).
- If the role doesn't have sufficient permissions for AWS Clean Rooms, you receive an error message stating that the role doesn't have sufficient permissions for AWS Clean Rooms. The role policy must be added before proceeding.
- If you can't modify the role policy, you receive an error message stating that AWS Clean Rooms couldn't find the policy for the service role.

- b. For **Job results**, choose the **Set default settings for jobs** checkbox, and then specify the **Results destination in Amazon S3** by entering the S3 destination or choose **Browse S3** to select from a list of available S3 buckets.

Example

For example: **s3://bucket/prefix**

- Specify the **Service access** permissions by choosing an **Existing service role name** from the dropdown list.
9. If you want to enable **Tags** for the membership resource, choose **Add new tag** and then enter the **Key** and **Value** pair.
 10. If the collaboration creator has designated you as the member who will **Pay for queries** or **Pay for queries and jobs**, indicate your acceptance by selecting the **I agree to pay for the compute costs in this collaboration** checkbox.

Note

You must select this checkbox to proceed.

For more information about how pricing is calculated, see [Pricing for AWS Clean Rooms](#).

If you are the [member paying for query compute costs](#) or the [member paying for queries and job compute costs](#) but not the [member who can query](#), it is recommended that you use AWS Budgets to configure a budget for AWS Clean Rooms and receive notifications once the maximum budget has been reached. For more information about setting up a budget, see [Managing your costs with AWS Budgets](#) in the *AWS Cost Management User Guide*. For more information about setting up notifications, see [Creating an Amazon SNS topic for budget notifications](#) in the *AWS Cost Management User Guide*. If the maximum budget has been reached, you can contact the member who can run queries and jobs or [leave the collaboration](#). If you leave the collaboration, no more queries will be allowed to run, and therefore you will no longer be billed for query compute costs.

11. If you are sure that you want to create a membership and join the collaboration, choose **Create membership**.

You are given read access to the collaboration metadata. This includes information such as the display name and description of the collaboration, in addition to all the names and AWS account IDs of other members.

You are now ready to:

- [Prepare your data table to be queried in AWS Clean Rooms](#). (Optional if you want to query your own event data or if you want to query identity data.)
- [Associate the configured table to your collaboration](#) – if you want to query event data.
- [Add an analysis rule for the configured table](#) – if you want to query event data.
- [Create and associate a new ID namespace](#) – if you want to create an ID mapping table to query identity data.

For information about how to leave a collaboration, see [Leaving a collaboration](#).

Editing collaborations

As a collaboration creator, you can edit the different parts of a collaboration.

For information about how to edit a collaboration using the AWS SDKs, see the [AWS Clean Rooms API Reference](#).

Topics

- [Edit collaboration name and description](#)
- [Update collaboration analytics engine](#)
- [Turn off log storage](#)
- [Edit collaboration logs settings](#)
- [Edit collaboration tags](#)
- [Edit membership tags](#)
- [Edit associated table tags](#)
- [Edit analysis template tags](#)
- [Edit differential privacy policy tags](#)

Edit collaboration name and description

After you create the collaboration, you can only edit the collaboration name and description.

To edit the collaboration name and description

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you haven't yet done so).
2. In the left navigation pane, choose **Collaborations**.
3. Choose the collaboration that you created.
4. On the collaboration detail page, choose **Actions**, and then choose **Edit collaboration**.
5. On the **Edit collaboration** page, for **Details**, edit the **Name** and **Description** of the collaboration.
6. Choose **Save changes**.

Update collaboration analytics engine

After you create the collaboration, you can change the analytics engine from AWS Clean Rooms SQL to Spark.

Note

Changing the analytics engine from AWS Clean Rooms SQL to Spark might break existing workflows.

To update the collaboration analytics engine

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you haven't yet done so).
2. In the left navigation pane, choose **Collaborations**.
3. Choose the collaboration that you created.
4. On the collaboration detail page, choose **Actions**, and then choose **Edit collaboration**.
5. On the **Edit collaboration** page, for **Analytics engine**,
 - If **AWS Clean Rooms SQL** is selected, choose **Spark**.
 - If **Spark** is selected, choose **Submit a support ticket** to submit a support ticket to change the analytics engine to AWS Clean Rooms SQL.

Note

AWS Clean Rooms will end support for the legacy Clean Rooms SQL analytics engine on December 17th, 2025. Before July 16, 2025, you must request a limit increase via AWS Customer Support to create any new Clean Rooms SQL engine-based collaborations. After July 16, 2025, the creation of new Clean Rooms SQL engine-based collaborations will no longer be available.

6. Choose **Save changes**.

Turn off log storage

If you have enabled **Analysis logging**, you can edit whether the analysis logs are stored in your Amazon CloudWatch Logs account.

To turn off log storage

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you haven't yet done so).
2. In the left navigation pane, choose **Collaborations**.
3. Choose the collaboration that has analysis logging turned on.
4. On the collaboration detail page, choose **Actions**, and then choose **Turn off log storage**.

Note

A warning appears, indicating the following:

- New queries will no longer be logged to your CloudWatch account.
- Existing logs will be preserved according to your current retention settings.
- If you reactivate logging in the future, it will only apply to queries made after reactivation.
- This change affects only your logs - other team members' logging settings remain unchanged.

5. Choose **Turn off**.

Edit collaboration logs settings

If you have enabled **Query logging**, you can edit whether the query logs are stored in your Amazon CloudWatch Logs account.

To edit collaboration logs settings

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you haven't yet done so).
2. In the left navigation pane, choose **Collaborations**.
3. Choose the collaboration that you created.
4. On the collaboration detail page, do one of the following:
 - Choose **Actions**, and then choose **Edit logs settings**.
 - On the **Logs** tab, choose **Edit logs settings**.

5. On the **Edit logs settings modal**, for **Log storage in Amazon CloudWatch Logs**:

- If you don't want logs relevant to you to be stored in your Amazon CloudWatch Logs account, choose **Turn off**.
- If you do want logs relevant to you to be stored in your Amazon CloudWatch Logs account, choose **Turn on**.

You can only receive logs for queries that you initiated or that contain your data.

The member who can receive results also receives logs for all queries run in a collaboration, even if their data isn't accessed in a query.

1. Under **Supported log types**, choose from the log types the collaboration creator has chosen to support:

- If you want to receive logs generated from SQL queries, choose the **Logs from queries** checkbox.
- If you want to receive logs generated from jobs using PySpark, choose the **Logs from jobs** checkbox.

6. Choose **Save changes**.

Note

After you turn on logging, it can take a few minutes for log storage to be set up and start receiving logs in Amazon CloudWatch Logs. During this brief period, the member who can query might run queries that don't actually send logs.

Edit collaboration tags

As a collaboration creator, after you have created a collaboration, you can manage the tags on the collaboration resource.

To edit the collaboration tags

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you haven't yet done so).
2. In the left navigation pane, choose **Collaborations**.
3. Choose the collaboration that you created.

4. Choose one of the following:

If you are...	Then ...
The collaboration creator and a member of the collaboration	Choose the Details tab.
The collaboration creator but not a member of the collaboration	Scroll down the page to the Tags section.

5. For **Collaboration details**, choose **Manage tags**.

6. On the **Manage tags** page, you can do the following:

- To remove a tag, choose **Remove**.
- To add a tag, choose **Add new tag**.
- To save your changes, choose **Save changes**

Edit membership tags

As a collaboration creator, after you have created a collaboration, you can manage the tags on the membership resource.

To edit the membership tags

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you haven't yet done so).
2. In the left navigation pane, choose **Collaborations**.
3. Choose the collaboration that you created.
4. Choose the **Details** tab.
5. For **Membership details**, choose **Manage tags**.
6. On the **Manage membership tags** page, you can do the following:
 - To remove a tag, choose **Remove**.
 - To add a tag, choose **Add new tag**.
 - To save your changes, choose **Save changes**.

Edit associated table tags

As a collaboration creator, after you associate tables to a collaboration, you can manage the tags on the associated table resource.

To edit the associated table tags

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you haven't yet done so).
2. In the left navigation pane, choose **Collaborations**.
3. Choose the collaboration that you created.
4. Choose the **Tables** tab.
5. For **Tables associated by you**, choose a table.
6. On the configured table detail page, for **Tags**, choose **Manage tags**.

On the **Manage tags** page, you can do the following:

- To remove a tag, choose **Remove**.
- To add a tag, choose **Add new tag**.
- To save your changes, choose **Save changes**.

Edit analysis template tags

As a collaboration creator, after you have created a collaboration, you can manage the tags on the analysis template resource.

To edit the membership tags

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you haven't yet done so).
2. In the left navigation pane, choose **Collaborations**.
3. Choose the collaboration that you created.
4. Choose the **Templates** tab.
5. On the **Analysis templates created by you** section, choose the analysis template.
6. On the analysis template table detail page, scroll down to the **Tags** section.

7. Choose **Manage tags**.
8. On the **Manage tags** page, you can do the following:
 - To remove a tag, choose **Remove**.
 - To add a tag, choose **Add new tag**.
 - To save your changes, choose **Save changes**.

Edit differential privacy policy tags

As a collaboration creator, after you have created a collaboration, you can manage the tags on the analysis template resource.

To edit the membership tags

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you haven't yet done so).
2. In the left navigation pane, choose **Collaborations**.
3. Choose the collaboration that contains the differential privacy policy you want to edit.
4. Choose the **Tables** tab.
5. On the **Tables** tab, choose the **Manage tags**.
6. On the **Manage tags** page, you can do the following:
 - To remove a tag, choose **Remove**.
 - To add a tag, choose **Add new tag**.
 - To save your changes, choose **Save changes**.

Deleting collaborations

As a collaboration creator, you can delete a collaboration that you created.

Note

When you delete a collaboration, you and all members can't run queries, receive results, or contribute data. Each collaboration member continues to have access to their own data as part of their membership.

To delete a collaboration

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you haven't yet done so).
2. In the left navigation pane, choose **Collaborations**.
3. Choose the collaboration that you want to delete.
4. Under **Actions**, choose **Delete collaboration**.
5. Confirm the deletion and then choose **Delete**.

Viewing collaborations

As a collaboration creator, you can view all of the collaborations that you created.

To view collaborations

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you have not yet done so).
2. In the left navigation pane, choose **Collaborations**.
3. On the **Collaborations** page, under **Last used**, view the last 5 collaborations used.
4. On the **With active membership** tab, view the list of **Collaborations with active membership**.

You can sort by **Name**, the **Membership created date**, and **Your member details**.

You can use the **Search** bar to search for a collaboration.

5. On the **Available to join** tab, view the list of **Collaborations available to join**.
6. On the **No longer available** tab, view the list of deleted collaborations and **Memberships for collaborations that are no longer available** (removed memberships).

Inviting members to a collaboration

As a collaboration creator, after you have created a collaboration, you can send an invitation link to the members listed on the **Members** tab.

To invite members to a collaboration

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you haven't yet done so).
2. In the left navigation pane, choose **Collaborations**.
3. Choose the collaboration that you created.
4. Choose the **Members** tab.
5. In the **Members** table, choose the **Copy invitation link** button.

The invitation link is copied.

6. Paste the invitation link in the secure communication method of your choice and send it to each member of the collaboration.

Monitoring members

As a collaboration creator, after you have created a collaboration, you can monitor the status of all members on the **Members** tab.

To check the status of a member

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you haven't yet done so).
2. In the left navigation pane, choose **Collaborations**.
3. Choose the collaboration that you created.
4. Choose the **Members** tab.
5. In the **Members** table, review the **Status** of each member.
6. In the **Member abilities** table, review which members can query, receive results, contribute data, and perform other tasks.
7. In the **Payment configuration** table, review which members are paying for queries, ID mapping tables, and ML modeling.

Removing a member from a collaboration

Note

Removing a member also removes all of their associated datasets from the collaboration.

To remove a member from a collaboration

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you have not yet done so).
2. In the left navigation pane, choose **Collaborations**.
3. Choose the collaboration that you created.
4. Choose the **Members** tab.
5. Select the option button next to the member to be removed.

Note

A collaboration creator can't choose their own account ID.

6. Choose **Remove**.
7. In the dialog box, confirm the decision to remove the member by typing **confirm** in the text input field.

Note

If you remove the [member paying for query compute costs](#), no more queries are allowed to run in the collaboration.

Leaving a collaboration

As a collaboration member, you can leave a collaboration by deleting your membership. If you are the collaboration creator, you can only leave a collaboration by [deleting the collaboration](#).

 Note

When you delete your membership, you leave the collaboration and can't re-join it. If you are the [member paying for query compute costs](#) and you delete your membership, no more queries are allowed to run.

To leave a collaboration

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you haven't yet done so).
2. In the left navigation pane, choose **Collaborations**.
3. For **With active membership**, choose the collaboration of which you are a member.
4. Choose **Actions**.
5. Choose **Delete membership**.
6. In the dialog box, confirm the decision to leave the collaboration by typing **confirm** in the text input field, and then choose **Empty and delete membership**.

You see a message on the console indicating that the membership was deleted.

The collaboration creator sees the **Member status** as **Left**.

Prepare data tables in AWS Clean Rooms

Note

Preparing data tables can take place before or after you have joined a collaboration. After a table is prepared, you can reuse it across multiple collaborations as long as your privacy needs for that table are the same.

As a member in the collaboration, you must prepare your data tables before they can be queried in AWS Clean Rooms by the collaboration member who can query.

The data tables that you use for queries in AWS Clean Rooms are commonly the same types of data tables that you use for other applications. For example, the same types of datasets are used with Amazon Athena, Amazon EMR, Amazon Redshift Spectrum, and Amazon QuickSight.

You can query the data in its original format directly from any of the following data sources:

- Amazon Simple Storage Service (Amazon S3)
- Amazon Athena
- Snowflake

AWS Clean Rooms accesses the dataset at query run time, ensuring that members who can query always access the most up-to-date data. Any data that is temporarily read into an AWS Clean Rooms collaboration is deleted after the query completes. The query results are written to your Amazon S3 bucket.

If your use case involves querying identity data, see [AWS Entity Resolution in AWS Clean Rooms](#).

Topics

- [Data formats for AWS Clean Rooms](#)
- [Apache Iceberg tables in AWS Clean Rooms](#)
- [Preparing data tables for queries in AWS Clean Rooms](#)
- [Preparing encrypted data tables with Cryptographic Computing for Clean Rooms](#)
- [Decrypting data tables with the C3R encryption client](#)

Data formats for AWS Clean Rooms

To analyze data, the datasets must be in a format that AWS Clean Rooms supports.

Topics

- [Supported data formats for PySpark jobs](#)
- [Supported data formats for SQL queries](#)
- [Supported data types](#)
- [File compression types for AWS Clean Rooms](#)
- [Server-side encryption for AWS Clean Rooms](#)

Supported data formats for PySpark jobs

AWS Clean Rooms supports the following structured formats for running PySpark jobs.

- Parquet
- OpenCSV
- JSON

Supported data formats for SQL queries

AWS Clean Rooms supports different structured formats for running SQL queries, depending on whether you choose the Spark SQL analytics engine or the AWS Clean Rooms SQL analytics engine.

Spark SQL analytics engine

- [Apache Iceberg tables](#)
- Parquet
- OpenCSV
- JSON

AWS Clean Rooms SQL analytics engine

- [Apache Iceberg tables](#)

- Parquet
- RCFile
- TextFile
- SequenceFile
- RegexSerde
- OpenCSV
- AVRO
- JSON

 Note

A timestamp value in a text file must be in the format `yyyy-MM-dd HH:mm:ss.SSSSSS`. For example: `2017-05-01 11:30:59.000000`.

We recommend using a columnar storage file format, such as Apache Parquet. With a columnar storage file format, you can minimize data movement by selecting only the columns that you need. For optimal performance, large objects should be split into 100mb–1gb objects.

Supported data types

AWS Clean Rooms supports different types, depending on whether you choose the Spark SQL analytics engine or the AWS Clean Rooms SQL analytics engine.

Spark SQL analytics engine

- ARRAY
- BIGINT
- BOOLEAN
- BYTE
- CHAR
- DATE
- DECIMAL
- FLOAT

- INTEGER
- INTERVAL
- LONG
- MAP
- REAL
- SHORT
- SMALLINT
- STRUCT
- TIME
- TIMESTAMP_LTZ
- TIMESTAMP_NTZ
- TINYINT
- VARCHAR

For more information, see [Data types](#) in the *AWS Clean Rooms SQL Reference*.

AWS Clean Rooms SQL

- ARRAY
- BIGINT
- BOOLEAN
- CHAR
- DATE
- DECIMAL
- DOUBLE PRECISION
- INTEGER
- MAP
- REAL
- SMALLINT
- STRUCT
- SUPER

- TIME
- TIMESTAMP
- TIMESTAMPTZ
- TIMETZ
- VARBYTE
- VARCHAR

For more information, see [Data types](#) in the *AWS Clean Rooms SQL Reference*.

File compression types for AWS Clean Rooms

To reduce storage space, improve performance, and minimize costs, we strongly recommend that you compress your datasets.

AWS Clean Rooms recognizes file compression types based on the file extension and supports the compression types and extensions shown in the following table.

Compression algorithm	File extension
GZIP	.gz
Bzip2	.bz2
Snappy	.snappy

You can apply compression at different levels. Most commonly, you compress a whole file or compress individual blocks within a file. Compressing columnar formats at the file level doesn't yield performance benefits.

Server-side encryption for AWS Clean Rooms

Note

Server-side encryption does not replace cryptographic computing for those use cases that require it.

AWS Clean Rooms transparently decrypts datasets that are encrypted using the following encryption options:

- **SSE-S3** – Server-side encryption using an AES-256 encryption key managed by Amazon S3
- **SSE-KMS** – Server-side encryption with keys managed by AWS Key Management Service

To use SSE-S3, the AWS Clean Rooms service role used to associate the configured table to the collaboration must have KMS-decrypt permissions. To use SSE-KMS, the KMS key policy must also allow the AWS Clean Rooms service role to decrypt.

AWS Clean Rooms doesn't support Amazon S3 client-side encryption. For more information about server-side encryption, see [Protecting data using server-side encryption](#) in the *Amazon Simple Storage Service User Guide*.

Apache Iceberg tables in AWS Clean Rooms

Apache Iceberg is an open source table format for data lakes. AWS Clean Rooms can use the statistics stored in Apache Iceberg metadata to optimize query plans and reduce file scans during clean room query processing. For more information, see the [Apache Iceberg](#) documentation.

Consider the following when using AWS Clean Rooms with Iceberg tables:

- **Apache Iceberg tables for S3** – Apache Iceberg tables must be defined in the AWS Glue Data Catalog based on the [open source glue catalog implementation](#).
- **Apache Iceberg tables for Athena** – For more information, see <https://docs.aws.amazon.com/athena/latest/ug/querying-iceberg.html>
- **Apache Iceberg tables for Snowflake** – For more information, see <https://docs.snowflake.com/en/user-guide/tables-iceberg>
- **Parquet file format** – AWS Clean Rooms only supports Iceberg tables in the Parquet data file format.
- **GZIP and Snappy compression** – AWS Clean Rooms supports Parquet with GZIP and Snappy compression.
- **Iceberg versions** – AWS Clean Rooms supports running queries against version 1 and version 2 Iceberg tables.
- **Partitions** – You don't need to manually add partitions for your Apache Iceberg tables in AWS Glue. AWS Clean Rooms detects new partitions in Apache Iceberg tables automatically and no manual operation is needed to update partitions in the table definition. Iceberg partitions appear

as regular columns in the AWS Clean Rooms table schema and not separately as a partition key in the configured table schema.

- **Limitations**

- **New Iceberg tables only**

Apache Iceberg tables converted from Apache Parquet tables are not supported.

- **Time travel queries**

AWS Clean Rooms does not support time travel queries with Apache Iceberg tables.

- **Athena engine version 2**

Iceberg tables created with Athena engine version 2 are not supported.

- **File formats**

Avro and Optimized Row Columnar (ORC) file formats are not supported.

- **Compression**

Zstandard (Zstd) compression for Parquet is not supported.

Supported data types for Iceberg tables

AWS Clean Rooms can query Iceberg tables that contain the following data types:

- BOOLEAN
- DATE
- DECIMAL
- DOUBLE
- FLOAT
- INT
- LIST
- LONG
- MAP
- STRING
- STRUCT
- TIMESTAMP WITHOUT TIME ZONE

For more information about Iceberg data types, see the [Schemas for Iceberg](#) in the Apache Iceberg documentation.

Preparing data tables for queries in AWS Clean Rooms

If your use case doesn't require you to bring your own data, you can skip this procedure.

If your use case involves querying identity data, see [AWS Entity Resolution in AWS Clean Rooms](#).

For more information about the data formats that you can use, see [Data formats for AWS Clean Rooms](#).

Topics

- [Preparing data tables in Amazon S3](#)
- [Preparing data tables in Amazon Athena](#)
- [Preparing data tables in Snowflake](#)

Preparing data tables in Amazon S3

You can analyze data tables that have been cataloged in AWS Glue and stored in Amazon S3. If your data tables are already cataloged in AWS Glue, skip to [Creating a configured table in AWS Clean Rooms](#).

Preparing your data tables in Amazon S3 involves the following steps:

Topics

- [Step 1: Complete the prerequisites](#)
- [Step 2: \(Optional\) Prepare your data for cryptographic computing](#)
- [Step 3: Upload your data table to Amazon S3](#)
- [Step 4: Create an AWS Glue table](#)
- [Step 5: Next steps](#)

Step 1: Complete the prerequisites

To prepare your data tables for use with AWS Clean Rooms, you must complete the following prerequisites:

- Your data tables are saved as one of the [supported data formats for AWS Clean Rooms](#).
- Your data tables are cataloged in AWS Glue and use the [supported data types for AWS Clean Rooms](#).
- All of your data tables are stored in Amazon Simple Storage Service (Amazon S3) in the same AWS Region in which the collaboration was created.
- The AWS Glue Data Catalog is in the same Region in which the collaboration was created.
- The AWS Glue Data Catalog is in the same AWS account as the membership.
- The Amazon S3 bucket isn't registered with AWS Lake Formation.

Step 2: (Optional) Prepare your data for cryptographic computing

(Optional) If you're using cryptographic computing and your data table contains sensitive information that you want to encrypt, you must encrypt the data table using the C3R encryption client.

To prepare your data for cryptographic computing, follow the procedures in [Preparing encrypted data tables with Cryptographic Computing for Clean Rooms](#).

Step 3: Upload your data table to Amazon S3

Note

If you intend to use encrypted data tables in the collaboration, you must first encrypt the data for cryptographic computing before you upload your data table to Amazon S3. For more information, see [Preparing encrypted data tables with Cryptographic Computing for Clean Rooms](#).

To upload your data table to Amazon S3

1. Sign in to the AWS Management Console and open the Amazon S3 console at <https://console.aws.amazon.com/s3/>.
2. Choose **Buckets**, and then choose a bucket where you want to store your data table.
3. Choose **Upload**, and then follow the prompts.
4. Choose the **Objects** tab to view the prefix where your data is stored. Make a note of the name of the folder.

You can select the folder to view the data.

Step 4: Create an AWS Glue table

If you already have an AWS Glue data table, you can skip this step.

In this step, you set up a crawler in AWS Glue that crawls all the files in your S3 bucket and creates an AWS Glue table. For more information, see [Defining crawlers in AWS Glue](#) in the *AWS Glue User Guide*.

For more information about supported AWS Glue Data Catalog data types, see [Supported data types](#).

Note

AWS Clean Rooms doesn't currently support S3 buckets registered with AWS Lake Formation.

The following procedure describes how to create an AWS Glue table. If you want to use an encrypted AWS Glue Data Catalog object with an AWS Key Management Service (AWS KMS) key, you need to configure the KMS key permissions policy to allow access to that encrypted table. For more information, see [Setting up encryption in AWS Glue](#) in the *AWS Glue Developer Guide*.

To create an AWS Glue table

1. Follow the [Working with crawlers on the AWS Glue console](#) procedure in the *AWS Glue User Guide*.
2. Make a note of the AWS Glue database name and AWS Glue table name.

Step 5: Next steps

Now that you have prepared your data tables in Amazon S3, you are ready to:

- [Create a configured table](#)
- [Create an ML model](#)

The tables can be queried after:

- The collaboration creator has set up a collaboration in AWS Clean Rooms. For more information, see [Creating a collaboration](#).
- The collaboration creator has sent the collaboration ID to you as a participant in the collaboration.

Preparing data tables in Amazon Athena

You can query data tables that have been created as AWS Glue Data Catalog (GDC) Views in Amazon Athena.

A GDC View is a virtual table, created from one or more underlying AWS Glue tables. It must be created using Athena SQL in the Athena `AwsGlueCatalog` catalog.

Preparing your data tables in Amazon Athena involves the following steps:

Topics

- [Step 1: Complete the prerequisites](#)
- [Step 2: \(Optional\) Prepare your data for cryptographic computing](#)
- [Step 3: Next steps](#)

Step 1: Complete the prerequisites

To prepare your data tables for use with AWS Clean Rooms, you must complete the following prerequisites:

- Your data tables are saved as one of the [supported data formats for AWS Clean Rooms](#).
- Your data tables use the [supported data types for AWS Clean Rooms](#).
- You have created a GDC View on your AWS Glue table using Athena SQL in the Athena `AwsDataCatalog` catalog.

The view will appear in:

- The Athena console (under the `AwsDataCatalog`) as a View: <https://console.aws.amazon.com/athena/>
- The AWS Glue console as a AWS Glue table: <https://console.aws.amazon.com/glue/>

For more information, see [Use Data Catalog views in Athena](#) in the *Amazon Athena User Guide*.

Note

You need appropriate permissions to create Views in Athena and AWS Glue. Also, ensure that you have access to the underlying tables referenced in your View definition. AWS Clean Rooms only supports the AWS Glue Catalog Type for Athena, not Lambda or Hive Catalog Types.

- Your data tables or GDC Views are cataloged in AWS Glue and are registered with AWS Lake Formation.
- You have created a separate output bucket in Amazon S3 to receive the Athena results.
- You have set up a service role to read the data from Amazon Athena. For more information, see [Create a service role to read data from Amazon Athena](#).
- The service role has Lake Formation Select and Describe access permissions on the GDC View or table.

Step 2: (Optional) Prepare your data for cryptographic computing

(Optional) If you're using cryptographic computing and your data table contains sensitive information that you want to encrypt, you must encrypt the data table using the C3R encryption client.

To prepare your data for cryptographic computing, follow the procedures in [Preparing encrypted data tables with Cryptographic Computing for Clean Rooms](#).

Step 3: Next steps

Now that you have prepared your data tables in Amazon Athena, you are ready to:

- [Create a configured table](#)
- [Create an ML model](#)

The tables can be queried after:

- The collaboration creator has set up a collaboration in AWS Clean Rooms. For more information, see [Creating a collaboration](#).

- The collaboration creator has sent the collaboration ID to you as a participant in the collaboration.

Preparing data tables in Snowflake

You can query data tables that have been stored in Snowflake data warehouse.

Preparing your data tables in Snowflake involves the following steps:

Topics

- [Step 1: Complete the prerequisites](#)
- [Step 2: \(Optional\) Prepare your data for cryptographic computing](#)
- [Step 3: Create an AWS Secrets Manager secret](#)
- [Step 4: Next steps](#)

Step 1: Complete the prerequisites

To prepare your data tables for use with AWS Clean Rooms, you must complete the following prerequisites:

- You have an AWS account with the proper permissions granted to read your data tables. For more information, see [Create a service role to read data from Snowflake](#).
- Your data tables are saved as one of the [supported data formats for AWS Clean Rooms](#).
- Your data tables use the [supported data types for AWS Clean Rooms](#).
- Your data table is stored in a Snowflake warehouse. For more information, see the [Snowflake documentation](#).
- You have set up a new Snowflake user with read-only privileges to the Snowflake table you are going to associate with your collaboration.

Step 2: (Optional) Prepare your data for cryptographic computing

(Optional) If you're using cryptographic computing and your data table contains sensitive information that you want to encrypt, you must encrypt the data table using the C3R encryption client.

To prepare your data for cryptographic computing, follow the procedures in [Preparing encrypted data tables with Cryptographic Computing for Clean Rooms](#).

Step 3: Create an AWS Secrets Manager secret

To connect to Snowflake from AWS Clean Rooms, you will need to create and store your Snowflake credentials in a AWS Secrets Manager secret, then associate that secret with a Snowflake table in AWS Clean Rooms.

Note

We recommend that you create a new user that is exclusively for AWS Clean Rooms. That user should only have a role with Read permissions for the data that you want AWS Clean Rooms to access.

To create an AWS Secrets Manager secret

1. In Snowflake, generate a user, `snowflakeUser` and password, `snowflakePassword`.
2. Determine which Snowflake warehouse this user will interact with, `snowflakeWarehouse`. Either set it as the `DEFAULT_WAREHOUSE` for `snowflakeUser` in Snowflake or remember it for the next step.
3. In [AWS Secrets Manager](#), create a secret using your Snowflake credentials. To create a secret in Secrets Manager, follow the tutorial available in [Create an AWS Secrets Manager secret](#) in the *AWS Secrets Manager User Guide*. After creating the secret, keep the Secret name, `secretName` for the next step.
 - When selecting **Key/value pairs**, create a pair for `snowflakeUser` with the key `sfUser`.
 - When selecting **Key/value pairs**, create a pair for `snowflakePassword` with the key `sfPassword`.
 - When selecting **Key/value pairs**, create a pair for `snowflakeWarehouse` with the key `sfWarehouse`.

This isn't needed if a default is set in Snowflake. This isn't needed if a default is set in Snowflake.

- When selecting **Key/value pairs**, create a pair for `snowflakeRole` with the key `sfrole`.

Step 4: Next steps

Now that you have prepared your data tables in Snowflake, you are ready to:

- [Create a configured table](#)
- [Create an ML model](#)

The tables can be queried after:

- The collaboration creator has set up a collaboration in AWS Clean Rooms. For more information, see [Creating a collaboration](#).
- The collaboration creator has sent the collaboration ID to you as a participant in the collaboration.

Preparing encrypted data tables with Cryptographic Computing for Clean Rooms

Cryptographic Computing for Clean Rooms (C3R) is a capability in AWS Clean Rooms. You can use C3R to limit cryptographically what can be learned by any party and AWS in an AWS Clean Rooms collaboration.

You can encrypt the data table using the C3R encryption client, a client-side encryption tool, before uploading the data table to your data source: Amazon Simple Storage Service (Amazon S3), Amazon Athena, or Snowflake.

For more information, see [Cryptographic Computing for Clean Rooms](#).

Preparing encrypted data tables with C3R involves the following steps:

Steps

- [Step 1: Complete the prerequisites](#)
- [Step 2: Download the C3R encryption client](#)
- [Step 3: \(Optional\) View available commands in the C3R encryption client](#)
- [Step 4: Generate an encryption schema for a tabular file](#)
- [Step 5: Create a shared secret key](#)
- [Step 6: Store the shared secret key in an environment variable](#)

- [Step 7: Encrypt data](#)
- [Step 8: Verify data encryption](#)
- [\(Optional\) Create a schema \(advanced users\)](#)

Step 1: Complete the prerequisites

To prepare your data tables for use with C3R, you must complete the following prerequisites:

- You can access the Cryptographic Computing for Clean Rooms repository on GitHub:

<https://github.com/aws/c3r>

- You have set up AWS credentials to use the C3R encryption client. These credentials are used by C3R encryption client for read-only API calls to AWS Clean Rooms to retrieve collaboration metadata. For more information, see [Configuring the AWS CLI](#) in the *AWS Command Line Interface User Guide for Version 2*.
- You have Java Runtime Environment (JRE) 11 or later installed on your machine.
 - The recommended Java Runtime Environment, Amazon Corretto 11 or higher, can be downloaded from <https://aws.amazon.com/corretto>.
 - The Java Development Kit (JDK) includes a corresponding JRE of the same version. However, the additional capabilities of the JDK are not needed for running the Cryptographic Computing for Clean Rooms (C3R) encryption client.
- Your tabular data files (.csv) or Parquet files (.parquet) are saved locally.
- You or another member in the collaboration has the ability to create a shared secret key. For more information, see [Step 5: Create a shared secret key](#).
- The collaboration creator has created a collaboration in AWS Clean Rooms with **Cryptographic computing** enabled for the collaboration. For more information, see [Creating a collaboration](#).
- The collaboration creator has sent the collaboration ID to you as a participant in the collaboration. The collaboration Amazon Resource Name (ARN) is included in the invitation that is sent, which contains the collaboration ID.

Step 2: Download the C3R encryption client

To download the C3R encryption client from GitHub

1. Go to the Cryptographic Computing for Clean Rooms AWS GitHub repository: <https://github.com/aws/c3r>
2. Select and download the files.

The source code, licenses, and related material can be cloned or downloaded as a .zip file from the GitHub repository's landing page. (See the **Code** button at the top-right of the repository's content list).

The latest signed C3R encryption client Java Executable File (that is, the command line interface application) is on the **Releases** page of the GitHub repository.

The C3R encryption client package for Apache Spark (`c3r-cli-spark`) is a version of the `c3r-cli` that must be submitted as a job to a running Apache Spark server. For more information, see [Running C3R on Apache Spark](#).

Step 3: (Optional) View available commands in the C3R encryption client

Use this procedure to familiarize yourself with the available commands in the C3R encryption client.

To view all of the available commands in the C3R encryption client

1. From a command line interface (CLI), navigate to the folder that contains the downloaded `c3r-cli.jar` file.
2. Run the following command: `java -jar c3r-cli.jar`
3. View the list of available commands and options.

Step 4: Generate an encryption schema for a tabular file

To encrypt data, an encryption schema describing how the data will be used is required. This section describes how the C3R encryption client assists in generating an encryption schema for a CSV file with a header row or a Parquet file.

You only need to do this once per file. After the schema exists, it can be re-used to encrypt the same file (or any file with identical column names). If the column names or desired encryption schema changes, you must update the schema file. For more information, see [\(Optional\) Create a schema \(advanced users\)](#).

⚠ Important

It is paramount that all collaborating parties use the same shared secret key. Collaborating parties should also coordinate column names to match if they will be JOINed or otherwise compared for equality in queries. Otherwise, the SQL queries might produce unexpected or incorrect results. However, this is not necessary if the collaboration creator enabled the `allowJoinsOnColumnsWithDifferentNames` encryption setting during collaboration creation. For more information about encryption-relevant settings, see [Cryptographic computing parameters](#).

When run in schema mode, the C3R encryption client goes through the input file column by column, prompting you if and how that column should be treated. If the file contains many columns that aren't wanted for the encrypted output, the interactive schema generation might become tedious because you must skip each undesired column. To avoid this, you could manually write a schema, or create a simplified version of the input file featuring only the wanted columns. Then, the interactive schema generator could be run on that reduced file. The C3R encryption client outputs information about the schema file and asks you how the source columns should be included or encrypted (if at all) in the target output.

For each source column in the input file, you are prompted for:

1. How many target columns should be generated
2. How each target column should be encrypted (if at all)
3. The name of each target column
4. How data should be padded before encryption if the column is being encrypted as a sealed column

Note

When you encrypt data for a column that has been encrypted as a sealed column, you must determine which data needs padding. The C3R encryption client suggests a default padding during schema generation that pads all entries in a column to the same length. When determining the length for `fixed`, note that padding is in bytes, not bits.

The following is a decision table for creating the schema.

Schema decision table

Decision	Number of target columns from source column <'name-of-column'> ?	Target column type: [c] cleartext, [f] fingerprint, or [s] sealed ?	Target column header name <default 'name-of-column'>	Add suffix <suffix> to header to indicate how it was encrypted, [y] yes or [n] no <default 'yes'>	<'name-of-column'_sealed'> padding type: [n] none, [f] fixed, or [m] max <default 'max'>
Leave the column unencrypted.	1	c	Not applicable	Not applicable	Not applicable
Encrypt the column as a fingerprint column.	1	f	Choose default or enter a new header name.	Enter y to choose default (<code>_fingerprint</code>) or enter n.	Not applicable
Encrypt the column as a sealed column.	1	s	Choose default or enter a new header name.	Enter y to choose default	Choose padding type .

Decision	Number of target columns from source column <'name-of-column'> ?	Target column type: [c] cleartext, [f] fingerprint, or [s] sealed ?	Target column header name <default 'name-of-column'>	Add suffix <suffix> to header to indicate how it was encrypted, [y] yes or [n] no <default 'yes'>	<'name-of-column_sealed'> padding type: [n] one, [f] fixed, or [m] max <default 'max'>
				(_sealed) or enter n.	For more information, see (Optional) Create a schema (advanced users) .
Encrypt the column as both fingerprint and sealed.	2	Enter first target column: f . Enter second target column: s .	Choose the target headers for each target column.	Enter y to choose default or enter n .	Choose padding type (for sealed columns only). For more information, see (Optional) Create a schema (advanced users) .

The following are two examples of how to create encryption schemas. The exact content of your interaction depends on the input file and the responses that you provide.

Examples

- [Example: Generate an encryption schema for a fingerprint column and a cleartext column](#)
- [Example: Generate an encryption schema with sealed, fingerprint, and cleartext columns](#)

Example: Generate an encryption schema for a fingerprint column and a cleartext column

In this example, for `ads.csv`, there are only two columns: `username` and `ad_variant`. For these columns, we want the following:

- For the `username` column to be encrypted as a fingerprint column
- For the `ad_variant` column to be a cleartext column

To generate an encryption schema for a fingerprint column and a cleartext column

1. (Optional) To ensure the `c3r-cli.jar` file and file to be encrypted are present:
 - a. Navigate to the desired directory and run `ls` (if using a Mac or Unix/Linux) or `dir` if using Windows).
 - b. View the list of tabular data files (for example, `.csv`) and choose a file to encrypt.

In this example, `ads.csv` is the file that we want to encrypt.

2. From the CLI, run the following command to create a schema interactively.

```
java -jar c3r-cli.jar schema ads.csv --interactive --output=ads.json
```

Note

- You can run `java --jar PATH/T0/c3r-cli.jar`. Or, if you have added `PATH/T0/c3r-cli.jar` to your `CLASSPATH` environment variable, you can also run the class name. The C3R encryption client will look in the `CLASSPATH` to find it (for example, `java com.amazon.psion.cli.Main`).
- The `--interactive` flag selects the interactive mode for developing the schema. This walks the user through a wizard for creating the schema. Users with advanced skills can create their own schema JSON without using the wizard. For more information, see [\(Optional\) Create a schema \(advanced users\)](#).

- The `--output` flag sets an output name. If you don't include the `--output` flag, the C3R encryption client tries to pick a default output name (such as `<input>.out.csv` or for the schema, `<input>.json`).

3. For Number of target columns from source column 'username'?, enter **1** and then press **Enter**.
4. For Target column type: [c]leartext, [f]ingerprint, or [s]ealed?, enter **f** and then press **Enter**.
5. For Target column headername <default 'username'>, press **Enter**.

The default name 'username' is used.

6. For Add suffix '_fingerprint' to header to indicate how it was encrypted, [y]es or [n]o <default 'yes'>, enter **y** and then press **Enter**.

Note

The interactive mode suggests suffixes to add to the encrypted column headers (`_fingerprint` for fingerprint columns and `_sealed` for sealed columns). The suffixes might be helpful when you're performing tasks such as uploading data to AWS services or creating AWS Clean Rooms collaborations. These suffixes can help indicate what can be done with the encrypted data in each column. For example, things will not work if you encrypt a column as a sealed column (`_sealed`) and try to JOIN on it or try the reverse.

7. For Number of target columns from source column 'ad_variant'?, enter **1** and then press **Enter**.
8. For Target column type: [c]leartext, [f]ingerprint, or [s]ealed?, enter **c** and then press **Enter**.
9. For Target column headername <default 'username'>, press **Enter**.

The default name 'ad_variant' is used.

The schema is written to a new file called `ads.json`.

Note

You can view the schema by opening it in any text editor, such as Notepad on Windows or TextEdit on macOS.

10. You are now ready to [encrypt data](#).

Example: Generate an encryption schema with sealed, fingerprint, and cleartext columns

In this example, for `sales.csv`, there are three columns: `username`, `purchased`, and `product`. For these columns, we want the following:

- For the `product` column to be a sealed column
- For the `username` column to be encrypted as a fingerprint column
- For the `purchased` column to be a cleartext column

To generate an encryption schema with sealed, fingerprint, and cleartext columns

1. (Optional) To ensure the `c3r-cli.jar` file and file to be encrypted are present:
 - a. Navigate to the desired directory and run `ls` (if using a Mac or Unix/Linux) or `dir` if using Windows).
 - b. View the list of tabular data files (`.csv`) and choose a file to encrypt.

In this example, `sales.csv` is the file that we want to encrypt.

2. From the CLI, run the following command to create a schema interactively.

```
java -jar c3r-cli.jar schema sales.csv --interactive --  
output=sales.json
```

Note

- The `--interactive` flag selects the interactive mode for developing the schema. This walks the user through a guided workflow for creating the schema.

- If you are an advanced user, you can create your own schema JSON without using the guided workflow. For more information, see [\(Optional\) Create a schema \(advanced users\)](#).
- For .csv files with no column headers, see the `--noHeaders` flag for the schema command available in the CLI.
- The `--output` flag sets an output name. If you don't include the `--output` flag, the C3R encryption client tries to pick a default output name (such as `<input>.out` or for the schema, `<input>.json`).

3. For Number of target columns from source column 'username'?, enter **1** and then press **Enter**.
4. For Target column type: [c]leartext, [f]ingerprint, or [s]ealed?, enter **f** and then press **Enter**.
5. For Target column headername <default 'username'>, press **Enter**.

The default name 'username' is used.

6. For Add suffix '_fingerprint' to header to indicate how it was encrypted, [y]es or [n]o <default 'yes'>, enter **y** and then press **Enter**.
7. For Number of target columns from source column 'purchased'?, enter **1** and then press **Enter**.
8. For Target column type: [c]leartext, [f]ingerprint, or [s]ealed?, enter **c** and then press **Enter**.
9. For Target column headername <default 'purchased'>, press **Enter**.

The default name 'purchased' is used.

10. For Number of target columns from source column 'product'?, enter **1** and then press **Enter**.
11. For Target column type: [c]leartext, [f]ingerprint, or [s]ealed?, enter **s** and then press **Enter**.
12. For Target column headername <default 'product'>, press **Enter**.

The default name 'product' is used.

13. For 'product_sealed' padding type: [n]one, [f]ixed, or [m]ax <default 'max' ?>, press **Enter** to choose the default.

14. For Byte-length beyond max length to pad cleartext to in 'product_sealed' <default '0'? press **Enter** to choose the default.

The schema is written to a new file called `sales.json`.

15. You are now ready to [encrypt data](#).

Step 5: Create a shared secret key

To encrypt the data tables, the collaboration participants must agree upon and securely share a shared secret key.

The shared secret key must be at least 256-bits (32 bytes). You can specify a larger key, but it won't give you any additional security.

Important

Remember, the key and collaboration ID used for encryption and decryption must be identical for all collaboration participants.

The following sections provide examples of console commands for generating a shared secret key saved as `secret.key` in the respective terminal's current working directory.

Topics

- [Example: Key generation using OpenSSL](#)
- [Example: Key generation on Windows using PowerShell](#)

Example: Key generation using OpenSSL

For a common general purpose cryptography library, run the following command to create a shared secret key.

```
openssl rand 32 > secret.key
```

If you're using Windows and don't have OpenSSL installed, you can generate keys using the example described in [Example: Key generation on Windows using PowerShell](#).

Example: Key generation on Windows using PowerShell

For PowerShell, a terminal application available on Windows, run the following command to create a shared secret key.

```
$bs = New-Object Byte[](32);  
[Security.Cryptography.RandomNumberGenerator]::Create().GetBytes($bs); Set-  
Content 'secret.key' -Encoding Byte -Value $bs
```

Step 6: Store the shared secret key in an environment variable

An environment variable is a convenient and extensible way for users to provide a secret key from various key stores like AWS Secrets Manager and pass it to the C3R encryption client.

The C3R encryption client can use keys stored in AWS services if you use the AWS CLI to store those keys in the relevant environment variable. For example, the C3R encryption client can use a key from AWS Secrets Manager. For more information, see [Create and manage secrets with AWS Secrets Manager](#) in the *AWS Secrets Manager User Guide*.

Note

However, before you use an AWS service such as AWS Secrets Manager to hold your C3R keys, verify that your use case permits it. Certain use cases might require that the key be withheld from AWS. This is to ensure that the encrypted data and the key are never held by the same third party.

The only requirements for a shared secret key are that the shared secret key is base64-encoded and stored in the environment variable C3R_SHARED_SECRET.

The following sections describe the console commands for converting a secret.key file to base64 and storing it as an environment variable. The secret.key file could have been generated from any of the commands listed in [Step 5: Create a shared secret key](#) and is only an example source.

Store key in an environment variable on Windows using PowerShell

To convert to base64 and set the environment variable on Windows using PowerShell, run the following command.

```
$Bytes=[IO.File]::ReadAllBytes((Get-Location).ToString()+"\secret.key");  
$env:C3R_SHARED_SECRET=[Convert]::ToBase64String($Bytes)
```

Store key in an environment variable on Linux or macOS

To convert to base64 and set the environment variable on Linux or macOS, run the following command.

```
export C3R_SHARED_SECRET="$(cat secret.key | base64)"
```

Step 7: Encrypt data

To perform this step, you must acquire the AWS Clean Rooms collaboration ID and the shared secret key. For more information, see the [Prerequisites](#).

In the following example, we run the encryption on `ads.csv`, using the schema that we created called `ads.json`.

To encrypt data

1. Store the shared secret key for the collaboration in [Step 6: Store the shared secret key in an environment variable](#).

2. From the command line, enter the following command.

```
java -jar c3r-cli.jar encrypt <name of input .csv file> --schema=<name of schema .json file> --id=<collaboration id> --output=<name of output.csv file> <optional flags>
```

3. For *<name of input .csv file>*, enter the name of the input .csv file.
4. For `schema=`, enter the name of the .json encryption schema file.
5. For `id=`, enter the collaboration ID.
6. For `output=`, enter the name of the output file (for example, `ads-output.csv`).
7. Include any of the command line flags described in [Cryptographic computing parameters](#) and [Optional flags in Cryptographic Computing for Clean Rooms](#).
8. Run the command.

In the example for `ads.csv`, we run the following command.

```
java -jar c3r-cli.jar encrypt ads.csv --schema=ads.json --id=123e4567-e89b-42d3-a456-556642440000 --output=ads-output.csv
```

In the example for `sales.csv`, we run the following command.

```
java -jar c3r-cli.jar encrypt sales.csv --schema=sales.json --id=123e4567-e89b-42d3-a456-556642440000
```

 Note

In this example, we don't specify an output file name (`--output=sales-output.csv`). As a result, the default output file name `name-of-file.out.csv` was generated.

You are now ready to verify the encrypted data.

Step 8: Verify data encryption

To verify that the data was encrypted

1. View the encrypted data file (for example, `sales-output.csv`).
2. Verify the following columns:
 - a. Column 1 – Encrypted (for example, `username_fingerprint`).

For the fingerprint columns (HMAC), after the version and type prefix (for example, `01:hmac:`), there are 44 characters of base64-encoded data.

- b. Column 2 – Not encrypted (for example, `purchased`).
- c. Column 3 – Encrypted (for example, `product_sealed`).

For encrypted (SELECT) columns, the length of the cleartext plus any padding after the version and type prefix (for example, `01:enc:`) is directly proportional to the length of the cleartext that was encrypted. That is, the length is the size of the input plus approximately 33 percent overhead because of the encoding.

You are now ready to:

1. [Upload the encrypted data to S3.](#)
2. [Create an AWS Glue table.](#)

3. [Create a configured table in AWS Clean Rooms.](#)

The C3R encryption client will create temporary files that don't contain unencrypted data (unless that data would also be unencrypted in the final output). However, some encrypted values might not be padded properly. Fingerprint columns might contain duplicate values, even if the collaboration setting `allowRepeatedFingerprintValue` is false. This issue occurs because the temporary file is written before proper padding lengths and duplicate-removal properties are checked.

If the C3R encryption client fails or is interrupted during encryption, it might stop after writing the temporary file but before checking these properties and deleting the temporary files. Therefore, these temporary files might still be on disk. If this is the case, the contents in these files doesn't protect the plaintext data to the same levels that the output does. In particular, these temporary files might reveal plaintext data to statistical analyses that would not work against the final output. The user should delete these files (particularly a SQLite database) to prevent these files from falling into unauthorized hands.

(Optional) Create a schema (advanced users)

Creating a schema manually is for advanced users.

The following is a description of the JSON schema file format for input files with or without column headers. Advanced users can directly write or modify the schema if desired.

Note

The C3R encryption client can assist you in making a schema through either the interactive process described in [Example: Generate an encryption schema with sealed, fingerprint, and cleartext columns](#) or through the creation of a stub template.

Mapped and positional table schemas

The following section describes two kinds of table schemas:

- **Mapped table schema** – This schema is used for encrypting .csv files with a header row and Apache Parquet files.
- **Positional table schema** – This schema is used for encrypting .csv files without a header row.

The C3R encryption client can encrypt a tabular file for a collaboration. To do this, it must have a corresponding schema file that specifies how the encrypted output should be derived from the input.

The C3R encryption client can help generate a schema for an INPUT file by running the C3R encryption client schema command at the command line. An example of a command is `java -jar c3r-cli.jar schema --interactive INPUT`.

The schema specifies the following information:

1. Which source columns map to which transformed columns in the output file through their header names (mapped schemas) or position (positional schemas)
2. Which target columns are to remain cleartext
3. Which target columns are to be encrypted for SELECT queries
4. Which target columns are to be encrypted for JOIN queries

This information is encoded in a table-specific JSON schema file, which consists of a single object whose `headerRow` field is a Boolean value. The value must be `true` for Parquet files and `.csv` files with a header row, and `false` otherwise.

Mapped table schema

The mapped schema has the following shape.

```
{
  "headerRow": true,
  "columns": [
    {
      "sourceHeader": STRING,
      "targetHeader": STRING,
      "type": TYPE,
      "pad": PAD
    },
    ...
  ]
}
```

If `headerRow` is `true`, the next field in the object is `columns`, which contains an array of column schemas that map source headers to target headers (that is, JSON objects describing what the output columns should contain).

- `sourceHeader` – The STRING header name of the source column that the data is derived from.

Note

The same source column can be used for multiple target columns.
A column from the input file not listed as a `sourceHeader` anywhere in the schema doesn't appear in the output file.

- `targetHeader` – The STRING header name of the corresponding column in the output file.

Note

This field is optional for mapped schemas. If this field is omitted, the `sourceHeader` is re-used for the header name in the output. Either `_fingerprint` or `_sealed` is appended if the output column is a fingerprint column or sealed column respectively.

- `type` – The TYPE of the target column in the output file. That is, one of `cleartext`, `sealed`, or `fingerprint` depending on how the column will be used in the collaboration.
- `pad` – A field of a column schema object that is only present when the TYPE is `sealed`. Its corresponding value of `PAD` is an object that describes how the data should be padded before it's encrypted.

```
{
  "type": PAD_TYPE,
  "length": INT
}
```

To specify pre-encryption padding, `type` and `length` are used as follows:

- `PAD_TYPE` as `none` – No padding will be applied to the column's data and the `length` field is not applicable (that is, omitted).
- `PAD_TYPE` as `fixed` – The column's data is padded to the specified `length` of bytes.
- `PAD_TYPE` as `max` – The column's data is padded to the size of the longest value's byte length plus an additional `length` bytes.

The following is an example mapped schema, with a column of each type.

```
{
```

```

"headerRow": true,
"columns": [
  {
    "sourceHeader": "FullName",
    "targetHeader": "name",
    "type": "cleartext"
  },
  {
    "sourceHeader": "City",
    "targetHeader": "city_sealed",
    "type": "sealed",
    "pad": {
      "type": "max",
      "length": 16
    }
  },
  {
    "sourceHeader": "PhoneNumber",
    "targetHeader": "phone_number_fingerprint",
    "type": "fingerprint"
  },
  {
    "sourceHeader": "PhoneNumber",
    "targetHeader": "phone_number_sealed",
    "type": "sealed",
    "pad": {
      "type": "fixed",
      "length": 20
    }
  }
]
}

```

As a more complex example, the following is an example .csv file with headers.

```

FirstName,LastName,Address,City,State,PhoneNumber,Title,Level,Notes
Jorge,Souza,12345 Mills Rd,Anytown,SC,703-555-1234,CEO,10,
Paulo,Santos,0 Street,Anytown,MD,404-555-111,CIO,9,This is a really long note that
could really be a paragraph
Mateo,Jackson,1 Two St,Anytown,NY,304-555-1324,C00,9,""
Terry,Whitlock4 N St,Anytown,VA,407-555-8888,EA,7,Secret notes
Diego,Ramirez,9 Hollows Rd,Anytown,VA,407-555-1222,SDE I,4,null
John,Doe,8 Hollows Rd,Anytown,VA,407-555-4321,SDE I,4,Jane's younger brother

```

```
Jane,Doe,8 Hollows Rd,Anytown,VA,407-555-4322,SDE II,5,John's older sister
```

In the following mapped schema example, the columns `FirstName` and `LastName` are `cleartext` columns. The `State` column is encrypted as a fingerprint column and as a sealed column with a padding of none. The remaining columns are omitted.

```
{
  "headerRow": true,
  "columns": [
    {
      "sourceHeader": "FirstName",
      "targetHeader": "GivenName",
      "type": "cleartext"
    },
    {
      "sourceHeader": "LastName",
      "targetHeader": "Surname",
      "type": "cleartext"
    },
    {
      "sourceHeader": "State",
      "targetHeader": "State_Join",
      "type": "fingerprint"
    },
    {
      "sourceHeader": "State",
      "targetHeader": "State",
      "type": "sealed",
      "pad": {
        "type": "none"
      }
    }
  ]
}
```

The following is the `.csv` file that results from the mapped schema.

```
givenname,surname,state_fingerprint,state
John,Doe,01:hmac:UK8s8Cn/WR2J0/To2dTxD73aDEe2ZUXeSHy3Tv
+1Mk=,01:enc:FQ3n3Ahv9BQQNWQGcugeHzHYzEZE1vapHa2Uu4SRgSAZ3q0bjPA4TcsHt
+B0kMKBcnHWI13BeGG/SBqmj7vKpI=
```

```
Paulo,Santos,01:hmac:CHF4eIrtTNgAooU9v4h9Qjc
+txBnMidQTjdjWuaDTTA=,01:enc:KZ5n5GtaXACco65AXk48BQ02durDNR2ULc4YxmMC8NaZZKKJiksU1IwFadAvV4iBQ1
Mateo,Jackson,01:hmac:iIRnjfNBzryusIJ1w35lgNzeY1RQ1bSfq6PDHW8Xrbk=,01:enc:mLKpS5HIOSgphdEsrzhEd
eN9nB02gAbIygt40Fn4LalYn9Xyj/XUWXlmn8zFe2T4kyDTD8kG0vpQEUGxAUFk=
Diego,Ramirez,01:hmac:UK8s8Cn/WR2J0/To2dTxD73aDEe2ZUXeSHy3Tv+1Mk=,01:enc:rmZhT98Zm
+IIGw1UTjMIJP4IrW/AAItBLMXcHvnYfRgmWP623VFQ6aUnhsb2MDqEw4G5Uwg5rKKZepUxx5uKbfk=
Jorge,Souza,01:hmac:3BxJdXiFFyZ8HBbYNqqEhBVqhN0d7s2ZiKUe7QiTy08=,01:enc:vVaqWC1VRbhvkf8gnuR7q0z
Terry,Whitlock01:hmac:UK8s8Cn/WR2J0/To2dTxD73aDEe2ZUXeSHy3Tv+1Mk=,01:enc:3c9VEWb0D0/
xbQjdGuccLvI7oZTBdPU+SyrJIyr2kudfAxbuMQ2uRdU/q7rbgyJjxZS8M2U35ILJf/1DgTyg7cM=
Jane,Doe,01:hmac:UK8s8Cn/WR2J0/To2dTxD73aDEe2ZUXeSHy3Tv+1Mk=,01:enc:9RWv46YLveykeNZ/
G0Nd1YFg+AVd0nu05hHyAYTQkPLHnyX+0/jbzD/g9ZT8GCgVE9aB5bV4ooJIXHGBVMXcjrQ=
```

Positional table schema

The positional schema has the following shape.

```
{
  "headerRow": false,
  "columns": [
    [
      {
        "targetHeader": STRING,
        "type": TYPE,
        "pad": PAD
      },
      {
        "targetHeader": STRING,
        "type": TYPE,
        "pad": PAD
      }
    ],
    [],
    ...
  ]
}
```

If `headerRow` is `false`, the next field in the object is `columns`, which contains an array of entries. Each entry is itself an array of zero or more positional column schemas (no `sourceHeader` field), which are JSON objects describing what the output should contain.

- `sourceHeader` – The `STRING` header name of the source column that the data is derived from.

Note

This field must be omitted in positional schemas. In positional schemas, the source column is inferred by the column's corresponding index in the schema file.

- `targetHeader` – The STRING header name of the corresponding column in the output file.

Note

This field is required for positional schemas.

- `type` – The TYPE of the target column in the output file. That is, one of `cleartext`, `sealed`, or `fingerprint` depending on how the column will be used in the collaboration.
- `pad` – A field of a column schema object that is only present when the TYPE is `sealed`. Its corresponding value of `PAD` is an object that describes how the data should be padded before it's encrypted.

```
{
  "type": PAD_TYPE,
  "length": INT
}
```

To specify pre-encryption padding, `type` and `length` are used as follows:

- `PAD_TYPE` as `none` – No padding will be applied to the column's data and the `length` field is not applicable (that is, omitted).
- `PAD_TYPE` as `fixed` – The column's data is padded to the specified `length` of bytes.
- `PAD_TYPE` as `max` – The column's data is padded to the size of the longest value's byte length plus an additional `length` bytes.

Note

`fixed` is useful if you know ahead of time of an upper bound on the byte size of the column's data. An error is raised if any data in that column is longer than the specified `length`.

`max` is convenient when the exact size of input data is unknown because it works regardless of the data's size. However, `max` requires additional processing time because

it encrypts the data twice. max encrypts the data once when read in to the temporary file and once after the longest data entry in the column is known. Also, the length of the longest value isn't saved between invocations of the client. If you plan to encrypt your data in batches, or to encrypt new data periodically, be aware that the resulting ciphertext-lengths might vary among batches.

The following is an example of a positional schema.

```
{
  "headerRow": false,
  "columns": [
    [
      {
        "targetHeader": "name",
        "type": "cleartext"
      }
    ],
    [
      {
        "targetHeader": "city_sealed",
        "type": "sealed",
        "pad": {
          "type": "max",
          "length": 16
        }
      }
    ],
    [
      {
        "targetHeader": "phone_number_fingerprint",
        "type": "fingerprint"
      },
      {
        "targetHeader": "phone_number_sealed",
        "type": "sealed",
        "pad": {
          "type": "fixed",
          "length": 20
        }
      }
    ]
  ]
}
```



```
]
}
```

As a complex example, the following is an example .csv file if it didn't have the first row with the headers.

```
Jorge,Souza,12345 Mills Rd,Anytown,SC, 703 -555 -1234,CEO, 10,
Paulo,Santos, 0 Street,Anytown,MD, 404-555-111,CIO, 9,This is a really long note that
could really be a paragraph
Mateo,Jackson, 1 Two St,Anytown,NY, 304-555-1324,C00, 9, ""
Terry,Whitlock, 4 N St,Anytown,VA, 407-555-8888,EA, 7,Secret notes
Diego,Ramirez, 9 Hollows Rd,Anytown,VA, 407-555-1222,SDE I, 4,null
John,Doe, 8 Hollows Rd,Anytown,VA, 407-555-4321,SDE I, 4,Jane's younger brother
Jane,Doe, 8 Hollows Rd,Anytown,VA, 407-555-4322,SDE II, 5,John's older sister
```

The positional schema has the following form.

```
{
  "headerRow": false,
  "columns": [
    [
      {
        "targetHeader": "GivenName",
        "type": "cleartext"
      }
    ],
    [
      {
        "targetHeader": "Surname",
        "type": "cleartext"
      }
    ],
    [],
    [],
    [
      {
        "targetHeader": "State_Join",
        "type": "fingerprint"
      },
      {
        "targetHeader": "State",
        "type": "sealed",
        "pad": {
```

```

        "type": "none"
    }
}
],
[],
[],
[],
[]
]
}

```

The preceding schema produces the following output file with a header row containing the specified target headers.

```

givenname,surname,state_fingerprint,state
Mateo,Jackson,01:hmac:iIRnjfNBzryusIJ1w35lgNzeY1RQ1bSfq6PDHW8Xrbk=,01:enc:ENS6QD3cMV19vQEGfe9MN
Q8m/Y5SA89dJwKpT5rGPp8e36h6klwDoslpFzGvU0=
Jorge,Souza,01:hmac:3BxJdXiFFyZ8HBbYNqqEhBVqhN0d7s2ZiKUe7QiTy08=,01:enc:LKo0zirq2+
+XEIIIMNRjAsGMdyWUDwYaum0B+IFP+rUf1BNeZDJjtFe1Z+zbZfXQWwJy52Rt7HqvAb2WIK1oMmk=
Paulo,Santos,01:hmac:CHF4eIrtTNgAooU9v4h9Qjc
+txBnMidQTjdjWuaDTTA=,01:enc:MyQKyWxJ9kvK1xDQQtX1UNwv3F+yRBRr0xrUY/1BGg5KFg0n9pK+MZ7g
+ZNqZEPcPz4lht1u0t/wbTaQz0CLXFQ=
Jane,Doe,01:hmac:UK8s8Cn/WR2J0/To2dTxD73aDEe2ZUXeSHy3Tv+1Mk=,01:enc:Pd8sbITBfb0/
ttUB4svVsgoYkDfnDvgkvxzeCi0Yxq54rLSwccy1o3/B50C3cpkkn56dovCwzgmmPNwrmCmYtb4=
Terry,Whitlock01:hmac:UK8s8Cn/WR2J0/To2dTxD73aDEe2ZUXeSHy3Tv
+1Mk=,01:enc:Qmtzu3B3GAXKh2KkRYTiEAaMopYedsSdF2e/
ADUiBQ9kv2CxKPzWyYTD3ztmKPMka19dHre5VhUHNp030+j1AQ8=
Diego,Ramirez,01:hmac:UK8s8Cn/WR2J0/To2dTxD73aDEe2ZUXeSHy3Tv+1Mk=,01:enc:ysdg
+GHKdeZrS/geBIoo0EPLHG68MsWpx1dh3xjb+fG5rmFmqUcJLNuuYBHhHA1xchM2WVeV1fmHkBX3mvZNVkc=
John,Doe,01:hmac:UK8s8Cn/WR2J0/To2dTxD73aDEe2ZUXeSHy3Tv+1Mk=,01:enc:9uX0wZu07kAPAx
+Hf6uvQownkWqFSKtWS7gQIJSe5aXFquKWCK6yZN0X5Ea2N3bn03Uj1kh0agDwoiP9FRZGJA4=

```

Decrypting data tables with the C3R encryption client

Follow this procedure for collaborations that use Cryptographic Computing for Clean Rooms and the C3R encryption client to encrypt data tables. Use this procedure after you have [queried data in the collaboration](#).

The shared secret key and collaboration ID are required for this procedure.

The member who can receive results decrypts the data using the same shared secret key and collaboration ID that was used to encrypt the data for the collaboration.

Note

AWS Clean Rooms collaborations already limit who can perform and view query results. To perform the decryption, whoever has access to these results needs the same shared secret key and collaboration ID that was used to encrypt the data.

To decrypt an encrypted data table

1. (Optional) [View the available commands in the C3R encryption client.](#)
2. (Optional) Navigate to the desired directory and run `ls` (macOS) or `dir` (Windows).
 - Verify that the `c3r-cli.jar` file and encrypted query results data file are in the desired directory.

Note

If query results are downloaded from the AWS Clean Rooms console interface, they are likely in the **Downloads** folder for your user account. (For example, the **Downloads** folder in your user directory on Windows and macOS.) We recommend that you move the query results file to the same folder as the `c3r-cli.jar`.

3. Store the shared secret key in the `C3R_SHARED_SECRET` environment variable. For more information, see [Step 6: Store the shared secret key in an environment variable.](#)
4. From the AWS Command Line Interface (AWS CLI), run the following command.

```
java -jar c3r-cli.jar decrypt <name of input .csv file> --id=<collaboration id> --  
output=<output file name>
```

5. Replace each *user input placeholder* with your own information:
 - a. For `id=`, enter the collaboration ID.
 - b. For `output=`, enter the name of the output file (for example, `results-decrypted.csv`).

If you don't specify an output name, a default name is displayed in the terminal.

- c. View the decrypted data in the specified output file using your preferred CSV or Parquet viewing application (such as Microsoft Excel, a text editor, or other application).

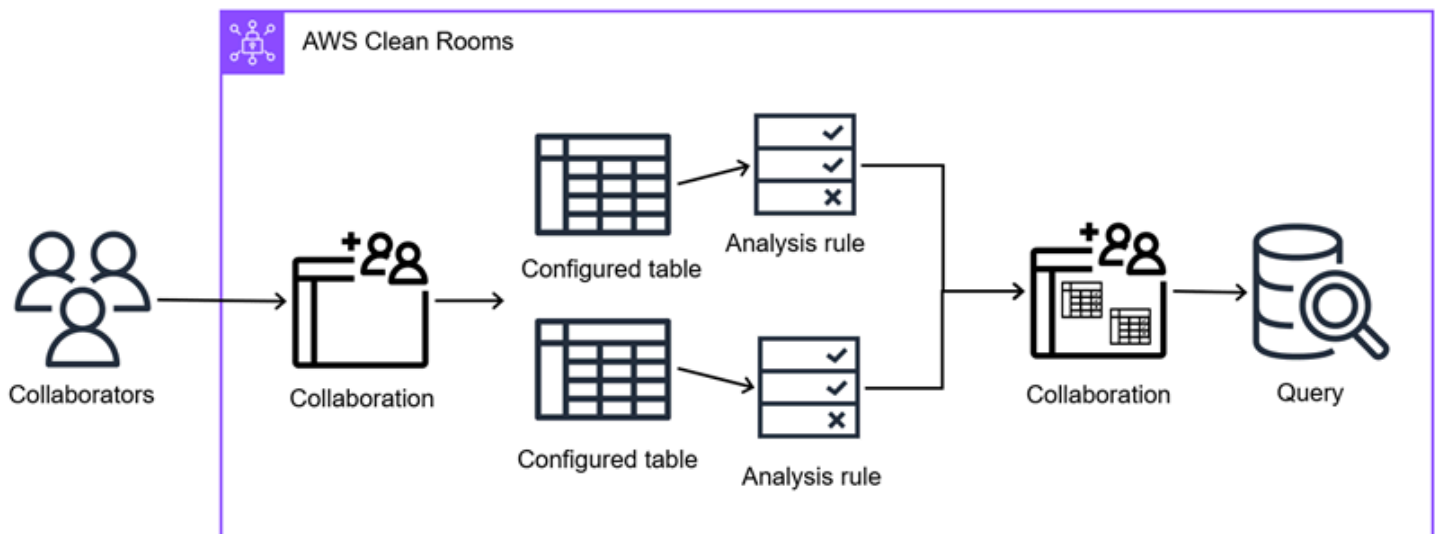
Configured tables in AWS Clean Rooms

A *configured table* is a reference to an existing table in a data source. It contains an analysis rule that determines how the data can be queried in AWS Clean Rooms. Configured tables can be associated to one or more collaborations.

With AWS Clean Rooms, you can perform aggregation analysis on event data, such as number of purchases compared to number of purchases. You can also perform list analysis on event data, such as enriching overlapping customer data from segment data to CRM data. You can also perform custom queries and set differential privacy on event data, such as viewership data and segment attributes.

First, you create a collaboration in AWS Clean Rooms and add the AWS accounts you want to invite, or join a collaboration you're invited to by creating a membership. Next, you and the other member in the collaboration create configured tables. You both add an analysis rule to the configured tables (aggregation, list, or custom) and associate the configured tables to the collaboration. Finally, the member who can query runs a query across the two data tables.

The following diagram summarizes how to work with event data in AWS Clean Rooms.



Topics

- [Creating a configured table in AWS Clean Rooms](#)
- [Adding an analysis rule to a configured table](#)
- [Associating a configured table to a collaboration](#)
- [Adding a collaboration analysis rule to a configured table](#)

- [Configuring differential privacy policy \(optional\)](#)
- [Viewing tables and analysis rules](#)
- [Editing configured table details](#)
- [Editing configured table tags](#)
- [Editing configured table analysis rule](#)
- [Deleting configured table analysis rule](#)
- [Configured table disallowed columns](#)
- [Editing configured table associations](#)
- [Disassociating configured tables](#)

Creating a configured table in AWS Clean Rooms

A *configured table* is a reference to an existing table in a data source. It contains an analysis rule that determines how the data can be queried in AWS Clean Rooms. Configured tables can be associated to one or more collaborations.

For information about how to create a configured table using the AWS SDKs, see the [AWS Clean Rooms API Reference](#).

Topics

- [Creating a configured table – Amazon S3 data source](#)
- [Creating a configured table – Amazon Athena data source](#)
- [Creating a configured table – Snowflake data source](#)

Creating a configured table – Amazon S3 data source

In this procedure, the [member](#) does the following tasks:

- Configures an existing AWS Glue table for use in AWS Clean Rooms. (This step can be done before or after joining a collaboration, unless using Cryptographic Computing for Clean Rooms.)

Note

AWS Clean Rooms supports AWS Glue tables. For more information about getting your data in AWS Glue, see [Step 3: Upload your data table to Amazon S3](#).

- Names the [configured table](#) and chooses which columns to use in the collaboration.

The following procedure assumes that:

- The collaboration member has already [uploaded their data tables to Amazon S3](#) and [created an AWS Glue table](#).

 Note

If you are using the Spark analytics engine, the **Results destination in Amazon S3** can't be within the same S3 bucket as any data source.

- (Optional) For [encrypted](#) data tables only, the collaboration member has already [prepared encrypted data tables](#) using the C3R encryption client.

You can use the statistic generation provided by AWS Glue to compute column-level statistics for AWS Glue Data Catalog tables. After AWS Glue generates statistics for tables in the Data Catalog, Amazon Redshift Spectrum automatically uses those statistics to optimize the query plan. For more information about computing column-level statistics using AWS Glue, see [Optimizing query performance using column statistics](#) in the *AWS Glue User Guide*. For more information about AWS Glue, see the [AWS Glue Developer Guide](#).

To create a configured table – Amazon S3 data source

- Sign in to the AWS Management Console and open the AWS Clean Rooms console at <https://console.aws.amazon.com/cleanrooms>.
- In the left navigation pane, choose **Tables**.
- In the upper right corner, choose **Configure new table**.
- For **Data source**, under **AWS data sources**, choose **Amazon S3**.
- Under **Amazon S3 table**:
 - Choose the **Database** from the dropdown list.
 - Choose the **Table** that you want to configure from the dropdown list.

 Note

To verify that this is the correct table, do either one of the following:

- Choose **View in AWS Glue**.
- Turn on **View schema from AWS Glue** to view the schema.

 Important

For AWS Glue tables where the data is in CSV format, the column names and order in the Glue schema must exactly match the CSV data. If they don't align, the allowed columns list for the configured table might not be enforced properly.

6. For **Columns and analysis methods allowed in collaborations**,

a. For **Which columns do you want to allow in collaborations?**

- Choose **All columns** to allow all columns to be queried in the collaboration.
- Choose **Custom list** to allow one or more columns from the **Specify allowed columns** dropdown list to be queried in the collaboration.

b. For **Allowed analysis methods**,

- Choose **Direct query** to allow SQL queries to be run directly on this table
- Choose **Direct job** to allow PySpark jobs to be run directly on this table.

Example Example

For example, if you want to allow collaboration members to run both direct SQL queries and PySpark jobs on all columns, then choose **All columns**, **Direct query**, and **Direct job**.

7. For **Configured table details**,

a. Enter a **Name** for the configured table.

You can use the default name or rename this table.

b. Enter a **Description** of the table.

The description helps differentiate between other configured tables with similar names.

8. If you want to enable **Tags** for the configured table resource, choose **Add new tag** and then enter the **Key** and **Value** pair.
9. Choose **Configure new table**.

Now that you have created a configured table, you are ready to:

- [Add an analysis rule to the configured table](#)
- [Associate the configured table to a collaboration](#)

Creating a configured table – Amazon Athena data source

The Amazon Athena datasource option allows you to query data stored in Amazon S3, cataloged in the AWS Glue data catalog, and access controlled via AWS Lake Formation. Both tables and AWS Glue Data Catalog Views are supported. Lake Formation resource links can be used to share tables and views across AWS accounts and across AWS Regions to the AWS Clean Rooms member account that joins them to an AWS Clean Rooms collaboration.

Note

Only Amazon S3-based datasets can be queried via the Athena data source integration.

In this procedure, the [member](#) does the following tasks:

- Configures an existing table or view in the AWS Glue Data Catalog for use the AWS Clean Rooms
- Names the [configured table](#) and chooses which columns to use in the collaboration.

The following procedure assumes that:

- The collaboration member has already created the AWS Glue Data Catalog database and table or GDC view.

To create a configured table – Athena data source

1. Sign in to the AWS Management Console and open the AWS Clean Rooms console at <https://console.aws.amazon.com/cleanrooms>.
2. In the left navigation pane, choose **Tables**.
3. In the upper right corner, choose **Configure new table**.
4. For **Data source**, under **AWS data sources**, choose **Amazon Athena**.
5. Under **Amazon Athena table**:
 - a. Choose the **Database** from the dropdown list.
 - b. Choose the **Table** that you want to configure from the dropdown list.

Note

To verify that this is the correct table, do either one of the following:

- Choose **View in AWS Glue**.
- Turn on **View schema from AWS Glue** to view the schema.

6. For **Amazon Athena configurations**,
 - a. Choose a **Workgroup** from the dropdown list.
 - b. For **S3 output location**, choose a recommended action, based on one of the following scenarios.

Scenario	Recommended action
Your Workgroup doesn't have a default output location.	Enter the S3 output location or choose Browse S3 .
Your Workgroup enforces your default output location.	The S3 output location is automatically chosen and you can't change it.
Your Workgroup doesn't enforce your default output location.	Enter the S3 output location or choose Browse S3 .

7. For **Columns allowed in collaborations**, choose an option based on your goal.

Your goal	Recommended option
Allow all columns for use in AWS Clean Rooms (subject to analysis rules)	All columns
Allow one or more columns from the Specify allowed columns dropdown list	Custom list

8. For **Configured table details**,

- a. Enter a **Name** for the configured table.

You can use the default name or rename this table.

- b. Enter a **Description** of the table.

The description helps differentiate between other configured tables with similar names.

- c. If you want to enable **Tags** for the configured table resource, choose **Add new tag** and then enter the **Key** and **Value** pair.

9. Choose **Configure new table**.

Now that you have created a configured table, you are ready to:

- [Add an analysis rule to the configured table](#)
- [Associate the configured table to a collaboration](#)

Creating a configured table – Snowflake data source

In this procedure, the [member](#) does the following tasks:

- Configures an existing Snowflake table for use in AWS Clean Rooms. (This step can be done before or after joining a collaboration, unless using Cryptographic Computing for Clean Rooms.)
- Names the [configured table](#) and chooses which columns to use in the collaboration.

The following procedure assumes that:

- The collaboration member has already uploaded their data tables to Snowflake.

- (Optional) For [encrypted](#) data tables only, the collaboration member has already [prepared encrypted data tables](#) using the C3R encryption client.

To create a configured table – Snowflake data source

1. Sign in to the AWS Management Console and open the AWS Clean Rooms console at <https://console.aws.amazon.com/cleanrooms>.
2. In the left navigation pane, choose **Tables**.
3. In the upper right corner, choose **Configure new table**.
4. For **Data source**, under **Third-party clouds and data sources**, choose **Snowflake**.
5. Specify the **Snowflake credentials** using an existing secret ARN or storing a new secret for this table.

Use existing secret ARN

1. If you have a secret ARN, enter it in the **Secret ARN** field.

You can look up your secret ARN by choosing **Go to AWS Secrets Manager**.

2. If you have an existing secret from another table, choose **Import secret ARN from existing table**.

Note

The secret ARN can be cross-account.

Store a new secret for this table

1. Enter the following Snowflake credentials:
 - **Snowflake username**
 - **Snowflake password**
 - **Snowflake warehouse**
 - **Snowflake role**
2. To use the default AWS managed key, leave the **Customize encryption settings** check box unchecked.

3. To use an AWS KMS key, select the **Customize encryption settings** checkbox and enter the KMS key.
4. Enter a **Secret name** to help you find your credentials later.
6. For **Snowflake table and schema details**, enter the details manually or automatically import the details.

Enter the details manually

1. Enter the **Snowflake account identifier**.

For more information, see [Account identifiers](#) in the Snowflake documentation.

Your account identifier must be in the format used for Snowflake drivers. You need to replace the period (.) with a hyphen (-) so the identifier is formatted as **<orgname>-<account_name>**.

2. Enter the **Snowflake database**.

For more information, see [Snowflake database](#) in the Snowflake documentation.

3. Enter the **Snowflake schema name**.

4. Enter the **Snowflake table name**.

For more information, see [Understanding Snowflake Table Structures](#) in the Snowflake documentation.

5. For the **Schema**, enter the **Column name** and choose the **Data type** from the dropdown list.
6. Choose **Add column** to add more columns.
 - If you choose an **Object data type**, specify the **Object schema**.

Example Example object schema

```
name STRING,  
location OBJECT(  
  x INT,  
  y INT,  
  metadata OBJECT(uuid STRING)  
)  
history ARRAY(TEXT)
```

- If you choose an **Array data type**, specify the **Array schema**.

Example Example array schema

```
OBJECT(x INT, y INT)
```

- If you choose a **Map data type**, specify the **Map schema**.

Example Example map schema

```
STRING, OBJECT(x INT, y INT)
```

Automatically import the details

1. Export your COLUMNS view from Snowflake as a CSV file.

For more information about the Snowflake COLUMNS view, see [COLUMNS view](#) in the Snowflake documentation.

2. Choose **Import from file** to import the CSV file and specify any additional information.

The database name, schema name, table name, column names and data types are automatically imported.

- If you choose an **Object data type**, specify the **Object schema**.
- If you choose an **Array data type**, specify the **Array schema**.
- If you choose a **Map data type**, specify the **Map schema**.

3. Enter the **Snowflake account identifier**.

For more information, see [Account identifiers](#) in the Snowflake documentation.

Note

Only S3 tables cataloged in AWS Glue can be used to retrieve the table schema automatically.

7. For **Columns allowed in collaborations**, choose an option based on your goal.

Your goal	Recommended option
Allow all columns for use in AWS Clean Rooms (subject to analysis rules)	All columns
Allow one or more columns from the Specify allowed columns dropdown list	Custom list

8. For **Configured table details**,

- a. Enter a **Name** for the configured table.

You can use the default name or rename this table.

- b. Enter a **Description** of the table.

The description helps differentiate between other configured tables with similar names.

- c. If you want to enable **Tags** for the configured table resource, choose **Add new tag** and then enter the **Key** and **Value** pair.

9. Choose **Configure new table**.

Now that you have created a configured table, you are ready to:

- [Add an analysis rule to the configured table](#)
- [Associate the configured table to a collaboration](#)

Adding an analysis rule to a configured table

The following sections describe how to add an analysis rule to your configured table. By defining the analysis rules, you can authorize the member who can query to run queries that match a specific analysis rule supported by AWS Clean Rooms.

AWS Clean Rooms supports the following types of analysis rules:

- [Aggregation analysis rule](#)
- [List analysis rule](#)
- [Custom analysis rule in AWS Clean Rooms](#)

There can be only one analysis rule per configured table. You can configure the analysis rule any time before you associate your configured tables with the collaboration.

Important

If you are using Cryptographic Computing for Clean Rooms and have encrypted data tables in the collaboration, the analysis rule you add to the encrypted configured table should be consistent with how the data was encrypted. For example, if you encrypted the data for SELECT (aggregation analysis rule), you shouldn't add the analysis rule for JOIN (list analysis rule).

Topics

- [Adding an aggregation analysis rule to a table \(guided flow\)](#)
- [Adding a list analysis rule to a table \(guided flow\)](#)
- [Adding a custom analysis rule to a table \(guided flow\)](#)
- [Adding analysis rule to a table \(JSON editor\)](#)
- [Next steps](#)

Adding an aggregation analysis rule to a table (guided flow)

The *aggregation analysis rule* allows queries that aggregate statistics without revealing row-level information using COUNT, SUM, and AVG functions along optional dimensions.

This procedure describes the process of adding an aggregation analysis rule to your configured table by using the **Guided flow** option in the AWS Clean Rooms console.

Note

Configured tables using non-S3 data sources only support [custom analysis rules](#).

To add the aggregation analysis rule to a table (guided flow)

1. Sign in to the AWS Management Console and open the AWS Clean Rooms console at <https://console.aws.amazon.com/cleanrooms>.
2. In the left navigation pane, choose **Tables**.

3. Choose the configured table.
 4. On the configured table detail page, choose **Configure analysis rule**.
 5. Under **Step 1: Choose analysis rule type**, under **Analysis rule type**, choose the **Aggregation** option.
 6. Under **Creation method**, select **Guided flow**, and then choose **Next**.
 7. Under **Step 2: Specify query controls**, for **Aggregate functions**:
 - a. Choose an **Aggregate function** from the dropdown:
 - **COUNT**
 - **COUNT DISTINCT**
 - **SUM**
 - **SUM DISTINCT**
 - **AVG**
 - b. Choose which columns can be used in the **Aggregate function** from the **Columns** dropdown.
 - c. (Optional) Choose **Add another function** to add another aggregate function and associate one or more columns to that function.
-  **Note**

At least one aggregate function is required.
- d. (Optional) Choose **Remove** to remove an aggregate function.
8. For **Join controls**,
 - a. Choose one option for **Allow table to be queried by itself**:

If you choose...	Then ...
No, only overlap can be queried	The table can be queried only when joined to a table owned by the member who can query.
Yes	The table can be queried by itself or when joined to other tables.

- b. Under **Specify join columns**, choose the columns that you want to allow to be used in the INNER JOIN statement.

This is *optional* if you have selected **Yes** in the previous step.

- c. Under **Specify allowed operators for matching**, choose which, if any, operators can be used for matching on multiple join columns. If you select two or more JOIN columns, one of these operators is required.

If you choose...	Then ...
AND	You can include AND in the INNER JOIN match conditions to join one column to another column between tables.
OR	You can include OR in the INNER JOIN match conditions to combine multiple column matches between tables. This logical operator is useful for obtaining a higher match rate.

9. (Optional) For **Dimension controls**, in the **Specify dimension columns** dropdown, choose which columns you want to allow to be used in the SELECT statement, and the WHERE, GROUP BY, and ORDER BY parts of the query.

 Note

Aggregate function or join columns can't be used as **Dimension** columns.

10. For **Scalar functions**, choose one option for **Which scalar functions do you want to allow?**

If you choose...	Then ...
All currently supported by AWS Clean Rooms	You allow all scalar functions currently supported by AWS Clean Rooms.

If you choose...	Then ...
	You can choose View list to see the entire list of Scalar functions supported in AWS Clean Rooms.
A custom list	You can customize which scalar functions to allow. Choose one or more options from the Specify allowed scalar functions dropdown.
None	You don't want to allow any scalar functions .

For more information, see [Scalar functions](#).

11. Choose **Next**.

12. Under **Step 3: Specify query results controls**, for **Aggregation constraints**:

- Select the dropdown list for each **Column name**.
- Select the dropdown list for each **Minimum number of distinct values** that must be met for each output row to be returned, after the COUNT DISTINCT function is applied to it.
- Choose **Add constraint** to add more aggregation constraints.
- (Optional) Choose **Remove** to remove an aggregation constraint.

13. For **Additional analyses applied to output**, select an option based on your goal.

Your goal	Recommended option
Allow only direct queries on this table. Deny additional analyses from being run on query results. The table can only be used for direct querying.	Not allowed

Your goal	Recommended option
Allow but don't require both direct queries and additional analyses on this table.	Allowed
Require that the table can only be used in direct queries that are processed with one of the required additional analyses. Direct queries on this table must be further processed before they can be returned.	Required

14. Choose **Next**.

15. Under **Step 4: Review and configure**, review the selections you've made for the previous steps, edit if necessary, and then choose **Configure analysis rule**.

You see a confirmation message that you've successfully configured an aggregation analysis rule to the table.

Adding a list analysis rule to a table (guided flow)

The *list analysis rule* allows queries that output row-level lists of the overlap between the associated table and a table of the member who can query.

This procedure describes the process of adding the list analysis rule to your configured table using the **Guided flow** option in the AWS Clean Rooms console.

Note

Configured tables using non-S3 data sources only support [custom analysis rules](#).

To add a list analysis rule to a table (guided flow)

1. Sign in to the AWS Management Console and open the AWS Clean Rooms console at <https://console.aws.amazon.com/cleanrooms>.
2. In the left navigation pane, choose **Tables**.
3. Choose the configured table.

4. On the configured table detail page, choose **Configure analysis rule**.
5. Under **Step 1: Choose analysis rule type**, under **Analysis rule type**, choose the **List** option.
6. Under **Creation method**, select **Guided flow**, and then choose **Next**.
7. Under **Step 2: Specify query controls**, for **Join controls**:
 - a. Under **Specify join columns**, choose the columns that you want to allow to be used in the INNER JOIN statement.
 - b. Under **Specify allowed operators for matching**, choose which, if any, operators can be used for matching on multiple join columns. If you select two or more JOIN columns, one of these operators is required.

If you choose...	Then ...
AND	You can include AND in the INNER JOIN match conditions to join one column to another column between tables.
OR	You can include OR in the INNER JOIN match conditions to combine multiple column matches between tables. This logical operator is useful for obtaining a higher match rate.

8. *(Optional)* For **List controls**, in the **Specify list columns** dropdown, choose which columns you want to allow to be used in the query output (that is, used in the SELECT statement), or used to filter results (that is, the WHERE statement).
9. Choose **Next**.
10. Under **Step 3: Specify query results controls**, for **Additional analyses applied to output**, select an option based on your goal.

Your goal	Recommended option
Allow only direct queries on this table. Deny additional analyses from being run on query results. The table can only be used for direct querying.	Not allowed

Your goal	Recommended option
Allow but don't require both direct queries and additional analyses on this table.	Allowed
Require that the table can only be used in direct queries that are processed with one of the required additional analyses. Direct queries on this table must be further processed before they can be returned.	Required

11. Under **Step 4: Review and configure**, review the selections you've made for the previous steps, edit if necessary, and then choose **Configure analysis rule**.

You see a confirmation message that you've successfully configured a list analysis rule for the table.

Adding a custom analysis rule to a table (guided flow)

The custom analysis rule enables custom SQL queries or PySpark jobs on a configured table. The custom analysis rule is required if you're using:

- [Analysis templates](#) to allow a specific set of pre-approved SQL queries or PySpark jobs or a specific set of accounts that can provide queries that use your data.
- [AWS Clean Rooms Differential Privacy](#) to protect against user-identification attempts.
- Non-S3 data sources, such as Amazon Athena or Snowflake.

This procedure describes the process of adding the custom analysis rule to your configured table using the **Guided flow** option in the AWS Clean Rooms console.

To add a custom analysis rule to a table (guided flow)

1. Sign in to the AWS Management Console and open the AWS Clean Rooms console at <https://console.aws.amazon.com/cleanrooms>.
2. In the left navigation pane, choose **Tables**.
3. Choose the configured table.
4. On the configured table detail page, choose **Configure analysis rule**.

5. Under **Step 1: Choose analysis rule type**, under **Analysis rule type**, choose the **Custom** option.
6. Under **Creation method**, select **Guided flow**, and then choose **Next**.
7. Under **Step 2: Specify analysis controls**, for **Direct analysis controls**, choose an option based on your goal.

Your goal	Recommended action
Review each new analysis before it is allowed to be run on this configured table	1. Under Analysis templates allowed to be run, choose Add analysis template. 2. Choose the appropriate Collaboration and the Analysis template from the dropdown lists. 3. Choose Next.
Allow specific collaborators to run any analyses of a chosen type without review on this table	1. Under Analysis type, a. Choose Any query to allow any query created by the AWS account you specify. b. Choose Any query to allow any job created by the AWS account you specify. 2. Under AWS accounts allowed to create any analysis, choose Add AWS account. 3. Enter an AWS account or choose the an AWS account ID from the dropdown list. 4. (Optional) Choose Add another AWS account to add another AWS account. 5. Choose Next.

8. Under **Step 3: Specify analysis results controls**,
 - a. For **Job results controls**, note that no additional results controls are supported.
 - b. Under **Query results controls**, for **Columns not allowed in output**, choose the columns you want to be allowed in the query output, based on your goal.

Your goal	Recommended action
Allow all columns to be returned in query outputs	1. Choose None 2. Proceed to Additional analyses applied to output.
Disallow certain columns from being returned in query outputs	1. Choose Custom list 2. Under Specify disallowed columns, choose the columns that you want removed from query outputs.

- c. For **Additional analyses applied to output** choose whether additional analyses can be applied to the query output, based on your goal.

Your goal	Recommended option
• Allow only direct queries on this table. • Deny additional analyses from being run on query results. • The table can only be used for direct querying.	Not allowed
Allow but don't require both direct queries and additional analyses on this table.	Allow
• Require that the table can only be used in direct queries that are processed with one of the required additional analyses. • Direct queries on this table must be further processed before they can be returned.	Required

- d. Choose **Next**.

9. (Optional) Under **Step 4: Set differential privacy**, determine whether you want differential privacy turned on or off.

Differential privacy is a mathematically-proven technique to protect your data from re-identification attacks.



Note

AWS Clean Rooms Differential Privacy is only available for collaborations using data stored in Amazon S3.

For **Differential privacy**, choose whether to turn differential privacy on or off, based on your goal.

Your goal	Recommended action
- You don't require protection against re-identification attempts - Your table doesn't have user-level data	- Choose Turn off. - Choose Next.

Your goal	Recommended action
- You require protection against re-identification attempts - Your table has user-level data	- Choose Turn on. - Select the User identifier column that contains the unique identifier of your users, such as the <code>user_id</code> column, whose privacy you want to protect. To turn on differential privacy for two or more tables in a collaboration, you must configure the same column as the User identifier column in both analysis rules to maintain a consistent definition of users across tables. In case of a misconfiguration, the member who can query receives an error message that there are two columns to choose from in order to compute the number of user contributions (for example, the number of ad impressions made by a user) while running the query. - Choose Next.

- Under **Step 5: Review and configure**, review the selections you've made for the previous steps, edit if necessary, and then choose **Configure analysis rule**.

You see a confirmation message that you've successfully configured a custom analysis rule for the table.

Adding analysis rule to a table (JSON editor)

The following procedure shows how to add an analysis rule to a table using the **JSON editor** option in the AWS Clean Rooms console.

Note

Configured tables using non-S3 data sources only support [custom analysis rules](#).

To add an aggregation, list, or custom analysis rule to a table (JSON editor)

1. Sign in to the AWS Management Console and open the AWS Clean Rooms console at <https://console.aws.amazon.com/cleanrooms>.
2. In the left navigation pane, choose **Tables**.
3. Choose the configured table.
4. On the configured table detail page, choose **Configure analysis rule**.
5. Under **Step 1: Choose analysis rule type**, under **Analysis rule type**, choose either the **Aggregation**, **List**, or **Custom** option.
6. Under **Creation method**, select **JSON editor**, and then choose **Next**.
7. Under **Step 2: Specify controls**, you can choose to insert a query structure (**Insert template**) or insert a file (**Import from file**).

If you choose...	Then ...
Insert template	1. Specify the parameters for the selected analysis rule in the Analysis rule definition. 2. You can press Ctrl + Spacebar to enable auto-complete. For more information about aggregation analysis rule parameters, see Aggregation analysis rule - query controls. For more information about list analysis rule parameters, see List analysis rule - query controls.
Import from file	1. Select your JSON file from your local drive. 2. Choose Open. The Analysis rule definition displays the analysis rule from the uploaded file.

8. Choose **Next**.
9. Under **Step 3: Review and configure**, review the selections you've made for the previous steps, edit if necessary, and then choose **Configure analysis rule**.

You receive a confirmation message that you've successfully configured an analysis rule for the table.

Next steps

Now that you configured an analysis rule to your configured table, you are ready to:

- [Associate a configured table to a collaboration](#)
- [Query the data tables](#) (as a member who can query)

Associating a configured table to a collaboration

After you have created a configured table and added an analysis rule to it, you can associate it to a collaboration and give AWS Clean Rooms a service role to access your AWS Glue tables.

Note

This service role has permissions to the tables. The service role is assumable only by AWS Clean Rooms to run allowed queries on behalf of the member who can query. No collaboration members (other than the data owner) have access to the underlying tables in the collaboration. The data owner can turn on differential privacy to make their tables available for querying by other members.

Important

Before you associate the configured AWS Glue tables to the collaboration, the AWS Glue table location must point to an Amazon Simple Storage Service (Amazon S3) folder and not to a single file. You can verify this location by viewing the table in the AWS Glue console at <https://console.aws.amazon.com/glue/>.

Note

If you have configured encryption in AWS Glue and created a service role, you must give that role access to use AWS KMS keys to decrypt AWS Glue tables.

If you associated a configured table that is backed by an AWS KMS-encrypted Amazon S3 dataset, you must give the role access to use the KMS key to decrypt Amazon S3 data.

For more information, see [Setting up encryption in AWS Glue](#) in the *AWS Glue Developer Guide*.

The following topics describe how to associate a configured table to a collaboration using the AWS Clean Rooms console:

Topics

- [Associate a configured table from the configured table detail page](#)
- [Associate a configured table from the collaboration detail page](#)
- [Next steps](#)

For information about how to associate your configured tables to the collaboration using the AWS SDKs, see the [AWS Clean Rooms API Reference](#).

Associate a configured table from the configured table detail page

To associate AWS Glue tables to the collaboration from the configured table detail page

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you haven't yet done so).
2. In the left navigation pane, choose **Tables**.
3. Choose the configured table.
4. On the configured table detail page, choose **Associate to collaboration**.
5. For the **Associate table to collaboration** dialog box, choose the **Collaboration** from the dropdown list.
6. Choose **Choose collaboration**.

On the **Associate table** page, the name of the configured table you chose appears under the **Choose configured table** section.

7. (Optional) For **Choose configured table**, do the following:

If you want to...	Then ...
Configure a new table	Choose Configure table and follow the prompts on the Configure table page.
View the schema and analysis rule for the configured table	Turn on View schema and analysis rule .

8. For **Table association details**,

- a. Enter a **Name** for the associated table.

You can use the default name or rename this table.

- b. (Optional) Enter a **Description** of the table.

The description helps with writing queries.

9. Specify the **Service access** permissions by selecting either **Create and use a new service role** or **Use an existing service role**.

 Note

If you are associating a configured table backed by Amazon Athena, choose an **Existing service role name** from the dropdown list. Ensure the service role has IAM and, if needed, Lake Formation permissions to the dataset.

If you choose...	Then ...
Create and use a new service role	- AWS Clean Rooms creates a service role with the required policy for this table. - The default Service role name is <code>cleanrooms-<timestamp></code> - You must have permissions to create roles and attach policies.

If you choose...	Then ...
	• If your input data is encrypted, you can select This data is encrypted with a KMS key and then enter an AWS KMS key that will be used to decrypt your data input.
Use an existing service role	1. Choose an Existing service role name from the dropdown list. The list of roles are displayed if you have permissions to list roles. If you don't have permissions to list roles, you can enter the Amazon Resource Name (ARN) of the role that you want to use. 2. View the service role by choosing the View in IAM external link. If there are no existing service roles, the option to Use an existing service role is unavailable. By default, AWS Clean Rooms doesn't attempt to update the existing role policy to add necessary permissions. 3. (Optional) Select the Add a pre-configured policy with necessary permissions to this role check box to add attach necessary permissions to the role. You must have permissions to modify roles and create policies.

 Note

- AWS Clean Rooms requires permissions to query according to the analysis rules. For more information about permissions for AWS Clean Rooms, see [AWS managed policies for AWS Clean Rooms](#).
- If the role doesn't have sufficient permissions for AWS Clean Rooms, you receive an error message stating that the role doesn't have sufficient permissions for AWS Clean Rooms. The role policy must be added before proceeding.
- If you can't modify the role policy, you receive an error message stating that AWS Clean Rooms couldn't find the policy for the service role.

10. If you want to enable **Tags** for the configured table association resource, choose **Add new tag** and then enter the **Key** and **Value** pair.
11. Choose **Associate table**.

Associate a configured table from the collaboration detail page

To associate AWS Glue tables to the collaboration from the collaboration detail page

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you haven't yet done so).
2. In the left navigation pane, choose **Collaborations**.
3. Choose the collaboration.
4. On the **Tables** tab, choose **Associate table**.
5. For **Choose configured table**, do one the following:

If you want to...	Then ...
Choose an existing configured table	Choose the Configured table name that you want to associate with the collaboration from the dropdown list.

If you want to...	Then ...
Configure a new table	Choose Configure table and follow the prompts on the Configure table page.
View the schema and analysis rule for the configured table	Turn on View schema and analysis rule .

6. For **Table association details**,

- a. Enter a **Name** for the associated table.

You can use the default name or rename this table.

- b. (Optional) Enter a **Description** of the table.

The description helps with writing queries.

7. Specify the **Service access** permissions by selecting either **Create and use a new service role** or **Use an existing service role**.

 Note

If you are associating a configured table backed by Amazon Athena, choose an **Existing service role name** from the dropdown list. Ensure the service role has IAM and, if needed, Lake Formation permissions to the dataset.

If you choose...	Then ...
Create and use a new service role	- AWS Clean Rooms creates a service role with the required policy for this table. - The default Service role name is <code>cleanrooms-<timestamp></code>. - You must have permissions to create roles and attach policies. - If your input data is encrypted, you can select This data is encrypted with a KMS

If you choose...	Then ...
	key and then enter an AWS KMS key that will be used to decrypt your data input.
Use an existing service role	1. Choose an Existing service role name from the dropdown list. The list of roles are displayed if you have permissions to list roles. If you don't have permissions to list roles, you can enter the Amazon Resource Name (ARN) of the role that you want to use. 2. View the service role by choosing the View in IAM external link. If there are no existing service roles, the option to Use an existing service role is unavailable. By default, AWS Clean Rooms doesn't attempt to update the existing role policy to add necessary permissions. 3. (Optional) Select the Add a pre-configured policy with necessary permissions to this role check box to add attach necessary permissions to the role. You must have permissions to modify roles and create policies.

Note

- AWS Clean Rooms requires permissions to query according to the analysis rules. For more information about permissions for AWS Clean Rooms, see [AWS managed policies for AWS Clean Rooms](#).

- If the role doesn't have sufficient permissions for AWS Clean Rooms, you receive an error message stating that the role doesn't have sufficient permissions for AWS Clean Rooms. The role policy must be added before proceeding.
- If you can't modify the role policy, you receive an error message stating that AWS Clean Rooms couldn't find the policy for the service role.

8. If you want to enable **Tags** for the configured table association resource, choose **Add new tag** and then enter the **Key** and **Value** pair.
9. Choose **Associate table**.

Next steps

Now that you associated your configured data table to the collaboration, you are ready to:

- [Add a collaboration analysis rule](#) to the configured table
- [Edit the collaboration](#), if you're the collaboration creator
- [Query the data tables](#) (as a member who can query)

Adding a collaboration analysis rule to a configured table

The *collaboration analysis rule* allows you to specify controls that are specific to this collaboration. These controls work together with the configured table analysis rule to determine how this table can be analyzed within this collaboration.

You add a collaboration analysis rule to a configured table after you've [created a configured table](#), [added an analysis rule](#), and [associated it to a collaboration](#). You need to add a collaboration analysis rule if the table is configured to support direct analysis or to allow additional analysis.

- **Direct analysis** – The table can be used in queries that analyze it directly. For example, in a query that outputs an aggregate measurement analysis or a list of identifiers for activation.
- **Additional analysis** – The table can also be used as input into additional analyses, in addition to queries that analyze it directly. For example, the table can be used in a query that is a seed for a lookalike ML model, or an ML input channel for a custom ML model.

To add the collaboration analysis rule to a table

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you haven't yet done so).
2. In the left navigation pane, choose **Collaborations**.
3. Choose the collaboration.
4. On the **Tables** tab, under **Tables associated by you**, view the configured table you've associated to the collaboration.

If **Direct analysis status** or **Additional analysis status** has a status of **Ready**, then the table is ready to be queried.

5. If **Direct analysis status** or **Additional analysis status** has a status of **Not ready**, then select the status, and then choose **Configure** in the dialog box.
6. On the **Configure collaboration analysis rule** page, expand **View configured table analysis rule** to view the details.
7. For **Allowed additional analyses**, choose the option based on your goal.

Your goal	Recommended option
Allow any additional analyses on the table.	Any
Allow only additional analyses on the table by a specific member.	Any by specific members
Allow only specific analyses on the table.	Custom list

8. For **Results delivery**, specify who can receive results from the **Members allowed to receive results for query output** dropdown.
9. Choose **Configure analysis rule**.

Configuring differential privacy policy (optional)

Note

AWS Clean Rooms Differential Privacy is only available for collaborations using AWS Clean Rooms SQL as the analytics engine and data stored in Amazon S3.

This procedure describes the process of configuring the differential privacy policy in a collaboration by using the **Guided flow** option in the AWS Clean Rooms console. This is a one-time step for all tables with differential privacy protection.

To configure differential privacy settings (guided flow)

1. Sign in to the AWS Management Console and open the AWS Clean Rooms console at <https://console.aws.amazon.com/cleanrooms>.
2. In the left navigation pane, choose **Collaborations**.
3. Choose the collaboration.
4. On the **Tables** tab of the collaboration page, choose **Configure differential privacy policy**.
5. On the **Configure differential privacy policy** page, choose values for the following properties:
 - **Privacy budget**
 - **Refresh privacy budget monthly**
 - **Noise added per query**

You can use the default values or enter custom values that support your specific use case. After choosing values for **Privacy budget** and **Noise added per query**, you can preview the resulting utility in terms of the number of aggregations that are possible across all queries on your data.

6. Choose **Configure**.

You'll see a confirmation message that you've successfully configured the differential privacy policy for the collaboration.

Now that you configured differential privacy, you are ready to:

- [Query the data tables](#) (as a member who can query)
- [Collaborations](#) (if you're the collaboration creator)

Viewing differential privacy usage logs

As a collaboration member who is protecting data with differential privacy, after you have created a collaboration with differential privacy, you can monitor the usage of the privacy budget.

To view how many aggregations were run and how much of the privacy budget was used

1. Sign in to the AWS Management Console and open the AWS Clean Rooms console at <https://console.aws.amazon.com/cleanrooms>.
2. In the left navigation pane, choose **Collaborations**.
3. Choose the collaboration.
4. Choose the **Tables** tab.
5. Choose **View usage logs** (blue text).
6. View the usage details, including the privacy budget and how much utility was provided.

Editing a differential privacy policy

At any time after configuring the differential privacy policy, you can update it to better reflect your privacy needs.

To edit the differential privacy policy

1. Sign in to the AWS Management Console and open the AWS Clean Rooms console at <https://console.aws.amazon.com/cleanrooms>.
2. In the left navigation pane, choose **Collaborations**.
3. Choose the collaboration.
4. On the **Tables** tab of the collaboration page, under **Tables associated by you**, choose **Edit**.
5. On the **Edit differential privacy** page, choose new values for the following properties:
 - **Privacy budget** – Move the slider bar to either increase or decrease the budget at any point during a collaboration. You can't decrease the budget after the member who can query has started querying your data. If the **Privacy budget** is increased, AWS Clean Rooms will continue using the existing budget until it is fully consumed before utilizing the newly added privacy budget.
 - **Noise added per query** – Move the slider bar to either increase or decrease the **Noise added per query** at any point during a collaboration.

Note

You can choose **Interactive examples** to explore how different values of **Privacy budget** and **Noise added per query** affect the number of aggregate functions that you can run.

You can't change the value of the **Privacy budget refresh**. To change your selection, you must delete the differential privacy policy and create a new one.

6. Choose **Save changes**.

You see a confirmation message that you've successfully edited the differential privacy policy.

Deleting a differential privacy policy

You can delete the differential privacy policy from the **Tables** tab of a collaboration.

To delete the differential privacy policy

1. Sign in to the AWS Management Console and open the AWS Clean Rooms console at <https://console.aws.amazon.com/cleanrooms>.
2. In the left navigation pane, choose **Collaborations**.
3. Choose the collaboration.
4. On the **Tables** tab of the collaboration page, next to **Differential privacy policy**, select **Delete**.
5. If you're certain that you want to delete the differential privacy policy, choose **Delete**.

After deleting a differential privacy policy, you can't access the privacy budget usage logs from that policy. Tables with differential privacy turned on can't be queried if the differential privacy policy is deleted.

Viewing the calculated differential privacy parameters

For users with expertise in differential privacy, you can view the calculated differential privacy parameters from the **Queries** tab of a collaboration.

To view the calculated differential privacy parameters

1. Sign in to the AWS Management Console and open the AWS Clean Rooms console at <https://console.aws.amazon.com/cleanrooms>.
2. In the left navigation pane, choose **Collaborations**.
3. Choose the collaboration.
4. On the **Queries** tab, in the **Results** section, select **View calculated differential privacy parameters**.

In the **Calculated differential privacy parameters** table, you can see sensitivity values of aggregate functions, which is defined as the maximum amount by which the result of a function can change if a single user's records are added, removed, or modified. The list includes the following differential privacy parameters:

- **User contribution limit (UCL)** is the maximum number of rows contributed by a user in a SQL query. For example, if you want to count the total number of matched impressions in a specified campaign where each user can have multiple impressions, AWS Clean Rooms Differential Privacy needs to bound the number of impressions of a single user in order to ensure that the differential privacy calculation is accurate. In other words, if any user has more impressions than the bound, then AWS Clean Rooms automatically takes a uniform random sample of that user's impressions as per the computed UCL value and exclude the remaining impressions of that user while executing the query. The UCL value equals to 1 if you are counting the number of unique users. This is because adding, removing, or modifying a single user can change the count of distinct users by at most 1.
- **Minimum value** is the lower bound of an expression used within an aggregate function such as `sum( )`. For example, if the expression is a column known as `purchase_value`, minimum value is the lower bound of the column.
- **Maximum value** is the upper bound of an expression used within an aggregate function such as `sum( )`. For example, if the expression is a column known as `purchase_value`, maximum value is the upper bound of the column.

In the **Calculated differential privacy parameters** table, you can use these parameters to better understand the total amount of noise in query results. For example, when the configured **Noise added per query** is 30 users and a `COUNT DISTINCT (user_id)` query is run, then AWS Clean Rooms Differential Privacy adds random noise that falls between -30 and 30 with high probability

because the sensitivity of COUNT DISTINCT is 1. In the case of a COUNT query with the same configuration, AWS Clean Rooms Differential Privacy adds statistical noise that is scaled by the user contribution limit because a single user could contribute multiple rows to the query result. In the case of SUM query like SUM (purchase_value) where all the column values are positive, the total noise is scaled by the user contribution limit times the maximum value. AWS Clean Rooms Differential Privacy automatically computes the sensitivity parameters to perform noise addition at query run-time and depletes the privacy budget. The depletion of privacy budget is required because the sensitivity parameters are data-dependent.

Viewing tables and analysis rules

To view tables associated with the collaboration and the analysis rules

1. Sign in to the AWS Management Console and open the AWS Clean Rooms console at <https://console.aws.amazon.com/cleanrooms>.
2. In the left navigation pane, choose **Collaborations**.
3. Choose the collaboration.
4. Choose the **Tables** tab.
5. Choose one of the following:
 - a. To view your tables associated in the collaboration, for **Tables associated by you**, choose a table (blue text).
 - b. To view other tables associated in the collaboration, for **Tables associated by collaborators**, choose a table (blue text).
6. View the table details and analysis rules on the table details page.

Editing configured table details

As a collaboration member, you can edit the configured table details.

To edit configured table details

1. Sign in to the AWS Management Console and open the AWS Clean Rooms console at <https://console.aws.amazon.com/cleanrooms>.
2. In the left navigation pane, choose **Tables**.
3. Choose the configured table that you created.

4. On the configured table detail page, scroll down to **Configured table details**.
5. Choose **Edit**.
6. Update the **Name** or **Description** of the configured table.
7. Choose **Save changes**.

Editing configured table tags

As a collaboration member, after you have created a configured table, you can manage the tags on the configured table resource on the **Configured tables** tab.

To edit the configured table tags

1. Sign in to the AWS Management Console and open the AWS Clean Rooms console at <https://console.aws.amazon.com/cleanrooms>.
2. In the left navigation pane, choose **Tables**.
3. Choose the configured table that you created.
4. On the configured table detail page, scroll down to the **Tags** section.
5. Choose **Manage tags**.
6. On the **Manage tags** page, you can do the following:
 - To remove a tag, choose **Remove**.
 - To add a tag, choose **Add new tag**.
 - To save your changes, choose **Save changes**.

Editing configured table analysis rule

To edit the configured table analysis rule

1. Sign in to the AWS Management Console and open the AWS Clean Rooms console at <https://console.aws.amazon.com/cleanrooms>.
2. In the left navigation pane, choose **Tables**.
3. Choose the configured table that you created.

4. On the configured table detail page, scroll down to either the **Aggregation analysis rule**, **List analysis rule**, or the **Custom analysis rule** section. (Your choice depends on which type of analysis rule you chose for the configured table.)
5. Choose **Edit**.
6. On the **Edit analysis rule** page, you can:
 - Modify the **Analysis rule definition** by:
 - Modifying the JSON editor.
 - Choosing **Import from file** to upload a new analysis rule definition.
 - Preview what members will see in a collaboration by selecting from the following options:
 - **Table view**
 - **JSON**
 - **Example query**
7. Choose **Save changes** to save your changes.

Deleting configured table analysis rule

Warning

This action can't be undone and impacts all related resources.

To delete the configured table analysis rule

1. Sign in to the AWS Management Console and open the AWS Clean Rooms console at <https://console.aws.amazon.com/cleanrooms>.
2. In the left navigation pane, choose **Tables**.
3. Choose the configured table that you created.
4. On the configured table detail page, scroll down to either the **Aggregation analysis rule**, **List analysis rule**, or the **Custom analysis rule** section. (Your choice depends on which type of analysis rule you chose for the configured table.)
5. Choose **Delete**.
6. If you're certain that you want to delete the analysis rule, choose **Delete**.

Configured table disallowed columns

The disallowed output columns configuration is a control in the AWS Clean Rooms custom analysis rule that enables you to define the list of columns (if any) that you don't allow to be projected in the query result. The columns referenced in this list are considered "disallowed output columns". This means that any reference to such column through transformation, aliasing, or other means may not be present in the final SELECT (projection) of the query.

While the capability prohibits columns from being directly projected in the output, it doesn't fully prevent underlying values from being indirectly inferred through other mechanisms. These columns can still be used in a projection clause (such as in a subquery or a Common Table Expression (CTE)), as long as they aren't referenced in the very final projection.

The disallowed output columns configuration gives you the flexibility to apply and codify control on your table in combination with analysis template level reviews based on use cases and corresponding privacy requirements.

For more information on how to set this configuration, see [Adding a custom analysis rule to a table \(guided flow\)](#).

Examples

The following examples display how the disallowed output columns control is applied.

- Member A is in a collaboration with Member B.
- Member B is member who can run queries.
- Member A defines a table *users* with the columns *age*, *gender*, *email*, and *name*. The columns *age* and *name* are disallowed output columns.
- Member B defines a table *pets* with a similar set of columns *age*, *gender*, and *owner_name*. However, they don't set any constraints on the output columns, meaning that all columns in the table can be projected freely in the query.

If Member B runs the following query, it's blocked because disallowed output columns can't be directly projected:

```
SELECT
  age
```

```
FROM
  users
```

If Member B runs the following query, it's blocked because disallowed output columns can't be implicitly projected via project star:

```
SELECT
  *
FROM
  users
```

If Member B runs the following query, it's blocked because transformations of disallowed output columns can't be projected:

```
SELECT
  COUNT(age)
FROM
  users
```

If Member B runs the following query, it's blocked because disallowed output columns can't be referenced in final projection using an alias:

```
SELECT
  count_age
FROM
  (SELECT COUNT(age) AS count_age FROM users)
```

If Member B runs the following query, it's blocked because transformed restricted columns are projected in output:

```
SELECT
  CONCAT(name, email)
FROM
  users
```

If Member B runs the following query, it's blocked because disallowed output columns defined in CTE can't be referenced in the final projection:

```
WITH cte AS (  
  SELECT  
    age AS age_alias  
  FROM  
    users  
)  
SELECT age_alias FROM cte
```

If Member B runs the following query, it's blocked because disallowed output columns can't be used as sort or partition keys in the final projection:

```
SELECT  
  LISTAGG(gender) WITHIN GROUP (ORDER BY age) OVER (PARTITION BY age)  
FROM  
  users
```

If Member B runs the following query, it succeeds because columns that are part of the disallowed output columns can still be used across other constructs in the query, such as in join or filter clauses.

```
SELECT  
  u.name,  
  p.gender,  
  p.age  
FROM  
  users AS u  
JOIN  
  pets AS p  
ON  
  u.name = p.owner_name
```

In the same scenario, Member B can also use the *name* column in *users* as a filter or sort key:

```
SELECT  
  u.email,
```

```
u.gender
FROM
  users AS u
WHERE
  u.name = 'Mike'
ORDER BY
  u.name
```

Additionally, the disallowed output columns from *users* can be used in intermediate projections such as subqueries and CTEs, such as:

```
WITH cte AS (
  SELECT
    u.gender,
    u.id,
    u.first_name
  FROM
    users AS u
)
SELECT
  first_name
FROM
  (SELECT cte.gender, cte.id, cte.first_name FROM cte)
```

Editing configured table associations

As a collaboration member, you can edit the configured table associations that you have created.

To edit configured table associations

1. Sign in to the AWS Management Console and open the AWS Clean Rooms console at <https://console.aws.amazon.com/cleanrooms>.
2. In the left navigation pane, choose **Collaborations**.
3. Choose the collaboration.
4. Choose **Tables** tab.
5. For **Tables associated by you**, choose a table.

6. On the table details page, scroll down to view the **Table association details**.
7. Choose **Edit**.
8. On the **Edit configured table associations** page, update the **Description** or the **Service access information**.
9. Choose **Save changes**.

Disassociating configured tables

As a collaboration member, you can disassociate a configured table from the collaboration. This action prevents the member who can query from querying the table.

To disassociate a configured table

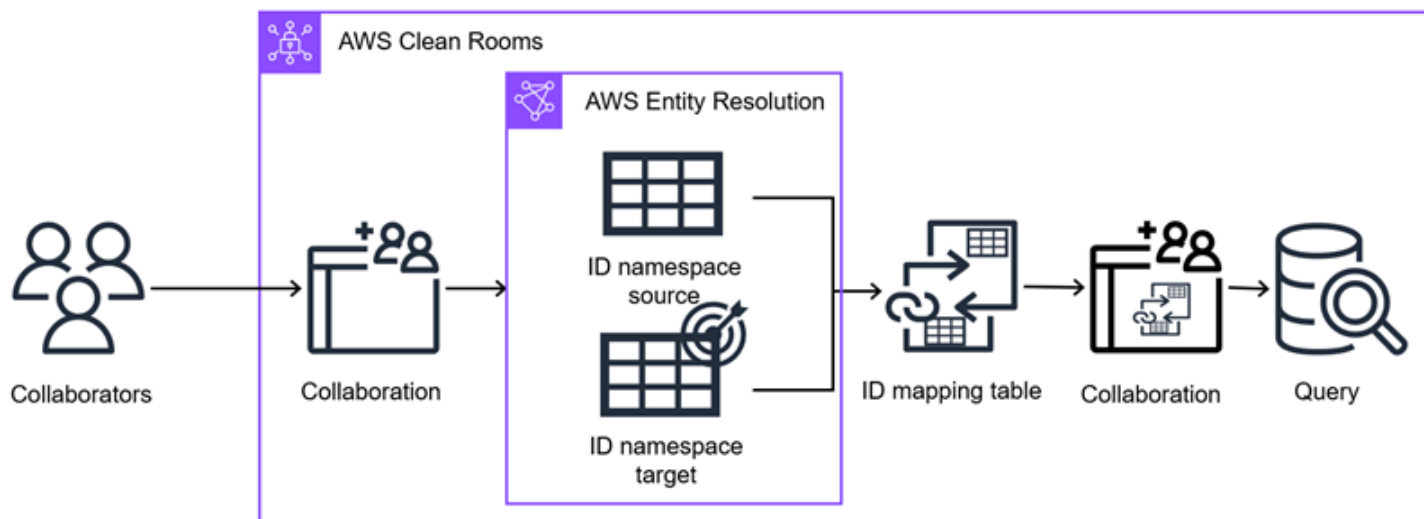
1. Sign in to the AWS Management Console and open the AWS Clean Rooms console at <https://console.aws.amazon.com/cleanrooms>.
2. In the left navigation pane, choose **Collaborations**.
3. Choose the collaboration.
4. Choose **Tables** tab.
5. For **Tables associated by you**, select the option button next to the table that you want to disassociate.
6. Choose **Disassociate**.
7. In the dialog box, confirm the decision to disassociate the configured table and prevent the member who can query from querying the table by choosing **Disassociate**.

AWS Entity Resolution in AWS Clean Rooms

With AWS Entity Resolution in AWS Clean Rooms, you can translate data from a source to a target, populate an ID mapping table with the translated data, and query the data.

First, you create a collaboration in AWS Clean Rooms and add the AWS accounts you want to invite, or join a collaboration you're invited to by creating a membership. Next, you perform ID mapping on two data tables. You do this by either associating an existing ID namespace source or creating a new one in AWS Entity Resolution. The other member of the collaboration associates an existing ID namespace target or creates a new ID namespace target. Then, you create and populate an ID mapping table from the two associated ID namespaces. Finally, the member who can query runs a query across the two data tables by joining on the ID mapping table.

The following diagram summarizes how to work with AWS Entity Resolution in AWS Clean Rooms.



Note

The currently supported transcoding service provider is LiveRamp, which is available in the following AWS Regions: US East (N. Virginia), US East (Ohio), and US West (Oregon).

Topics

- [ID namespaces in AWS Clean Rooms](#)
- [ID mapping tables in AWS Clean Rooms](#)

ID namespaces in AWS Clean Rooms

An *ID namespace* is a wrapper around your identity table that enables you to provide metadata explaining your dataset and how to use it in an ID mapping workflow. An *ID mapping workflow* is a data processing job that maps data from an input data source to an input data target based on the specified ID mapping method. It produces an ID mapping table.

There are two types of ID namespaces: **Source** and **Target**. The **Source** contains configurations for the source data that will be processed in an ID mapping workflow. The **Target** contains a configuration of the target data which all sources will resolve to. To define the input data that you want to resolve across two AWS accounts, create an ID namespace source and an ID namespace target to translate your data from one set (**Source**) to another (**Target**).

You can either create a new ID namespace or you can associate an existing one. For more information about how to create an ID namespace in AWS Entity Resolution, see [Creating an ID namespace](#) in the *AWS Entity Resolution User Guide*.

Topics

- [Creating and associating a new ID namespace](#)
- [Associating an existing ID namespace](#)
- [Editing ID namespace associations](#)
- [Disassociating ID namespace associations](#)

Creating and associating a new ID namespace

Each member of the collaboration must create and associate either an ID namespace **Source** or an ID namespace **Target** before creating an ID mapping table to query identity data.

If you have already created an ID namespace in AWS Entity Resolution, skip to [Associating an existing ID namespace](#).

To create and associate a new ID namespace

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you haven't yet done so).
2. In the left navigation pane, choose **Collaborations**.
3. Choose the collaboration.

4. On the **Entity resolution** tab, choose **Associate ID namespace**.
5. On the **Associate ID namespace** page, for **Entity resolution data**, choose **Create ID namespace**.

The AWS Entity Resolution console appears in a new tab.

6. Follow the prompts on the **Create ID namespace** page in the AWS Entity Resolution console.
 - a. For **Details**, enter the **ID namespace name**, **Description**, and select the **ID namespace type** (either **Source** or **Target**).
 - b. For the **ID namespace method**, choose either the **Rule-based** method for rule-based matching or **Provider services** for third-party transcoding.
 - c. Specify the **Data input type**, depending on the ID namespace method you've chosen.
 - d. Choose **Create ID namespace**.
7. Go back to the AWS Clean Rooms console.
8. On the **Associate ID namespace** page, for **Entity resolution data**, choose the **AWS Entity Resolution ID namespace** source or target that you want to associate with the collaboration from the dropdown list.
9. For **Association details**, take the following steps.
 - a. Enter a **Name** for the associated ID namespace.

You can use the default name or rename this ID namespace.

- b. (Optional) Enter a **Description** of the ID namespace.

The description helps with writing queries.

10. Specify the **AWS Clean Rooms access** permissions by selecting an option and then taking the recommended action.

Option	Recommended action
Allow AWS Clean Rooms to add and manage permission policy	AWS Clean Rooms creates a service role with the required policy for this association.
Add and manage permissions manually	Do one of the following: Review the Resource policy and add necessary permissions to the policy.

Option	Recommended action
	Use an existing policy by choosing Add policy statement. You must have permissions to modify roles and create policies.  Note If you can't modify the role policy, you receive an error message stating that AWS Clean Rooms couldn't find the policy for the service role.

- (Optional) For **Advanced ID mapping table configurations**, modify the default protections for the column that comes from the ID namespace.

The ID mapping table is configured by default to only allow an `INNER JOIN` on both the `sourceID` column and the `targetID` column. You can modify this configuration so that the column that comes from this ID namespace (either `sourceID` or `targetID`) can be allowed anywhere in the query.

Your goal	Recommended option
Categorize the column as a "join column" and only allow it in an <code>INNER JOIN</code> clause	Yes
Categorize the column as a "dimension column" and allow it anywhere in the query, including a <code>JOIN</code> clause, <code>SELECT</code> , <code>WHERE</code> and <code>GROUP BY</code> statements of the query.	No, allow anywhere in the query

- (Optional) If you want to enable **Tags** for the ID namespace resource, choose **Add new tag** and then enter the **Key** and **Value** pair.
- Choose **Associate**.

14. On the **Entity resolution** tab, under the **Associated ID namespaces** table, view the associated ID namespace and verify that the ID namespace type is correct (**Source** or **Target**).

After all members in the collaboration have associated their ID namespaces, you can [create an ID mapping table](#) and query the data.

Associating an existing ID namespace

In this procedure, each member associates either their existing ID namespace source or their ID namespace target in the collaboration.

To associate an existing ID namespace

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you haven't yet done so).
2. In the left navigation pane, choose **Collaborations**.
3. Choose the collaboration.
4. On the **Entity resolution** tab, choose **Associate ID namespace**.
5. On the **Associate ID namespace** page, for **Entity resolution data**, choose the **AWS Entity Resolution ID namespace** source or target that you want to associate with the collaboration from the dropdown list.
6. For **Association details**, take the following steps.
 - a. Enter a **Name** for the associated ID namespace.

You can use the default name or rename this ID namespace.
 - b. (Optional) Enter a **Description** of the ID namespace.

The description helps with writing queries.
7. Specify the **AWS Clean Rooms access** permissions by selecting an option and then taking the recommended action.

Option	Recommended action
Allow AWS Clean Rooms to add and manage permission policy	AWS Clean Rooms creates a service role with the required policy for this association.

Option	Recommended action
Add and manage permissions manually	Do one of the following: - Review the Resource policy and add necessary permissions to the policy. - Use an existing policy by choosing Add policy statement. You must have permissions to modify roles and create policies.  Note If you can't modify the role policy, you receive an error message stating that AWS Clean Rooms couldn't find the policy for the service role.

8. (Optional) For **Advanced ID mapping table configurations**, modify the default protections for the column that comes from the ID namespace.

The ID mapping table is configured by default to only allow an `INNER JOIN` on both the `sourceID` column and the `targetID` column. You can modify this configuration so that the column that comes from this ID namespace (either `sourceID` or `targetID`) can be allowed anywhere in the query.

Your goal	Recommended option
Categorize the column as a "join column" and only allow it in an <code>INNER JOIN</code> clause.	Yes
Categorize the column as a "dimension column" and allow it anywhere in the query, including a <code>JOIN</code> clause, <code>SELECT</code> , <code>WHERE</code> , and <code>GROUP BY</code> statements of the query.	No, allow anywhere in the query

9. (Optional) If you want to enable **Tags** for the ID namespace resource, choose **Add new tag** and then enter the **Key** and **Value** pair.
10. Choose **Associate**.
11. On the **Entity resolution** tab, under the **Associated ID namespaces** table, view the associated ID namespace and verify that the ID namespace type is correct (**Source** or **Target**).

After all members in the collaboration have associated their ID namespaces, you can [create an ID mapping table](#) and query the data.

Editing ID namespace associations

As a collaboration member, you can edit the ID namespace associations that you have created.

To edit an ID namespace association

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you haven't yet done so).
2. In the left navigation pane, choose **Collaborations**.
3. Choose the collaboration.
4. Choose the **Entity resolution** tab.
5. For **Associated ID namespaces**, choose an ID namespace.
6. On the ID namespace details page, scroll down to view the **ID namespace association details**.
7. Choose **Edit**.
8. On the **Edit ID namespace associations** page, edit any of the following:
 - a. For **Association details**, update the **Name** or the **Description**.
 - b. (Optional) For **Advanced ID mapping table configurations**, modify the default protections for the column that comes from the ID namespace.

The ID mapping table is configured by default to only allow an `INNER JOIN` on both the `sourceID` column and the `targetID` column. You can modify this configuration so that the column that comes from this ID namespace (either `sourceID` or `targetID`) can be allowed anywhere in the query.

Your goal	Recommended option
Categorize the column as a "join column" and only allow it in an INNER JOIN clause	Yes
Categorize the column as a "dimension column" and allow it anywhere in the query, including a JOIN clause, SELECT, WHERE and GROUP BY statements of the query.	No, allow anywhere in the query

9. Choose **Save changes**.

Disassociating ID namespace associations

As a collaboration member, you can disassociate an ID namespace from the collaboration. This action prevents the member who can query from querying the table.

Warning

Disassociating an ID namespace association from a collaboration deletes any data from derived ID mapping tables, rendering them not queryable.

For example, if your ID namespace association was used as a SOURCE in three different ID mapping tables, then all the data from these ID mapping tables will be deleted when you disassociate your ID namespace association.

To disassociate an ID namespace association

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you haven't yet done so).
2. In the left navigation pane, choose **Collaborations**.
3. Choose the collaboration.
4. Choose the **Entity resolution** tab.

5. For **Associated ID namespaces**, select the option button next to the ID namespace that you want to disassociate.
6. Choose **Disassociate**.
7. In the dialog box, confirm your decision to disconnect the ID namespace by choosing **Disassociate**. This action prevents any member who can query from accessing the ID mapping table.

If a member of the collaboration removes one of the ID namespaces, you can't repopulate the ID mapping table if the source has left the collaboration.

Even though the ID mapping table was populated previously, disassociating the ID namespace means you can no longer run queries on that table.

ID mapping tables in AWS Clean Rooms

An *ID mapping table* is a resource in AWS Clean Rooms that enables multiparty identity mapping in a collaboration.

Before you create an ID mapping table, you must first have both source and target data configured as ID namespaces.

After you create an ID mapping table, you use an ID mapping workflow to translate the source ID namespace to the target ID namespace. You can do this using either a rule-based method, or a provider service transcoding method.

An *ID mapping workflow* is a data processing job that maps data from an input data source to an input data target based on the specified ID mapping workflow method. This workflow populates an ID mapping table.

Note

ID mapping tables can only be created from datasets that are stored in Amazon S3 and crawled into AWS Glue tables.

There are two ID mapping workflow methods: rule-based ID mapping or provider services ID mapping:

- Rule-based ID mapping – You use matching rules to translate first-party data from a source to a target.
- Provider services ID mapping – You use the LiveRamp provider service to translate third-party data from a source to a target.

Note

The currently supported transcoding service provider is LiveRamp. Any member in the collaboration who has an subscription with LiveRamp through AWS Data Exchange can create the ID mapping table. If you already have a subscription to LiveRamp, but not through AWS Data Exchange, contact LiveRamp to get a private offer. For more information, see [Subscribe to a provider service on AWS Data Exchange](#) in the *AWS Entity Resolution User Guide*.

Topics

- [Creating and populating a new ID mapping table](#)
- [Populating an existing ID mapping table](#)
- [Editing an ID mapping table](#)
- [Deleting an ID mapping table](#)

Creating and populating a new ID mapping table

Before you create an ID mapping table, you must first have an associated ID namespace source and target. The ID namespace source and target that you associate to the collaboration must be configured for the type of ID mapping you want to perform (either rule-based ID mapping or provider services ID mapping).

After you create an ID mapping table, you have two options. You can populate it immediately, which runs the ID mapping workflow. Or, you can wait to populate the table later.

After the ID mapping table is successfully populated, you can then run a multi-table join query on the ID mapping table to join the `sourceId` with the `targetId` and analyze the data.

Topics

- [Create an ID mapping table \(rule-based\)](#)

- [Create an ID mapping table \(provider services\)](#)

Create an ID mapping table (rule-based)

This topic describes the process of creating an ID mapping table that uses matching rules to translate first-party data from a source to a target.

To create and populate a new ID mapping table using the rule-based method

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you haven't yet done so).
2. In the left navigation pane, choose **Collaborations**.
3. Choose the collaboration.
4. On the **Entity resolution** tab, choose **Create ID mapping table**.
5. On the **Create ID mapping table** page under **ID mapping settings**, take one of the following actions based on your goal.

Your goal	Recommended action
Create a new ID mapping workflow	1. Leave the Create a new ID mapping workflow checkbox selected. 2. Continue with Step 6.
Reuse an existing ID mapping workflow	1. Clear the Create a new ID mapping workflow checkbox. 2. Select a rule-based ID mapping workflow from the dropdown list. 3. Skip to Step 9.

6. Under **Identity data**, take one of the following actions based on your scenario

Your scenario	Recommended action
There is only one ID namespace source and one ID namespace target in the collaboration	View the Source and Target ID namespace associations.

Your scenario	Recommended action
There are multiple ID namespace associations in the collaboration	Select the Source and Target ID namespace associations you want to use from the dropdown lists.

7. Under **Method**, view the selected ID mapping workflow method: **Rule-based**
8. For **Rule parameters**, specify the **Rule controls**, **Comparison type**, and **Record matching** configurations.
 - a. For **Rule controls**, choose if you want the matching rules to be provided by either the **Target** or **Source** ID namespace.

You can view the rules by turning on **Show rules**.

Rule controls must be compatible between the source and the target ID namespace to be used in an ID mapping workflow. For example, if a source ID namespace limits rules to the target but the target ID namespace limits rules to the source, this results in an error.

- b. **Comparison type** is automatically set to **Multiple input fields**.

This is because both participants had selected this option previously.

- c. Specify the **Record matching type** by choosing one of the following options.

Your goal	Recommended option
Limit the record matching type to store only one matching record in the source for each matched record in the target when you create the ID mapping workflow.	One source to one target
Limit the record matching type to store all matching records in the source for each matched record in the target when you create the ID mapping workflow.	Many sources to one target

 **Note**

The limitations specified for the source and target ID namespaces must be compatible.

9. For **ID mapping details**, take the following actions.

a. Enter an **ID mapping table name**.

You can use the default name or rename this ID mapping table.

b. (Optional) Enter a **Description** of the ID mapping table.

The description helps with writing queries.

10. Specify the **Permissions** for **AWS Clean Rooms access** by choosing an option and taking the recommended action.

Option	Recommended action
Allow AWS Clean Rooms to add and manage permission policy	AWS Clean Rooms creates a service role with the required policy for this association.
Add and manage permissions manually	Do one of the following: - Review the Resource policy and add necessary permissions to the policy. - Use an existing policy by choosing Add policy statement. You must have permissions to modify roles and create policies.  Note If you can't modify the role policy, you receive an error message stating

Option	Recommended action
	that AWS Clean Rooms couldn't find the policy for the service role.

11. Specify the **Permissions** for **AWS Entity Resolution access** by choosing an option and taking the recommended action:

This section is only visible if you're creating a new ID mapping table.

Option	Recommended action
Create and use a new service role	AWS Clean Rooms creates a service role with the required policy for this table. The default Service role name is <code>entityresolution-id-mapping-workflow- <timestamp></code> You must have permissions to create roles and attach policies. If your input data is encrypted, you can choose This data is encrypted by a KMS key and then enter an AWS KMS key that will be used to decrypt your data input.
Use an existing service role	1. Choose an Existing service role name from the dropdown list. The list of roles are displayed if you have permissions to list roles. If you don't have permissions to list roles, you can enter the Amazon Resource Name (ARN) of the role that you want to use.

Option	Recommended action
	2. View the service role by choosing the View in IAM external link. If there are no existing service roles, the option to Use an existing service role is unavailable. By default, AWS Clean Rooms doesn't attempt to update the existing role policy to add necessary permissions. 3. (Optional) Select the Add a pre-configured policy with necessary permissions to this role checkbox to attach necessary permissions to the role. You must have permissions to modify roles and create policies.

12. (Optional) Specify any **Additional settings** by selecting one of the following:

- a. For **ID mapping table**, take one of the following actions based on your goal.

Your goal	Recommended action
Enable custom encryption settings for the ID mapping table	Choose Customize encryption settings and then enter the AWS KMS key.  Note This KMS key needs to grant the required permissions to use within AWS Entity Resolution to <code>cleanrooms.amazonaws.com</code> using a KMS key policy. For more details about the required permissions for working with encryptions with an ID mapping

Your goal	Recommended action
	workflow, see Create a workflow job role for AWS Entity Resolution in the <i>AWS Entity Resolution User Guide</i>.
Enable Tags for the ID mapping table resource	Choose Add new tag and then enter the Key and Value pair.

- b. For **ID mapping workflow**, take one of the following actions based on your goal.

This section is only visible if you're creating a new ID mapping table.

Your goal	Recommended action
Modify the Name and description of the ID mapping workflow	Clear the Keep the same ID mapping table name and description checkbox and enter a new ID mapping workflow name and Description .
Enable Tags for the ID mapping workflow resource	Choose Add new tag and then enter the Key and Value pair.

13. Choose one of the following options based on your goal.

Your goal	Recommended option
Create an empty ID mapping table but not run the ID mapping workflow	Create ID mapping table You can populate the ID mapping table later by following the Populating an existing ID mapping table process.
Create the ID mapping table and run the ID mapping workflow	Create and populate ID mapping table The ID mapping workflow process begins. During this process, the ID mapping table is populated with translated IDs. The ID

Your goal	Recommended option
	mapping workflow might take a few hours to process. After the ID mapping table is successfully populated, you can query the ID mapping table to join the sourceId with the targetId and analyze the data.

Create an ID mapping table (provider services)

This topic describes the process of creating an ID mapping table that uses a provider service (LiveRamp). The LiveRamp provider services translates a set of source RampIDs to another using either maintained or derived RampIDs.

To create a new ID mapping table using the provider services method

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you haven't yet done so).
2. In the left navigation pane, choose **Collaborations**.
3. Choose the collaboration.
4. On the **Entity resolution** tab, choose **Create ID mapping table**.
5. On the **Create ID mapping table** page under **ID mapping settings**, take one of the following actions based on your goal.

Your goal	Recommended action
Create a new ID mapping workflow	1. Leave the Create a new ID mapping workflow checkbox selected. 2. Continue with Step 6.
Reuse an existing ID mapping workflow	1. Clear the Create a new ID mapping workflow checkbox. 2. Select a rule-based ID mapping workflow from the dropdown list.

Your goal	Recommended action
	3. Skip to Step 9.

6. Under **Identity data**, take one of the following actions based on your scenario.

Your scenario	Recommended action
There is only one ID namespace source and one ID namespace target in the collaboration	View the Source and Target ID namespace associations
There are multiple ID namespace associations in the collaboration	Select the Source and Target ID namespace associations you want to use from the dropdown lists.

7. Under **Method**, verify that the selected ID mapping workflow method is **LiveRamp transcoding**.
8. For **LiveRamp configurations**, enter the following information provided by LiveRamp:
- **LiveRamp ID manager ARN**
 - **LiveRamp secret manager ARN**

Alternatively, you can choose **Import from existing workflow**:

9. For **ID mapping details**, take the following steps.

- a. Enter an **ID mapping table name**.

You can use the default name or rename this ID mapping table.

- b. (Optional) Enter a **Description** of the ID mapping table.

The description helps with writing queries.

10. Specify the **Permissions** for **AWS Clean Rooms access** by selecting one of the following:

Option	Recommended action
Allow AWS Clean Rooms to add and manage permission policy	AWS Clean Rooms creates a service role with the required policy for this association.
Add and manage permissions manually	Do one of the following: - Review the Resource policy and add necessary permissions to the policy. - Use an existing policy by choosing Add policy statement. You must have permissions to modify roles and create policies.  Note If you can't modify the role policy, you receive an error message stating that AWS Clean Rooms couldn't find the policy for the service role.

11. Specify the **Permissions** for **AWS Entity Resolution access** by selecting an option and taking the recommended action.

This section is only visible if you're creating a new ID mapping table.

Option	Recommended action
Create and use a new service role	AWS Clean Rooms creates a service role with the required policy for this table. The default Service role name is <code>entityresolution-id-mapping-workflow-<timestamp></code>

Option	Recommended action
	You must have permissions to create roles and attach policies. If your input data is encrypted, you can choose the This data is encrypted by a KMS key option and then enter an AWS KMS key that will be used to decrypt your data input.
Use an existing service role	1. Choose an Existing service role name from the dropdown list. The list of roles are displayed if you have permissions to list roles. If you don't have permissions to list roles, you can enter the Amazon Resource Name (ARN) of the role that you want to use. 2. View the service role by choosing View in IAM. If there are no existing service roles, the option to Use an existing service role is unavailable. By default, AWS Clean Rooms doesn't attempt to update the existing role policy to add necessary permissions. 3. (Optional) Select the Add a pre-configured policy with necessary permissions to this role checkbox to add attach necessary permissions to the role. You must have permissions to modify roles and create policies.

12. (Optional) Specify any **Additional settings** by selecting one of the following:

- a. For **ID mapping table**, take one of the following actions based on your goal.

Your goal	Recommended action
Enable custom encryption settings for the ID mapping table	Choose Customize encryption settings and then enter the AWS KMS key.  Note This KMS key needs to grant the required permissions to use within AWS Entity Resolution to <code>cleanrooms.amazonaws.com</code> using a KMS key policy. For more details about the required permissions for working with encryptions with an ID mapping workflow, see Create a workflow job role for AWS Entity Resolution in the <i>AWS Entity Resolution User Guide</i>.
Enable Tags for the ID mapping table resource	Choose Add new tag and then enter the Key and Value pair.

- b. For **ID mapping workflow**, take one of the following actions based on your goal.

This section is only visible if you're creating a new ID mapping table.

Your goal	Recommended action
Modify the Name and description of the ID mapping workflow	Clear the Keep the same ID mapping table name and description checkbox and enter a new ID mapping workflow name and Description .
Enable Tags for the ID mapping workflow resource	Choose Add new tag and then enter the Key and Value pair.

13. Choose one of the following actions based on your goal.

Your goal	Recommended action
Create an empty ID mapping table but not run the ID mapping workflow	Choose Create ID mapping table. You can populate the ID mapping table later by following the Populating an existing ID mapping table process.
Create the ID mapping table and run the ID mapping workflow	Choose Create and populate ID mapping table. The ID mapping workflow process begins. During this process, the ID mapping table is populated with transcoded IDs. The ID mapping workflow might take a few hours to process. After the ID mapping table is successfully populated, you can query the ID mapping table to join the sourceId with the targetId and analyze the data.

Populating an existing ID mapping table

When new data is added to an ID namespace, use this workflow.

To populate an existing ID mapping table

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you haven't yet done so).
2. In the left navigation pane, choose **Collaborations**.
3. Choose the collaboration.
4. On the **Entity resolution** tab, under the **ID mapping tables** section, do one of the following:
 - Choose an ID mapping table and then choose **Populate**.

- Select the option button next to the ID mapping table, and on the ID mapping table details page, choose **Populate**.

The ID mapping workflow process begins. During this process, the ID mapping table is populated with transcoded IDs. The ID mapping workflow might take a few hours to process.

After the ID mapping table is successfully populated, you can [query the ID mapping table](#) to join the `sourceId` with the `targetId`.

Editing an ID mapping table

As a collaboration member, you can edit the ID mapping table that you have created.

To edit an ID mapping table

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you haven't yet done so).
2. In the left navigation pane, choose **Collaborations**.
3. Choose the collaboration.
4. Choose the **Entity resolution** tab.
5. For **ID mapping tables**, choose a table.
6. On the ID mapping table details page, scroll down to view the **ID mapping table details**.
7. Choose **Edit**.
8. On the **Edit ID mapping table** page, update the **Description** or the **Service access information**.
9. Choose **Save changes**.

Deleting an ID mapping table

As a collaboration member, you can delete an ID mapping table that you have created. This action prevents the member who can query from querying the table.

Warning

Deleting a mapping table permanently removes any populated data.

To delete an ID mapping table

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you haven't yet done so).
2. In the left navigation pane, choose **Collaborations**.
3. Choose the collaboration.
4. Choose the **Entity resolution** tab.
5. For ID mapping tables, choose a table.
6. On the ID mapping table details page, scroll down to view the **ID mapping tables**.
7. Choose an ID mapping table, and then choose **Delete**.
8. If you're certain that you want to delete the ID mapping table, choose **Delete**.

Analysis templates in AWS Clean Rooms

Analysis templates work with the [Custom analysis rule in AWS Clean Rooms](#). With an analysis template, you can define parameters to help you reuse the same query. AWS Clean Rooms supports a subset of parameterization with literal values.

Analysis templates are collaboration-specific. For each collaboration, members can only see the queries in that collaboration. If you plan to use differential privacy in a collaboration, you should make sure that your analysis templates are compatible with the [general-purpose query structure](#) of AWS Clean Rooms Differential Privacy.

You can create an analysis template in two ways: using SQL code or using Python code for Spark.

- SQL analysis templates are available in collaborations that use both the Spark analytics engine and the AWS Clean Rooms SQL analytics engine.
- PySpark analysis templates are available in collaborations that use the Spark analytics engine.

Topics

- [SQL analysis templates](#)
- [PySpark analysis templates](#)
- [Troubleshooting PySpark analysis templates](#)

SQL analysis templates

SQL analysis templates enable you to query and analyze data across different datasets within a collaboration. You can use these templates to perform various types of analysis, such as identifying audience overlaps and calculating aggregated metrics.

With SQL analysis templates, you can:

- Write standard SQL queries
- Add parameters to make your queries dynamic
- Control access to specific columns and tables
- Set aggregation requirements for sensitive data

Topics

- [Creating a SQL analysis template](#)
- [Reviewing a SQL analysis template](#)

Creating a SQL analysis template

Prerequisites

Before you create a SQL analysis template, you must have:

- An active AWS Clean Rooms collaboration
- Access to at least one configured table in the collaboration

For information about configuring tables in AWS Clean Rooms, see [Creating a configured table in AWS Clean Rooms](#).

- Permissions to create analysis templates
- Basic knowledge of SQL query syntax

The following procedure describes the process of creating a SQL analysis template using the [AWS Clean Rooms console](#).

For information about how to create a SQL analysis template using the AWS SDKs, see the [AWS Clean Rooms API Reference](#).

To create a SQL analysis template

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with the AWS account that will function as the collaboration creator.
2. In the left navigation pane, choose **Collaborations**.
3. Choose the collaboration.
4. On the **Templates** tab, go to the **Analysis templates created by you** section.
5. Choose **Create analysis template**.
6. On the **Create analysis template** page, for **Details**,
 - a. Enter a **Name** for the analysis template.
 - b. (Optional) Enter a **Description**.

- c. For **Format**, leave the **SQL** option selected.
7. For **Tables**, view the configured tables associated with the collaboration.
8. For **Definition**,
 - a. Enter the definition for the analysis template.
 - b. Choose **Import from** to import a definition.
 - c. (Optional) Specify a parameter in the SQL editor by entering a colon (:) in front of the parameter name.

For example:

```
WHERE table1.date + :date_period > table1.date
```

9. If you added parameters previously, under **Parameters – optional**, for each **Parameter name**, choose the **Type** and **Default value** (optional).
10. If you want to enable **Tags** for the configured table resource, choose **Add new tag** and then enter the **Key** and **Value** pair.
11. Choose **Create**.
12. You are now ready to inform your collaboration member that they can [Review an analysis template](#). (Optional if you want to query your own data.)

Reviewing a SQL analysis template

After a collaboration member has created a SQL analysis template, you can review and approve it. After the analysis template and approved, it can be used in a query in AWS Clean Rooms.

Note

When you bring your analysis code into a collaboration, be aware of the following:

- AWS Clean Rooms does not validate or guarantee the behavior of the analysis code.
 - If you need to ensure certain behavior, review the code of your collaboration partner directly or work with a trusted third-party auditor to review it.
- In the shared security model:
 - You (the customer) are responsible for the security of the code running in the environment.

- AWS Clean Rooms is responsible for the security of the environment, ensuring that
 - only the approved code runs
 - only specified configured tables are accessible
 - the only output destination is the result receiver's S3 bucket.

To review a SQL analysis template using the AWS Clean Rooms console

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with the AWS account that will function as the collaboration creator.
2. In the left navigation pane, choose **Collaborations**.
3. Choose the collaboration.
4. On the **Templates** tab, go to the **Analysis templates created by other members** section.
5. Choose the analysis template that has the **Can run status** of **No requires your review**.
6. Choose **Review**.
7. Review the analysis rule **Overview**, **Definition**, and **Parameters** (if any).
8. Review the configured tables listed under **Tables referenced in definition**.

The **Status** next to each table will read **Template not allowed**.

9. Choose a table.

If you	Then choose
Approve the analysis template	Allow template on table. Confirm your approval by choosing Allow .
Don't approve the analysis template	Disallow

You are now ready to query the configured table using a SQL analysis template. For more information, see [Running SQL queries](#).

PySpark analysis templates

PySpark analysis templates require a Python user script and an optional virtual environment to use custom and open-source libraries. These files are called artifacts.

Before you create an analysis template, you first create the artifacts and then store the artifacts in an Amazon S3 bucket. AWS Clean Rooms uses these artifacts when running analysis jobs. AWS Clean Rooms only accesses the artifacts when running a job.

Before running any code on a PySpark analysis template, AWS Clean Rooms validates artifacts by:

- Checking the specific S3 object version used when creating the template
- Verifying the SHA-256 hash of the artifact
- Failing any job where artifacts have been modified or removed

Note

The maximum size of all combined artifacts for a given PySpark analysis template in AWS Clean Rooms is 1 GB.

Security for PySpark analysis templates

To preserve a secure compute environment, AWS Clean Rooms uses a two-tier compute architecture to isolate user code from system operations. This architecture is based on Amazon EMR Serverless Fine Grained Access Control technology, also known as Membrane. For more information, see [Membrane – Safe and performant data access controls in Apache Spark in the presence of imperative code](#).

The compute environment components are divided into a separate user space and system space. The user space executes the PySpark code in the PySpark analysis template. AWS Clean Rooms uses the system space to enable the job to run including using service roles provided by customers to read data to run the job and implementing the column allowlist. As a result of this architecture, a customer's PySpark code that affects the system space, which could include small number of Spark SQL and PySpark DataFrames APIs, is blocked.

PySpark limitations in AWS Clean Rooms

When customers submit an approved PySpark analysis template, AWS Clean Rooms runs it on its own secure compute environment which no customer can access. The compute environment implements a compute architecture with a user space and system space to preserve a secure compute environment. For more information, see [Security for PySpark analysis templates](#).

Consider the following limitations before you use PySpark in AWS Clean Rooms.

Limitations

- Only DataFrame outputs are supported
- Single Spark session per job execution

Unsupported features

- **Data management**
 - Iceberg table formats
 - LakeFormation managed tables
 - Resilient distributed datasets (RDD)
 - Spark streaming
 - Access control for nested columns
- **Custom functions and extensions**
 - User-defined table functions (UDTFs)
 - HiveUDFs
 - Custom classes in user-defined functions
 - Custom data sources
 - Additional JAR files for:
 - Spark extensions
 - Connectors
 - Metastore configurations
- **Monitoring and analysis**
 - Spark logging
 - Spark UI

- ANALYZE TABLE commands

Important

These limitations are in place to maintain the security isolation between user and system spaces.

All restrictions apply regardless of collaboration configuration.

Future updates may add support for additional features based on security evaluations.

Best practices

We recommend the following best practices when creating PySpark analysis templates.

- Design your analysis templates with the [PySpark limitations in AWS Clean Rooms](#) in mind.
- Test your code in a development environment first.
- Use supported DataFrame operations exclusively.
- Plan your output structure to work with DataFrame limitations.

We recommend the following best practices for managing artifacts

- Keep all PySpark analysis template artifacts in a dedicated S3 bucket or prefix.
- Use clear version naming for different artifact versions.
- Create new analysis templates when artifact updates are needed.
- Maintain an inventory of which templates use which artifact versions.

For more information about how to write Spark code, see the following:

- [Apache Spark Examples](#)
- [Write a Spark application](#) in the *Amazon EMR Release Guide*
- [Tutorial: Writing an AWS Glue for Spark script](#) in the *AWS Glue User Guide*

The following topics explain how to create Python user scripts and libraries before creating and reviewing the analysis template.

Topics

- [Creating a user script](#)
- [Creating a virtual environment \(optional\)](#)
- [Storing a user script and virtual environment in S3](#)
- [Creating a PySpark analysis template](#)
- [Reviewing a PySpark analysis template](#)

Creating a user script

The user script must contain an entrypoint function (in other words, a handler). You can name your user script file with any valid Python filename.

The following procedure describes how to create a user script to define the core functionality of your PySpark analysis.

Prerequisites

- PySpark 1.0 (corresponds to Python 3.9 and Python 3.11 and Spark 3.5.2)
- Datasets in Amazon S3 can only be read as configured table associations in the Spark session you define.
- Your code can't directly call Amazon S3 and AWS Glue
- Your code can't make network calls

To create a user script

1. Open a text editor or Integrated Development Environment (IDE) of your choice.

You can use any text editor or IDE (such as Visual Studio Code, PyCharm, or Notepad++) that supports Python files.

2. Create a new Python file with a name of your choice (for example, **my_analysis.py**).
3. Define an entrypoint function that accepts a context object parameter.

```
def entrypoint(context)
```

The context object parameter is a dictionary that provides access to essential Spark components and referenced tables. It contains Spark session access for running Spark operations and the referenced tables:

Spark session access is available via `context['sparkSession']`

Referenced tables are available via `context['referencedTables']`

4. Define the results of the entrypoint function:

```
return results
```

The `results` must return an object containing a results dictionary of filenames to an output DataFrame.

 Note

AWS Clean Rooms automatically writes the DataFrame objects to the S3 bucket of the result receiver.

5. You are now ready to:
 - a. Store this user script in S3. For more information, see [Storing a user script and virtual environment in S3](#).
 - b. Create the optional virtual environment to support any additional libraries required by your user script. For more information, see [Creating a virtual environment \(optional\)](#).

Example Example 1

<caption>The following example demonstrates a generic user script for a PySpark analysis template.</caption>

```
# File name: my_analysis.py

def entrypoint(context):
    try:
        # Access Spark session
        spark = context['sparkSession']

        # Access input tables
```



```

input_table1 = context['referencedTables']['table1_name']
input_table2 = context['referencedTables']['table2_name']

# Example data processing operations
output_df1 = input_table1.select("column1", "column2")
output_df2 = input_table2.join(input_table1, "join_key")
output_df3 = input_table1.groupBy("category").count()

# Return results - each key creates a separate output folder
return {
    "results": {
        "output1": output_df1,          # Creates output1/ folder
        "output2": output_df2,          # Creates output2/ folder
        "analysis_summary": output_df3 # Creates analysis_summary/ folder
    }
}

except Exception as e:
    print(f"Error in main function: {str(e)}")
    raise e

```

The folder structure of this example is as follows:

```

analysis_results/
#
### output1/ # Basic selected columns
# ### part-000000.parquet
# ### _SUCCESS
#
### output2/ # Joined data
# ### part-000000.parquet
# ### _SUCCESS
#
### analysis_summary/ # Aggregated results
### part-000000.parquet
### _SUCCESS

```

Example Example 2

<caption>The following example demonstrates a more complex user script for a PySpark analysis template.</caption>

```
def entrypoint(context):
```

```
try:
    # Get DataFrames from context
    emp_df = context['referencedTables']['employees']
    dept_df = context['referencedTables']['departments']

    # Apply Transformations
    emp_dept_df = emp_df.join(
        dept_df,
        on="dept_id",
        how="left"
    ).select(
        "emp_id",
        "name",
        "salary",
        "dept_name"
    )

    # Return Dataframes
    return {
        "results": {
            "outputTable": emp_dept_df
        }
    }

except Exception as e:
    print(f"Error in entrypoint function: {str(e)}")
    raise e
```

Creating a virtual environment (optional)

If you have any additional libraries required by your user script, you have the option to create a virtual environment to store those libraries. If you don't need additional libraries, you can skip this step.

When working with libraries that have native extensions, keep in mind that PySpark in AWS Clean Rooms operates on Linux with ARM64 architecture.

The following procedure demonstrates how to create a virtual environment using a basic CLI command.

To create a virtual environment

1. Open a terminal or command prompt.

2. Add the following content:

```
# create and activate a python virtual environment
python3 -m venv pyspark_venvsource
source pyspark_venvsource/bin/activate

# install the python packages
pip3 install pandas # add packages here

# package the virtual environment into an archive
pip3 install venv-pack
venv-pack -f -o pyspark_venv.tar.gz

# optionally, remove the virtual environment directory
deactivate
rm -fr pyspark_venvsource
```

3. You are now ready to store this virtual environment in S3. For more information, see [Storing a user script and virtual environment in S3](#).

For more information about working with Docker and Amazon ECR, see the [Amazon ECR User Guide](#).

Storing a user script and virtual environment in S3

The following procedure explains how to store a user script and optional virtual environment in Amazon S3. Complete this step before creating a PySpark analysis template.

Important

Do not modify or remove artifacts (user scripts or virtual environments) after creating an analysis template.

Doing so will:

- Cause all future analysis jobs using this template to fail.
- Require creation of a new analysis template with new artifacts.
- Not affect previously completed analysis jobs

Prerequisites

- An AWS account with appropriate permissions
- A user script file (such as `my_analysis.py`)
- (Optional, if one exists) A virtual environment package (`.tar.gz` file)
- Access to create or modify IAM roles

Console

To store a user script and virtual environment in S3 using the console:

1. Sign in to the AWS Management Console and open the Amazon S3 console at <https://console.aws.amazon.com/s3/>.
2. Create a new S3 bucket or use an existing one.
3. Enable versioning for the bucket.
 - a. Select your bucket.
 - b. Choose **Properties**.
 - c. In the **Bucket Versioning** section, choose **Edit**.
 - d. Select **Enable** and save changes.
4. Upload your artifacts and enable SHA-256 hash.
 - a. Navigate to your bucket.
 - b. Choose **Upload**.
 - c. Choose **Add files** and add your user script file.
 - d. (Optional, if one exists) Add your `.tar.gz` file.
 - e. Expand **Properties**.
 - f. Under **Checksums**, for **Checksum function**, select **SHA256**.
 - g. Choose **Upload**.
5. You are now ready to create a PySpark analysis template.

CLI

To store the user script and virtual environment in S3 using the AWS CLI:

1. Run the following command:

```
aws s3 cp --checksum-algorithm sha256 pyspark_venv.tar.gz s3://ARTIFACT-BUCKET/EXAMPLE-PREFIX/
```

2. You are now ready to create a PySpark analysis template.

Note

If you need to update script or virtual environment:

1. Upload the new version as a separate object.
2. Create a new analysis template using the new artifacts.
3. Deprecate the old template.
4. Keep the original artifacts in S3 if the old template might still be needed.

Creating a PySpark analysis template

Prerequisites

Before you create a PySpark analysis template, you must have:

- A membership in an active AWS Clean Rooms collaboration
- Access to at least one configured table in the active collaboration
- Permissions to create analysis templates
- A Python user script and a virtual environment created and stored in S3
 - S3 bucket has versioning enabled. For more information, see [Using versioning in S3 buckets](#)
 - S3 bucket can calculate SHA-256 checksums for uploaded artifacts. For more information, see [Using checksums](#)
- Permissions to read code from an S3 bucket

For information about creating the required service role, see [Create a service role to read code from an S3 bucket \(PySpark analysis template role\)](#).

The following procedure describes the process of creating a PySpark analysis template using the [AWS Clean Rooms console](#). It assumes that you have already created a user script and virtual environment files and stored your user script and virtual environment files in an Amazon S3 bucket.

 Note

The member who creates the PySpark analysis template must also be the member who receives results.

For information about how to create a PySpark analysis template using the AWS SDKs, see the [AWS Clean Rooms API Reference](#).

To create a PySpark analysis template

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with the AWS account that will function as the collaboration creator.
2. In the left navigation pane, choose **Collaborations**.
3. Choose the collaboration.
4. On the **Templates** tab, go to the **Analysis templates created by you** section.
5. Choose **Create analysis template**.
6. On the **Create analysis template** page, for **Details**,
 - a. Enter a **Name** for the analysis template.
 - b. (Optional) Enter a **Description**.
 - c. For **Format**, choose the **PySpark** option.
7. For **Definition**,
 - a. Review the **Prerequisites** and ensure each prerequisite is met before continuing.
 - b. For **Entry point file**, enter the S3 bucket or choose **Browse S3**.
 - c. (Optional) For **Libraries file**, enter the S3 bucket or choose **Browse S3**.

8. For **Tables referenced in the definition**,

- If all tables referenced in the definition have been associated to the collaboration:
 - Leave the **All tables referenced in the definition have been associated to the collaboration** checkbox selected.
 - Under **Tables associated to the collaboration**, choose all associated tables that are referenced in the definition.
- If all tables referenced in the definition haven't been associated to the collaboration:
 - Clear the **All tables referenced in the definition have been associated to the collaboration** checkbox.
 - Under **Tables associated to the collaboration**, choose all associated tables that are referenced in the definition.
 - Under **Tables that will be associated later**, enter a table name.
 - Choose **List another table** to list another table.

9. Specify the **Service access** permissions by selecting an **Existing service role name** from the dropdown list.

1. The list of roles are displayed if you have permissions to list roles.

If you don't have permissions to list roles, you can enter the Amazon Resource Name (ARN) of the role that you want to use.

2. View the service role by choosing the **View in IAM** external link.

If there are no existing service roles, the option to **Use an existing service role** is unavailable.

By default, AWS Clean Rooms doesn't attempt to update the existing role policy to add necessary permissions.

Note

- AWS Clean Rooms requires permissions to query according to the analysis rules. For more information about permissions for AWS Clean Rooms, see [AWS managed policies for AWS Clean Rooms](#).

- If the role doesn't have sufficient permissions for AWS Clean Rooms, you receive an error message stating that the role doesn't have sufficient permissions for AWS Clean Rooms. The role policy must be added before proceeding.
- If you can't modify the role policy, you receive an error message stating that AWS Clean Rooms couldn't find the policy for the service role.

10. If you want to enable **Tags** for the configured table resource, choose **Add new tag** and then enter the **Key** and **Value** pair.
11. Choose **Create**.
12. You are now ready to inform your collaboration member that they can [Review an analysis template](#). (Optional if you want to query your own data.)

Important

Do not modify or remove artifacts (user scripts or virtual environments) after creating an analysis template.

Doing so will:

- Cause all future analysis jobs using this template to fail.
- Require creation of a new analysis template with new artifacts.
- Not affect previously completed analysis jobs.

Reviewing a PySpark analysis template

When another member creates an analysis template in your collaboration, you must review and approve it before it can be used.

The following procedure shows you how to review a PySpark analysis template, including its rules, parameters, and referenced tables. As a collaboration member, you'll assess whether the template aligns with your data sharing agreements and security requirements.

After the analysis template and approved, it can be used in a job in AWS Clean Rooms.

Note

When you bring your analysis code into a collaboration, be aware of the following:

- AWS Clean Rooms does not validate or guarantee the behavior of the analysis code.
 - If you need to ensure certain behavior, review the code of your collaboration partner directly or work with a trusted third-party auditor to review it.
- AWS Clean Rooms guarantees that the SHA-256 hashes of the code listed in the PySpark analysis template matches the code running in the PySpark analysis environment.
- AWS Clean Rooms does not perform any auditing or security analysis of additional libraries you bring into the environment.
- In the shared security model:
 - You (the customer) are responsible for the security of the code running in the environment.
 - AWS Clean Rooms is responsible for the security of the environment, ensuring that
 - only the approved code runs
 - only specified configured tables are accessible
 - the only output destination is the result receiver's S3 bucket.

AWS Clean Rooms generates SHA-256 hashes of the user script and virtual environment for your review. However, the actual user script and libraries aren't directly accessible within AWS Clean Rooms.

To validate that the user script and libraries shared are the same as those referenced in the analysis template, you can create a SHA-256 hash of the files shared and compare it to the analysis template hash created by AWS Clean Rooms. The hashes of the code run will also be in the job logs.

Prerequisites

- Linux/Unix operating system or Windows Subsystem for Linux (WSL)
- User script file you want to hash
 - Request that the analysis template creator share the file through a secure channel.
- The analysis template hash created by AWS Clean Rooms

To review a PySpark analysis template using the AWS Clean Rooms console

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with the AWS account that will function as the collaboration creator.
2. In the left navigation pane, choose **Collaborations**.
3. Choose the collaboration.
4. On the **Templates** tab, go to the **Analysis templates created by other members** section.
5. Choose the analysis template that has the **Can run status** of **No requires your review**.
6. Choose **Review**.
7. Review the analysis rule **Overview**, **Definition**, and **Parameters** (if any).
8. Validate that the shared user script and libraries are the same as those referenced in the analysis template.
 - a. Create a SHA-256 hash of the files shared and compare it to the analysis template hash created by AWS Clean Rooms.

You can generate a hash by navigating to the directory containing your user script file and then running the following command:

```
sha256sum your_script_filename.py
```

Example output:

```
e3b0c44298fc1c149afb4c8996fb92427ae41e4649b934ca495991b7852b855 my_analysis.py
```

- b. Alternatively, you can use Amazon S3 checksum features. For more information, see [Checking object integrity in Amazon S3](#) in the *Amazon S3 User Guide*.
 - c. Another alternative is to view the hashes of the executed code in the job logs.
9. Review the configured tables listed under **Tables referenced in definition**.

The **Status** next to each table will read **Template not allowed**.

10. Choose a table.
 - a. To approve the analysis template, choose **Allow template on table**. Confirm your approval by choosing **Allow**.
 - b. To decline approval, choose **Disallow**.

If you have chosen to approve the analysis template, the member who can run jobs can now run a PySpark job on a configured table using a PySpark analysis template. For more information, see [Running PySpark jobs](#).

Troubleshooting PySpark analysis templates

When running jobs using PySpark analysis templates, you might encounter failures during job initialization or execution. These failures typically relate to script configuration, data access permissions, or environment setup.

For more information about PySpark limitations, see [PySpark limitations in AWS Clean Rooms](#).

Topics

- [Troubleshooting your code](#)
- [Analysis template job doesn't start](#)
- [Analysis template job starts but fails during processing](#)
- [Virtual environment setup fails](#)

Troubleshooting your code

AWS Clean Rooms restricts sensitive data from error messages and logs to protect customer's underlying data. To help you develop and troubleshoot your code, we suggest you simulate AWS Clean Rooms in your own account and run jobs using your own test data.

You can simulate PySpark in AWS Clean Rooms in Amazon EMR Serverless with the following steps. It will have small differences with PySpark in AWS Clean Rooms but mostly covers how your code can be run.

To simulate PySpark in AWS Clean Rooms in EMR Serverless

1. Create a dataset in Amazon S3, catalog it in the AWS Glue Data Catalog, and set up Lake Formation permissions.
2. Register the S3 location with Lake Formation using a custom role.
3. Create an Amazon EMR Studio instance if you don't already have one (Amazon EMR Studio is needed to use Amazon EMR Serverless).
4. Create an EMR Serverless app

- Select release version `emr-7.7.0`.
- Select ARM64 architecture.
- Opt for **Use custom settings**.
- Disable preinitialized capacity.
- If you plan to do interactive work, select **Interactive endpoint** > **Enable endpoint for EMR studio**.
- Select **Additional configurations** > **Use Lake Formation for fine-grained access control**.
- Create the application.

5. Use EMR-S either via EMR-Studio notebooks or the `StartJobRun` API.

Analysis template job doesn't start

Common causes

Analysis template jobs can fail immediately at startup due to three main configuration issues:

- Incorrect script naming that doesn't match the required format
- Missing or incorrectly formatted entrypoint function in the user script
- Incompatible Python version in the virtual environment

Resolution

To resolve:

1. Verify your user script:
 - Check that your user script has a valid Python filename.

Valid Python filenames use lowercase letters, underscores to separate words, and the `.py` extension.
2. Verify the entrypoint function. If your user script doesn't have an entrypoint function, add one.
 - a. Open your user script.
 - b. Add this entrypoint function:

```
def entrypoint(context):  
    # Your analysis code here
```

- c. Ensure the function name is spelled exactly as `entrypoint`.
 - d. Verify the function accepts the `context` parameter.
3. Check Python version compatibility:
- a. Verify your virtual environment uses Python 3.9.
 - b. To check your version, run: `python --version`
 - c. If needed, update your virtual environment:

```
conda create -n analysis-env python=3.9  
conda activate analysis-env
```

Prevention

- Use the provided analysis template starter code that includes the correct file structure.
- Set up a dedicated virtual environment with Python 3.9 for all analysis templates.
- Test your analysis template locally using the template validation tool before submitting jobs.
- Implement CI/CD checks to verify script naming and entrypoint function requirements.

Analysis template job starts but fails during processing

Common causes

Analysis jobs can fail during execution for these security and formatting reasons:

- Unauthorized direct access attempts to AWS services like Amazon S3 or AWS Glue
- Returning output in incorrect formats that don't match required DataFrame specifications
- Blocked network calls due to security restrictions in the execution environment

Resolution

To resolve

1. Remove direct AWS service access:
 - a. Search your code for direct AWS service imports and calls.
 - b. Replace direct S3 access with provided Spark session methods.
 - c. Use only pre-configured tables through the collaboration interface.
2. Format outputs correctly:
 - a. Verify all outputs are Spark DataFrames.
 - b. Update your return statement to match this format:

```
return {  
    "results": {  
        "output1": dataframe1  
    }  
}
```

- c. Remove any non-DataFrame return objects.
3. Remove network calls:
 - a. Identify and remove any external API calls.
 - b. Remove any urllib, requests, or similar network libraries.
 - c. Remove any socket connections or HTTP client code.

Prevention

- Use the provided code linter to check for unauthorized AWS imports and network calls.
- Test jobs in the development environment where security restrictions match production.
- Follow the output schema validation process before deploying jobs.
- Review the security guidelines for approved service access patterns.

Virtual environment setup fails

Common causes

Virtual environment configuration failures commonly occur due to:

- Mismatched CPU architecture between development and execution environments
- Python code formatting issues that prevent proper environment initialization
- Incorrect base image configuration in container settings

Resolution

To resolve

1. Configure the correct architecture:

- a. Check your current architecture with `uname -m`.
- b. Update your Dockerfile to specify ARM64:

```
FROM --platform=linux/arm64 public.ecr.aws/amazonlinux/amazonlinux:2023-minimal
```

- c. Rebuild your container with `docker build --platform=linux/arm64`.

2. Fix Python indentation:

- a. Run a Python code formatter like `black` on your code files.
- b. Verify consistent use of spaces or tabs (not both).
- c. Check indentation of all code blocks:

```
def my_function():  
    if condition:  
        do_something()  
    return result
```

- d. Use an IDE with Python indentation highlighting.

3. Validate environment configuration:

- a. Run `python -m py_compile your_script.py` to check for syntax errors.
- b. Test the environment locally before deployment.

- c. Verify all dependencies are listed in `requirements.txt`.

Prevention

- Use Visual Studio Code or PyCharm with Python formatting plugins
- Configure pre-commit hooks to run code formatters automatically
- Build and test environments locally using the provided ARM64 base image
- Implement automated code style checking in your CI/CD pipeline

Analyze data in a collaboration

In AWS Clean Rooms, you can analyze data by running queries or jobs.

A *query* is a method to access and analyze configured tables in a collaboration, using a supported set of functions, classes, and variables. The currently supported query language in AWS Clean Rooms is SQL. There are 3 ways to run a query in AWS Clean Rooms: Write SQL code, use an approved SQL analysis template, or use the Analysis builder UI.

A *job* is a method to access and analyze configured tables in a collaboration using a supported set of functions, classes, and variables. The currently supported type of job in AWS Clean Rooms is PySpark. There is one way to run a job in AWS Clean Rooms: by using an approved PySpark analysis template.

The following topics describe how to analyze data in AWS Clean Rooms by running SQL queries or PySpark jobs.

Topics

- [Running SQL queries](#)
- [Running PySpark jobs](#)

Running SQL queries

Note

You can only run queries if the member who is responsible to pay for query compute costs has joined the collaboration as an active member.

As the [member who can query](#), you can run a SQL query by:

- Building a SQL query manually using the SQL code editor.
- Using an approved SQL [analysis template](#).
- Using the **Analysis builder UI** to build a query without having to write SQL code.

When the member who can query runs a SQL query on the tables in the collaboration, AWS Clean Rooms assumes the relevant roles to access the tables on their behalf. AWS Clean Rooms applies the analysis rules as necessary to the input query and its output.

The analysis rules and output constraints are enforced automatically. AWS Clean Rooms only returns the results that comply with the defined analysis rules.

AWS Clean Rooms supports SQL queries that can be different than other query engines. For specifications, see the [AWS Clean Rooms SQL Reference](#). If you want to run queries on data tables protected with differential privacy, you should ensure that your queries are compatible with the [general-purpose query structure](#) of AWS Clean Rooms Differential Privacy.

Note

When using [Cryptographic Computing for Clean Rooms](#), not all SQL operations generate valid results. For example, you can conduct a COUNT on an encrypted column but conducting a SUM on encrypted numbers leads to errors. In addition, queries might also yield incorrect results. For example, queries that SUM sealed columns produce errors. However, a GROUP BY query over sealed columns seems to succeed but produces different groups than those produced by a GROUP BY query over the cleartext.

The [member paying for query compute costs](#) is charged for the queries run in the collaboration.

The member who can query can select multiple [members who can receive results](#) to receive the results from a single query. For more information, see [Querying configured tables using the SQL code editor](#). For general information about receiving query results, see [Receiving and using analysis results](#).

Prerequisites

Before you run a SQL query, make sure that you have the following:

- An active membership in AWS Clean Rooms collaboration
- Access to at least one configured table in the collaboration
- Confirmation that the member responsible for query compute costs is an active collaboration member

For information about how to query data or view queries by calling the AWS Clean Rooms `StartProtectedQuery` API operation directly or by using the AWS SDKs, see the [AWS Clean Rooms API Reference](#).

For information about query logging, see [Analysis logging in AWS Clean Rooms](#).

 Note

If you run a query on [encrypted](#) data tables, the results from the encrypted columns are encrypted.

The following topics explain how to query data in a collaboration using the AWS Clean Rooms console.

Topics

- [Querying configured tables using the SQL code editor](#)
- [Querying ID mapping tables using the SQL code editor](#)
- [Querying configured tables using a SQL analysis template](#)
- [Querying with the analysis builder](#)
- [Viewing the impact of differential privacy](#)
- [Viewing recent queries](#)
- [Viewing query details](#)

Querying configured tables using the SQL code editor

As a member who can query, you can build a query manually by writing SQL code in the SQL code editor. The SQL code editor is located in the **Analysis** section of the **Queries** tab in the AWS Clean Rooms console.

The SQL code editor is displayed by default. If you want to use the analysis builder to build queries, see [Querying with the analysis builder](#).

 Important

If you start writing a SQL query in the code editor and then turn on the **Analysis builder UI**, your query isn't saved.

AWS Clean Rooms supports many SQL commands, functions, and conditions. For more information, see the [AWS Clean Rooms SQL Reference](#).

 Tip

If a scheduled maintenance occurs while a query is running, the query is terminated and rolled back. You must restart the query.

To query configured tables using the SQL code editor

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you haven't yet done so).
2. In the left navigation pane, choose **Collaborations**.
3. Choose the collaboration that has **Your member abilities** status of **Query**.
4. On the **Queries** tab, go to the **Analysis** section.

 Note

The **Analysis** section only displays if the member who can receive results and the member who is responsible to pay for query compute costs have joined the collaboration as an active member.

5. On the **Queries** tab, under **Tables**, view the list of tables and their associated analysis rule type (**Aggregation analysis rule**, **List analysis rule**, or **Custom analysis rule**).

 Note

If you don't see the tables that you expect in the list, it might be for the following reasons:

- The tables haven't been [associated](#).
- The tables don't have an [analysis rule configured](#).

6. (Optional) To view the table's schema and analysis rule controls, expand the table by selecting the plus sign icon (+).
7. Build the query by typing the query into the SQL code editor.

For more information about supported SQL commands and functions, see the [AWS Clean Rooms SQL Reference](#).

You can also use the following options to build your query.

Use an example query

To use an example query

1. Select the three vertical dots next to the table.
2. Under **Insert in editor**, choose **Example query**.

 Note

Inserting an **Example query** appends it to the query already in the editor.

The query example appears. All of the tables listed under **Tables** are included in the query.

3. Edit the placeholder values in the query.

Insert column names or functions

To insert a column name or function

1. Select the three vertical dots next to a column.
2. Under **Insert in editor**, choose **Column name**.
3. To manually insert a function that is permitted on a column, select the three vertical dots next to a column, select **Insert in editor**, and then select the name of the permitted function (such as INNER JOIN, SUM, SUM DISTINCT, or COUNT).
4. Press **Ctrl + Space** to view the table schemas in the code editor.

Note

Members who can query can view and use the partition columns in each configured table association. Ensure the partition column is labeled as a partition column in the AWS Glue table underlying the configured table.

5. Edit the placeholder values in the query.
8. (Spark analytics engine only) Specify the supported **Worker type** and the **Number of workers**.

Use the following table to determine the type and number of workers you need for your use case.

Note

Different worker types and number of workers have associated costs. To learn more about the pricing, see [AWS Clean Rooms pricing](#).

Worker type	vCPU	Memory (GB)	Storage (GB)	Number of workers	Total Clean Rooms Processing Units (CRPU)
CR.1X (default)	4	30	100	2	4
				16 (default)	32
CR.4X	16	120	400	8	64
				32	256

9. For **Send results to**, specify who can receive results.

 Note

To receive results, the collaboration member must be configured as a result receiver and must be an active participant in the collaboration (**Status: Active**)

10. (Member who can query only) The **Use your default result settings** checkbox is selected by default. Keep this selected if you want to keep your default result settings.

If you want to specify different results settings for this query, clear the **Use your default result settings** checkbox, and then choose the following.

- a. **Result format (CSV or PARQUET)**
- b. **Result files (Single or Multiple)**
- c. **Results destination in Amazon S3**

Each member who can receive results can specify a different **Result format**, **Result files**, and **Results destination in Amazon S3**.

11. Choose **Run**.

 Note

You can't run the query if the member who can receive results hasn't configured the query results settings.

12. View the **Results**.

For more information, see [Receiving and using analysis results](#).

13. Continue to adjust parameters and run your query again, or choose the + button to start a new query in a new tab.

 Note

AWS Clean Rooms aims to provide clear error messaging. If an error message doesn't have enough details to help you troubleshoot, contact the account team. Provide them with a

description of how the error occurred and the error message (including any identifiers). For more information, see [Troubleshooting AWS Clean Rooms](#).

Querying ID mapping tables using the SQL code editor

The following procedure describes how to run a multi-table join query on the ID mapping table to join the `sourceId` with the `targetId`.

Before you query the ID mapping table, the ID mapping table must be successfully populated.

To query ID mapping tables using the SQL code editor

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you haven't yet done so).
2. In the left navigation pane, choose **Collaborations**.
3. Choose the collaboration that has **Your member abilities** status of **Run queries**.
4. On the **Queries** tab, go to the **Analysis** section.

Note

The **Analysis** section only displays if the member who can receive results and the member who is responsible to pay for query compute costs have joined the collaboration as an active member.

5. On the **Queries** tab, under **Tables**, view the list of ID mapping tables (under **Managed by AWS Clean Rooms**) and their associated analysis rule type (**ID mapping table analysis rule**).

Note

If you don't see the ID mapping tables that you expect in the list, it might be because the ID mapping tables haven't been successfully populated. For more information, see [Populating an existing ID mapping table](#).

6. Build the query by typing the query into the SQL code editor.

(Optional) If you want to use an example query

1. Select the three vertical dots next to the table.
2. Under **Insert in editor**, choose **Example JOIN statement**.

Note

Inserting an **Example JOIN statements** appends the query already in the editor.

The example JOIN statement appears.

3. Edit the placeholder values in the query.

(Optional) If you want to insert a table name

1. Select the three vertical dots next to a column.
2. Under **Insert in editor**, choose **Table name**.
3. Edit the placeholder values in the query.

7. Choose **Run**.

Note

You can't run the query if the member who can receive results hasn't configured the query results settings.

8. View the **Results**.

For more information, see [Receiving and using analysis results](#).

9. Continue to adjust parameters and run your query again, or choose the **+** button to start a new query in a new tab.

Note

AWS Clean Rooms aims to provide clear error messaging. If an error message doesn't have enough details to help you troubleshoot, contact the account team. Provide them with a

description of how the error occurred and the error message (including any identifiers). For more information, see [Troubleshooting AWS Clean Rooms](#).

Querying configured tables using a SQL analysis template

This procedure demonstrates how to use an analysis template in the AWS Clean Rooms console to query configured tables with the **Custom** analysis rule.

To use a SQL analysis template to query configured tables with the Custom analysis rule

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you haven't yet done so).
2. In the left navigation pane, choose **Collaborations**.
3. Choose the collaboration that has **Your member abilities** status of **Run queries**.
4. On the **Analyses** tab, under the **Tables** section, view the tables and their associated analysis rule type (**Custom analysis rule**).

Note

If you don't see the tables that you expect in the list, it might be for the following reasons:

- The tables haven't been [associated](#).
- The tables don't have an [analysis rule configured](#).

5. Under the **Analysis** section, select **Run analysis templates** and then choose the analysis template from the dropdown list.
6. Enter the value of the parameters from the analysis template you want to use in the query.

The value must be in the parameter's specified data type.

You can use different values each time you run the analysis template.

Empty or NULL values for the parameter aren't supported. Using parameters in LIMIT clause is also not supported.

7. Choose **Run**.

Note

You can't run the query if the member who can receive results hasn't configured the query results settings.

8. Continue to adjust parameters and run your query again, or choose the **+** button to start a new query in a new tab.

Querying with the analysis builder

You can use the analysis builder to build queries without having to write SQL code. With the analysis builder, you can build a query for a collaboration that has:

- A single table that uses the [aggregation analysis rule](#) with no JOIN required
- Two tables (one from each member) that both use the [aggregation analysis rule](#)
- Two tables (one from each member) that both use the [list analysis rule](#)
- Two tables (one from each member) that both use the aggregation analysis rule and two tables (one from each member) that both use the list analysis rule

If you want to manually write SQL queries, see [Querying configured tables using the SQL code editor](#).

The analysis builder appears as the **Analysis builder UI** option in the **Analysis** section of the **Queries** tab in the AWS Clean Rooms console.

Important

If you turn on the **Analysis builder UI**, start building a query in the analysis builder, and then turn off the **Analysis builder UI**, your query isn't saved.

Tip

If a scheduled maintenance occurs while a query is running, the query is terminated and rolled back. You must restart the query.

The following topics explain how to use the analysis builder.

Topics

- [Use the analysis builder to query a single table \(aggregation\)](#)
- [Use the analysis builder to query two tables \(aggregation or list\)](#)

Use the analysis builder to query a single table (aggregation)

This procedure demonstrates how to use the **Analysis builder UI** in the AWS Clean Rooms console to build a query. The query is for a collaboration that has a single table that uses the [aggregation analysis rule](#) with no JOIN required.

To use the analysis builder to query a single table

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you haven't yet done so).
2. In the left navigation pane, choose **Collaborations**.
3. Choose the collaboration that has **Your member abilities** status of **Query**.
4. On the **Queries** tab, under **Tables**, view the table and its associated analysis rule type. (The analysis rule type should be the **Aggregation analysis rule**.)

Note

If you don't see the table you expect, it might be for the following reasons:

- The table hasn't been [associated](#).
- The table doesn't have an [analysis rule configured](#).

5. Under the **Analysis** section, turn on **Analysis builder UI**.
6. Build a query.

If you want to see all of the aggregation metrics, skip to step 9.

- a. For **Choose metrics**, review the aggregate metrics that have been preselected by default and remove any metric if needed.
- b. (Optional) For **Add segments – optional**, choose one or more parameters.

 Note

Add segments – optional is only displayed if dimensions are specified for the table.

- c. (Optional) For **Add filters – optional**, choose **Add filter**, and then choose a **Parameter**, operator, and **Value**.

To add more filters, choose **Add another filter**.

To remove a filter, choose **Remove**.

 Note

ORDER BY isn't supported for aggregation queries.
Only the AND operator is supported in filters.

- d. (Optional) For **Add description – optional**, enter a description to help identify the query in the list of queries.
7. Expand **Preview SQL code**.
 - a. View the SQL code that's generated from the analysis builder.
 - b. To copy the SQL code, choose **Copy**.
 - c. To edit the SQL code, choose **Edit in SQL code editor**.
 8. Choose **Run**.

 Note

You can't run the query if the member who can receive results hasn't configured the query results settings.

9. Continue to adjust parameters and run your query again, or choose the **+** button to start a new query in a new tab.

Note

AWS Clean Rooms aims to provide clear error messaging. If an error message doesn't have enough details to help you troubleshoot, contact the account team. Provide them with a description of how the error occurred and the error message (including any identifiers). For more information, see [Troubleshooting AWS Clean Rooms](#).

Use the analysis builder to query two tables (aggregation or list)

This procedure describes how to use the analysis builder in the AWS Clean Rooms console to build a query for a collaboration that has:

- Two tables (one from each member) that both use the [aggregation analysis rule](#)
- Two tables (one from each member) that both use the [list analysis rule](#)
- Two tables (one from each member) that both use the aggregation analysis rule and two tables (one from each member) that both use the list analysis rule

To use the analysis builder to query two tables

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you haven't yet done so).
2. In the left navigation pane, choose **Collaborations**.
3. Choose the collaboration that has **Your member abilities** status of **Query**.
4. On the **Queries** tab, under **Tables**, view the two tables and their associated analysis rule type (**Aggregation analysis rule** or **List analysis rule**).

Note

If you don't see the tables you expect in the list, it might be for the following reasons:

- The tables haven't been [associated](#).
- The tables don't have an [analysis rule configured](#).

5. Under the **Analysis** section, turn on **Analysis builder UI**.
6. Build a query.

If the collaboration contains two tables that use the **Aggregation analysis rule** and two tables that use the **List analysis rule**, first choose **Aggregation** or **List**, and then follow the prompts based on the selected analysis rule.

If the two tables use the aggregation analysis rule

1. For **Choose metrics**, review the aggregate metrics that have been preselected by default and remove any metric if needed.
2. For **Match records**, choose one or more records.

Note

When using the analysis builder, you can match only on a single pair of columns.

3. (Optional) For **Add segments – optional**, choose one or more parameters.

Note

Add segments – optional is only displayed if dimensions are specified for the table.

4. (Optional) For **Add filters – optional**, choose **Add filter**, and then choose a parameter, operator, and value.

To add more filters, choose **Add another filter**.

To remove a filter, choose **Remove**.

Note

ORDER BY is not supported for aggregation queries.

If the two tables use the list analysis rule

1. For **Choose attributes**, review the list attributes that have been preselected by default and remove any metric if needed.
2. For **Match records**, choose one or more records.

Note

When using the analysis builder, you can match only on a single pair of columns.

3. (Optional) For **Add filters – optional**, choose **Add filter**, and then choose a parameter, operator, and value.

To add more filters, choose **Add another filter**.

To remove a filter, choose **Remove**.

Note

LIMIT is not supported for list queries.

Only the AND operator is supported in filters.

4. (Optional) For **Add description – optional**, enter a description to help identify the query in the list of recent queries.

If the two tables use the aggregation analysis rule

Only the AND operator is supported in filters.

If the two tables use the list analysis rule

5. (Optional) For **Add description – optional**, enter a description to help identify the query in the list of recent queries.

7. Expand **Preview SQL code**.

- a. View the SQL code that's generated from the analysis builder.
- b. To copy the SQL code, choose **Copy**.
- c. To edit the SQL code, choose **Edit in SQL code editor**.

8. Choose **Run**.

Note

You can't run the query if the member who can receive results hasn't configured the query results settings

9. Continue to adjust parameters and run your query again, or choose the + button to start a new query in a new tab.

Note

AWS Clean Rooms aims to provide clear error messaging. If an error message doesn't have enough details to help you troubleshoot, contact the account team. Provide them with a description of how the error occurred and the error message (including any identifiers). For more information, see [Troubleshooting AWS Clean Rooms](#).

Viewing the impact of differential privacy

In general, writing and running queries doesn't change when differential privacy is turned on. However, you can't run a query if there isn't enough privacy budget remaining. As you run queries and consume the privacy budget, you can see approximately how many aggregations you can run and how that might impact future queries.

To view the impact of differential privacy in a collaboration

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you haven't yet done so).
2. In the left navigation pane, choose **Collaborations**.
3. Choose the collaboration that has **Your member details** status of **Run queries**.
4. On the **Queries** tab, under **Tables**, view the remaining privacy budget. This is displayed as the estimated number of **aggregation functions remaining** and the **Utility used** (rendered as a percentage).

Note

The estimated number of **aggregate functions remaining** and the percentage of the **Utility used** only display for the member who can query.

5. Choose **View impact** to view how much noise is injected into the results and approximately how many aggregation functions you can run.

Viewing recent queries

You can view the queries that ran in the last 90 days on the **Analysis** tab.

Note

If your only member ability is **Contribute data**, and you aren't the [member paying for query compute costs](#), the **Analysis** tab doesn't appear on the console.

To view recent queries

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you haven't yet done so).
2. In the left navigation pane, choose **Collaborations**.
3. Choose a collaboration.
4. On the **Analysis** tab, under **Analyses**, select **All queries** from the dropdown, and view the queries that have been run in the last 90 days.
5. To sort recent queries by **Status**, select a status from the **All statuses** dropdown list.

The statuses are: **Submitted**, **Started**, **Cancelled**, **Success**, **Failed**, and **Timed out**.

Viewing query details

You can view the query details as the member who can run queries or as a member who can receive results.

To view the details of the query

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you haven't yet done so).
2. In the left navigation pane, choose **Collaborations**.
3. Choose a collaboration.
4. On the **Queries** tab, do one of the following:
 - Choose the option button for the specific query you want to view, and then choose **View details**.
 - Choose the **Protected query ID**.
5. On the **Query details** page,
 - If you are the member who can run queries, view the **Query details**, **SQL text** and **Results**.

You see a message confirming that the query results were delivered to the member who can receive results.

- If you are the member who can receive results, view the **Query details** and **Results**.

Running PySpark jobs

As the [member who can query](#), you can run a PySpark job on a configured table by using an approved PySpark [analysis template](#).

Prerequisites

Before you run a PySpark job, you must have:

- An active membership in AWS Clean Rooms collaboration
- Access to at least one analysis template in the collaboration
- Access to at least one configured table in the collaboration
- Permissions to write the results of a PySpark job to a specified S3 bucket

For information about creating the required service role, see [Create a service role to write results of a PySpark job](#).

- The member who is responsible to pay for compute costs has joined the collaboration as an active member

For information about how to query data or view queries by calling the AWS Clean Rooms StartProtectedJob API operation directly or by using the AWS SDKs, see the [AWS Clean Rooms API Reference](#).

For information about job logging, see [Analysis logging in AWS Clean Rooms](#).

For information about receiving job results, see [Receiving and using analysis results](#).

The following topics explain how to run a PySpark job on a configured table in a collaboration using the AWS Clean Rooms console.

Topics

- [Running a PySpark job on a configured table using a PySpark analysis template](#)
- [Viewing recent jobs](#)
- [Viewing job details](#)

Running a PySpark job on a configured table using a PySpark analysis template

This procedure demonstrates how to use a PySpark analysis template in the AWS Clean Rooms console to analyze configured tables with the **Custom** analysis rule.

To run a PySpark job on a configured table using a Pyspark analysis template

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you haven't yet done so).
2. In the left navigation pane, choose **Collaborations**.
3. Choose the collaboration that has **Your member abilities** status of **Run jobs**.
4. On the **Analyses** tab, under the **Tables** section, view the tables and their associated analysis rule type (**Custom analysis rule**).

Note

If you don't see the tables that you expect in the list, it might be for the following reasons:

- The tables haven't been [associated](#).
- The tables don't have an [analysis rule configured](#).

5. Under the **Analysis** section, select **Run analysis templates** and then choose the PySpark analysis template from the dropdown list.

The parameters from the PySpark analysis template will automatically populate in the **Definition**.

6. Choose **Run**.

Note

You can't run the job if the member who can receive results hasn't configured the job results settings.

7. Continue to adjust parameters and run your job again, or choose the **+** button to start a new job in a new tab.

Viewing recent jobs

You can view the jobs that ran in the last 90 days on the **Analysis** tab.

Note

If your only member ability is **Contribute data**, and you aren't the [member paying for job compute costs](#), the **Analysis** tab doesn't appear on the console.

To view recent jobs

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you haven't yet done so).
2. In the left navigation pane, choose **Collaborations**.
3. Choose a collaboration.
4. On the **Analysis** tab, under **Analyses**, select **All jobs** from the dropdown, and view the jobs that have been run in the last 90 days.
5. To sort recent jobs by **Status**, select a status from the **All statuses** dropdown list.

The statuses are: **Submitted**, **Started**, **Cancelled**, **Success**, **Failed**, and **Timed out**.

Viewing job details

You can view the job details as the member who can run jobs or as a member who can receive results.

To view the details of the job

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you haven't yet done so).
2. In the left navigation pane, choose **Collaborations**.
3. Choose a collaboration.
4. On the **Analysis** tab, under **Analyses**, select **All jobs** from the dropdown, and then do one of the following:

- Choose the option button for the specific job you want to view, and then choose **View details**.
- Choose the **Protected job ID**.

5. On the **Job details** page,

- If you are the member who can run jobs, view the **Job details**, **Job**, and **Results**.

You see a message confirming that the job results were delivered to the member who can receive results.

- If you are the member who can receive results, view the **Job details** and **Results**.

Receiving and using analysis results

The [member who can receive results](#) reviews the query results in either the AWS Clean Rooms console or in the Amazon S3 bucket that they specified when they joined the collaboration.

Note

For encrypted data tables only, the member who can receive results decrypts the query results by running the C3R encryption client in the [decrypt](#) mode.

If you are using the Spark analytics engine, the **Results destination in Amazon S3** can't be within the same S3 bucket as any data source.

The following topics explain how to receive analysis results using the AWS Clean Rooms console.

Topics

- [Receiving query results](#)
- [Receiving job results](#)
- [Editing default values for query results settings](#)
- [Editing default values for job results settings](#)
- [Using query output in other AWS services](#)

For information about how to query data or view queries by calling the AWS Clean Rooms API directly or by using the AWS SDKs, see the [AWS Clean Rooms API Reference](#).

For information about query logging, see [Analysis logging in AWS Clean Rooms](#).

Note

If you run a query on encrypted data tables, the results from the encrypted columns are encrypted.

Receiving query results

Note

If you are using the Spark analytics engine, the **Results destination in Amazon S3** can't be within the same S3 bucket as any data source.

The results of the query are located in the **Results settings defaults** section of the **Analysis** tab in the AWS Clean Rooms console.

To receive query results

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you haven't yet done so).
2. In the left navigation pane, choose **Collaborations**.
3. Choose the collaboration that has **Your member abilities** status of **Receive results**.
4. To receive the query results directly from AWS Clean Rooms, on the **Analysis** tab, under **Analyses**, select **All queries** from the dropdown, and then under the **Protected query ID** column, select the query.
5. On the **Query details** page, under **Results**, do one of the following:

If you want to...	Then choose...
Copy the results.	Copy
Download the results.	Download Note By default, the downloaded file's name is the corresponding Query id that was displayed when the query was run in AWS Clean Rooms.
View the results in Amazon S3.	View in Amazon S3

If you want to...	Then choose...
	The Amazon S3 console opens in a separate tab.

6. If you're using encrypted data, you can now [decrypt](#) the data tables.

For more information, see [Decrypting data tables with the C3R encryption client](#).

Receiving job results

Note

If you are using the Spark analytics engine, the **Results destination in Amazon S3** can't be within the same S3 bucket as any data source.

The results of the job are located in the **Results settings defaults** section of the **Analysis** tab in the AWS Clean Rooms console.

To receive job results

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you haven't yet done so).
2. In the left navigation pane, choose **Collaborations**.
3. Choose the collaboration that has **Your member abilities** status of **Receive results**.
4. To receive the job results directly from AWS Clean Rooms, on the **Analysis** tab, under **Analyses**, select **All jobs** from the dropdown, and then under the **Protected job ID** column, select the job.
5. On the **Job details** page, under **Results**, copy the Job ID.

Go back to the **Analysis** tab and expand the **Result settings defaults**.

Under **Results destination**, select the link to view the results in Amazon S3.

The Amazon S3 console opens in a separate tab.

In Amazon S3, paste the Job ID in the Search bar and press enter.

The folder containing the results appears. Select the folder to view the job results.

Editing default values for query results settings

Note

If you are using the Spark analytics engine, the **Results destination in Amazon S3** can't be within the same S3 bucket as any data source.

As a member who can receive results, you can edit the default values for query results settings in the AWS Clean Rooms console.

To edit the default values for query results settings

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you haven't yet done so).
2. In the left navigation pane, choose **Collaborations**.
3. Choose the collaboration that has **Your member abilities** status of **Receive results**.
4. On the **Analysis** tab, under **Results settings defaults**, choose **Edit**.
5. On the **Edit results settings defaults** page, modify any of the following, as needed:
 - a. Under **Query results**, modify the **Results destination in Amazon S3**, the **Result format**, or the **Result files**.
 - b. (Optional) For **Service access**, if you want to deliver queries that take up to 24 hours to your S3 destination, select the **Add a service role to support queries that take up to 24 hours to complete** checkbox.

Large queries that take up to 24 hours to complete will be delivered to your S3 destination.

If you don't select the checkbox, only queries that complete within 12 hours will be delivered to your S3 location.

- Specify the **Service access** permissions by selecting either **Create and use a new service role** or **Use an existing service role**.

Create and use a new service role

- AWS Clean Rooms creates a service role with the required policy for this table.
- The default **Service role name** is `cleanrooms-query-receiver-
<timestamp>`
- You must have permissions to create roles and attach policies.

Use an existing service role

1. Choose an **Existing service role name** from the dropdown list.

The list of roles are displayed if you have permissions to list roles.

If you don't have permissions to list roles, you can enter the Amazon Resource Name (ARN) of the role that you want to use.

2. View the service role by choosing the **View in IAM** external link.

If there are no existing service roles, the option to **Use an existing service role** is unavailable.

By default, AWS Clean Rooms doesn't attempt to update the existing role policy to add necessary permissions.

Note

- AWS Clean Rooms requires permissions to query according to the analysis rules. For more information about permissions for AWS Clean Rooms, see [AWS managed policies for AWS Clean Rooms](#).
- If the role doesn't have sufficient permissions for AWS Clean Rooms, you receive an error message stating that the role doesn't have sufficient permissions for AWS Clean Rooms. The role policy must be added before proceeding.
- If you can't modify the role policy, you receive an error message stating that AWS Clean Rooms couldn't find the policy for the service role.

6. Choose **Save changes**.

7. The updated **Query results settings** appear on the collaboration detail page.

Editing default values for job results settings

Note

If you are using the Spark analytics engine, the **Results destination in Amazon S3** can't be within the same S3 bucket as any data source.

As a member who can receive results, you can edit the default values for job results settings in the AWS Clean Rooms console.

To edit the default values for job results settings

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you haven't yet done so).
2. In the left navigation pane, choose **Collaborations**.
3. Choose the collaboration that has **Your member abilities** status of **Receive results**.
4. On the **Analysis** tab, under **Results settings defaults**, choose **Edit**.
5. On the **Edit results settings defaults** page, modify any of the following, as needed:
 - a. Under **Job results**, modify the **Results destination in Amazon S3**.
 - b. Under **Service access**, modify the **Existing service role name**.
6. Choose **Save changes**.
7. The updated **Job results settings** appear on the collaboration detail page.

Using query output in other AWS services

SQL query output can be used for the seed data for a Clean Rooms ML model. For more information, see [AWS Clean Rooms ML](#).

Query output from AWS Clean Rooms is available on the console (if the console is used to run queries) and downloaded in a specified Amazon S3 bucket. From there, you can use the query output in other AWS services, such as Amazon QuickSight and Amazon SageMaker AI, depending on how those services use data from Amazon S3.

For more information about Amazon QuickSight, see the [Amazon QuickSight Documentation](#).

For more information about Amazon SageMaker AI, see the [Amazon SageMaker AI Documentation](#).

Create AWS Clean Rooms ML models as a training data provider

A *lookalike model* is a model of a training data provider's data that allows a seed data provider to create a lookalike segment of training data provider's data that most closely resembles their seed data. To create a lookalike model that can be used in a collaboration, you must import your training data, create a lookalike model, configure that lookalike model, and then associate it to a collaboration.

Working with lookalike models requires that two parties, a training data provider and a seed data provider, work sequentially in AWS Clean Rooms to bring their data into a collaboration. This is the workflow that the training data provider must complete first:

1. The training data provider's data must be stored in a AWS Glue data catalog table of user-item interactions. At a minimum, the training data must contain a user ID column, interaction ID column, and a timestamp column.
2. The training data provider registers the training data with AWS Clean Rooms.
3. The training data provider creates a lookalike model that can be shared with multiple seed data providers. The lookalike model is a deep neural network that can take up to 24 hours to train. It isn't automatically retrained and we recommend that you retrain the model weekly.
4. The training data provider configures the lookalike model, including whether to share relevance metrics and the Amazon S3 location of the output segments. The training data provider can create multiple configured lookalike models from a single lookalike model.
5. The training data provider associates the configured audience model to a collaboration that's shared with a seed data provider.

After the training data provider is done creating the ML model, the [seed data provider can create and export the lookalike segment](#).

Topics

- [Importing training data](#)
- [Creating a lookalike model](#)
- [Configuring a lookalike model](#)
- [Associating a configured lookalike model](#)

- [Updating a configured lookalike model](#)

Importing training data

Note

You can only supply a training data set for using in a Clean Rooms ML lookalike model that has data stored in Amazon S3. However, you can supply the seed data for a lookalike model using SQL that runs across data stored in any supported data source.

Before you create a lookalike model, you must specify the AWS Glue table that contains the training data. Clean Rooms ML doesn't store a copy of this data, just metadata that allows it to access the data.

To import training data in AWS Clean Rooms

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you haven't yet done so).
2. In the left navigation pane, choose **AWS ML models**.
3. On the **Training datasets** tab, choose **Create training dataset**.
4. On the **Create training dataset** page, for **Training dataset details**, enter a **Name** and optional **Description**.
5. Choose the **Training data source** by selecting the **Database** and **Table** that you want to configure from the dropdown lists.

Note

To verify that this is the correct table, do either one of the following:

- Choose **View in AWS Glue**.
- Turn on **View schema** to view the schema.

6. For **Training details**, choose the **User identifier column**, **Item identifier column**, and **Timestamp column** from the dropdown lists. The training data must contain these three columns. You can also select any other columns that you want to include in the training data.

The data in the **Timestamp column** must be in the Unix epoch time in seconds format.

7. (Optional) If you have any **Additional columns to train**, choose the **Column name** and **Type** from the dropdown lists.
8. In **Service access**, you must specify a service role that can access your data and provide a KMS key if your data is encrypted. Choose **Create and use a new service role** and Clean Rooms ML will automatically create a service role and add the necessary permissions policy. Choose **Use an existing service role** and enter it in the **Service role name** field if you have a specific service role that you want to use.

If your data is encrypted, enter your KMS key in the **AWS KMS key** field, or click **Create an AWS KMS key** to generate a new KMS key.

9. If you want to enable **Tags** for the training dataset, choose **Add new tag** and then enter the **Key** and **Value** pair.
10. Choose **Create training dataset**.

For the corresponding API action, see [CreateTrainingDataset](#).

Creating a lookalike model

After you have created a training dataset, you are ready to create a lookalike model. You can create many lookalike models from a single training dataset.

You must create a default database in your AWS Glue Data Catalog or include the `glue:createDatabase` permission in the provided role.

To create a lookalike model in AWS Clean Rooms

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you haven't yet done so).
2. In the left navigation pane, choose **AWS ML models**.
3. On the **Lookalike models** tab, choose **Create lookalike model**.
4. On the **Create lookalike model** page, for **Lookalike model details**, enter a **Name** and optional **Description**.
 - a. Choose the **Training dataset** that you want to model from the dropdown list.

Note

To verify that this is the correct training dataset, turn on **Show training dataset details** to view the details.

To create a new training dataset, choose **Create training dataset**.

- b. (Optional) Enter a **Training window**.
5. If you want to enable custom encryption settings for the lookalike model, choose **Customize encryption settings** and then enter the KMS key.
6. If you want to enable **Tags** for the lookalike model, choose **Add new tag** and then enter the **Key** and **Value** pair.
7. Choose **Create lookalike model**.

Note

Model training can take several hours to 2 days.

For the corresponding API action, see [CreateAudienceModel](#).

Configuring a lookalike model

After you have created a lookalike model, you are ready to configure it for use in a collaboration. You can create multiple configured lookalike models from a single lookalike model.

To configure a lookalike model in AWS Clean Rooms

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you haven't yet done so).
2. In the left navigation pane, choose **AWS ML models**.
3. On the **Configured lookalike models** tab, choose **Configure lookalike model**.
4. On the **Configure lookalike model** page, for **Configured lookalike model details**, enter a **Name** and optional **Description**.
 - a. Choose the **Lookalike model** that you want to configure from the dropdown list.

Note

To verify that this is the correct lookalike model, turn on **Show lookalike model details** to view the details.

To create a new lookalike model, choose **Create lookalike model**.

- b. Choose the **Minimum matching seed size** that you want. This is the minimum number of users in the seed data provider's data that overlap with users in the training data. This value must be greater than 0.
5. For **Metrics to share with other members**, choose whether you want the seed data provider in your collaboration to receive model metrics, including relevance scores.
6. For **Lookalike segment destination location**, enter the Amazon S3 bucket where the lookalike segment is exported. This bucket must be located in the same region as your other resources.
7. For **Service access**, choose the **Existing service role name** that will be used to access this table.
8. For **Advanced bin size configuration**, specify the **Audience size type** as either an **Absolute** number or a **Percentage**.
9. If you want to enable **Tags** for the configured table resource, choose **Add new tag** and then enter the **Key** and **Value** pair.
10. Choose **Configure lookalike model**.

For the corresponding API action, see [CreateConfiguredAudienceModel](#).

Associating a configured lookalike model

After you have configured a lookalike model, you can associate it to a collaboration.

To associate a configured lookalike model in AWS Clean Rooms

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you haven't yet done so).
2. In the left navigation pane, choose **Collaborations**.
3. On the **With active membership** tab, choose a collaboration.
4. On the **ML models** tab, under **Ready-to-use lookalike models**, choose **Associate lookalike model**.

5. On the **Associate configured lookalike model** page, for **Configured lookalike model association details**:
 - a. Enter a **Name** for the associated configured audience model.
 - b. Enter a **Description** of the table.

The description helps differentiate between other associated configured audience models with similar names.
6. For **Configured lookalike model**, choose a configured lookalike model from the dropdown list.
7. Choose **Associate**.

For the corresponding API action, see [CreateConfiguredAudienceModelAssociation](#).

Updating a configured lookalike model

After you have associated a configured a lookalike model, you can update it to change information such as the name, metrics to share, or output Amazon S3 location.

To update an associated configured lookalike model in AWS Clean Rooms

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you haven't yet done so).
2. In the left navigation pane, choose **AWS ML models**.
3. On the **Configured lookalike models** tab, under **Ready-to-use lookalike models**, choose a configured lookalike model and select **Edit**.
4. On the **Edit** page, for **Configured lookalike model association details**:
 - a. Update the **Name** and optional **Description**.
 - b. Choose the **Lookalike model** that you want configured from the dropdown list.
 - c. Choose the **Minimum matching seed size** that you want. This is the minimum number of users in the seed data provider's data that overlap with users in the training data. This value must be greater than 0.
5. For **Metrics to share with other members**, choose whether you want the seed data provider in your collaboration to receive model metrics, including relevance scores.
6. For **Lookalike segment destination location**, enter the Amazon S3 bucket where lookalike segment is exported. This bucket must be located in the same region as your other resources.

7. For **Service access**, choose the **Existing service role name** that will be used to access this table.
8. For **Advanced bin size configuration**, choose how you want to configure the audience bin sizes.
9. Choose **Save changes**.

For the corresponding API action, see [UpdateConfiguredAudienceModel](#).

Creating AWS Clean Rooms ML models as a seed data provider

After the training data provider is done creating the ML model, the seed data provider can create and export the lookalike segment. The lookalike segment is a subset of the training data that most closely resembles the seed data.

This is the workflow that the seed data provider must complete:

1. The seed data provider's data can be stored in an Amazon S3 bucket or it can come from the results of query.
2. The seed data provider opens the collaboration that they share with the training data provider.
3. The seed data provider creates a lookalike segment from the Clean Rooms ML tab of the collaboration page.
4. The seed data provider can evaluate the relevance metrics, if they were shared, and export the lookalike segment for use outside AWS Clean Rooms.

Topics

- [Creating a lookalike segment](#)
- [Exporting a lookalike segment](#)

Creating a lookalike segment

Note

You can only supply a training data set for using in a Clean Rooms ML lookalike model that has data stored in Amazon S3. However, you can supply the seed data for a lookalike model using SQL that runs across data stored in any supported data source.

A lookalike segment is a subset of the training data that most closely resembles the seed data.

To create a lookalike segment in AWS Clean Rooms

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you haven't yet done so).
2. In the left navigation pane, choose **Collaborations**.
3. On the **With active membership** tab, choose a collaboration.
4. On the **ML Models** tab, choose **Create lookalike segment**.
5. On the **Create lookalike segment** page, for **Associated configured lookalike model**, choose the associated configured lookalike model to use for this lookalike segment.
6. For **Lookalike segment details** enter a **Name** and optional **Description**.
7. For **Seed profiles**, choose your **Seed method** by selecting an option and then taking the recommended action.

Option	Recommended action
Amazon S3 path	1. Select an Amazon S3 location. 2. (Optional) Choose Include seed profiles in the output.
SQL query	Write a SQL query and use its results as the seed data.
Analysis template	Choose an analysis template from the dropdown list and use the results created by an analysis template.

8. Choose the **Worker type** and **Number of workers** to use when creating this data channel.
9. For **Service access**, choose the **Existing service role name** that will be used to access this table.
10. If you want to enable **Tags** for the training dataset, choose **Add new tag** and then enter the **Key** and **Value** pair.
11. Choose **Create lookalike segment**.

For the corresponding API action, see [StartAudienceGenerationJob](#).

Exporting a lookalike segment

After you have created a lookalike segment, you can export that data to an Amazon S3 bucket.

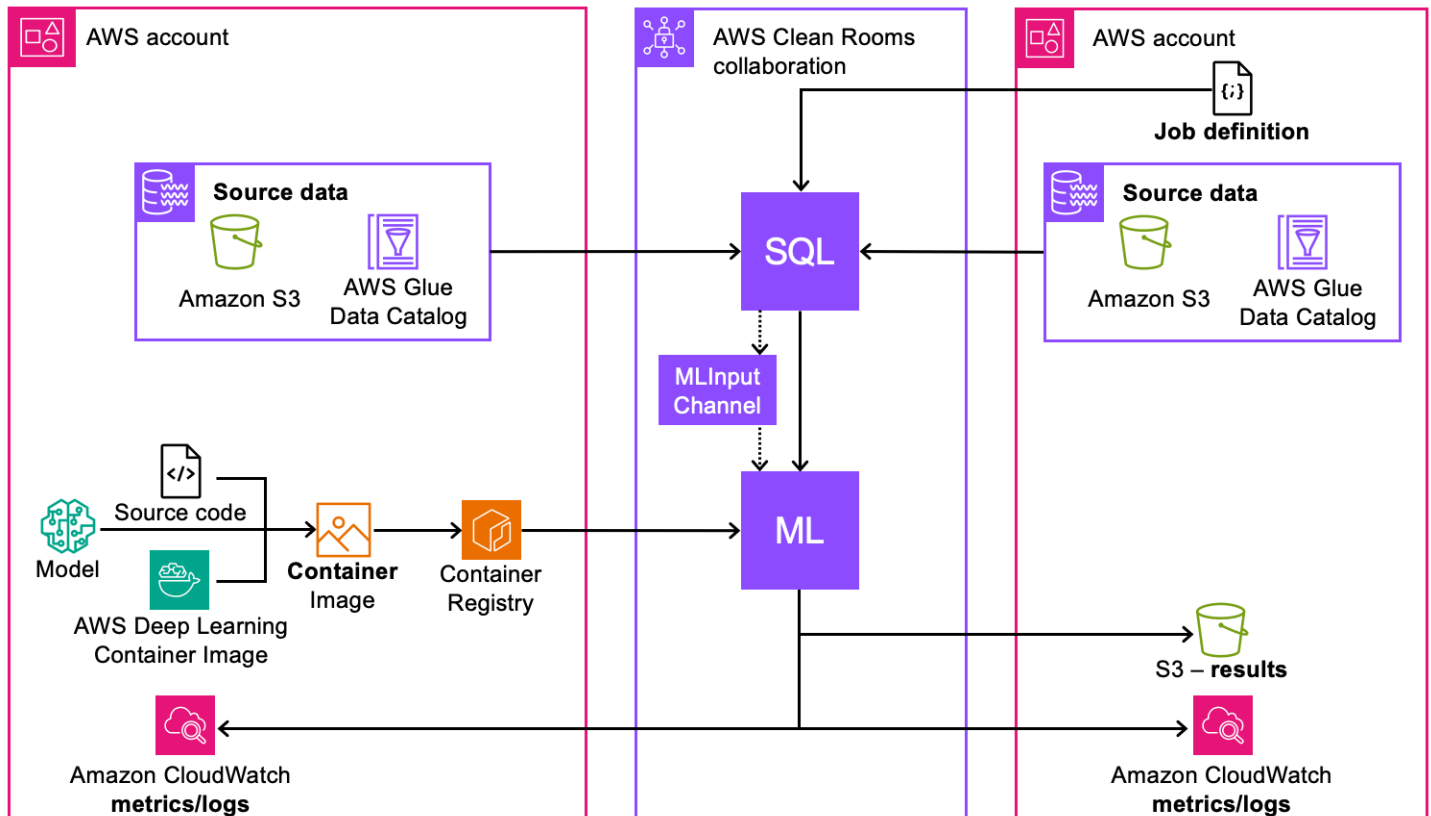
To export a lookalike segment in AWS Clean Rooms

1. Sign in to the AWS Management Console and open the [AWS Clean Rooms console](#) with your AWS account (if you haven't yet done so).
2. In the left navigation pane, choose **Collaborations**.
3. On the **With active membership** tab, choose a collaboration.
4. On the **ML Models** tab, select a lookalike segment and choose **Export**.
5. For **Export lookalike model**, for **Export lookalike model details** enter a **Name** and optional **Description**.
6. For **Segment size**, choose the size you want for the exported segment.
7. Choose **Export**.

For the corresponding API action, see [StartAudienceExportJob](#).

Custom modeling in AWS Clean Rooms ML

From a technical standpoint, the following diagram describes how custom ML modeling works in AWS Clean Rooms ML.



Here's how custom ML modeling works in Clean Rooms ML:

1. Data Source Configuration

- Source data can be stored in Amazon S3 catalog, in the AWS Glue Data Catalog, or Snowflake
- AWS Glue Data Catalog is used to organize and catalog
- Data from multiple AWS accounts can be used within the same collaboration

2. SQL Query and Data Processing

- SQL queries are used to access and process the source data
- The queries run within the AWS Clean Rooms collaboration boundaries
- Processed data feeds into ML Input Channels for model training

3. ML Model Development

- Source code for the model can be developed using AWS Deep Learning Container Images

- Custom container images must be created and stored in Amazon Elastic Container Registry

4. Infrastructure Components

- Amazon Elastic Container Registry stores and manages the ML model containers
- ML processing occurs within the secure AWS Clean Rooms collaboration environment

5. Monitoring and Logging

- Amazon CloudWatch provides metrics and logs for both collaborating parties
- Monitoring is available across AWS accounts involved in the collaboration
- Performance metrics and operational logs are accessible to relevant parties

6. Results Management

- Access to results is controlled according to collaboration permissions

Before you get started, see the [Custom ML modeling prerequisites](#) and [Model authoring guidelines for the training container](#) for more information.

Topics

- [Creating and joining the collaboration in AWS Clean Rooms ML](#)
- [Contributing training data in AWS Clean Rooms ML](#)
- [Configuring a model algorithm in AWS Clean Rooms ML](#)
- [Associating the configured model algorithm in AWS Clean Rooms ML](#)
- [Creating an ML input channel in AWS Clean Rooms ML](#)
- [Creating a trained model in AWS Clean Rooms ML](#)
- [Exporting model artifacts from AWS Clean Rooms ML](#)
- [Running inference on a trained model in AWS Clean Rooms ML](#)

Creating and joining the collaboration in AWS Clean Rooms ML

The collaboration creator is responsible for creating the collaboration, inviting members, and assigning their roles. The invited members join the collaboration and specify results settings, trained model artifacts destination settings and accept payment responsibilities, depending on how the collaboration is set up.

Creating a collaboration for machine learning

The following procedure shows how to create a collaboration for machine learning, invite one or more members, and assign members that can start model training, receive results, receive trained model results, including model artifacts and metrics, and receive model inference results. The collaboration creator also assigns a member who will pay for query compute, model training, and model inference costs.

Console

To create a collaboration for machine learning (console)

1. [Create a collaboration and invite one or more members to join the collaboration](#)
2. Assign the following **Member abilities** for **Analysis using queries and jobs**:
 - Assign **Run queries** to the member who will start model training.
 - Assign **Receive results from analysis** to the members who will receive query results.
3. Assign the following **Member abilities** for **ML modeling using purpose-built workflows**:
 - Assign **Receive output from trained models** to the member who will receive trained model results, including model artifacts and metrics.
 - Assign **Receive output from model inference** to the member who will receive the model inference results.
4. For **Configure payment**, specify the members who will pay for query compute, model training, and model inference costs. Each of these costs can be assigned to the same or different members. If an invited member is the member who is responsible to pay for payment costs, they must accept their payment responsibilities before joining the collaboration.
5. For **Configure membership**, the collaboration creator can decide to join the membership now or create a membership later. The collaboration creator must then set up the ML configuration.
 - a. If the collaboration creator is also the results receiver, they must also specify the query results destination and format in the **Results settings defaults**.
 - b. The ML configuration provides a role for Clean Rooms ML to publish metrics to an AWS account. If the collaboration creator is also receiving trained model artifacts, they can specify the Amazon S3 bucket used to receive results.

- c. In the **ML configurations** section, select **Create ML configuration** and then specify the **Model output destination on Amazon S3** and the **Service access role** needed to access this location.
- d. If the collaboration creator is the member who is responsible to pay for payment costs, they must accept their payment responsibilities before creating the collaboration.

API

To create a collaboration for machine learning (API)

1. [Create a collaboration and invite one or more members to join the collaboration](#)
2. Assign the following roles to collaboration members:
 - CAN_QUERY - assigned to the member who will start model training and inference.
 - CAN_RECEIVE_MODEL_OUTPUT - assigned to the members who will receive trained model results.
 - CAN_RECEIVE_INFERENCE_OUTPUT - assigned to the members who will receive model inference results.

If the collaboration creator is also the results receiver, they must also specify the query results destination and format during collaboration creation. They also give a service role Amazon Resource Name (ARN) to write the results to the query results destination.

3. Specify the members who will pay for query compute, model training, and model inference costs. Each of these costs can be assigned to the same or different members. If an invited member is the member who is responsible to pay for payment costs, they must accept their payment responsibilities before joining the collaboration.
4. The following code creates a collaboration, invites a member that can run queries and receive results, and specifies the collaboration creator as the model artifacts receiver.

```
import boto3
acr_client= boto3.client('cleanrooms')

collaboration = a_acr_client.create_collaboration(
    members=[
        {
            'accountId': 'invited_member_accountId',
            'memberAbilities': ["CAN_QUERY", "CAN_RECEIVE_RESULTS"],
            'displayName': 'member_display_name'
```

```

        }
    ],
    name='collaboration_name',
    description=collaboration_description,
    creatorMLMemberAbilities= {
        'customMLMemberAbilities':["CAN_RECEIVE_MODEL_OUTPUT",
"CAN_RECEIVE_INFERENCE_OUTPUT"],
    },
    creatorDisplayName='creator_display_name',
    queryLogStatus="ENABLED",
    analyticsEngine="SPARK",
    creatorPaymentConfiguration={
        "queryCompute": {
            "isResponsible": True
        },
        "machineLearning": {
            "modelTraining": {
                "isResponsible": True
            },
            "modelInference": {
                "isResponsible": True
            }
        }
    }
}
)

collaboration_id = collaboration['collaboration']['id']
print("collaborationId: {collaboration_id}")

member_membership = a_acr_client.create_membership(
    collaborationIdentifier = collaboration_id,
    queryLogStatus = 'ENABLED',
    paymentConfiguration={
        "queryCompute": {
            "isResponsible": True
        },
        "machineLearning": {
            "modelTraining": {
                "isResponsible": True
            },
            "modelInference": {
                "isResponsible": True
            }
        }
    }
)

```

```
}
)
```

5. The collaboration creator must then set up the ML configuration. The ML configuration provides a role for Clean Rooms ML to publish metrics and logs to an AWS account. If the collaboration creator is also receiving results (model artifacts or inference results), they can specify the Amazon S3 bucket used to receive results.

```
import boto3
acr_ml_client= boto3.client('cleanroomsmml')

acr_ml_client.put_ml_configuration(
    membershipIdentifier=membership_id,
    defaultOutputLocation={
        'roleArn': 'arn:aws:iam::account:role/roleName',
        'destination':{
            's3Destination':{
                's3Uri': "s3://bucketName/prefix"
            }
        }
    }
)
```

Joining a collaboration

After the collaboration creator has finished their tasks, the invited members must complete theirs.

Console

To create a membership and join a collaboration (console)

1. The invited member [creates a membership and joins the collaboration](#).
2. If the invited member is the member who is responsible to pay, including query compute, model training, and model inference costs, they must accept their payment responsibilities before joining the collaboration.
3. The invited member sets up the ML configuration, which provides a role for Clean Rooms ML to publish model metrics to an AWS account. If they're also the member receiving trained model artifacts, they must give an Amazon S3 bucket where trained model artifacts are stored.

API

To create a membership and join a collaboration (API)

1. If the invited member is the member who can receive results, they specify the query results destination and format. They also provide a service role ARN that allows the service to write to the query results destination

If the invited member is the member who is responsible to pay, including query compute, model training, and model inference costs, they must accept their payment responsibilities before joining the collaboration.

If the invited member is the member who is responsible to pay for model training and model inference for custom modeling, they must accept their payment responsibilities before joining the collaboration.

The following code creates a membership with query logging enabled.

```
import boto3
acr_client= boto3.client('cleanrooms')

acr_client.create_membership(
    membershipIdentifier='membership_id',
    queryLogStatus='ENABLED'
)
```

2. The invited member sets up the ML configuration, which provides a role for Clean Rooms ML to publish model metrics to an AWS account. If they're also the member receiving trained model artifacts, they must provide an Amazon S3 bucket where trained model artifacts are stored.

```
import boto3
acr_ml_client= boto3.client('cleanroomsmml')

acr_ml_client.put_ml_configuration(
    membershipIdentifier='membership_id',
    defaultOutputLocation={
        'roleArn':"arn:aws:iam::account:role/role_name",
        'destination':{
            's3Destination':{
                's3Uri':"s3://bucket_name/prefix"
            }
        }
    }
```

```
}  
}  
)
```

Contributing training data in AWS Clean Rooms ML

After the collaboration creator has created the collaboration and invited members have joined, you are ready to contribute training data to the collaboration. Any member can contribute training data.

Console

To contribute training data (console)

1. Sign in to the AWS Management Console and open the AWS Clean Rooms console at <https://console.aws.amazon.com/cleanrooms>.
2. In the left navigation pane, choose **Tables**.
3. On the **Tables** page, choose **Configure new table**.
4. For **Configure new table**, for **Data source**, choose **Amazon S3**, **Amazon Athena**, or **Snowflake** and complete the following steps, based on your data source:

If you're using	Then
Amazon S3	1. Choose a Database from the dropdown list, and then select the Table from the database. 2. For Columns allowed in collaborations, choose either All columns or Custom list. 3. For Configured table details, provide the Name and an optional Description for this table. 4. If you want to report model metrics, enter the Name of the metrics and the Regex statement that will search the output logs to find the metric.

If you're using	Then
	5. If you want to enable Tags for the configured table resource, choose Add new tag and then enter the Key and Value pair.
Amazon Athena	1. Choose a Database from the dropdown list, and then select the Table from the database. 2. For Columns allowed in collaborations, choose either All columns or Custom list. 3. For Configured table details, provide the Name and an optional Description for this table. 4. If you want to report model metrics, enter the Name of the metrics and the Regex statement that will search the output logs to find the metric. 5. If you want to enable Tags for the configured table resource, choose Add new tag and then enter the Key and Value pair.

If you're using	Then
Snowflake	1. Specify the Snowflake credentials using an existing secret ARN or storing a new secret for this table. 2. For Snowflake table and schema details, enter the details manually or automatically import the details. 3. For the Schema, enter the Column name and choose the Data type from the dropdown list. 4. If you want to enable Tags for the configured table resource, choose Add new tag and then enter the Key and Value pair.

5. Choose **Configure new table**.
6. On the table details page, choose **Configure analysis rule** to configure a custom analysis rule for this table. A custom analysis rule limits access to your data. You can either allow a specific set of pre-authorized queries on your data or allow a specific set of accounts to query your data.
 - a. For **Analysis rule type**, choose **Custom** and for **Creation method**, choose **Guided flow**.
 - b. Choose **Next**.
 - c. For **Specify analysis controls**, choose between **Review each new analysis** and **Allow any analysis by specific collaborators**.
 - d. Choose **Next**.
 - e. (Optional) For **Specify analysis results controls**, for **Columns not allowed in output** specify whether you want to exclude any columns from the output. If you choose **None**, no columns are excluded from the output. If you choose **Custom list**, you can specify certain columns that will be removed from the output.
 - f. For **Additional analyses applied to output** specify whether you want to allow, deny, or require an additional analysis before results are generated.
 - g. Choose **Next**.
 - h. (Optional) For **Set differential privacy**, choose **Turn off**.

- i. Choose **Next**.
 - j. Review the information on the **Review and configure** page, then choose **Configure analysis rule**.
7. From the table details page, choose **Associate to collaboration**.
8. In the **Associate table** dialog box, select the collaboration that you want to associate this table to and choose **Choose collaboration**.
9. On the **Associate table** page, review and verify the information in **Table association details**, **Service access**, and **Tags**. Choose **Associate table**.
10. In the **Tables associated by you** table, select the radio button next to the table that you just associated. From the **Actions** menu, choose **Configure** in the **Collaboration analysis rule** group.
11. On the **Configure collaboration analysis rule** page, for **Allowed additional analyses**, choose whether any collaboration members or specific collaboration members can perform additional analyses.

For **Results delivery**, choose which members are allowed to receive results from query outputs.

12. Choose **Configure analysis rule**.

API

To contribute training data (API)

1. Configure an existing AWS Glue table for use in AWS Clean Rooms by providing the table and the columns that can be used.

Run the following code with your specific parameters.

```
import boto3
acr_client= boto3.client('cleanrooms')

acr_client.create_configured_table(
    name='configured_table_name',
    tableReference= {
        'glue': {
            'tableName': 'glue_table_name',
            'databaseName': 'glue_database_name'
```

```

    }
  },
  analysisMethod="DIRECT_QUERY",
  allowedColumns=["column1", "column2", "column3",...]
)

```

2. Configure a custom analysis rule that limits access to your data. You can either allow a specific set of pre-authorized queries on your data or allow a specific set of accounts to query your data.

Run the following code with your specific parameters.

```

import boto3
acr_client= boto3.client('cleanrooms')

acr_client.create_configured_table_analysis_rule(
    configuredTableIdentifier='configured_table_id',
    analysisRuleType='CUSTOM',
    analysisRulePolicy= {
        'v1': {
            'custom': {
                'allowedAnalyses': ['ANY_QUERY'],
                'allowedAnalysisProviders': ['query_runner_account'],
                'additionalAnalyses': "REQUIRED"
            }
        }
    }
)

```

In this example, a specific account is allowed to run any query on the data and an additional analysis is required.

3. Associate a configured table to the collaboration and provide a service access role to the AWS Glue tables.

Run the following code with your specific parameters.

```

import boto3
acr_client= boto3.client('cleanrooms')

acr_client.create_configured_table_association(
    name='configured_table_association_name',
    membershipIdentifier='membership_id',

```

```
configuredTableIdentifier='configured_table_id',
roleArn='arn:aws:iam::account:role/role_name'
)
```

Note

This service role has permissions to the tables. The service role is assumable only by AWS Clean Rooms to run allowed queries on behalf of the member who can query. No collaboration members (other than the data owner) have access to the underlying tables in the collaboration. The data owner can turn off differential privacy to make their tables available for querying by other members.

4. Finally, add an analysis rule to the configured table association.

Run the following code with your specific parameters.

```
import boto3
acr_client= boto3.client('cleanrooms')

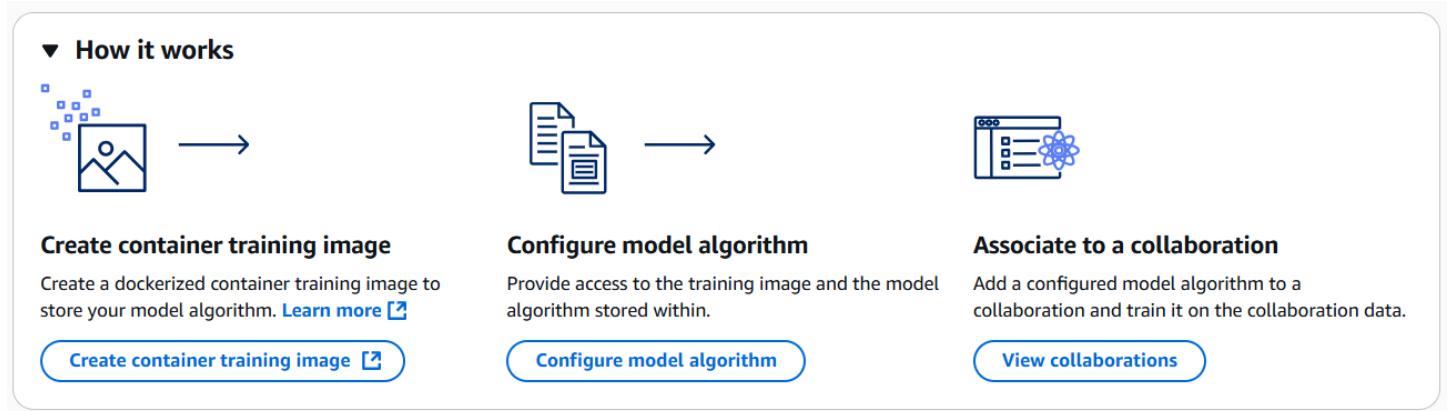
acr_client.create_configured_table_association_analysis_rule(

    configuredTableAssociationIdentifier='configured_table_association_identifier',
    membershipIdentifier='membership_id',
    configuredTableIdentifier='configured_table_id',
    analysisRuleType = 'CUSTOM',
    analysisRulePolicy= {
        'v1': {
            'custom': {
                'allowedAdditionalAnalyses':
                ['configured_model_algorithm_association_arns'],
                'allowedResultReceivers': ['query_runner_account']
            }
        }
    }
)
```

Configuring a model algorithm in AWS Clean Rooms ML

After you have [created a container training image](#), you must configure your model algorithm. Configuring a model algorithm makes it available for association to a collaboration.

The following image shows configuring a model algorithm as a step that happens after you create the container training image and before you associate it with the collaboration.



Console

To configure a custom ML model algorithm (console)

1. Sign in to the AWS Management Console and open the AWS Clean Rooms console at <https://console.aws.amazon.com/cleanrooms>.
2. In the left navigation pane, choose **Custom ML models**.
3. On the **Custom ML models** page, choose **Configure model algorithm**.
4. On the **Configure model algorithm** page, for **Model algorithm details**, enter a **Name** and optional **Description**.
5. If you want to perform model training, for **Training image ECR container details**,
 - a. Select the **Specify training image URI** checkbox.
 - b. Select the **Repository** that has the training model, inference container, or both, from the dropdown list.
 - c. Select the **Image**.
 - d. (Optional) Enter the **Value** for the **Entrypoints** to access the training image.
 - e. (Optional) Enter the **Value** for the **Arguments**.
6. (Optional) If you want to report model metrics, for **Training metrics**, enter the **Name** of the metrics and the **Regex** statement that will search the output logs to find the metric.
7. If you want to perform model inference, for **Inference image ECR container details**,
 - a. Select the **Specify inference image URI** checkbox.
 - b. Select the **Repository** from the dropdown list.

- c. Select the **Image**.
8. For **Service access**, choose the **Existing service role name** that will be used to access this table.
9. For **Encryption**, choose the **Customize encryption settings** to specify your own KMS key and related information. Otherwise, Clean Rooms ML will manage the encryption.
10. If you want to enable **Tags**, choose **Add new tag** and then enter the **Key** and **Value** pair.
11. Choose **Configure model algorithm**.

API

To configure a custom ML model algorithm (API)

1. Create a SageMaker AI compatible docker image. Clean Rooms ML only supports SageMaker AI compatible docker images.
2. After you have created a SageMaker AI compatible docker image, use Amazon ECR to create a training image. Follow the directions in [Amazon Elastic Container Registry User Guide](#) to create a container training image.
3. Configure the model algorithm for use in Clean Rooms ML. You must give the following information:
 - The Amazon ECR repository link and additional arguments to train the model and run inference. Clean Rooms ML supports running batch transform jobs on an inference container.
 - A service access role that allows Clean Rooms ML to access the repository.
 - (Optional) An inference container. Although you can provide this in a separate configured model algorithm, we recommend that you provide it in this step so that both the training and inference container are managed as part of the same resource.

Run the following code with your specific parameters.

```
import boto3
acr_ml_client= boto3.client('cleanroomsm1')

acr_ml_client.create_configured_model_algorithm(
    name='configured_model_algorithm_name',
    trainingContainerConfig={
        'imageUri': 'account.dkr.ecr.region.amazonaws.com/image_name:tag',
        'metricDefinitions': [
```

```

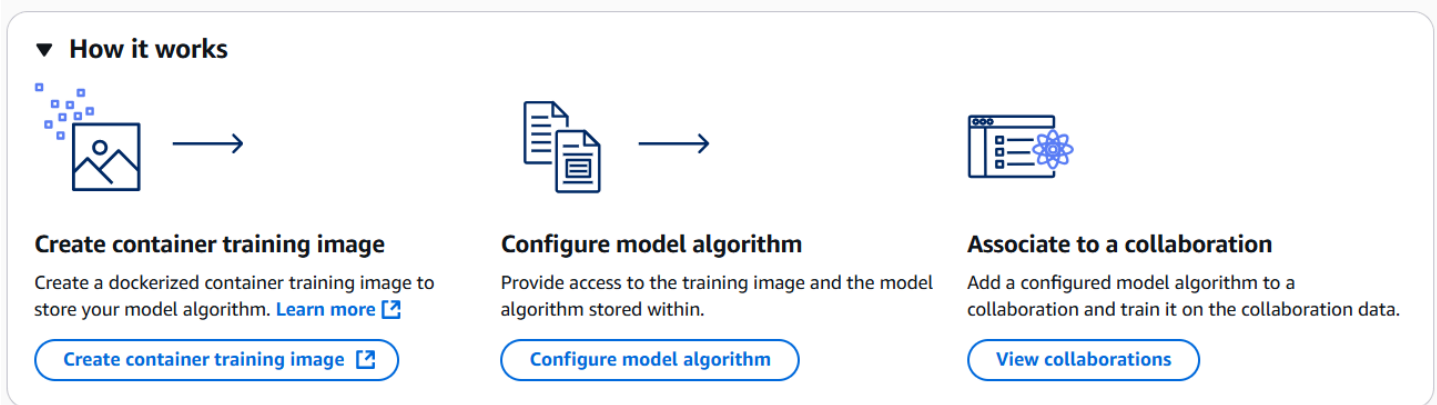
        {
            'name': 'custom_metric_name_1',
            'regex': 'custom_metric_regex_1'
        }
    ],
    inferenceContainerConfig={
        'imageUri': 'account.dkr.ecr.region.amazonaws.com/image_name:tag',
    }
    roleArn='arn:aws:iam::account:role/role_name'
)

```

Associating the configured model algorithm in AWS Clean Rooms ML

After you have configured the model algorithm, you are ready to associate the model algorithm to a collaboration. Associating a model algorithm makes the model algorithm available to all members of the collaboration.

The following image shows associating the configured model algorithm as the last step, after creating the container training image and configuring a model algorithm.



Console

To associate a custom ML model algorithm (console)

1. Sign in to the AWS Management Console and open the AWS Clean Rooms console at <https://console.aws.amazon.com/cleanrooms>.
2. In the left navigation pane, choose **Custom ML models**.

3. On the **Custom ML models** page, choose the configured model algorithm that you want to associate to a collaboration and click **Associate to collaboration**.
4. In the **Associate configured model algorithm** window, choose the **Collaboration** that you want to associate to.
5. Choose **Choose collaboration**.

API

To associate a custom ML model algorithm (API)

Run the following code with your specific parameters.

You also provide a privacy policy that defines who has access to the different logs, allows customers to define regex, and how much data can be exported from the training model outputs or inference results.

Note

Configured model algorithm associations are immutable.

```
import boto3
acr_ml_client= boto3.client('cleanroomsmml')

acr_ml_client.create_configured_model_algorithm_association(
    name='configured_model_algorithm_association_name',
    description='purpose of the association',
    membershipIdentifier='membership_id',
    configuredModelAlgorithmArn= 'arn:aws:cleanrooms-ml:region:account:membership/
membershipIdentifier/configured-model-algorithm/identifier',
    privacyConfiguration = {
        "policies": {
            "trainedModels": {
                "containerLogs": [
                    {
                        "allowedAccountIds": ['member_account_id'],
                    },
                ],
            },
            {
                "allowedAccountIds": ['member_account_id'],
            },
        },
    },
)
```

```

        "filterPattern": "INFO"
    },
    ],
    "containerMetrics": {
        "noiseLevel": 'noise value'
    },
    },
    "trainedModelInferenceJobs": {
        "containerLogs": [
            {
                "allowedAccountIds": ['member_account_id']
            }
        ]
    },
    trainedModelExports: {
        maxSize: {
            unit: GB,
            value: 5
        },
        filesToExport: [
            "MODEL",    // final model artifacts that container should write
to /opt/ml/model directory
            "OUTPUT"   // other artifacts that container should write to /
opt/ml/output/data directory
        ]
    }
}
}
)

```

After the configured model algorithm is associated to the collaboration, training data providers must add a collaboration analysis rule to their table. This rule allows the configured model algorithm association to access their configured table. All contributing training data providers must run the following code:

```

import boto3
acr_client= boto3.client('cleanrooms')

acr_client.create_configured_table_association_analysis_rule(
    membershipIdentifier= 'membership_id',
    configuredTableAssociationIdentifier= 'configured_table_association_id',
    analysisRuleType= 'CUSTOM',
    analysisRulePolicy = {

```

```

    'v1': {
      'custom': {
        'allowedAdditionalAnalyses': ['arn:aws:cleanrooms-
ml:region*:membership/*/configured-model-algorithm-association/*'],
        'allowedResultReceivers': []
      }
    }
  }
)

```

Note

Because configured model algorithm associations are immutable, we recommend that training data providers who want to allowlist models for use to use wild cards in `allowedAdditionalAnalyses` during the first few iterations of custom model configuration. This allows model providers to iterate on their code without requiring other training providers to re-associate before training their updated model code with data.

Creating an ML input channel in AWS Clean Rooms ML

Prerequisites:

- An AWS account with access to AWS Clean Rooms
- A collaboration set up in AWS Clean Rooms where you want to create the ML input channel
- Permissions to query data and create ML input channels in the collaboration.
- (Optional) An existing model algorithm to associate with the ML input channel, or permissions to create a new one
- (Optional) Tables with analysis rules that can be run for your specified model.
- (Optional) An existing SQL query or analysis template to use for generating the dataset
- (Optional) An existing service role with appropriate permissions, or permissions to create a new service role
- (Optional) A custom AWS KMS key if you want to use your own encryption key
- Appropriate permissions to create and manage ML models in the collaboration

An *ML input channel* is a dataset that is created from a specific data query. Members with the ability to query data can prepare their data for training and inference by creating an ML input channel. Creating an ML input channel allows that data to be used in different training models within the same collaboration. You should create separate ML input channels for training and inference.

To create an ML input channel, you must specify the SQL query that is used to query the input data and create the ML input channel. The results of this query are never shared with any member and remain within the boundaries of Clean Rooms ML. The reference Amazon Resource Name (ARN) is used in the next steps to train a model or run inference.

Console

To create an ML input channel (console)

1. Sign in to the AWS Management Console and open the AWS Clean Rooms console at <https://console.aws.amazon.com/cleanrooms>.
2. In the left navigation pane, choose **Collaborations**.
3. On the **Collaborations** page, choose the collaboration where you want to create an ML input channel.
4. After the collaboration opens, choose the **ML models** tab..
5. Under **Custom ML models**, in the **ML input channels** section, choose **Create ML input channel**.
6. On the **Create ML input channel** page, for **ML input channel details**, do the following:
 - a. For **Name**, enter a unique name for your channel.
 - b. (Optional) For **Description**, enter a description of your channel.
 - c. For **Associated model algorithm**, select the algorithm to use.

Choose **Associate model algorithm** to add a new one.

7. For **Dataset**, choose a method to generate the training dataset:
 - Choose **SQL query** to use the results of a SQL query as the training dataset.

If you chose **SQL query**, enter your query in the **SQL query** field.

(Optional) To import a query you've used recently, choose **Import from recent queries**.

- Choose **Analysis template** to use the results of an analysis template as the training dataset.

If you chose **Analysis template**, specify the analysis template that you want.

- If no tables are associated, choose **Associate table** to add tables with an analysis rule that can be run for the specified model.
 - For **Worker type**, choose the type of worker to use. The default is **CR.1X**.
 - For **Number of workers** choose the number of workers to use when creating this data channel. The default is **16**.
 - For **Data retention in days**, enter the number of days to keep the data.
 - For **Result format**, choose either **CSV** or **Parquet** as the data format the ML input channel should use.
- For **Service access**, choose the **Existing service role name** that will be used to access this table or choose **Create and use a new service role**.
 - For **Encryption**, choose the **Encrypt secret with a custom KMS key** to specify your own KMS key and related information. Otherwise, Clean Rooms ML will manage the encryption.
 - Choose **Create ML input channel**.

It will take a few minutes to create the ML input channel. You can see a list of ML input channels on the **ML input** tab.

 Note

After the ML input channel is created, you can't edit it.

API

To create an ML input channel (API)

Run the following code with your specific parameters:

```
import boto3
acr_client = boto3.client('cleanroomsm1')
```

```

acr_client.create_ml_input_channel(
    name="ml_input_channel_name",
    membershipIdentifier='membership_id',

    configuredModelAlgorithmAssociations=[configured_model_algorithm_association_arn],
    retentionInDays=1,
    inputChannel={
        "dataSource": {
            "protectedQueryInputParameters": {
                "sqlParameters": {
                    "queryString": "select * from table"
                }
                "computeConfiguration": {
                    "worker": {
                        "type": "CR.1X",
                        "number": 16
                    }
                },
                "resultFormat": "PARQUET"
            }
        },
        "roleArn": "arn:aws:iam::111122223333:role/ezcrc-ctm-role"
    }
)
channel_arn = resp['ML Input Channel ARN']

```

Creating a trained model in AWS Clean Rooms ML

Prerequisites:

- An AWS account with access to AWS Clean Rooms
- A collaboration set up in AWS Clean Rooms
- A configured model algorithm associated with the collaboration
- At least one configured ML input channel
- Appropriate permissions to create and manage ML models in the collaboration

After you have associated the configured model algorithm to a collaboration, then created and configured an ML input channel, you are ready to create a trained model. A *trained model* is used by members of a collaboration to jointly analyze their data.

You can create a trained model using the following procedure.

Alternatively, you can use incremental training to improve an existing model with new data, or distributed training to train models across multiple compute instances.

Topics

- [Using incremental training in AWS Clean Rooms ML](#)
- [Using distributed training in AWS Clean Rooms ML](#)

Console

To create a trained model (console)

1. Sign in to the AWS Management Console and open the AWS Clean Rooms console at <https://console.aws.amazon.com/cleanrooms>.
2. In the left navigation pane, choose **Collaborations**.
3. On the **Collaborations** page, choose the collaboration where you want to create a trained model.
4. After the collaboration opens, choose the **ML models** tab.
5. Under **Custom ML models**, in the **Trained models** section, choose **Create trained model**.
6. On the **Create trained model** page, for **Associated model algorithm**, specify the algorithm.
7. For **Trained model details**, enter the following:
 - a. For **Name**, enter a unique name for the model in the collaboration.
 - b. (Optional) For **Description**, enter a description of the trained model.
 - c. For **Training data input mode**, choose one of the following:
 - Select **File** if you have a smaller dataset that can fit on the ML storage volume and you prefer traditional file system access for your training script.
 - Select **Pipe** for large datasets to stream data directly from S3, avoiding the need to download everything to disk, which can improve training speed and reduce storage requirements.
 - Select **FastFile** if you want to combine the benefits of streaming from S3 with file system access, especially for sequentially read data or when dealing with fewer files for faster startup times.

8. For **ML input channel details**, do the following:

- a. For **ML input channel**, specify the ML input channel that provides data to the model algorithm.

To add another channel, choose **Add another ML input channel**. You can add up to 19 additional ML input channels.

- b. For **Channel name**, enter the name of the ML input channel.
- c. For **Amazon S3 data distribution type**, choose one of the following:
 - Select **Fully replicated** to give each training instance with a complete copy of your dataset. This works best when your dataset is small enough to fit in memory or when each instance needs access to all data.
 - Select **Sharded by S3 key** to divide your dataset across training instances based on S3 keys. Each instance receives about $1/n$ of the total S3 objects, where 'n' is the number of instances. This works best for large datasets that you want to process in parallel.

 Note

Consider your dataset size and training requirements when selecting a distribution type. **Fully replicated** provides complete data access but requires more storage, while **Sharded by S3 key** enables distributed processing of large datasets.

9. For **Maximum training duration**, choose the maximum amount of time you want to train your model.
10. For **Hyperparameters**, specify any algorithm-specific parameters and their intended values. Hyperparameters are specific to the model being trained and are used to fine-tune model training.
11. For **Environment variables**, specify any algorithm-specific variables and their intended values. Environment variables are set in the Docker container.
12. For **Encryption**, to use a custom AWS KMS key, select the **Encrypt secret with a custom KMS key** checkbox.
13. For **EC2 Resource configuration**, specify information about the compute resources that are used for model training.

- a. For **Instance type**, choose the type of instance you want to run.
- b. For **Instance count**, enter the number of instances.
- c. For **Volume size in GB**, enter the ML storage volume size.

14. Choose **Create trained model**.

API

To create a trained model (API)

The member with the ability to train a model starts training by selecting the ML input channel and the model algorithm.

Run the following code with your specific parameters:

```
import boto3
acr_ml_client= boto3.client('cleanroomsmml')

acr_ml_client.create_trained_model(
    membershipIdentifier= 'membership_id',
    configuredModelAlgorithmAssociationArn = 'arn:aws:cleanrooms-
ml:region:account:membership/membershipIdentifier/configured-model-algorithm-
association/identifier',
    name=' trained_model_name ',
    resourceConfig={
        'instanceType': "ml.m5.xlarge",
        'volumeSizeInGB': 1
    },
    dataChannels=[
        {
            "mlInputChannelArn": channel_arn_1,
            "channelName": " channel_name "
        },
        {
            "mlInputChannelArn": channel_arn_2,
            "channelName": " channel_name "
        }
    ]
)
```

Note

After the trained model is created, you can't edit it. To make changes, delete the trained model and create a new one.

Using incremental training in AWS Clean Rooms ML

Prerequisites:

- An AWS account with access to AWS Clean Rooms
- An existing trained model in a collaboration
- A new or updated dataset for incremental training
- Appropriate permissions to create and manage ML models in the collaboration
- Familiarity with the existing model's hyperparameters and configuration

With incremental training, you can use the artifacts of an existing model and an updated dataset to train a new model. Incremental training saves both time and resources.

Use incremental training to:

- Train a new model using an expanded dataset that has an underlying pattern that wasn't accounted for in the earlier training.
- Train several variants of a model, either with different hyperparameters or using different datasets.

Console

To run an incremental training job (console)

1. Sign in to the AWS Management Console and open the AWS Clean Rooms console at <https://console.aws.amazon.com/cleanrooms>.
2. In the left navigation pane, choose **Collaborations**.
3. On the **Collaborations** page, choose the collaboration in which the model artifacts you want to use for incremental training exist.
4. After the collaboration opens, choose the **ML models** tab.

5. Under **Custom ML models**, in the **Trained models** section, choose the radio button next to the trained model you want to incrementally train.
6. On the **Overview** page, under **Versions**,
 - a. Choose the radio button next to the trained model you want to incrementally train.
 - b. Choose **Train from version**.
7. On the **Create trained model from version** page, for **Trained model version**, choose the version.

The base model version is automatically selected. You can change this version if other versions exist.

8. For **Trained model details**, enter the following:
 - a. For **Name**, enter a unique name for the model in the collaboration.
 - b. (Optional) For **Description**, enter a description of the trained model.
 - c. For **Training data input mode**, choose one of the following:
 - Select **File** if you have a smaller dataset that can fit on the ML storage volume and you prefer traditional file system access for your training script.
 - Select **Pipe** for large datasets to stream data directly from S3, avoiding the need to download everything to disk, which can improve training speed and reduce storage requirements.
 - Select **FastFile** if you want to combine the benefits of streaming from S3 with file system access, especially for sequentially read data or when dealing with fewer files for faster startup times.
 - d. For **Incremental training channel name**, enter a name for the incremental training channel

 Note

If you specify the **Incremental training channel name** without a version ID, the system uses the base model for incremental training.

9. For **ML input channel details**, do the following:
 - a. For **ML input channel**, specify the ML input channel that provides data to the model algorithm.

To add another channel, choose **Add another ML input channel**. You can add up to 19 additional ML input channels.

- b. For **Channel name**, enter the name of the ML input channel.
- c. For **Amazon S3 data distribution type**, choose one of the following:
 - Select **Fully replicated** to give each training instance with a complete copy of your dataset. This works best when your dataset is small enough to fit in memory or when each instance needs access to all data.
 - Select **Sharded by S3 key** to divide your dataset across training instances based on S3 keys. Each instance receives about $1/n$ of the total S3 objects, where 'n' is the number of instances. This works best for large datasets that you want to process in parallel.

 Note

Consider your dataset size and training requirements when selecting a distribution type. **Fully replicated** provides complete data access but requires more storage, while **Sharded by S3 key** enables distributed processing of large datasets.

10. For **Maximum training duration**, choose the maximum amount of time you want to train your model.
11. For **Hyperparameters**, specify any algorithm-specific parameters and their intended values. Hyperparameters are specific to the model being trained and are used to fine-tune model training.
12. For **Environment variables**, specify any algorithm-specific variables and their intended values. Environment variables are set in the Docker container.
13. For **Encryption**, to use a custom AWS KMS key, select the **Encrypt secret with a custom KMS key** checkbox.
14. For **EC2 Resource configuration**, specify information about the compute resources that are used for model training.
 - a. For **Instance type**, choose the type of instance you want to run.
 - b. For **Instance count**, enter the number of instances.

- c. For **Volume size in GB**, enter the ML storage volume size.

15. Choose **Create trained model from version**.

API

To run an incremental training job (API)

Run the following code with your specific parameters:

```
import boto3
acr_ml_client= boto3.client('cleanroomsmml')

acr_ml_client.create_trained_model(
    membershipIdentifier= 'membership_id',
    configuredModelAlgorithmAssociationArn = 'arn:aws:cleanrooms-
ml:region:account:membership/membershipIdentifier/configured-model-algorithm-
association/identifier',
    name='trained_model_name',
    resourceConfig={
        'instanceType': 'ml.m5.xlarge',
        'volumeSizeInGB': 1
    },
    incrementalTrainingDataChannels=[
        {
            'trainedModelArn': trained_model_arn,
            'channelName': 'channel_name'
        },
    ],
    dataChannels=[
        {
            'mlInputChannelArn': channel_arn_1,
            'channelName': 'channel_name'
        },
        {
            'mlInputChannelArn': channel_arn_2,
            'channelName': 'channel_name'
        }
    ]
)
```

Note

Limit: Maximum of 20 channels total (including both `dataChannels` and `incrementalTrainingDataChannels`).

Note

After the trained model is created, you can't edit it. To make changes, delete the trained model and create a new one.

Using distributed training in AWS Clean Rooms ML

Prerequisites:

- An AWS account with access to AWS Clean Rooms
- A collaboration set up in AWS Clean Rooms
- A configured model algorithm that supports distributed training
- A large dataset suitable for distributed processing
- Appropriate permissions to create and manage ML models in the collaboration
- Sufficient Amazon EC2 quota to run multiple instances for distributed training

Distributed training leverages the power of many computing nodes working in parallel to process large amounts of data and update model parameters efficiently.

For more information about distributed training, see [Distributed training concepts](#) in the *Amazon SageMaker AI Developer Guide*.

Console

To run a distributed training job (console)

1. Sign in to the AWS Management Console and open the AWS Clean Rooms console at <https://console.aws.amazon.com/cleanrooms>.
2. In the left navigation pane, choose **Collaborations**.

3. On the **Collaborations** page, choose the collaboration where you want to create a trained model.
4. After the collaboration opens, choose the **ML models** tab.
5. Under **Custom ML models**, in the **Trained models** section, choose **Create trained model**.
6. On the **Create trained model** page, for **Associated model algorithm**, specify the algorithm
7. For **Trained model details**, enter the following:
 - a. For **Name**, enter a unique name for the model in the collaboration.
 - b. (Optional) For **Description**, enter a description of the trained model.
 - c. For **Training data input mode**, choose one of the following:
 - Select **File** if you have a smaller dataset that can fit on the ML storage volume and you prefer traditional file system access for your training script.
 - Select **Pipe** for large datasets to stream data directly from S3, avoiding the need to download everything to disk, which can improve training speed and reduce storage requirements.
 - Select **FastFile** if you want to combine the benefits of streaming from S3 with file system access, especially for sequentially read data or when dealing with fewer files for faster startup times.
8. For **ML input channel details**, do the following:

- a. For **ML input channel**, specify the ML input channel that provides data to the model algorithm.

To add another channel, choose **Add another ML input channel**. You can add up to 19 additional ML input channels.

- b. For **Channel name**, enter the name of the ML input channel.
- c. For **Amazon S3 data distribution type**, choose one of the following:
 - Select **Fully replicated** to give each training instance with a complete copy of your dataset. This works best when your dataset is small enough to fit in memory or when each instance needs access to all data.
 - Select **Sharded by S3 key** to divide your dataset across training instances based on S3 keys. Each instance receives about 1/n of the total S3 objects, where 'n' is the number of instances. This works best for large datasets that you want to process in parallel.

 Note

Consider your dataset size and training requirements when selecting a distribution type. **Fully replicated** provides complete data access but requires more storage, while **Sharded by S3 key** enables distributed processing of large datasets.

9. For **Maximum training duration**, choose the maximum amount of time you want to train your model.
10. For **Hyperparameters**, specify any algorithm-specific parameters and their intended values. Hyperparameters are specific to the model being trained and are used to fine-tune model training.
11. For **Environment variables**, specify any algorithm-specific variables and their intended values. Environment variables are set in the Docker container.
12. For **Encryption**, to use a custom AWS KMS key, select the **Encrypt secret with a custom KMS key** checkbox.
13. For **EC2 Resource configuration**, specify information about the compute resources that are used for model training.
 - a. For **Instance type**, choose the type of instance you want to run.

Supported instance types for distributed training are:

 - ml.m5.4xlarge
 - ml.m5.12xlarge
 - ml.m5.2xlarge
 - ml.g5.12xlarge
 - ml.g5.24xlarge
 - b. For **Instance count**, enter the number of instances.
 - c. For **Volume size in GB**, enter the ML storage volume size.
14. Choose **Create trained model**.

API

To run a distributed training job (API)

Run the following code with your specific parameters:

```
import boto3
acr_ml_client= boto3.client('cleanroomsm1')

acr_ml_client.create_trained_model(
    membershipIdentifier= 'membership_id',
    configuredModelAlgorithmAssociationArn = 'arn:aws:cleanrooms-
ml:region:account:membership/membershipIdentifier/configured-model-algorithm-
association/identifier',
    name='trained_model_name',
    trainingInputMode: "File",
    resourceConfig={
        'instanceCount': "3"
        'instanceType': "ml.m5.xlarge",
        'volumeSizeInGB': 3
    },
    dataChannels=[
        {
            "mlInputChannelArn": channel_arn_1,
            "channelName": "channel_name",
            "S3DataDistributionType:" "FullyReplicated"
        }
    ]
)
```

Note

After the trained model is created, you can't edit it. To make changes, delete the trained model and create a new one.

Exporting model artifacts from AWS Clean Rooms ML

This task is optional and should be completed when you have assigned the `CAN_RECEIVE_MODEL_OUTPUT` member ability to a member of the collaboration.

After model training has completed, the member who trained the model can initiate the export of model artifacts. The member who trained the model chooses who will receive model artifacts, provided that member can receive results and a valid ML configuration.

Console

To configure a custom ML model algorithm (console)

1. Sign in to the AWS Management Console and open the AWS Clean Rooms console at <https://console.aws.amazon.com/cleanrooms>.
2. In the left navigation pane, choose **Collaborations**.
3. On the **Collaborations** page, choose the collaboration that contains the custom model that you want to export.
4. After the collaboration opens, choose the **ML Models** tab, then choose your model from the **Custom trained model** table
5. On the custom trained model details page, click **Export model output**.
6. For **Export model output**, for **Export model output details**, enter a **Name** and optional **Description**.

Choose which member will receive the model artifacts in the **Model output exported to members of collaboration** drop down list.

7. Choose **Export**.

The results are exported to the following path in the Amazon S3 location that was specified in the ML configuration: `yourSpecifiedS3Path/collaborationIdentifier/trainedModelName/callerAccountId/jobName`. Only the **Files to export**, up to the maximum file size specified, that you selected when associating the configured model algorithm are exported.

API

To configure a custom ML model algorithm (API)

Initiate the model export by running the following code:

```
import boto3
acr_ml_client= boto3.client('cleanroomsm1')
```

```
acr_ml_client.start_trained_model_export_job(  
    membershipIdentifier='membership_id',  
    trainedModelArn='arn:aws:cleanrooms-ml:region:account:membership/  
membershipIdentifier/trained-model/identifier',  
    outputConfiguration={  
        'member': {  
            'accountId': 'model_output_receiver_account'  
        }  
    },  
    name='export_job_name'  
)
```

The results are exported to the following path in the Amazon S3 location that was specified in the ML configuration: `yourSpecifiedS3Path/collaborationIdentifier/trainedModelName/callerAccountId/jobName`. Only the filesToExport, up to the maxSize specified, that you selected when associating the configured model algorithm are exported.

Running inference on a trained model in AWS Clean Rooms ML

Members with the ability to run queries can also initiate inference job once the training job is complete. They pick the inference dataset against which they want to run inference and reference the trained model outputs that they'd like to run inference container with.

The member who will receive inference output must be granted the member ability `CAN_RECEIVE_INFERENCE_OUTPUT`.

Console

To create a model inference job (console)

1. Sign in to the AWS Management Console and open the AWS Clean Rooms console at <https://console.aws.amazon.com/cleanrooms>.
2. In the left navigation pane, choose **Collaborations**.
3. On the **Collaborations** page, choose the collaboration that contains the custom model that you want to create an inference job on.
4. After the collaboration opens, choose the **ML Models** tab, then choose your model from the **Custom trained model** table.
5. On the custom trained model details page, click **Start inference job**.

6. For **Start inference job**, for **Inference job details**, enter a **Name** and optional **Description**.

Enter the following information:

- **Associated model algorithm** - The associated model algorithm that is used during the inference job.
- **ML input channel details** - The ML input channel that will provide the data for this inference job.
- **Transform resources** - The compute instance that is used to perform the transform function of the inference job.
- **Output configuration** - Who will receive the inference job output and the MIME type of the output.
- **Encryption** - choose the **Customize encryption settings** to specify your own KMS key and related information. Otherwise, Clean Rooms ML will manage the encryption.
- **Transform job details** - The maximum payload of the inference job, in MB.
- **Environment variables** - Any environment variables necessary to access the inference job container image.

7. Choose **Start inference job**.

The results are exported to the following path in the Amazon S3 location that was specified in the ML configuration: `yourSpecifiedS3Path/collaborationIdentifier/trainedModelName/callerAccountId/jobName`.

API

To create a model inference job (API)

Initiate the inference job by running the following code:

```
import boto3
acr_ml_client= boto3.client('cleanroomsm1')

acr_ml_client.start_trained_model_inference_job(
    name="inference_job",
    membershipIdentifier='membership_id',
    trainedModelArn='arn:aws:cleanrooms-ml:region:account:membership/
membershipIdentifier/trained-model/identifier',
```

```
dataSource={
  "mlInputChannelArn": 'channel_arn_3'
},
resourceConfig={'instanceType': 'ml.m5.xlarge'},
outputConfiguration={
  'accept': 'text/csv',
  'members': [
    {
      "accountId": 'member_account_id'
    }
  ]
}
)
```

The results are exported to the following path in the Amazon S3 location that was specified in the ML configuration: `yourSpecifiedS3Path/collaborationIdentifier/trainedModelName/callerAccountId/jobName`.

Troubleshooting AWS Clean Rooms

This section describes some common issues that might arise when using AWS Clean Rooms and how to fix them.

Issues

- [One or more tables referenced by the query is not accessible by its associated service role. The table/role owner must grant the service role access to the table.](#)
- [One of the underlying datasets has an unsupported file format.](#)
- [Query results are not as expected when using Cryptographic Computing for Clean Rooms.](#)

One or more tables referenced by the query is not accessible by its associated service role. The table/role owner must grant the service role access to the table.

- Verify that the permissions for the service role are set up as required. For more information, see [Setting up AWS Clean Rooms](#).

One of the underlying datasets has an unsupported file format.

- Ensure that your dataset is in one of the supported file formats:
 - Parquet
 - RCFile
 - TextFile
 - SequenceFile
 - RegexSerde
 - OpenCSV
 - AVRO
 - JSON

For more information, see [Data formats for AWS Clean Rooms](#).

Query results are not as expected when using Cryptographic Computing for Clean Rooms.

If you are using Cryptographic Computing for Clean Rooms (C3R), verify that your query uses encrypted columns correctly:

- The sealed columns are only used in SELECT clauses.
- The fingerprint columns are only used in JOIN clauses (and GROUP BY clauses under certain conditions).
- That you are only JOINing fingerprint columns with the same name if the collaboration settings require it.

For more information, see [the section called “Cryptographic computing”](#) and [the section called “Column types”](#).

Security in AWS Clean Rooms

Cloud security at AWS is the highest priority. As an AWS customer, you benefit from a data center and network architecture that is built to meet the requirements of the most security-sensitive organizations.

Security is a shared responsibility between AWS and you. The [shared responsibility model](#) describes this as security of the cloud and security in the cloud:

- **Security of the cloud** – AWS is responsible for protecting the infrastructure that runs AWS services in the AWS Cloud. AWS also provides you with services that you can use securely. Third-party auditors regularly test and verify the effectiveness of our security as part of the [AWS Compliance Programs](#). To learn about the compliance programs that apply to AWS Clean Rooms, see [AWS Services in Scope by Compliance Program](#).
- **Security in the cloud** – Your responsibility is determined by the AWS service that you use. You are also responsible for other factors including the sensitivity of your data, your company's requirements, and applicable laws and regulations

This documentation helps you understand how to apply the shared responsibility model when using AWS Clean Rooms. It shows you how to configure AWS Clean Rooms to meet your security and compliance objectives. You also learn how to use other AWS services that help you to monitor and secure your AWS Clean Rooms resources.

Contents

- [Data protection in AWS Clean Rooms](#)
- [Data retention in AWS Clean Rooms](#)
- [Best practices for data collaborations in AWS Clean Rooms](#)
- [Identity and Access Management for AWS Clean Rooms](#)
- [Compliance validation for AWS Clean Rooms](#)
- [Resilience in AWS Clean Rooms](#)
- [Infrastructure security in AWS Clean Rooms](#)
- [Access AWS Clean Rooms or AWS Clean Rooms ML using an interface endpoint \(AWS PrivateLink\)](#)

Data protection in AWS Clean Rooms

The AWS [shared responsibility model](#) applies to data protection in AWS Clean Rooms. As described in this model, AWS is responsible for protecting the global infrastructure that runs all of the AWS Cloud. You are responsible for maintaining control over your content that is hosted on this infrastructure. You are also responsible for the security configuration and management tasks for the AWS services that you use. For more information about data privacy, see the [Data Privacy FAQ](#). For information about data protection in Europe, see the [AWS Shared Responsibility Model and GDPR](#) blog post on the *AWS Security Blog*.

For data protection purposes, we recommend that you protect AWS account credentials and set up individual users with AWS IAM Identity Center or AWS Identity and Access Management (IAM). That way, each user is given only the permissions necessary to fulfill their job duties. We also recommend that you secure your data in the following ways:

- Use multi-factor authentication (MFA) with each account.
- Use SSL/TLS to communicate with AWS resources. We require TLS 1.2 and recommend TLS 1.3.
- Set up API and user activity logging with AWS CloudTrail. For information about using CloudTrail trails to capture AWS activities, see [Working with CloudTrail trails](#) in the *AWS CloudTrail User Guide*.
- Use AWS encryption solutions, along with all default security controls within AWS services.
- Use advanced managed security services such as Amazon Macie, which assists in discovering and securing sensitive data that is stored in Amazon S3.
- If you require FIPS 140-3 validated cryptographic modules when accessing AWS through a command line interface or an API, use a FIPS endpoint. For more information about the available FIPS endpoints, see [Federal Information Processing Standard \(FIPS\) 140-3](#).

We strongly recommend that you never put confidential or sensitive information, such as your customers' email addresses, into tags or free-form text fields such as a **Name** field. This includes when you work with AWS Clean Rooms or other AWS services using the console, API, AWS CLI, or AWS SDKs. Any data that you enter into tags or free-form text fields used for names may be used for billing or diagnostic logs. If you provide a URL to an external server, we strongly recommend that you do not include credentials information in the URL to validate your request to that server.

Encryption at rest

AWS Clean Rooms always encrypts all service metadata at rest without requiring any additional configuration. This encryption is automatic when you use AWS Clean Rooms.

Clean Rooms ML encrypts all data stored within the service at rest with AWS KMS. If you choose to provide your own KMS key, the contents of your lookalike models and lookalike segment generation jobs are encrypted at rest with your KMS key.

When using AWS Clean Rooms custom ML models, the service encrypts all data stored at rest with AWS KMS. AWS Clean Rooms supports the use of symmetric customer managed keys that you create, own, and manage to encrypt data at rest. If customer managed keys are not specified, AWS owned keys are used by default.

AWS Clean Rooms uses grants and key policies to access customer managed keys. You can revoke access to the grant, or remove the service's access to the customer managed key at any time. If you do, AWS Clean Rooms won't be able to access any of the data encrypted by the customer managed key, which affects operations that are dependent on that data. For example, if you attempt to create a trained model from an encrypted ML input channel that AWS Clean Rooms can't access, then the operation would return a `ValidationException` error.

Note

You can use the encryption options in Amazon S3 to protect your data at rest.
For more information, see [Specifying Amazon S3 encryption](#) in the *Amazon S3 User Guide*.

When using an ID mapping table within AWS Clean Rooms, the service encrypts all data stored at rest with AWS KMS. If you choose to provide your own KMS key, the contents of your ID mapping table are encrypted at rest with your KMS key via AWS Entity Resolution. For more details about the required permissions for working with encryptions with an ID mapping workflow, see [Create a workflow job role for AWS Entity Resolution](#) in the *AWS Entity Resolution User Guide*.

Encryption in transit

AWS Clean Rooms uses Transport Layer Security (TLS) for encryption in transit. Communication with AWS Clean Rooms is always done over HTTPS so your data is always encrypted in transit, regardless of whether it's stored in Amazon S3, Amazon Athena, or Snowflake. This includes all data in transit when using Clean Rooms ML.

Encrypting underlying data

For more information about how to encrypt your underlying data, see [Cryptographic Computing for Clean Rooms](#).

Key policy

Key policies control access to your customer managed key. Every customer managed key must have exactly one key policy, which contains statements that determine who can use the key and how they can use it. When you create your customer managed key, you can specify a key policy. For more information, see Managing access to customer managed keys in the AWS Key Management Service Developer Guide.

To use your customer managed key with your AWS Clean Rooms Custom ML models, the following API operations must be permitted in the key policy:

- `kms:DescribeKey` – Provides the customer managed key details to allow AWS Clean Rooms to validate the key.
- `kms:Decrypt` – Provides access to AWS Clean Rooms to decrypt the encrypted data and use it in related jobs.
- `kms:CreateGrant` - Clean Rooms ML encrypts training and inference images at rest in Amazon ECR by creating grants for Amazon ECR. To learn more, see [Encryption at Rest in Amazon ECR](#). Clean Rooms ML also uses Amazon SageMaker AI to run training and inference jobs, and creates grants for SageMaker AI to encrypt the Amazon EBS volumes attached to the instances as well as the output data in Amazon S3. To learn more, see [Protect Data at Rest Using Encryption in Amazon SageMaker AI](#).
- `kms:GenerateDataKey` - Clean Rooms ML encrypts data at rest stored in Amazon S3 using server-side encryption with AWS KMS keys. To learn more, see [Using server-side encryption with AWS KMS keys \(SSE-KMS\) in Amazon S3](#).

The following are policy statement examples you can add for AWS Clean Rooms for the following resources:

ML input channel

JSON

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Sid": "Allow access to principals authorized to use ",
      "Effect": "Allow",
      "Principal": {
        "AWS": "arn:aws:iam::444455556666:role/ExampleRole"
      },
      "Action": [
        "kms:DescribeKey",
        "kms:GenerateDataKey",
        "kms:Decrypt"
      ],
      "Resource": "*",
      "Condition": {
        "StringEquals": {
          "kms:ViaService": "cleanrooms-ml.region.amazonaws.com"
        }
      }
    },
    {
      "Sid": "Allow access to service principal",
      "Effect": "Allow",
      "Principal": {
        "Service": "cleanrooms-ml.amazonaws.com"
      },
      "Action": [
        "kms:DescribeKey",
        "kms:GenerateDataKey",
        "kms:Decrypt"
      ],
      "Resource": "*"
    }
  ]
}
```

Trained model job or Trained model inference job

JSON

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Sid": "Allow access to principals authorized to use ",
      "Effect": "Allow",
      "Principal": { "AWS": "arn:aws:iam::444455556666:role/ExampleRole" },
      "Action": [
        "kms:GenerateDataKey",
        "kms:DescribeKey",
        "kms:CreateGrant",
        "kms:Decrypt"
      ],
      "Resource": "*",
      "Condition": {
        "StringEquals": {
          "kms:ViaService": "cleanrooms-ml.region.amazonaws.com"
        }
        "ForAllValues:StringEquals": {
          "kms:GrantOperations": [
            "Decrypt",
            "Encrypt",
            "GenerateDataKeyWithoutPlaintext",
            "ReEncryptFrom",
            "ReEncryptTo",
            "CreateGrant",
            "DescribeKey",
            "RetireGrant",
            "GenerateDataKey"
          ]
        },
        "BoolIfExists": {
          "kms:GrantIsForAWSResource": true
        }
      }
    },
    {
      "Sid": "Allow access to service principal",
      "Effect": "Allow",
      "Principal": {
        "Service": "cleanrooms-ml.amazonaws.com"
      }
    }
  ]
}
```

```

    },
    "Action": [
        "kms:GenerateDataKey",
        "kms:DescribeKey",
        "kms:CreateGrant",
        "kms:Decrypt"
    ],
    "Resource": "*",
    "Condition": {
        "ForAllValues:StringEquals": {
            "kms:GrantOperations": [
                "Decrypt",
                "Encrypt",
                "GenerateDataKeyWithoutPlaintext",
                "ReEncryptFrom",
                "ReEncryptTo",
                "CreateGrant",
                "DescribeKey",
                "RetireGrant",
                "GenerateDataKey"
            ]
        }
    }
}

```

Clean Rooms ML does not support specifying service encryption context or source context in customer managed key policies. Encryption context used by the service internally is visible to customers in CloudTrail.

Data retention in AWS Clean Rooms

Any data that is temporarily read into an AWS Clean Rooms collaboration is deleted after the query completes.

When you create a lookalike model, Clean Rooms ML reads your training data, transforms it into a format suitable for our ML model, and stores the trained model parameters inside Clean Rooms ML. Clean Rooms ML does not retain a copy of your training data. AWS Clean Rooms SQL queries do not retain any of your data after the query has run. Clean Rooms ML then uses the trained

model to summarize the behavior of all of your users. Clean Rooms ML stores a user-level data set for each user in your data for as long as your lookalike model is active.

When you start a lookalike segment generation job, Clean Rooms ML reads the seed data, reads the behavior summaries from the associated lookalike model, and creates a lookalike segment that is stored within the AWS Clean Rooms service. Clean Rooms ML does not retain a copy of your seed data. Clean Rooms ML stores the user-level output of the job as long as the job is active.

If your seed data comes from an SQL query, the output of that query is only stored in the service for the duration of the job. The results of the query are encrypted at rest and in transit.

If you want to remove your lookalike model or lookalike segment generation job data, use the API to delete it. Clean Rooms ML asynchronously deletes all data associated with the model or job. Once this process is complete, Clean Rooms ML deletes the metadata for the model or job and it is no longer visible in the API. Clean Rooms ML retains deleted data for 3 days for disaster recovery prevention. Once the job or model is no longer visible in the API and 3 days have passed, all data associated with the model or job has been permanently deleted.

Best practices for data collaborations in AWS Clean Rooms

This topic describes the best practices for conducting data collaborations in AWS Clean Rooms.

AWS Clean Rooms follows the [AWS Shared Responsibility Model](#). AWS Clean Rooms offers [analysis rules](#) that you can configure to strengthen your ability to protect sensitive data in a collaboration. The analysis rules that you configure in AWS Clean Rooms will enforce the restrictions (query controls and query output controls) that you have configured. You are responsible for determining the restrictions and configuring analysis rules accordingly.

Data collaborations might involve more than just your use of AWS Clean Rooms. To help you maximize the benefit of data collaborations, we recommend that you perform the following best practices with your use of AWS Clean Rooms and specifically with analysis rules.

Topics

- [Best practices with AWS Clean Rooms](#)
- [Best practices for using analysis rules in AWS Clean Rooms](#)

Best practices with AWS Clean Rooms

You're responsible for assessing the risk of each data collaboration and comparing it to your privacy requirements such as external and internal compliance programs and policies. We recommend that you take additional actions with your use of AWS Clean Rooms. These actions might help further manage risks and help guard against third-party attempts to re-identify your data (for example, differencing attacks or side-channel attacks).

For example, consider conducting due diligence on your other collaborators and enter into legal agreements with them *before* engaging in a collaboration. To monitor the use of your data, also consider adopting other audit mechanisms with your use of AWS Clean Rooms.

Best practices for using analysis rules in AWS Clean Rooms

Analysis rules in AWS Clean Rooms allow you to restrict the queries that can be run by setting query controls on a configured table. For example, you can set a query control for how a configured table can be joined and which columns can be selected. You can also restrict the query output through setting query result controls such as aggregation thresholds on output rows. The service rejects any query and removes rows that don't comply with the analysis rules set by members on their configured tables in the query.

We recommend the following *10 best practices* for using analysis rules on your configured table:

- Create separate configured tables for separate query use cases (for example, audience planning or attribution). You can create multiple configured tables with the same underlying AWS Glue table.
- Specify columns in the analysis rule (for example, dimension columns, list columns, join columns) that are necessary for queries in a collaboration. This might help mitigate the risk of differencing attacks or enabling other members to reverse engineer your data. Use the **allowlist columns** feature to note other columns that you might want to make queryable in the future. To customize the columns that can be used for a certain collaboration, create additional configured tables with the same underlying AWS Glue table.
- Specify the functions in the analysis rule that are necessary for analysis in the collaboration. This can help mitigate risk from rare function errors that can present information on an individual data point. To customize the functions that can be used for a certain collaboration, create additional configured tables with the same underlying AWS Glue table.
- Add aggregation constraints on any columns whose values at a row-level are sensitive. This includes columns in your configured table that also exist in other collaboration members' tables

and analysis rules as an aggregation constraint. This also includes columns in your configured table that aren't queryable, that is, columns that are in your configured table but are not in the analysis rule. Aggregation constraints can help mitigate risk from correlating query results with data outside the collaboration.

- Create test collaborations and analysis rules to test restrictions created with specified analysis rules.
- Review collaborator configured tables and members' analysis rules on configured tables to check that they match what was agreed upon for the collaboration. This can help mitigate risk from other members engineering their own data to run queries that weren't agreed upon.
- Review the example query provided (console only) that is enabled on your configured table after you set up the analysis rule.

Note

In addition to the provided example query, other queries are possible based on the analysis rule and other collaboration member tables and analysis rules.

- You can add or update an analysis rule for a configured table in a collaboration. When you do, review all the collaborations where the configured table is associated and its resulting impact. This helps make sure that no collaborations use obsolete analysis rules.
- Review the queries run in the collaboration to check that the queries match the use cases or queries that were agreed upon for the collaboration. (The queries are available in the query logs when the **Query logging** feature is turned on.) This can help mitigate risk from members running analysis that was not agreed upon and potential attacks such as side channel attacks.
- Review the configured table columns used in collaboration members' analysis rules and in queries to check that they match what was agreed upon in the collaboration. (The queries are available in the query logs when that feature is turned on.) This can help mitigate risk from other members engineering their own data to do queries that weren't agreed upon.

Identity and Access Management for AWS Clean Rooms

AWS Identity and Access Management (IAM) is an AWS service that helps an administrator securely control access to AWS resources. IAM administrators control who can be *authenticated* (signed in) and *authorized* (have permissions) to use AWS Clean Rooms resources. IAM is an AWS service that you can use with no additional charge.

Topics

- [Audience](#)
- [Authenticating with identities](#)
- [Managing access using policies](#)
- [How AWS Clean Rooms works with IAM](#)
- [Identity-based policy examples for AWS Clean Rooms](#)
- [AWS managed policies for AWS Clean Rooms](#)
- [Troubleshooting AWS Clean Rooms identity and access](#)
- [Cross-service confused deputy prevention](#)
- [IAM behaviors for AWS Clean Rooms ML](#)
- [IAM behaviors for Clean Rooms ML Custom Models](#)

Audience

How you use AWS Identity and Access Management (IAM) differs, depending on the work that you do in AWS Clean Rooms.

Service user – If you use the AWS Clean Rooms service to do your job, then your administrator provides you with the credentials and permissions that you need. As you use more AWS Clean Rooms features to do your work, you might need additional permissions. Understanding how access is managed can help you request the right permissions from your administrator. If you cannot access a feature in AWS Clean Rooms, see [Troubleshooting AWS Clean Rooms identity and access](#).

Service administrator – If you're in charge of AWS Clean Rooms resources at your company, you probably have full access to AWS Clean Rooms. It's your job to determine which AWS Clean Rooms features and resources your service users should access. You must then submit requests to your IAM administrator to change the permissions of your service users. Review the information on this page to understand the basic concepts of IAM. To learn more about how your company can use IAM with AWS Clean Rooms, see [How AWS Clean Rooms works with IAM](#).

IAM administrator – If you're an IAM administrator, you might want to learn details about how you can write policies to manage access to AWS Clean Rooms. To view example AWS Clean Rooms identity-based policies that you can use in IAM, see [Identity-based policy examples for AWS Clean Rooms](#).

Authenticating with identities

Authentication is how you sign in to AWS using your identity credentials. You must be *authenticated* (signed in to AWS) as the AWS account root user, as an IAM user, or by assuming an IAM role.

You can sign in to AWS as a federated identity by using credentials provided through an identity source. AWS IAM Identity Center (IAM Identity Center) users or your company's single sign-on authentication are examples of federated identities. When you sign in as a federated identity, your administrator previously set up identity federation using IAM roles. When you access AWS by using federation, you are indirectly assuming a role.

Depending on the type of user you are, you can sign in to the AWS Management Console or the AWS access portal. For more information about signing in to AWS, see [How to sign in to your AWS account](#) in the *AWS Sign-In User Guide*.

If you access AWS programmatically, AWS provides a software development kit (SDK) and a command line interface (CLI) to cryptographically sign your requests using your credentials. If you don't use AWS tools, you must sign requests yourself. For more information about using the recommended method to sign requests yourself, see [Signature Version 4 signing process](#) in the *AWS General Reference*.

Regardless of the authentication method that you use, you might be required to provide additional security information. For example, AWS recommends that you use multi-factor authentication (MFA) to increase the security of your account. To learn more, see [Multi-factor authentication](#) in the *AWS IAM Identity Center User Guide* and [Using multi-factor authentication \(MFA\) in AWS](#) in the *IAM User Guide*.

AWS account root user

When you create an AWS account, you begin with one sign-in identity that has complete access to all AWS services and resources in the account. This identity is called the AWS account *root user* and is accessed by signing in with the email address and password that you used to create the account. We strongly recommend that you do not use the root user for your everyday tasks. Safeguard your root user credentials and use them to perform the tasks that only the root user can perform. For the complete list of tasks that require you to sign in as the root user, see [AWS account root user credentials and IAM identities](#) in the *AWS General Reference*.

Federated identity

As a best practice, require human users, including users that require administrator access, to use federation with an identity provider to access AWS services by using temporary credentials.

A *federated identity* is a user from your enterprise user directory, a web identity provider, the AWS Directory Service, the Identity Center directory, or any user that accesses AWS services by using credentials provided through an identity source. When federated identities access AWS accounts, they assume roles, and the roles provide temporary credentials.

For centralized access management, we recommend that you use AWS IAM Identity Center. You can create users and groups in IAM Identity Center, or you can connect and synchronize to a set of users and groups in your own identity source for use across all your AWS accounts and applications. For information about IAM Identity Center, see [What is IAM Identity Center?](#) in the *AWS IAM Identity Center User Guide*.

IAM users and groups

An [IAM user](#) is an identity within your AWS account that has specific permissions for a single person or application. Where possible, we recommend relying on temporary credentials instead of creating IAM users who have long-term credentials such as passwords and access keys. However, if you have specific use cases that require long-term credentials with IAM users, we recommend that you rotate access keys. For more information, see [Rotate access keys regularly for use cases that require long-term credentials](#) in the *IAM User Guide*.

An [IAM group](#) is an identity that specifies a collection of IAM users. You can't sign in as a group. You can use groups to specify permissions for multiple users at a time. Groups make permissions easier to manage for large sets of users. For example, you could have a group named *IAMAdmins* and give that group permissions to administer IAM resources.

Users are different from roles. A user is uniquely associated with one person or application, but a role is intended to be assumable by anyone who needs it. Users have permanent long-term credentials, but roles provide temporary credentials. To learn more, see [Use cases for IAM users](#) in the *IAM User Guide*.

IAM roles

An [IAM role](#) is an identity within your AWS account that has specific permissions. It is similar to an IAM user, but is not associated with a specific person. To temporarily assume an IAM role in the AWS Management Console, you can [switch from a user to an IAM role \(console\)](#). You can assume a

role by calling an AWS CLI or AWS API operation or by using a custom URL. For more information about methods for using roles, see [Methods to assume a role](#) in the *IAM User Guide*.

IAM roles with temporary credentials are useful in the following situations:

- **Federated user access** – To assign permissions to a federated identity, you create a role and define permissions for the role. When a federated identity authenticates, the identity is associated with the role and is granted the permissions that are defined by the role. For information about roles for federation, see [Create a role for a third-party identity provider \(federation\)](#) in the *IAM User Guide*. If you use IAM Identity Center, you configure a permission set. To control what your identities can access after they authenticate, IAM Identity Center correlates the permission set to a role in IAM. For information about permissions sets, see [Permission sets](#) in the *AWS IAM Identity Center User Guide*.
- **Temporary IAM user permissions** – An IAM user or role can assume an IAM role to temporarily take on different permissions for a specific task.
- **Cross-account access** – You can use an IAM role to allow someone (a trusted principal) in a different account to access resources in your account. Roles are the primary way to grant cross-account access. However, with some AWS services, you can attach a policy directly to a resource (instead of using a role as a proxy). To learn the difference between roles and resource-based policies for cross-account access, see [Cross account resource access in IAM](#) in the *IAM User Guide*.
- **Cross-service access** – Some AWS services use features in other AWS services. For example, when you make a call in a service, it's common for that service to run applications in Amazon EC2 or store objects in Amazon S3. A service might do this using the calling principal's permissions, using a service role, or using a service-linked role.
- **Forward access sessions (FAS)** – When you use an IAM user or role to perform actions in AWS, you are considered a principal. When you use some services, you might perform an action that then initiates another action in a different service. FAS uses the permissions of the principal calling an AWS service, combined with the requesting AWS service to make requests to downstream services. FAS requests are only made when a service receives a request that requires interactions with other AWS services or resources to complete. In this case, you must have permissions to perform both actions. For policy details when making FAS requests, see [Forward access sessions](#).
- **Service role** – A service role is an [IAM role](#) that a service assumes to perform actions on your behalf. An IAM administrator can create, modify, and delete a service role from within IAM. For more information, see [Create a role to delegate permissions to an AWS service](#) in the *IAM User Guide*.

- **Service-linked role** – A service-linked role is a type of service role that is linked to an AWS service. The service can assume the role to perform an action on your behalf. Service-linked roles appear in your AWS account and are owned by the service. An IAM administrator can view, but not edit the permissions for service-linked roles.
- **Applications running on Amazon EC2** – You can use an IAM role to manage temporary credentials for applications that are running on an EC2 instance and making AWS CLI or AWS API requests. This is preferable to storing access keys within the EC2 instance. To assign an AWS role to an EC2 instance and make it available to all of its applications, you create an instance profile that is attached to the instance. An instance profile contains the role and enables programs that are running on the EC2 instance to get temporary credentials. For more information, see [Use an IAM role to grant permissions to applications running on Amazon EC2 instances](#) in the *IAM User Guide*.

Managing access using policies

You control access in AWS by creating policies and attaching them to AWS identities or resources. A policy is an object in AWS that, when associated with an identity or resource, defines their permissions. AWS evaluates these policies when a principal (user, root user, or role session) makes a request. Permissions in the policies determine whether the request is allowed or denied. Most policies are stored in AWS as JSON documents. For more information about the structure and contents of JSON policy documents, see [Overview of JSON policies](#) in the *IAM User Guide*.

Administrators can use AWS JSON policies to specify who has access to what. That is, which **principal** can perform **actions** on what **resources**, and under what **conditions**.

Every IAM entity (user or role) starts with no permissions. By default, users can do nothing, not even change their own password. To give a user permission to do something, an administrator must attach a permissions policy to a user. Or the administrator can add the user to a group that has the intended permissions. When an administrator gives permissions to a group, all users in that group are granted those permissions.

IAM policies define permissions for an action regardless of the method that you use to perform the operation. For example, suppose that you have a policy that allows the `iam:GetRole` action. A user with that policy can get role information from the AWS Management Console, the AWS CLI, or the AWS API.

Identity-based policies

Identity-based policies are JSON permissions policy documents that you can attach to an identity, such as an IAM user, group of users, or role. These policies control what actions users and roles can perform, on which resources, and under what conditions. To learn how to create an identity-based policy, see [Define custom IAM permissions with customer managed policies](#) in the *IAM User Guide*.

Identity-based policies can be further categorized as *inline policies* or *managed policies*. Inline policies are embedded directly into a single user, group, or role. Managed policies are standalone policies that you can attach to multiple users, groups, and roles in your AWS account. Managed policies include AWS managed policies and customer managed policies. To learn how to choose between a managed policy or an inline policy, see [Choosing between managed policies and inline policies](#) in the *IAM User Guide*.

Resource-based policies

Resource-based policies are JSON policy documents that you attach to a resource. Examples of resource-based policies are *IAM role trust policies* and *Amazon S3 bucket policies*. In services that support resource-based policies, service administrators can use them to control access to a specific resource. For the resource where the policy is attached, the policy defines what actions a specified principal can perform on that resource and under what conditions. You must [specify a principal](#) in a resource-based policy. Principals can include accounts, users, roles, federated users, or AWS services.

Resource-based policies are inline policies that are located in that service. You can't use AWS managed policies from IAM in a resource-based policy.

Other policy types

AWS supports additional, less-common policy types. These policy types can set the maximum permissions granted to you by the more common policy types.

- **Permissions boundaries** – A permissions boundary is an advanced feature in which you set the maximum permissions that an identity-based policy can grant to an IAM entity (IAM user or role). You can set a permissions boundary for an entity. The resulting permissions are the intersection of entity's identity-based policies and its permissions boundaries. Resource-based policies that specify the user or role in the `Principal` field are not limited by the permissions boundary. An explicit deny in any of these policies overrides the allow. For more information about permissions boundaries, see [Permissions boundaries for IAM entities](#) in the *IAM User Guide*.

- **Service control policies (SCPs)** – SCPs are JSON policies that specify the maximum permissions for an organization or organizational unit (OU) in AWS Organizations. AWS Organizations is a service for grouping and centrally managing multiple AWS accounts that your business owns. If you enable all features in an organization, then you can apply service control policies (SCPs) to any or all of your accounts. The SCP limits permissions for entities in member accounts, including each AWS account root user. For more information about Organizations and SCPs, see [How SCPs work](#) in the *AWS Organizations User Guide*.
- **Session policies** – Session policies are advanced policies that you pass as a parameter when you programmatically create a temporary session for a role or federated user. The resulting session's permissions are the intersection of the user or role's identity-based policies and the session policies. Permissions can also come from a resource-based policy. An explicit deny in any of these policies overrides the allow. For more information, see [Session policies](#) in the *IAM User Guide*.

Multiple policy types

When multiple types of policies apply to a request, the resulting permissions are more complicated to understand. To learn how AWS determines whether to allow a request when multiple policy types are involved, see [Policy evaluation logic](#) in the *IAM User Guide*.

How AWS Clean Rooms works with IAM

Before you use IAM to manage access to AWS Clean Rooms, learn what IAM features are available to use with AWS Clean Rooms.

IAM features you can use with AWS Clean Rooms

IAM feature	AWS Clean Rooms support
Identity-based policies	Yes
Resource-based policies	Partial
Policy actions	Yes
Policy resources	Yes
Policy condition keys (service-specific)	Partial

IAM feature	AWS Clean Rooms support
ACLs	No
ABAC (tags in policies)	Yes
Temporary credentials	Yes
Forward access sessions (FAS)	Yes
Service roles	Yes
Service-linked roles	No

To get a high-level view of how AWS Clean Rooms and other AWS services work with most IAM features, see [AWS services that work with IAM](#) in the *IAM User Guide*.

Identity-based policies for AWS Clean Rooms

Supports identity-based policies: Yes

Identity-based policies are JSON permissions policy documents that you can attach to an identity, such as an IAM user, group of users, or role. These policies control what actions users and roles can perform, on which resources, and under what conditions. To learn how to create an identity-based policy, see [Define custom IAM permissions with customer managed policies](#) in the *IAM User Guide*.

With IAM identity-based policies, you can specify allowed or denied actions and resources as well as the conditions under which actions are allowed or denied. You can't specify the principal in an identity-based policy because it applies to the user or role to which it is attached. To learn about all of the elements that you can use in a JSON policy, see [IAM JSON policy elements reference](#) in the *IAM User Guide*.

Identity-based policy examples for AWS Clean Rooms

To view examples of AWS Clean Rooms identity-based policies, see [Identity-based policy examples for AWS Clean Rooms](#).

Resource-based policies within AWS Clean Rooms

Supports resource-based policies: Partial

Resource-based policies are JSON policy documents that you attach to a resource. Examples of resource-based policies are IAM *role trust policies* and Amazon S3 *bucket policies*. In services that support resource-based policies, service administrators can use them to control access to a specific resource. For the resource where the policy is attached, the policy defines what actions a specified principal can perform on that resource and under what conditions. You must [specify a principal](#) in a resource-based policy. Principals can include accounts, users, roles, federated users, or AWS services.

To enable cross-account access, you can specify an entire account or IAM entities in another account as the principal in a resource-based policy. Adding a cross-account principal to a resource-based policy is only half of establishing the trust relationship. When the principal and the resource are in different AWS accounts, an IAM administrator in the trusted account must also grant the principal entity (user or role) permission to access the resource. They grant permission by attaching an identity-based policy to the entity. However, if a resource-based policy grants access to a principal in the same account, no additional identity-based policy is required. For more information, see [Cross account resource access in IAM](#) in the *IAM User Guide*.

The AWS Clean Rooms service supports only one type of resource-based policy called a *configured lookalike model managed resource policy*, which is attached to a configured lookalike model. This policy defines which principals can perform actions on the configured lookalike model.

To learn how to attach a resource-based policy to a configured lookalike model, see [IAM behaviors for AWS Clean Rooms ML](#).

Policy actions for AWS Clean Rooms

Supports policy actions: Yes

Administrators can use AWS JSON policies to specify who has access to what. That is, which **principal** can perform **actions** on what **resources**, and under what **conditions**.

The `Action` element of a JSON policy describes the actions that you can use to allow or deny access in a policy. Policy actions usually have the same name as the associated AWS API operation. There are some exceptions, such as *permission-only actions* that don't have a matching API operation. There are also some operations that require multiple actions in a policy. These additional actions are called *dependent actions*.

Include actions in a policy to grant permissions to perform the associated operation.

To see a list of AWS Clean Rooms actions, see [Actions defined by AWS Clean Rooms](#) in the *Service Authorization Reference*.

Policy actions in AWS Clean Rooms use the following prefix before the action.

```
cleanrooms
```

To specify multiple actions in a single statement, separate them with commas.

```
"Action": [  
    "cleanrooms:action1",  
    "cleanrooms:action2"  
]
```

To view examples of AWS Clean Rooms identity-based policies, see [Identity-based policy examples for AWS Clean Rooms](#).

Policy resources for AWS Clean Rooms

Supports policy resources: Yes

Administrators can use AWS JSON policies to specify who has access to what. That is, which **principal** can perform **actions** on what **resources**, and under what **conditions**.

The Resource JSON policy element specifies the object or objects to which the action applies. Statements must include either a Resource or a NotResource element. As a best practice, specify a resource using its [Amazon Resource Name \(ARN\)](#). You can do this for actions that support a specific resource type, known as *resource-level permissions*.

For actions that don't support resource-level permissions, such as listing operations, use a wildcard (*) to indicate that the statement applies to all resources.

```
"Resource": "*"
```

To see a list of AWS Clean Rooms resource types and their ARNs, see [Resources defined by AWS Clean Rooms](#) in the *Service Authorization Reference*. To learn with which actions you can specify the ARN of each resource, see [Actions defined by AWS Clean Rooms](#).

To view examples of AWS Clean Rooms identity-based policies, see [Identity-based policy examples for AWS Clean Rooms](#).

Policy condition keys for AWS Clean Rooms

Supports service-specific policy condition keys: Partial

Administrators can use AWS JSON policies to specify who has access to what. That is, which **principal** can perform **actions** on what **resources**, and under what **conditions**.

The Condition element (or Condition *block*) lets you specify conditions in which a statement is in effect. The Condition element is optional. You can create conditional expressions that use [condition operators](#), such as equals or less than, to match the condition in the policy with values in the request.

If you specify multiple Condition elements in a statement, or multiple keys in a single Condition element, AWS evaluates them using a logical AND operation. If you specify multiple values for a single condition key, AWS evaluates the condition using a logical OR operation. All of the conditions must be met before the statement's permissions are granted.

You can also use placeholder variables when you specify conditions. For example, you can grant an IAM user permission to access a resource only if it is tagged with their IAM user name. For more information, see [IAM policy elements: variables and tags](#) in the *IAM User Guide*.

AWS supports global condition keys and service-specific condition keys. To see all AWS global condition keys, see [AWS global condition context keys](#) in the *IAM User Guide*.

To learn how AWS Clean Rooms ML uses policy condition keys, see [IAM behaviors for AWS Clean Rooms ML](#).

ACLs in AWS Clean Rooms

Supports ACLs: No

Access control lists (ACLs) control which principals (account members, users, or roles) have permissions to access a resource. ACLs are similar to resource-based policies, although they do not use the JSON policy document format.

ABAC with AWS Clean Rooms

Supports ABAC (tags in policies): Yes

Attribute-based access control (ABAC) is an authorization strategy that defines permissions based on attributes. In AWS, these attributes are called *tags*. You can attach tags to IAM entities (users or roles) and to many AWS resources. Tagging entities and resources is the first step of ABAC. Then you design ABAC policies to allow operations when the principal's tag matches the tag on the resource that they are trying to access.

ABAC is helpful in environments that are growing rapidly and helps with situations where policy management becomes cumbersome.

To control access based on tags, you provide tag information in the [condition element](#) of a policy using the `aws:ResourceTag/key-name`, `aws:RequestTag/key-name`, or `aws:TagKeys` condition keys.

If a service supports all three condition keys for every resource type, then the value is **Yes** for the service. If a service supports all three condition keys for only some resource types, then the value is **Partial**.

For more information about ABAC, see [Define permissions with ABAC authorization](#) in the *IAM User Guide*. To view a tutorial with steps for setting up ABAC, see [Use attribute-based access control \(ABAC\)](#) in the *IAM User Guide*.

Using temporary credentials with AWS Clean Rooms

Supports temporary credentials: Yes

Some AWS services don't work when you sign in using temporary credentials. For additional information, including which AWS services work with temporary credentials, see [AWS services that work with IAM](#) in the *IAM User Guide*.

You are using temporary credentials if you sign in to the AWS Management Console using any method except a user name and password. For example, when you access AWS using your company's single sign-on (SSO) link, that process automatically creates temporary credentials. You also automatically create temporary credentials when you sign in to the console as a user and then switch roles. For more information about switching roles, see [Switch from a user to an IAM role \(console\)](#) in the *IAM User Guide*.

You can manually create temporary credentials using the AWS CLI or AWS API. You can then use those temporary credentials to access AWS. AWS recommends that you dynamically generate temporary credentials instead of using long-term access keys. For more information, see [Temporary security credentials in IAM](#).

Forward access sessions for AWS Clean Rooms

Supports forward access sessions (FAS): Yes

When you use an IAM user or role to perform actions in AWS, you are considered a principal. When you use some services, you might perform an action that then initiates another action in a different service. FAS uses the permissions of the principal calling an AWS service, combined with the requesting AWS service to make requests to downstream services. FAS requests are only made when a service receives a request that requires interactions with other AWS services or resources to complete. In this case, you must have permissions to perform both actions. For policy details when making FAS requests, see [Forward access sessions](#).

Service roles for AWS Clean Rooms

Supports service roles: Yes

A service role is an [IAM role](#) that a service assumes to perform actions on your behalf. An IAM administrator can create, modify, and delete a service role from within IAM. For more information, see [Create a role to delegate permissions to an AWS service](#) in the *IAM User Guide*.

Warning

Changing the permissions for a service role might break AWS Clean Rooms functionality. Edit service roles only when AWS Clean Rooms provides guidance to do so.

Service-linked roles for AWS Clean Rooms

Supports service-linked roles: No

A service-linked role is a type of service role that is linked to an AWS service. The service can assume the role to perform an action on your behalf. Service-linked roles appear in your AWS account and are owned by the service. An IAM administrator can view, but not edit the permissions for service-linked roles.

For details about creating or managing service-linked roles, see [AWS services that work with IAM](#). Find a service in the table that includes a Yes in the **Service-linked role** column. Choose the **Yes** link to view the service-linked role documentation for that service.

Identity-based policy examples for AWS Clean Rooms

By default, users and roles don't have permission to create or modify AWS Clean Rooms resources. They also can't perform tasks by using the AWS Management Console, AWS Command Line Interface (AWS CLI), or AWS API. To grant users permission to perform actions on the resources that they need, an IAM administrator can create IAM policies. The administrator can then add the IAM policies to roles, and users can assume the roles.

To learn how to create an IAM identity-based policy by using these example JSON policy documents, see [Create IAM policies \(console\)](#) in the *IAM User Guide*.

For details about actions and resource types defined by AWS Clean Rooms, including the format of the ARNs for each of the resource types, see [Actions, resources, and condition keys for AWS Clean Rooms](#) in the *Service Authorization Reference*.

Topics

- [Policy best practices](#)
- [Using the AWS Clean Rooms console](#)
- [Allow users to view their own permissions](#)

Policy best practices

Identity-based policies determine whether someone can create, access, or delete AWS Clean Rooms resources in your account. These actions can incur costs for your AWS account. When you create or edit identity-based policies, follow these guidelines and recommendations:

- **Get started with AWS managed policies and move toward least-privilege permissions** – To get started granting permissions to your users and workloads, use the *AWS managed policies* that grant permissions for many common use cases. They are available in your AWS account. We recommend that you reduce permissions further by defining AWS customer managed policies that are specific to your use cases. For more information, see [AWS managed policies](#) or [AWS managed policies for job functions](#) in the *IAM User Guide*.
- **Apply least-privilege permissions** – When you set permissions with IAM policies, grant only the permissions required to perform a task. You do this by defining the actions that can be taken on

specific resources under specific conditions, also known as *least-privilege permissions*. For more information about using IAM to apply permissions, see [Policies and permissions in IAM](#) in the *IAM User Guide*.

- **Use conditions in IAM policies to further restrict access** – You can add a condition to your policies to limit access to actions and resources. For example, you can write a policy condition to specify that all requests must be sent using SSL. You can also use conditions to grant access to service actions if they are used through a specific AWS service, such as AWS CloudFormation. For more information, see [IAM JSON policy elements: Condition](#) in the *IAM User Guide*.
- **Use IAM Access Analyzer to validate your IAM policies to ensure secure and functional permissions** – IAM Access Analyzer validates new and existing policies so that the policies adhere to the IAM policy language (JSON) and IAM best practices. IAM Access Analyzer provides more than 100 policy checks and actionable recommendations to help you author secure and functional policies. For more information, see [Validate policies with IAM Access Analyzer](#) in the *IAM User Guide*.
- **Require multi-factor authentication (MFA)** – If you have a scenario that requires IAM users or a root user in your AWS account, turn on MFA for additional security. To require MFA when API operations are called, add MFA conditions to your policies. For more information, see [Secure API access with MFA](#) in the *IAM User Guide*.

For more information about best practices in IAM, see [Security best practices in IAM](#) in the *IAM User Guide*.

Using the AWS Clean Rooms console

To access the AWS Clean Rooms console, you must have a minimum set of permissions. These permissions must allow you to list and view details about the AWS Clean Rooms resources in your AWS account. If you create an identity-based policy that is more restrictive than the minimum required permissions, the console won't function as intended for entities (users or roles) with that policy.

You don't need to allow minimum console permissions for users that are making calls only to the AWS CLI or the AWS API. Instead, allow access to only the actions that match the API operation that they're trying to perform.

To ensure that users and roles can still use the AWS Clean Rooms console, also attach the AWS Clean Rooms *FullAccess* or *ReadOnly* AWS managed policy to the entities. For more information, see [Adding permissions to a user](#) in the *IAM User Guide*.

Allow users to view their own permissions

This example shows how you might create a policy that allows IAM users to view the inline and managed policies that are attached to their user identity. This policy includes permissions to complete this action on the console or programmatically using the AWS CLI or AWS API.

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Sid": "ViewOwnUserInfo",
      "Effect": "Allow",
      "Action": [
        "iam:GetUserPolicy",
        "iam:ListGroupsForUser",
        "iam:ListAttachedUserPolicies",
        "iam:ListUserPolicies",
        "iam:GetUser"
      ],
      "Resource": ["arn:aws:iam::*:user/${aws:username}"]
    },
    {
      "Sid": "NavigateInConsole",
      "Effect": "Allow",
      "Action": [
        "iam:GetGroupPolicy",
        "iam:GetPolicyVersion",
        "iam:GetPolicy",
        "iam:ListAttachedGroupPolicies",
        "iam:ListGroupPolicies",
        "iam:ListPolicyVersions",
        "iam:ListPolicies",
        "iam:ListUsers"
      ],
      "Resource": "*"
    }
  ]
}
```

AWS managed policies for AWS Clean Rooms

An AWS managed policy is a standalone policy that is created and administered by AWS. AWS managed policies are designed to provide permissions for many common use cases so that you can start assigning permissions to users, groups, and roles.

Keep in mind that AWS managed policies might not grant least-privilege permissions for your specific use cases because they're available for all AWS customers to use. We recommend that you reduce permissions further by defining [customer managed policies](#) that are specific to your use cases.

You cannot change the permissions defined in AWS managed policies. If AWS updates the permissions defined in an AWS managed policy, the update affects all principal identities (users, groups, and roles) that the policy is attached to. AWS is most likely to update an AWS managed policy when a new AWS service is launched or new API operations become available for existing services.

For more information, see [AWS managed policies](#) in the *IAM User Guide*.

AWS managed policy: `AWSCleanRoomsReadOnlyAccess`

You can attach `AWSCleanRoomsReadOnlyAccess` to your IAM principals.

This policy grants read-only permissions to resources and metadata in an `AWSCleanRoomsReadOnlyAccess` collaboration.

Permissions details

This policy includes the following permissions:

- `CleanRoomsRead` – Allows principals read-only access to the service.
- `ConsoleDisplayTables` – Allows principals read-only access to the AWS Glue metadata needed to show data about the underlying AWS Glue tables on the console.
- `ConsoleLogSummaryQueryLogs` – Allows principals to see the query logs.
- `ConsoleLogSummaryObtainLogs` – Allows principals to retrieve the log results.

For a JSON listing of the policy details, see [AWSCleanRoomsReadOnlyAccess](#) in the *AWS Managed Policy Reference Guide*.

AWS managed policy: `AWSCleanRoomsFullAccess`

You can attach `AWSCleanRoomsFullAccess` to your IAM principals.

This policy grants administrative permissions that allow full access (read, write, and update) to resources and metadata in an AWS Clean Rooms collaboration. This policy includes access to perform queries.

Permissions details

This policy includes the following permissions:

- `CleanRoomsAccess` – Grants full access to all actions on all resources for AWS Clean Rooms.
- `PassServiceRole` – Grants access to pass a service role to only the service (`PassedToService` condition) that has "cleanrooms" in its name.
- `ListRolesToPickServiceRole` – Allows principals to list all their roles in order to choose a service role when using AWS Clean Rooms.
- `GetRoleAndListRolePoliciesToInspectServiceRole` – Allows principals to see the service role and corresponding policy in IAM.
- `ListPoliciesToInspectServiceRolePolicy` – Allows principals to see the service role and corresponding policy in IAM.
- `GetPolicyToInspectServiceRolePolicy` – Allows principals to see the service role and corresponding policy in IAM.
- `ConsoleDisplayTables` – Allows principals read-only access to the AWS Glue metadata needed to show data about the underlying AWS Glue tables on the console.
- `ConsolePickQueryResultsBucketListAll` – Allows principals to choose an Amazon S3 bucket from a list of all available S3 buckets into which their query results are written.
- `SetQueryResultsBucket` – Allows principals to choose an S3 bucket into which their query results are written.
- `ConsoleDisplayQueryResults` – Allows principals to show the query results to the customer, read from the S3 bucket.
- `WriteQueryResults` – Allows principals to write the query results into a customer-owned S3 bucket.
- `EstablishLogDeliveries` – Allows principals to deliver query logs to a customer's Amazon CloudWatch Logs log group.

- `SetupLogGroupsDescribe` – Allows principals to use the Amazon CloudWatch Logs log group creation process.
- `SetupLogGroupsCreate` – Allows principals to create an Amazon CloudWatch Logs log group.
- `SetupLogGroupsResourcePolicy` – Allows principals to set up a resource policy on the Amazon CloudWatch Logs log group.
- `ConsoleLogSummaryQueryLogs` – Allows principals to see the query logs.
- `ConsoleLogSummaryObtainLogs` – Allows principals to retrieve the log results.

For a JSON listing of the policy details, see [AWSCleanRoomsFullAccess](#) in the *AWS Managed Policy Reference Guide*.

AWS managed policy: `AWSCleanRoomsFullAccessNoQuerying`

You can attach `AWSCleanRoomsFullAccessNoQuerying` to your IAM principals.

This policy grants administrative permissions that allow full access (read, write, and update) to resources and metadata in an AWS Clean Rooms collaboration. This policy excludes access to perform queries.

Permissions details

This policy includes the following permissions:

- `CleanRoomsAccess` – Grants full access to all actions on all resources for AWS Clean Rooms, except for querying in collaborations.
- `CleanRoomsNoQuerying` – Explicitly denies `StartProtectedQuery` and `UpdateProtectedQuery` to prevent querying.
- `PassServiceRole` – Grants access to pass a service role to only the service (`PassedToService` condition) that has "cleanrooms" in its name.
- `ListRolesToPickServiceRole` – Allows principals to list all their roles in order to choose a service role when using AWS Clean Rooms.
- `GetRoleAndListRolePoliciesToInspectServiceRole` – Allows principals to see the service role and corresponding policy in IAM.
- `ListPoliciesToInspectServiceRolePolicy` – Allows principals to see the service role and corresponding policy in IAM.

- `GetPolicyToInspectServiceRolePolicy` – Allows principals to see the service role and corresponding policy in IAM.
- `ConsoleDisplayTables` – Allows principals read-only access to the AWS Glue metadata needed to show data about the underlying AWS Glue tables on the console.
- `EstablishLogDeliveries` – Allows principals to deliver query logs to a customer's Amazon CloudWatch Logs log group.
- `SetupLogGroupsDescribe` – Allows principals to use the Amazon CloudWatch Logs log group creation process.
- `SetupLogGroupsCreate` – Allows principals to create an Amazon CloudWatch Logs log group.
- `SetupLogGroupsResourcePolicy` – Allows principals to set up a resource policy on the Amazon CloudWatch Logs log group.
- `ConsoleLogSummaryQueryLogs` – Allows principals to see the query logs.
- `ConsoleLogSummaryObtainLogs` – Allows principals to retrieve the log results.
- `cleanrooms` – Manage collaborations, analysis templates, configured tables, memberships, and associated resources within the AWS Clean Rooms service. Perform various operations such as creating, updating, deleting, listing, and retrieving information about these resources.
- `iam` – Pass service roles with names containing "cleanrooms" to the AWS Clean Rooms service. List roles, policies, and inspect service roles and policies related to the AWS Clean Rooms service.
- `glue` – Retrieve information about databases, tables, partitions, and schemas from AWS Glue. This is required for the AWS Clean Rooms service to display and interact with the underlying data sources.
- `logs` – Manage log deliveries, log groups, and resource policies for CloudWatch Logs. Query and retrieve logs related to the AWS Clean Rooms service. These permissions are necessary for monitoring, auditing, and troubleshooting purposes within the service.

The policy also explicitly denies the actions `cleanrooms:StartProtectedQuery` and `cleanrooms:UpdateProtectedQuery` to prevent users from directly executing or updating protected queries, which should be done through the AWS Clean Rooms controlled mechanisms.

For a JSON listing of the policy details, see [AWSCleanRoomsFullAccessNoQuerying](#) in the *AWS Managed Policy Reference Guide*.

AWS managed policy: `AWSCleanRoomsMLReadOnlyAccess`

You can attach `AWSCleanRoomsMLReadOnlyAccess` to your IAM principals.

This policy grants read-only permissions to resources and metadata in an `AWSCleanRoomsMLReadOnlyAccess` collaboration.

This policy includes the following permissions:

- `CleanRoomsConsoleNavigation` – Grants access to view the screens of the AWS Clean Rooms console.
- `CleanRoomsMLRead` – Allows principals read-only access to the Clean Rooms ML service.
- `PassCleanRoomsResources` – Grants access to pass specified AWS Clean Rooms resources.

For a JSON listing of the policy details, see [AWSCleanRoomsMLReadOnlyAccess](#) in the *AWS Managed Policy Reference Guide*.

AWS managed policy: `AWSCleanRoomsMLFullAccess`

You can attach `AWSCleanRoomsMLFullAccess` to your IAM principals. This policy grants administrative permissions that allow full access (read, write, and update) to resources and metadata needed by Clean Rooms ML.

Permissions details

This policy includes the following permissions:

- `CleanRoomsMLFullAccess` – Grants access to all Clean Rooms ML actions.
- `PassServiceRole` – Grants access to pass a service role to only the service (`PassedToService` condition) that has "cleanrooms-ml" in its name.
- `CleanRoomsConsoleNavigation` – Grants access to view the screens of the AWS Clean Rooms console.
- `CollaborationMembershipCheck` – When you start an audience generation (lookalike segment) job within a collaboration, the Clean Rooms ML service calls `ListMembers` to check that the collaboration is valid, the caller is an active member, and the configured audience model owner is an active member. This permission is always required; the console navigation SID is only required for console users.
- `PassCleanRoomsResources` – Grants access to pass specified AWS Clean Rooms resources.
- `AssociateModels` – Allows principals to associate a Clean Rooms ML model with your collaboration.

- **TagAssociations** – Allows principals to add tags to the association between a lookalike model and a collaboration.
- **ListRolesToPickServiceRole** – Allows principals to list all their roles in order to choose a service role when using AWS Clean Rooms.
- **GetRoleAndListRolePoliciesToInspectServiceRole** – Allows principals to see the service role and corresponding policy in IAM.
- **ListPoliciesToInspectServiceRolePolicy** – Allows principals to see the service role and corresponding policy in IAM.
- **GetPolicyToInspectServiceRolePolicy** – Allows principals to see the service role and corresponding policy in IAM.
- **ConsoleDisplayTables** – Allows principals read-only access to the AWS Glue metadata needed to show data about the underlying AWS Glue tables on the console.
- **ConsolePickOutputBucket** – Allows principals to select Amazon S3 buckets for configured audience model outputs.
- **ConsolePickS3Location** – Allows principals to select the location within a bucket for configured audience model outputs.
- **ConsoleDescribeECRRepositories** – Allows principals to describe Amazon ECR repositories and images.

For a JSON listing of the policy details, see [AWSCleanRoomsMLFullAccess](#) in the *AWS Managed Policy Reference Guide*.

AWS Clean Rooms updates to AWS managed policies

View details about updates to AWS managed policies for AWS Clean Rooms since this service began tracking these changes. For automatic alerts about changes to this page, subscribe to the RSS feed on the AWS Clean Rooms Document history page.

Change	Description	Date
AWSCleanRoomsMLReadOnlyAccess – Update to existing policy	Added PassCleanRoomsResources to AWSCleanRoomsMLReadOnlyAccess.	January 10, 2025
AWSCleanRoomsMLFullAccess – Update to existing policy	Added PassCleanRoomsResources and ConsoleDescribeECRRepositories to AWSCleanRoomsMLFullAccess.	

Change	Description	Date
AWSCleanRoomsFullAccessNoQuering – Update to existing policy	Added cleanrooms:BatchGetSchemaAnalysisRule to CleanRoomsAccess.	May 13, 2024
AWSCleanRoomsFullAccess – Update to existing policy	Updated the Statement ID in AWSCleanRoomsFullAccess from ConsolePickQueryResultsBucket to SetQueryResultsBucket in this policy to better represent the permissions since the permissions are needed for setting the query results bucket both with and without the console.	March 21, 2024
AWSCleanRoomsMLReadOnlyAccess – New policy	Added AWSCleanRoomsMLReadOnlyAccess and AWSCleanRoomsMLFullAccess to support AWS Clean Rooms ML.	November 29, 2023
AWSCleanRoomsMLFullAccess – New policy		
AWSCleanRoomsFullAccessNoQuering – Update to existing policy	Added cleanrooms:CreateAnalysisTemplate, cleanrooms:GetAnalysisTemplate, cleanrooms:UpdateAnalysisTemplate, cleanrooms:DeleteAnalysisTemplate, cleanrooms>ListAnalysisTemplates, cleanrooms:GetCollaborationAnalysisTemplate, cleanrooms:BatchGetCollaborationAnalysisTemplate, and cleanrooms>ListCollaborationAnalysisTemplates to CleanRoomsAccess to enable the new analysis templates feature.	July 31, 2023

Change	Description	Date
AWSCleanRoomsFullAccessNoQuering – Update to existing policy	Added cleanrooms:ListTagsForResource, cleanrooms:UntagResource, and cleanrooms:TagResource to CleanRoomsAccess to enable resource tagging.	March 21, 2023
AWS Clean Rooms started tracking changes	AWS Clean Rooms started tracking changes for its AWS managed policies.	January 12, 2023

Troubleshooting AWS Clean Rooms identity and access

Use the following information to help you diagnose and fix common issues that you might encounter when working with AWS Clean Rooms and IAM.

Topics

- [I am not authorized to perform an action in AWS Clean Rooms](#)
- [I am not authorized to perform iam:PassRole](#)
- [I want to allow people outside of my AWS account to access my AWS Clean Rooms resources](#)

I am not authorized to perform an action in AWS Clean Rooms

If you receive an error that you're not authorized to perform an action, your policies must be updated to allow you to perform the action.

The following example error occurs when the mateojackson IAM user tries to use the console to view details about a fictional *my-example-widget* resource but does not have the fictional `cleanrooms:GetWidget` permissions.

```
User: arn:aws:iam::123456789012:user/mateojackson is not authorized to perform:
cleanrooms:GetWidget on resource: my-example-widget
```

In this case, Mateo's policy must be updated to allow him to access the *my-example-widget* resource using the `cleanrooms:GetWidget` action.

If you need help, contact your AWS administrator. Your administrator is the person who provided you with your sign-in credentials.

I am not authorized to perform iam:PassRole

If you receive an error that you're not authorized to perform the `iam:PassRole` action, your policies must be updated to allow you to pass a role to AWS Clean Rooms.

Some AWS services allow you to pass an existing role to that service instead of creating a new service role or service-linked role. To do this, you must have permissions to pass the role to the service.

The following example error occurs when an IAM user named `marymajor` tries to use the console to perform an action in AWS Clean Rooms. However, the action requires the service to have permissions that are granted by a service role. Mary does not have permissions to pass the role to the service.

```
User: arn:aws:iam::123456789012:user/marymajor is not authorized to perform:
iam:PassRole
```

In this case, Mary's policies must be updated to allow her to perform the `iam:PassRole` action.

If you need help, contact your AWS administrator. Your administrator is the person who provided you with your sign-in credentials.

I want to allow people outside of my AWS account to access my AWS Clean Rooms resources

You can create a role that users in other accounts or people outside of your organization can use to access your resources. You can specify who is trusted to assume the role.

To learn more, consult the following:

- To learn whether AWS Clean Rooms supports these features, see [How AWS Clean Rooms works with IAM](#).
- To learn how to provide access to your resources across AWS accounts that you own, see [Providing access to an IAM user in another AWS account that you own](#) in the *IAM User Guide*.
- To learn how to provide access to your resources to third-party AWS accounts, see [Providing access to AWS accounts owned by third parties](#) in the *IAM User Guide*.
- To learn how to provide access through identity federation, see [Providing access to externally authenticated users \(identity federation\)](#) in the *IAM User Guide*.

- To learn the difference between using roles and resource-based policies for cross-account access, see [How IAM roles differ from resource-based policies](#) in the *IAM User Guide*.

Cross-service confused deputy prevention

The confused deputy problem is a security issue where an entity that doesn't have permission to perform an action can coerce a more-privileged entity to perform the action. In AWS, cross-service impersonation can result in the confused deputy problem. Cross-service impersonation can occur when one service (the *calling service*) calls another service (the *called service*). The calling service can be manipulated to use its permissions to act on another customer's resources in a way it should not otherwise have permission to access. To prevent this, AWS provides tools that help you protect your data for all services with service principals that have been given access to resources in your account.

We recommend using the [aws:SourceArn](#) global condition context keys in resource policies to limit the permissions that AWS Clean Rooms gives another service to the resource. Use `aws:SourceArn` if you want only one resource to be associated with the cross-service access.

The most effective way to protect against the confused deputy problem is to use the `aws:SourceArn` global condition context key with the full ARN of the resource. In AWS Clean Rooms, you also have to compare against the `sts:ExternalId` condition key.

The value of `aws:SourceArn` must be set to the ARN of the membership of the assumed role.

The following example shows how you can use the `aws:SourceArn` global condition context key in AWS Clean Rooms to prevent the confused deputy problem.

Note

The example policy applies to the trust policy of the service role that AWS Clean Rooms uses to access data and metadata for a configured table.

The value for `<query-runner-membership-id>` needs to be set to the membership ID of the query runner.

All members of the collaboration can view the configured table metadata so each membership ARN must be included in the list of membership ARNs.

JSON

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Sid": "AllowIfExternalIdMatches",
      "Effect": "Allow",
      "Principal": {
        "Service": "cleanrooms.amazonaws.com"
      },
      "Action": "sts:AssumeRole",
      "Condition": {
        "StringLike": {
          "sts:ExternalId": "arn:aws:*:<aws-region>:*:dbuser:*/<query-
runner-membership-id>*"
        }
      }
    },
    {
      "Sid": "AllowIfSourceArnMatches",
      "Effect": "Allow",
      "Principal": {
        "Service": "cleanrooms.amazonaws.com"
      },
      "Action": "sts:AssumeRole",
      "Condition": {
        "ForAnyValue:ArnEquals": {
          "aws:SourceArn": [
            "arn:aws:cleanrooms:<aws-region>:<member-1-account-
id>:membership/<member-1-membership-id>",
            "arn:aws:cleanrooms:<aws-region>:<member-2-account-
id>:membership/<member-2-membership-id>"
          ]
        }
      }
    }
  ]
}
```

IAM behaviors for AWS Clean Rooms ML

Cross-account jobs

Clean Rooms ML allows certain resources created by one AWS account to be securely accessed in their account by another AWS account. When a client in AWS account A calls `StartAudienceGenerationJob` on a `ConfiguredAudienceModel` resource owned by AWS account B, Clean Rooms ML creates two ARNs for the job. One ARN in AWS account A and another in AWS account B. The ARNs are identical except for their AWS account.

Clean Rooms ML creates two ARNs for the job to ensure that both accounts can apply their own IAM policies to the jobs. For example, both accounts can use tag-based access control and apply policies from their AWS organization. The job processes data from both accounts, so both accounts can delete the job and its associated data. Neither account can block the other account from deleting the job.

There is only one job execution and both accounts can see the job when they call `ListAudienceGenerationJobs`. Both accounts can call the `Get`, `Delete`, and `Export` APIs on the job using the ARN with their own AWS account ID.

Neither AWS account can access the job when using an ARN with the other AWS account ID.

The name of the job must be unique within an AWS account. The name in AWS account B is *\$accountA-\$name*. The name chosen by AWS account A is prefixed with AWS account A when the job is viewed in AWS account B.

In order for a cross-account `StartAudienceGenerationJob` to succeed, AWS account B must allow that action on both the new job in AWS account B and the `ConfiguredAudienceModel` in AWS account B using a resource policy similar to the following example:

JSON

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Sid": "Clean-Rooms-<CAMA ID>",
      "Effect": "Allow",
      "Principal": {
        "AWS": [
```

```

        "accountA"
    ],
    },
    "Action": [
        "cleanrooms-ml:StartAudienceGenerationJob"
    ],
    "Resource": [
        "arn:aws:cleanrooms-ml:us-west-1:AccountB:configured-audience-
model/id",
        "arn:aws:cleanrooms-ml:us-west-1:AccountB:audience-generation-
job/*"
    ],
    // optional - always set by AWS Clean Rooms
    "Condition":{"StringEquals":{"cleanrooms-ml:CollaborationId":"UUID"}}
}
]
}

```

If you use the [AWS Clean Rooms ML API](#) to create a configured lookalike model with `manageResourcePolicies` set to true, AWS Clean Rooms creates this policy for you.

Additionally, the identity policy of the caller in AWS account A needs `StartAudienceGenerationJob` permission on `arn:aws:cleanrooms-ml:us-west-1:AccountA:audience-generation-job/*`. So there are three IAM Resources for Action `StartAudienceGenerationJob`: the AWS account A job, the AWS account B job, and the AWS account B `ConfiguredAudienceModel`.

Warning

The AWS account that started the job receives an AWS CloudTrail audit log event about the job. The AWS account that owns the `ConfiguredAudienceModel` does not receive a AWS CloudTrail audit log event.

Tagging jobs

When you set the `childResourceTagOnCreatePolicy=FROM_PARENT_RESOURCE` parameter of `CreateConfiguredAudienceModel`, all lookalike segment generation jobs within your account that are created from that configured lookalike model default to having the same tags as

the configured lookalike model. The configured lookalike model is the parent and the lookalike segment generation job is the child.

If you are creating a job within your own account, the request tags of the job override the parent tags. Jobs created by other accounts never create tags in your account. If you set `childResourceTagOnCreatePolicy=FROM_PARENT_RESOURCE` and another account creates a job, there are two copies of the job. The copy in your account has the parent resource tags and the copy in the job submitter's account has tags from the request.

Validating collaborators

When granting permissions to other members of an AWS Clean Rooms collaboration, the resource policy should include the condition key `cleanrooms-ml:CollaborationId`. This enforces that the `collaborationId` parameter is included in the [StartAudienceGenerationJob](#) request. When the `collaborationId` parameter is included in the request, Clean Rooms ML validates that the collaboration exists, the job submitter is an active member of the collaboration, and the configured lookalike model owner is an active member of the collaboration.

When AWS Clean Rooms manages your configured lookalike model resource policy (the `manageResourcePolicies` parameter is `TRUE` in [CreateConfiguredAudienceModelAssociation request](#)), this condition key will be set in the resource policy. Therefore, you must specify the `collaborationId` in [StartAudienceGenerationJob](#).

Cross-account access

Only `StartAudienceGenerationJob` can be called across accounts. All other Clean Rooms ML APIs can only be used with resources in your own account. This ensures that your training data, lookalike model configuration, and other information stays private.

Clean Rooms ML never reveals Amazon S3 or AWS Glue locations across accounts. The training data location, configured lookalike model output location, and lookalike segment generation job seed location are never visible across accounts. Unless query logging is enabled in the collaboration, whether the seed data comes from an SQL query and the query itself are not visible across accounts. If you Get an audience generation job that another account submitted, the service does not show the seed location.

IAM behaviors for Clean Rooms ML Custom Models

Cross-account jobs

Clean Rooms ML allows certain resources associated with a collaboration created by one AWS account to be securely accessed in their account by another AWS account. A client in AWS account A with the member ability to run queries can call `CreateTrainedModel`, `CreateMLInputChannel`, or `StartTrainedModelInferenceJob` on a `ConfiguredModelAlgorithmAssociation` resource owned by another member in the collaboration, provided the `ConfiguredModelAlgorithmAssociation` is allowed by the custom analysis rule created with `CreateConfiguredTableAnalysisRule`.

Additionally, any active member of a collaboration can delete data associated with a trained model or ML input channel via the `DeleteTrainedModelOutput` and `DeleteMLInputChannelData` APIs.

Cross-account access

Clean Rooms ML allows users to retrieve metadata about resources created by other accounts via the `GetCollaboration` and `ListCollaboration` APIs. Clean Rooms ML does not reveal KMS key ARNs, tags, environment variables, or hyperparameters (for the `TrainedModel` action) to other accounts.

Membership and collaboration access

When accessing membership and collaboration resources in context of Clean Rooms ML custom models, a user's identity policy needs permissions to the actions `cleanrooms:PassMembership`, `cleanrooms:PassCollaboration`, or both. All APIs that accept `membershipId` need the `cleanrooms:PassMembership` permission, and all APIs that accept `collaborationId` need the `cleanrooms:PassCollaboration` permission. A sample identity policy for a role that can call `createTrainedModel` in the context of a membership ID that can call `GetCollaborationTrainedModel` in the context of a collaboration ID are provided.

JSON

```
{
  "Version": "2012-10-17",
  "Statement": [
```



```

    {
      "Sid": "AllowCleanroomsMLActions",
      "Effect": "Allow",
      "Action": [
        "cleanrooms-ml:PassMembership",
        "cleanrooms-ml:PassCollaboration",
      ],
      "Resource": ["*"]
    },
    {
      "Sid": "AllowMembership",
      "Effect": "Allow",
      "Action": [
        "cleanrooms-ml:PassMembership",
      ],
      "Resource": ["arn:aws:cleanrooms:region:account:membership/memberId"]
    },
    {
      "Sid": "AllowCollaboration",
      "Effect": "Allow",
      "Action": [
        "cleanrooms-ml:PassCollaboration",
      ],
      "Resource":
["arn:aws:cleanrooms:region:account:collaboration/collaborationId"]
    }
  ]
}

```

Compliance validation for AWS Clean Rooms

To learn whether an AWS service is within the scope of specific compliance programs, see [AWS services in Scope by Compliance Program](#) and choose the compliance program that you are interested in. For general information, see [AWS Compliance Programs](#).

You can download third-party audit reports using AWS Artifact. For more information, see [Downloading Reports in AWS Artifact](#).

Your compliance responsibility when using AWS services is determined by the sensitivity of your data, your company's compliance objectives, and applicable laws and regulations. AWS provides the following resources to help with compliance:

- [Security Compliance & Governance](#) – These solution implementation guides discuss architectural considerations and provide steps for deploying security and compliance features.
- [HIPAA Eligible Services Reference](#) – Lists HIPAA eligible services. Not all AWS services are HIPAA eligible.
- [AWS Compliance Resources](#) – This collection of workbooks and guides might apply to your industry and location.
- [AWS Customer Compliance Guides](#) – Understand the shared responsibility model through the lens of compliance. The guides summarize the best practices for securing AWS services and map the guidance to security controls across multiple frameworks (including National Institute of Standards and Technology (NIST), Payment Card Industry Security Standards Council (PCI), and International Organization for Standardization (ISO)).
- [Evaluating Resources with Rules](#) in the *AWS Config Developer Guide* – The AWS Config service assesses how well your resource configurations comply with internal practices, industry guidelines, and regulations.
- [AWS Security Hub](#) – This AWS service provides a comprehensive view of your security state within AWS. Security Hub uses security controls to evaluate your AWS resources and to check your compliance against security industry standards and best practices. For a list of supported services and controls, see [Security Hub controls reference](#).
- [Amazon GuardDuty](#) – This AWS service detects potential threats to your AWS accounts, workloads, containers, and data by monitoring your environment for suspicious and malicious activities. GuardDuty can help you address various compliance requirements, like PCI DSS, by meeting intrusion detection requirements mandated by certain compliance frameworks.
- [AWS Audit Manager](#) – This AWS service helps you continuously audit your AWS usage to simplify how you manage risk and compliance with regulations and industry standards.

Resilience in AWS Clean Rooms

The AWS global infrastructure is built around AWS Regions and Availability Zones. Regions provide multiple physically separated and isolated Availability Zones, which are connected through low-latency, high-throughput, and highly redundant networking. With Availability Zones, you can design and operate applications and databases that automatically fail over between zones without interruption. Availability Zones are more highly available, fault tolerant, and scalable than traditional single or multiple data center infrastructures.

For more information about AWS Regions and Availability Zones, see [AWS Global Infrastructure](#).

Infrastructure security in AWS Clean Rooms

As a managed service, AWS Clean Rooms is protected by AWS global network security. For information about AWS security services and how AWS protects infrastructure, see [AWS Cloud Security](#). To design your AWS environment using the best practices for infrastructure security, see [Infrastructure Protection](#) in *Security Pillar AWS Well-Architected Framework*.

You use AWS published API calls to access AWS Clean Rooms through the network. Clients must support the following:

- Transport Layer Security (TLS). We require TLS 1.2 and recommend TLS 1.3.
- Cipher suites with perfect forward secrecy (PFS) such as DHE (Ephemeral Diffie-Hellman) or ECDHE (Elliptic Curve Ephemeral Diffie-Hellman). Most modern systems such as Java 7 and later support these modes.

Additionally, requests must be signed by using an access key ID and a secret access key that is associated with an IAM principal. Or you can use the [AWS Security Token Service](#) (AWS STS) to generate temporary security credentials to sign requests.

Network security

When AWS Clean Rooms reads from your S3 bucket during query execution, the traffic between AWS Clean Rooms and Amazon S3 is securely routed through the AWS private network. In-flight traffic is signed using Amazon Signature Version 4 protocol (SIGv4) and encrypted using HTTPS. This traffic is authorized based on the IAM service role which you have set up for your configured table.

You can connect programmatically to AWS Clean Rooms through an endpoint. For a list of service endpoints, see [AWS Clean Rooms endpoints and quotas](#) in the *AWS General Reference*.

All service endpoints are HTTPS-only. You can use Amazon Virtual Private Cloud (VPC) endpoints in case you want to connect to AWS Clean Rooms from your VPC and do not want to have internet connectivity. For more information, see [Access AWS services through AWS PrivateLink](#) in the *AWS PrivateLink Guide*.

You can assign IAM policies to your IAM principals which make use of the [aws:SourceVpce context keys](#) to restrict your IAM principal to only be able to make calls to AWS Clean Rooms through a VPC endpoint and not over the internet.

Access AWS Clean Rooms or AWS Clean Rooms ML using an interface endpoint (AWS PrivateLink)

You can use AWS PrivateLink to create a private connection between your virtual private cloud (VPC) and AWS Clean Rooms or AWS Clean Rooms ML. You can access AWS Clean Rooms or AWS Clean Rooms ML as if it were in your VPC, without the use of an internet gateway, NAT device, VPN connection, or AWS Direct Connect connection. Instances in your VPC don't need public IP addresses to access AWS Clean Rooms.

You establish this private connection by creating an *interface endpoint*, powered by AWS PrivateLink. We create an endpoint network interface in each subnet that you enable for the interface endpoint. These are requester-managed network interfaces that serve as the entry point for traffic destined for AWS Clean Rooms.

For more information, see [Access AWS services through AWS PrivateLink](#) in the *AWS PrivateLink Guide*.

Considerations for AWS Clean Rooms

Before you set up an interface endpoint for AWS Clean Rooms, review [Considerations](#) in the *AWS PrivateLink Guide*.

AWS Clean Rooms and AWS Clean Rooms ML support making calls to all of their API actions through the interface endpoint.

VPC endpoint policies are not supported for AWS Clean Rooms or AWS Clean Rooms ML. By default, full access to AWS Clean Rooms and AWS Clean Rooms ML is allowed through the interface endpoint. Alternatively, you can associate a security group with the endpoint network interfaces to control traffic to AWS Clean Rooms or AWS Clean Rooms ML through the interface endpoint.

Create an interface endpoint for AWS Clean Rooms

You can create an interface endpoint for AWS Clean Rooms or AWS Clean Rooms ML using either the Amazon VPC console or the AWS Command Line Interface (AWS CLI). For more information, see [Create an interface endpoint](#) in the *AWS PrivateLink Guide*.

Create an interface endpoint for AWS Clean Rooms using the following service name.

```
com.amazonaws.region.cleanrooms
```

Create an interface endpoint for AWS Clean Rooms ML using the following service name.

```
com.amazonaws.region.cleanrooms-ml
```

If you enable private DNS for the interface endpoint, you can make API requests to AWS Clean Rooms using its default Regional DNS name. For example, `cleanrooms-ml.us-east-1.amazonaws.com`.

Monitoring AWS Clean Rooms

Monitoring is an important part of maintaining the reliability, availability, and performance of AWS Clean Rooms and your other AWS solutions. AWS provides the following monitoring tools to watch AWS Clean Rooms, report when something is wrong, and take automatic actions when appropriate:

- *Amazon CloudWatch Logs* enables you to monitor, store, and access your log files from Amazon EC2 instances, AWS CloudTrail, and other sources. Amazon CloudWatch Logs can monitor information in the log files and notify you when certain thresholds are met. You can also archive your log data in highly durable storage. For more information, see the [Amazon CloudWatch Logs User Guide](#).

Clean Rooms ML allows cross-account jobs for certain API actions. The AWS account that started the job receives the AWS CloudTrail audit log event for the job. For more information, see [IAM behaviors for AWS Clean Rooms ML](#)

- *AWS CloudTrail* captures API calls and related events made by or on behalf of your AWS account and delivers the log files to an Amazon S3 bucket that you specify. You can identify which users and accounts called AWS, the source IP address from which the calls were made, and when the calls occurred. For more information, see the [AWS CloudTrail User Guide](#).

Analysis logging in AWS Clean Rooms

Analysis logging is a feature in AWS Clean Rooms. When you [create a collaboration](#) and turn on **Analysis logging**, members can store relevant logs from queries or logs from jobs in Amazon CloudWatch Logs.

With query logs and job logs, members can determine if the queries comply with the analysis rules and align with the collaboration agreement. In addition, query logs help support audits.

When the **Analysis logging** option is turned on in the AWS Clean Rooms console, the query logs include the following:

- `analysisRule` – The analysis rule for the configured table.
- `analysisTemplateArn` – The analysis template that was run (appears depending on analysis rule).
- `collaborationId` – The unique identifier for collaboration in which the query was run.

- `configuredTableID` – The unique identifier for configured table referenced in the query.
- `directQueryAnalysisRulePolicy.custom.allowedAnalysis` – The analysis template allowed to run on configured table (appears depending on analysis rule).
- `directQueryAnalysisRulePolicy.v1.custom.allowedAnalysisProviders` – The query providers allowed to create query (appears depending on analysis rule).
- `errorCode` – The error code when a query failed to execute properly.
- `errorMessage` – The error message when a query failed to execute properly.
- `eventID` – The unique identifier for the query run. After August 31, 2023, the unique identifier is the same as the `protectedQueryID`.
- `eventTimestamp` – The query run time.
- `parameters.parameterValue` – The parameter values (appears depending on the query text).
- `queryText` – The SQL definition of query run. If there are parameters, they are labelled as `:parameterValue`.
- `queryValidationErrors` – The query errors at query validation.
- `schemaName` – The name of configured table association referenced in the query.
- `status` – The execution status of the query.

Receive query and job logs

You don't need to perform any actions outside of AWS Clean Rooms to set up query logs and job logs. AWS Clean Rooms creates log groups for collaborations after each collaboration member [creates a membership](#).

Members who can query, members who can run queries and jobs, members who can receive results, and members whose configuration tables are referenced in the query will receive a query log or a job log.

The member who can query and member who can receive results will receive query logs for each configured table that is referenced in the query. If they don't own the configured table, they won't be able to view the configured table ID (`configuredTableID`).

The member who can run queries and jobs and member who can receive results will receive job logs for each configured table that is referenced in the job. If they don't own the configured table, they won't be able to view the configured table ID (`configuredTableID`).

If a member has multiple configured table associations referenced in the query, they will receive a query log for each configured table.

If a member has multiple configured table associations referenced in the job, they will receive a job log for each configured table.

Logs are created for queries that contain unsupported and supported SQL in AWS Clean Rooms. For more details, see the [AWS Clean Rooms SQL Reference](#).

Logs are also created when queries or jobs reference configured tables that are not associated to the collaboration.

Logs are not created for incorrect SQL in AWS Clean Rooms.

Query and job logs indicate the status of a query but don't report whether query output was delivered. They confirm that a query or job was submitted by the member who can query. Query logs also confirm that the query contains supported SQL in AWS Clean Rooms and references configured tables associated to the collaboration.

Example

For example, a log isn't produced if the query was cancelled after AWS Clean Rooms validated its compliance with analysis rules and during query processing.

If you delete the log group, you must re-create the log group manually with the same log group name (collaboration ID of the collaboration). Or, you can turn the logging off and on in your membership.

For more information about how to turn on analysis logging, see [Creating a collaboration](#).

For more information about Amazon CloudWatch Logs, see the [Amazon CloudWatch Logs User Guide](#).

Recommended actions for query and job logs

We recommend that members periodically take the following actions:

- To verify that the queries and jobs match the use cases or queries that were agreed upon for the collaboration, review the queries and jobs that are run in the collaboration.

For more information about how to view recent queries, see [Viewing recent queries](#).

For more information about how to view recent jobs, see [Viewing recent jobs](#).

- To verify that the configured table columns match what was agreed upon for the collaboration, review the configured table columns that are used in collaboration members' analysis rules and in queries.

For more information about how to view the configured columns, see [Viewing tables and analysis rules](#).

Logging AWS Clean Rooms API calls using AWS CloudTrail

AWS Clean Rooms is integrated with AWS CloudTrail, a service that provides a record of actions taken by a user, role, or an AWS service in AWS Clean Rooms. CloudTrail captures all API calls for AWS Clean Rooms as events. The calls captured include calls from the AWS Clean Rooms console and code calls to the AWS Clean Rooms API operations. If you create a trail, you can enable continuous delivery of CloudTrail events to an Amazon S3 bucket, including events for AWS Clean Rooms. If you don't configure a trail, you can still view the most recent events in the CloudTrail console in **Event history**. Using the information collected by CloudTrail, you can determine the request that was made to AWS Clean Rooms, the IP address from which the request was made, who made the request, when it was made, and additional details.

To learn more about CloudTrail, see the [AWS CloudTrail User Guide](#).

AWS Clean Rooms information in CloudTrail

CloudTrail is enabled on your AWS account when you create the account. When activity occurs in AWS Clean Rooms, that activity is recorded in a CloudTrail event along with other AWS service events in **Event history**. You can view, search, and download recent events in your AWS account. For more information, see [Viewing events with CloudTrail Event history](#).

For an ongoing record of events in your AWS account, including events for AWS Clean Rooms, create a trail. A *trail* enables CloudTrail to deliver log files to an Amazon S3 bucket. By default, when you create a trail in the console, the trail applies to all AWS Regions. The trail logs events from all Regions in the AWS partition and delivers the log files to the Amazon S3 bucket that you specify. Additionally, you can configure other AWS services to further analyze and act upon the event data collected in CloudTrail logs. For more information, see the following:

- [Overview for creating a trail](#)
- [CloudTrail supported services and integrations](#)
- [Configuring Amazon SNS notifications for CloudTrail](#)

- [Receiving CloudTrail log files from multiple Regions](#)
- [Receiving CloudTrail log files from multiple accounts](#)

All AWS Clean Rooms actions are logged by CloudTrail and are documented in the [AWS Clean Rooms API Reference](#).

Every event or log entry contains information about who generated the request. The identity information helps you determine the following:

- Whether the request was made with root user or IAM user credentials.
- Whether the request was made with temporary security credentials for a role or federated user.
- Whether the request was made by another AWS service.

For more information, see the [CloudTrail `userIdentity` element](#).

Understanding AWS Clean Rooms log file entries

A trail is a configuration that enables delivery of events as log files to an Amazon S3 bucket that you specify. CloudTrail log files contain one or more log entries. An event represents a single request from any source and includes information about the requested action, the date and time of the action, request parameters, and so on. CloudTrail log files aren't an ordered stack trace of the public API calls, so they don't appear in any specific order.

Example AWS Clean Rooms CloudTrail events

The following examples demonstrate CloudTrail events for:

Topics

- [StartProtectedQuery \(successful\)](#)
- [StartProtectedQuery \(failed\)](#)

StartProtectedQuery (successful)

```
{
  "eventVersion": "1.08",
  "userIdentity": {
    "type": "AssumedRole",
    "principalId": "EXAMPLE_PRINCIPAL_ID",
```

```

    "arn": "arn:aws:sts::123456789012:assumed-role/query-runner/jdoe",
    "accountId": "123456789012",
    "accessKeyId": "EXAMPLE_KEY_ID",
    "sessionContext": {
      "sessionIssuer": {
        "type": "Role",
        "principalId": "EXAMPLE_PRINCIPAL_ID",
        "arn": "arn:aws:iam::123456789012:role/query-runner",
        "accountId": "123456789012",
        "userName": "query-runner"
      },
      "webIdFederationData": {},
      "attributes": {
        "creationDate": "2023-04-07T19:34:32Z",
        "mfaAuthenticated": "false"
      }
    },
    "eventTime": "2023-04-07T19:53:32Z",
    "eventSource": "cleanrooms.amazonaws.com",
    "eventName": "StartProtectedQuery",
    "awsRegion": "us-east-2",
    "sourceIPAddress": "203.0.113.1",
    "userAgent": "aws-internal/3",
    "requestParameters": {
      "resultConfiguration": {
        "outputConfiguration": {
          "s3": {
            "resultFormat": "CSV",
            "bucket": "cleanrooms-queryresults-jdoe-test",
            "keyPrefix": "test"
          }
        }
      },
      "sqlParameters": "****",
      "membershipIdentifier": "a1b2c3d4-5678-90ab-cdef-EXAMPLE11111",
      "type": "SQL"
    },
    "responseElements": {
      "Access-Control-Expose-Headers": "x-amzn-RequestId,x-amzn-ErrorType,x-amzn-ErrorMessage,Date",
      "protectedQuery": {
        "createTime": 1680897212.279,
        "id": "f5988bf1-771a-4141-82a8-26fcc4e41c9f",

```

```

        "membershipArn": "arn:aws:cleanrooms:us-east-2:123456789012:membership/
a1b2c3d4-5678-90ab-cdef-EXAMPLE11111",
        "membershipId": "a1b2c3d4-5678-90ab-cdef-EXAMPLE11111",
        "resultConfiguration": {
            "outputConfiguration": {
                "s3": {
                    "bucket": "cleanrooms-queryresults-jdoe-test",
                    "keyPrefix": "test",
                    "resultFormat": "CSV"
                }
            }
        },
        "sqlParameters": "****",
        "status": "SUBMITTED"
    }
},
"requestID": "7464211b-2277-4b55-9723-fb4f259aefd2",
"eventID": "f7610f5e-74b9-420f-ae43-206571ebcbf7",
"readOnly": false,
"eventType": "AwsApiCall",
"managementEvent": true,
"recipientAccountId": "123456789012",
"eventCategory": "Management"
}

```

StartProtectedQuery (failed)

```

{
    "eventVersion": "1.08",
    "userIdentity": {
        "type": "AssumedRole",
        "principalId": "EXAMPLE_PRINCIPAL_ID",
        "arn": "arn:aws:sts::123456789012:assumed-role/query-runner/jdoe",
        "accountId": "123456789012",
        "accessKeyId": "EXAMPLE_KEY_ID",
        "sessionContext": {
            "sessionIssuer": {
                "type": "Role",
                "principalId": "EXAMPLE_PRINCIPAL_ID",
                "arn": "arn:aws:iam::123456789012:role/query-runner",
                "accountId": "123456789012",
                "userName": "query-runner"
            }
        }
    },

```

```

        "webIdFederationData": {},
        "attributes": {
            "creationDate": "2023-04-07T19:34:32Z",
            "mfaAuthenticated": "false"
        }
    },
    "eventTime": "2023-04-07T19:47:27Z",
    "eventSource": "cleanrooms.amazonaws.com",
    "eventName": "StartProtectedQuery",
    "awsRegion": "us-east-2",
    "sourceIPAddress": "203.0.113.1",
    "userAgent": "aws-internal/3",
    "errorCode": "ValidationException",
    "requestParameters": {
        "resultConfiguration": {
            "outputConfiguration": {
                "s3": {
                    "resultFormat": "CSV",
                    "bucket": "cleanrooms-queryresults-jdoe-test",
                    "keyPrefix": "test"
                }
            }
        },
        "sqlParameters": "****",
        "membershipIdentifier": "a1b2c3d4-5678-90ab-cdef-EXAMPLE11111",
        "type": "SQL"
    },
    "responseElements": {
        "Access-Control-Expose-Headers": "x-amzn-RequestId,x-amzn-ErrorType,x-amzn-ErrorMessage,Date",
        "message": "Column(s) [identifier] is not allowed in select"
    },
    "requestID": "e29f9f74-8299-4a83-9d18-5ddce7302f07",
    "eventID": "c8ee3498-8e4e-44b5-87e4-ab9477e56eb5",
    "readOnly": false,
    "eventType": "AwsApiCall",
    "managementEvent": true,
    "recipientAccountId": "123456789012",
    "eventCategory": "Management"
}

```

Creating AWS Clean Rooms resources with AWS CloudFormation

AWS Clean Rooms is integrated with AWS CloudFormation, a service that helps you to model and set up your AWS resources. As a result of this integration, you can spend less time creating and managing your resources and infrastructure. You create a template that describes all the AWS resources that you want, and AWS CloudFormation provisions and configures those resources for you. Examples of resources include collaborations, configured tables, configured table associations, and memberships.

When you use AWS CloudFormation, you can reuse your template to set up your AWS Clean Rooms resources consistently and repeatedly. Describe your resources once, and then provision the same resources over and over in multiple AWS accounts and AWS Regions.

AWS Clean Rooms and AWS CloudFormation templates

To provision and configure resources for AWS Clean Rooms and related services, you must understand [AWS CloudFormation templates](#). Templates are formatted text files in JSON or YAML. These templates describe the resources that you want to provision in your AWS CloudFormation stacks. If you're unfamiliar with JSON or YAML, you can use AWS CloudFormation Designer to help you get started with AWS CloudFormation templates. For more information, see [What is AWS CloudFormation Designer?](#) in the *AWS CloudFormation User Guide*.

AWS Clean Rooms supports creating collaborations, configured tables, configured table associations, and memberships in AWS CloudFormation. For more information, including examples of JSON and YAML templates for collaborations, configured tables, configured table associations, and memberships, see the [AWS Clean Rooms](#) and [AWS Clean Rooms ML](#) resource type references in the *AWS CloudFormation User Guide*.

Learn more about AWS CloudFormation

To learn more about AWS CloudFormation, see the following resources:

- [AWS CloudFormation](#)
- [AWS CloudFormation User Guide](#)
- [AWS CloudFormation API Reference](#)

- [AWS CloudFormation Command Line Interface User Guide](#)

Quotas for AWS Clean Rooms

Your AWS account has default quotas, formerly referred to as limits, for each AWS service. Unless otherwise noted, each quota is specific to an AWS Region. You can request increases for some quotas, and other quotas can't be increased.

To view the quotas for AWS Clean Rooms, open the [Service Quotas console](#). In the navigation pane, choose **AWS services** and select **AWS Clean Rooms**.

To request a quota increase, see [Requesting a Quota Increase](#) in the *Service Quotas User Guide*. If the quota isn't yet available in Service Quotas, use the [Service limit increase form](#).

Topics

- [AWS Clean Rooms quotas](#)
- [AWS Clean Rooms ML quotas](#)

AWS Clean Rooms quotas

Your AWS account has the following quotas related to AWS Clean Rooms.

Name	Default	Adjustable	Description
Analysis rule size	Each supported Region: 100 Kilobytes	No	Maximum size of JSON for an analysis rule
Analysis templates per membership	Each supported Region: 25	Yes	Maximum number of analysis templates per membership
Collaborations created per account	Each supported Region: 10	Yes	Maximum number of collaborations created per account
Columns per configured table allowlist	Each supported Region: 100	Yes	Maximum number of columns that can be

Name	Default	Adjustable	Description
			allowlisted per configured table
Concurrent PySpark job vCPU usage per account	us-east-1: 1,024 Each of the other supported Regions: 512	Yes	Maximum total vCPU usage of all concurrently running PySpark jobs per account
Concurrent PySpark jobs per account	us-east-1: 5 Each of the other supported Regions: 2	Yes	Maximum number of concurrently running PySpark jobs per account
Concurrent SQL queries per account	us-east-1: 5 Each of the other supported Regions: 2	Yes	Maximum number of concurrently running SQL queries per account
Concurrent SQL query vCPU usage per account	Each supported Region: 512	Yes	Maximum total vCPU usage of all concurrently running SQL queries per account
Concurrent ongoing job per membership	Each supported Region: 1	No	Maximum number of concurrent ongoing jobs per membership
Concurrent ongoing queries per membership	Each supported Region: 5	No	Maximum number of concurrent ongoing queries per membership

Name	Default	Adjustable	Description
Configured audience model associations per membership	Each supported Region: 5	Yes	Maximum number of configured audience model associations per membership
Configured tables per account	Each supported Region: 250	Yes	Maximum number of configured tables created per account
Configured tables per protected query	Each supported Region: 15	Yes	Maximum number of configured tables in a protected query
ID mapping tables per membership	Each supported Region: 5	Yes	Maximum number of ID mapping tables per membership
ID namespace associations per membership	Each supported Region: 10	Yes	Maximum number of ID namespace associations per membership
Members invited per collaboration	Each supported Region: 5	Yes	Maximum number of members invited per collaboration
Memberships per account	Each supported Region: 100	Yes	Maximum number of memberships per account
Query text length (using differential privacy)	Each supported Region: 8 Kilobytes	No	Maximum text length for a SQL query statement using differential privacy

Name	Default	Adjustable	Description
Query text length on Clean Rooms SQL analytics engine	Each supported Region: 90 Kilobytes	No	Maximum text length for a SQL query statement on Clean Rooms SQL analytics engine
Query text length on Spark analytics engine	Each supported Region: 500 Kilobytes	No	Maximum text length for a SQL query statement on Spark analytics engine
Rate of BatchGetSchema requests	Each supported Region: 5	Yes	Maximum number of BatchGetSchema API calls per second
Rate of CreateCollaboration requests	Each supported Region: 5	Yes	Maximum number of CreateCollaboration API calls per second
Rate of CreateConfiguredTable requests	Each supported Region: 5	Yes	Maximum number of CreateConfiguredTable API calls per second
Rate of CreateConfiguredTableAnalysisRule requests	Each supported Region: 5	Yes	Maximum number of CreateConfiguredTableAnalysisRule API calls per second
Rate of CreateConfiguredTableAssociation requests	Each supported Region: 5	Yes	Maximum number of CreateConfiguredTableAssociation API calls per second
Rate of CreateMembership requests	Each supported Region: 5	Yes	Maximum number of CreateMembership API calls per second

Name	Default	Adjustable	Description
Rate of DeleteCollaboration requests	Each supported Region: 5	Yes	Maximum number of DeleteCollaboration API calls per second
Rate of DeleteConfiguredTable requests	Each supported Region: 5	Yes	Maximum number of DeleteConfiguredTable API calls per second
Rate of DeleteConfiguredTableAnalysisRule requests	Each supported Region: 5	Yes	Maximum number of DeleteConfiguredTableAnalysisRule API calls per second
Rate of DeleteConfiguredTableAssociation requests	Each supported Region: 5	Yes	Maximum number of DeleteConfiguredTableAssociation API calls per second
Rate of DeleteMember requests	Each supported Region: 5	Yes	Maximum number of DeleteMember API calls per second
Rate of DeleteMembership requests	Each supported Region: 5	Yes	Maximum number of DeleteMembership API calls per second
Rate of GetCollaboration requests	Each supported Region: 5	Yes	Maximum number of GetCollaboration API calls per second
Rate of GetConfiguredTable requests	Each supported Region: 20	Yes	Maximum number of GetConfiguredTable API calls per second

Name	Default	Adjustable	Description
Rate of GetConfiguredTableAnalysisRule requests	Each supported Region: 5	Yes	Maximum number of GetConfiguredTableAnalysisRule API calls per second
Rate of GetConfiguredTableAssociation requests	Each supported Region: 5	Yes	Maximum number of GetConfiguredTableAssociation API calls per second
Rate of GetMembership requests	Each supported Region: 5	Yes	Maximum number of GetMembership API calls per second
Rate of GetProtectedJob requests	Each supported Region: 5	Yes	Maximum number of GetProtectedJob API calls per second
Rate of GetProtectedQuery requests	Each supported Region: 20	Yes	Maximum number of GetProtectedQuery API calls per second
Rate of GetSchema requests	Each supported Region: 5	Yes	Maximum number of GetSchema API calls per second
Rate of GetSchemaAnalysisRule requests	Each supported Region: 5	Yes	Maximum number of GetSchemaAnalysisRule API calls per second
Rate of ListCollaborations requests	Each supported Region: 5	Yes	Maximum number of ListCollaborations API calls per second

Name	Default	Adjustable	Description
Rate of ListConfiguredTableAssociations requests	Each supported Region: 5	Yes	Maximum number of ListConfiguredTableAssociations API calls per second
Rate of ListConfiguredTables requests	Each supported Region: 5	Yes	Maximum number of ListConfiguredTables API calls per second
Rate of ListMembers requests	Each supported Region: 5	Yes	Maximum number of ListMembers API calls per second
Rate of ListMemberships requests	Each supported Region: 5	Yes	Maximum number of ListMemberships API calls per second
Rate of ListProtectedJobs requests	Each supported Region: 5	Yes	Maximum number of ListProtectedJobs API calls per second
Rate of ListProtectedQueries requests	Each supported Region: 5	Yes	Maximum number of ListProtectedQueries API calls per second
Rate of ListSchemas requests	Each supported Region: 5	Yes	Maximum number of ListSchemas API calls per second
Rate of StartProtectedJob requests	Each supported Region: 5	Yes	Maximum number of StartProtectedJob API calls per second
Rate of StartProtectedQuery requests	Each supported Region: 5	Yes	Maximum number of StartProtectedQuery API calls per second

Name	Default	Adjustable	Description
Rate of UpdateCollaboration requests	Each supported Region: 5	Yes	Maximum number of UpdateCollaboration API calls per second
Rate of UpdateConfiguredTable requests	Each supported Region: 5	Yes	Maximum number of UpdateConfiguredTable API calls per second
Rate of UpdateConfiguredTableAnalysisRule requests	Each supported Region: 5	Yes	Maximum number of UpdateConfiguredTableAnalysisRule API calls per second
Rate of UpdateConfiguredTableAssociation requests	Each supported Region: 5	Yes	Maximum number of UpdateConfiguredTableAssociation API calls per second
Rate of UpdateProtectedJob requests	Each supported Region: 5	Yes	Maximum number of UpdateProtectedJob API calls per second
Rate of UpdateProtectedQuery requests	Each supported Region: 5	Yes	Maximum number of UpdateProtectedQuery API calls per second
Table associations per membership	Each supported Region: 25	Yes	Maximum number of table associations per membership

AWS Clean Rooms resource parameter limits

Resource	Default	Description
Query text length	90 KB	Maximum text length for a SQL query statement
Query text length (using differential privacy)	90 KB	Maximum text length for a SQL query statement using differential privacy
Query run time	12 hours	Maximum duration a query is run before timeout

AWS Clean Rooms API throttling quotas

Your AWS account has the following API transaction per second (TPS) per account per endpoint quotas for the following resources:

- AnalysisTemplate
- ConfiguredAudienceModelAssociation
- PrivacyBudgetTempate
- CollaborationConfiguredAudienceModelAssociation

Resource	Rate limit	Description
Rate of BatchGetCollaborationAnalysisTemplate requests	5 TPS	Maximum number of BatchGetCollaborationAnalysisTemplate API calls per second
Rate of CreateAnalysisTemplate requests	5 TPS	Maximum number of CreateAnalysisTemplate API calls per second

Resource	Rate limit	Description
Rate of CreateConfiguredAudienceModelAssociation requests	5 TPS	Maximum number of CreateConfiguredAudienceModelAssociation calls per second
Rate of CreatePrivacyBudgetTemplate requests	5 TPS	Maximum number of CreatePrivacyBudgetTemplate calls per second
Rate of DeleteAnalysisTemplate requests	5 TPS	Maximum number of DeleteAnalysisTemplate calls per second
Rate of DeleteConfiguredAudienceModelAssociation requests	5 TPS	Maximum number of DeleteConfiguredAudienceModelAssociation calls per second
Rate of DeletePrivacyBudgetTemplate requests	5 TPS	Maximum number of DeletePrivacyBudgetTemplate calls per second
Rate of GetAnalysisTemplate requests	5 TPS	Maximum number of GetAnalysisTemplate calls per second
Rate of GetCollaborationConfiguredAudienceModelAssociation requests	5 TPS	Maximum number of GetCollaborationConfiguredAudienceModelAssociation calls per second

Resource	Rate limit	Description
Rate of GetCollaborationPrivacyBudgetTemplate requests	5 TPS	Maximum number of GetCollaborationPrivacyBudgetTemplate calls per second
Rate of GetConfiguredAudienceModelAssociation requests	5 TPS	Maximum number of GetConfiguredAudienceModelAssociation calls per second
Rate of GetPrivacyBudgetTemplate requests	5 TPS	Maximum number of GetPrivacyBudgetTemplate calls per second
Rate of ListAnalysisTemplates requests	5 TPS	Maximum number of ListAnalysisTemplates calls per second
Rate of ListCollaborationConfiguredAudienceModelAssociations requests	5 TPS	Maximum number of ListCollaborationConfiguredAudienceModelAssociations calls per second
Rate of ListCollaborationPrivacyBudgets requests	5 TPS	Maximum number of ListCollaborationPrivacyBudgets calls per second
Rate of ListCollaborationPrivacyBudgetTemplates requests	5 TPS	Maximum number of ListCollaborationPrivacyBudgetTemplates calls per second

Resource	Rate limit	Description
Rate of ListConfiguredAudienceModelAssociations requests	5 TPS	Maximum number of ListConfiguredAudienceModelAssociations calls per second
Rate of ListPrivacyBudgets requests	5 TPS	Maximum number of ListPrivacyBudgets calls per second
Rate of ListPrivacyBudgetTemplates requests	5 TPS	Maximum number of ListPrivacyBudgetTemplates calls per second
Rate of UpdateAnalysisTemplate requests	5 TPS	Maximum number of UpdateAnalysisTemplate calls per second
Rate of UpdateConfiguredAudienceModelAssociation requests	5 TPS	Maximum number of UpdateConfiguredAudienceModelAssociation calls per second
Rate of UpdatePrivacyBudgetTemplate requests	5 TPS	Maximum number of UpdatePrivacyBudgetTemplate calls per second

AWS Clean Rooms ML quotas

Your AWS account has the default quotas, formerly referred to as limits, for AWS Clean Rooms ML.

To view service quotas for AWS Clean Rooms ML, do one of the following:

- Follow the steps at [Viewing service quotas](#) in the *Service Quotas User Guide* and select AWS Clean Rooms ML as the service.
- Refer to the [AWS Clean Rooms ML service quotas](#) in the *Amazon Web Services General Reference*.

To maintain the performance of the service and to ensure appropriate usage of AWS Clean Rooms ML, the default quotas assigned to an account might be updated depending on Regional factors, payment history, fraudulent usage, and/or approval of a quota increase request.

Name	Default	Adjustable	Description
Active audience export jobs per audience generation job	Each supported Region: 25	No	The maximum number of active audience export jobs for an audience generation job
Active configured model algorithm associations per membership	Each supported Region: 1,000	Yes	The maximum number of active configured model algorithm associations per membership
Active configured model algorithms per membership	Each supported Region: 1,000	Yes	The maximum number of active configured model algorithms per membership
Active custom model input channels per membership	Each supported Region: 100	Yes	The maximum number of active custom model input channels per membership
Maximum number of active training instances per account	Each supported Region: 10	Yes	The maximum number of active training instances that can be used per account for creating trained models.
Maximum number of active/pending/in progress trained model versions per trained model	Each supported Region: 100	Yes	The maximum number of active/pending/in progress trained model versions that can be

Name	Default	Adjustable	Description
			created per trained model.
Maximum number of ml.c4.2xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.c4.2xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.c4.4xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.c4.4xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.c4.8xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.c4.8xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.c4.xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.c4.xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.c5.18xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.c5.18xlarge training instances that can be used per account for creating trained models.

Name	Default	Adjustable	Description
Maximum number of ml.c5.2xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.c5.2xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.c5.4xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.c5.4xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.c5.9xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.c5.9xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.c5.xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.c5.xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.c5n.18xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.c5n.18xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.c5n.2xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.c5n.2xlarge training instances that can be used per account for creating trained models.

Name	Default	Adjustable	Description
Maximum number of ml.c5n.4xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.c5n.4xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.c5n.9xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.c5n.9xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.c5n.xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.c5n.xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.c6i.12xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.c6i.12xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.c6i.16xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.c6i.16xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.c6i.24xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.c6i.24xlarge training instances that can be used per account for creating trained models.

Name	Default	Adjustable	Description
Maximum number of ml.c6i.2xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.c6i.2xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.c6i.32xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.c6i.32xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.c6i.4xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.c6i.4xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.c6i.8xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.c6i.8xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.c6i.xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.c6i.xlarge training instances that can be used per account for creating trained models.

Name	Default	Adjustable	Description
Maximum number of ml.g4dn.12xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.g4dn.12xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.g4dn.16xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.g4dn.16xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.g4dn.2xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.g4dn.2xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.g4dn.4xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.g4dn.4xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.g4dn.8xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.g4dn.8xlarge training instances that can be used per account for creating trained models.

Name	Default	Adjustable	Description
Maximum number of ml.g4dn.xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.g4dn.xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.g5.12xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.g5.12xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.g5.16xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.g5.16xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.g5.24xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.g5.24xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.g5.2xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.g5.2xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.g5.48xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.g5.48xlarge training instances that can be used per account for creating trained models.

Name	Default	Adjustable	Description
Maximum number of ml.g5.4xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.g5.4xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.g5.8xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.g5.8xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.g5.xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.g5.xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.m4.10xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.m4.10xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.m4.16xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.m4.16xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.m4.2xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.m4.2xlarge training instances that can be used per account for creating trained models.

Name	Default	Adjustable	Description
Maximum number of ml.m4.4xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.m4.4xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.m4.xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.m4.xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.m5.12xlarge training instances per account	Each supported Region: 3	Yes	The maximum number of ml.m5.12xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.m5.24xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.m5.24xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.m5.2xlarge training instances per account	Each supported Region: 3	Yes	The maximum number of ml.m5.2xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.m5.4xlarge training instances per account	Each supported Region: 3	Yes	The maximum number of ml.m5.4xlarge training instances that can be used per account for creating trained models.

Name	Default	Adjustable	Description
Maximum number of ml.m5.large training instances per account	Each supported Region: 0	Yes	The maximum number of ml.m5.large training instances that can be used per account for creating trained models.
Maximum number of ml.m5.xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.m5.xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.m6i.12xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.m6i.12xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.m6i.16xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.m6i.16xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.m6i.24xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.m6i.24xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.m6i.2xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.m6i.2xlarge training instances that can be used per account for creating trained models.

Name	Default	Adjustable	Description
Maximum number of ml.m6i.32xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.m6i.32xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.m6i.4xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.m6i.4xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.m6i.8xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.m6i.8xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.m6i.large training instances per account	Each supported Region: 0	Yes	The maximum number of ml.m6i.large training instances that can be used per account for creating trained models.
Maximum number of ml.m6i.xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.m6i.xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.p2.16xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.p2.16xlarge training instances that can be used per account for creating trained models.

Name	Default	Adjustable	Description
Maximum number of ml.p2.8xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.p2.8xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.p2.xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.p2.xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.p3.16xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.p3.16xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.p3.2xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.p3.2xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.p3.8xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.p3.8xlarge training instances that can be used per account for creating trained models.

Name	Default	Adjustable	Description
Maximum number of ml.p3dn.24xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.p3dn.24xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.p4d.24xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.p4d.24xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.p4de.24xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.p4de.24xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.p5.48xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.p5.48xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.r5.12xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.r5.12xlarge training instances that can be used per account for creating trained models.

Name	Default	Adjustable	Description
Maximum number of ml.r5.16xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.r5.16xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.r5.24xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.r5.24xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.r5.2xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.r5.2xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.r5.4xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.r5.4xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.r5.8xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.r5.8xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.r5.large training instances per account	Each supported Region: 0	Yes	The maximum number of ml.r5.large training instances that can be used per account for creating trained models.

Name	Default	Adjustable	Description
Maximum number of ml.r5.xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.r5.xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.r5d.12xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.r5d.12xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.r5d.16xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.r5d.16xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.r5d.24xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.r5d.24xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.r5d.2xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.r5d.2xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.r5d.4xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.r5d.4xlarge training instances that can be used per account for creating trained models.

Name	Default	Adjustable	Description
Maximum number of ml.r5d.8xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.r5d.8xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.r5d.large training instances per account	Each supported Region: 0	Yes	The maximum number of ml.r5d.large training instances that can be used per account for creating trained models.
Maximum number of ml.r5d.xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.r5d.xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.t3.2xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.t3.2xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.t3.large training instances per account	Each supported Region: 0	Yes	The maximum number of ml.t3.large training instances that can be used per account for creating trained models.
Maximum number of ml.t3.medium training instances per account	Each supported Region: 0	Yes	The maximum number of ml.t3.medium training instances that can be used per account for creating trained models.

Name	Default	Adjustable	Description
Maximum number of ml.t3.xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.t3.xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.trn1.2xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.trn1.2xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.trn1.32xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.trn1.32xlarge training instances that can be used per account for creating trained models.
Maximum number of ml.trn1n.32xlarge training instances per account	Each supported Region: 0	Yes	The maximum number of ml.trn1n.32xlarge training instances that can be used per account for creating trained models.
Pending/In-progress audience export jobs per customer	Each supported Region: 20	No	The maximum number of pending/in-progress audience export jobs per customer
Pending/In-progress audience generation jobs per customer	Each supported Region: 10	Yes	The maximum number of pending/in-progress audience generation jobs per customer

Name	Default	Adjustable	Description
Pending/In-progress audience models per customer	Each supported Region: 2	Yes	The maximum number of pending/in-progress audience model training jobs per customer
Pending/In-progress custom model inference jobs per account	Each supported Region: 10	Yes	The maximum number of pending/in-progress custom model inference jobs per account
Pending/In-progress custom model inference jobs per membership	Each supported Region: 5	Yes	The maximum number of pending/in-progress custom model inference jobs per membership
Pending/In-progress custom model training jobs per account	Each supported Region: 10	Yes	The maximum number of pending/in-progress custom model training jobs per account
Pending/In-progress custom model training jobs per membership	Each supported Region: 5	Yes	The maximum number of pending/in-progress custom model training jobs per membership

AWS Clean Rooms ML has additional quotas listed below

Clean Rooms ML quotas

Resource	Default	Description
Maximum duration of a custom modeling inference job	25 hours	

Resource	Default	Description
Maximum number of interactions	20 billion	Maximum number of interactions allowed in training data. Larger inputs are sampled down.
Minimum number of interactions	1 million	
Maximum number of distinct users for lookalike model training	100 million	If more are included, only the top 100 million are used, ranked by number of interactions.
Minimum number of distinct users for lookalike model training	100,000	
Minimum number of users for export lookalike segment (audience) job	10,000	
Maximum number of distinct items used for model training.	1 million	You can include up to 50 million items, but only the most popular 1 million are used.
Maximum number of feature columns in the training dataset.	10	
Minimum number of distinct items per user	2	AWS Clean Rooms ML requires that each row or user has two or more items, including repeated items.
Maximum size of the seed audience	500,000	

Resource	Default	Description
Minimum size of the seed audience	500	The training data provider can set this value to as low as 25.
<i>APIs</i>	<i>per customer</i>	
Total number of active training datasets	500	
Total number of active lookalike models (audience models)	500	
Total number of active configured lookalike models (audience models)	10,000	
Total number of completed lookalike segment (audience) generation jobs	No limit	
Total number of completed export lookalike segment (audience) jobs	No limit	
Maximum duration of a lookalike model (audience model) generation job	1 day (24 hours)	

Resource	Default	Description
Maximum duration of a lookalike segment (audience) generation job	10 hours	After you provide a seed, Clean Rooms ML takes a maximum of 10 hours to generate a lookalike segment. If you use an SQL query as the seed data, it can take up to 12 hours to run the query in addition to the 10 hours to generate the lookalike segment.
Minimum percentage for a segment (audience) size bin	1%	
Maximum percentage for a segment (audience) size bin	20%	
Minimum absolute size for a segment (audience) size bin	1% of the number of distinct users	
Maximum absolute size for a segment (audience) size bin	20% of the number of distinct users	

Clean Rooms ML API throttling quotas

Your AWS account has the following API transaction per second (TPS) per account per endpoint quotas.

Resource	Rate limit	Description
Rate of <code>CreateAudienceModel</code> requests	1 TPS rate, 3 TPS burst	Maximum number of <code>CreateAudienceModel</code> API calls per second

Resource	Rate limit	Description
Rate of CreateConfiguredAudienceModel requests	10 TPS	Maximum number of CreateConfiguredAudienceModel API calls per second
Rate of CreateTrainingDataset requests	10 TPS	Maximum number of CreateTrainingDataset API calls per second
Rate of DeleteAudienceGenerationJob requests	2 TPS rate, 10 TPS burst	Maximum number of DeleteAudienceGenerationJob API calls per second
Rate of DeleteAudienceModel requests	2 TPS rate, 10 TPS burst	Maximum number of DeleteAudienceModel API calls per second
Rate of DeleteConfiguredAudienceModel requests	10 TPS	Maximum number of DeleteConfiguredAudienceModel API calls per second
Rate of DeleteConfiguredAudienceModelPolicy requests	25 TPS	Maximum number of DeleteConfiguredAudienceModelPolicy API calls per second
Rate of DeleteTrainingDataset requests	10 TPS	Maximum number of DeleteTrainingDataset API calls per second
Rate of GetAudienceGenerationJob requests	50 TPS	Maximum number of GetAudienceGenerationJob API calls per second

Resource	Rate limit	Description
Rate of GetAudienceModel requests	50 TPS	Maximum number of GetAudienceModel API calls per second
Rate of GetConfiguredAudienceModel requests	50 TPS	Maximum number of GetConfiguredAudienceModel API calls per second
Rate of GetConfiguredAudienceModelPolicy requests	50 TPS	Maximum number of GetConfiguredAudienceModelPolicy API calls per second
Rate of GetTrainingDataset requests	50 TPS	Maximum number of GetTrainingDataset API calls per second
Rate of ListAudienceExportJobs requests	50 TPS	Maximum number of ListAudienceExportJobs API calls per second
Rate of ListAudienceGenerationJobs requests	50 TPS	Maximum number of ListAudienceGenerationJobs API calls per second
Rate of ListAudienceModels requests	50 TPS	Maximum number of ListAudienceModels API calls per second
Rate of ListConfiguredAudienceModels requests	50 TPS	Maximum number of ListConfiguredAudienceModels API calls per second

Resource	Rate limit	Description
Rate of ListTagsForResource requests	50 TPS	Maximum number of ListTagsForResource API calls per second
Rate of ListTrainingDatasets requests	50 TPS	Maximum number of ListTrainingDatasets API calls per second
Rate of PutConfiguredAudienceModelPolicy requests	25 TPS	Maximum number of PutConfiguredAudienceModelPolicy API calls per second
Rate of StartAudienceExportJob requests	1 TPS rate, 3 TPS burst	Maximum number of StartAudienceExportJob API calls per second
Rate of StartAudienceGenerationJob requests	1 TPS rate, 5 TPS burst	Maximum number of StartAudienceGenerationJob API calls per second
Rate of TagResource requests	10 TPS	Maximum number of TagResource API calls per second
Rate of UntagResource requests	50 TPS	Maximum number of UntagResource API calls per second
Rate of UpdateConfiguredAudienceModel requests	10 TPS	Maximum number of UpdateConfiguredAudienceModel API calls per second

Resource	Rate limit	Description
Rate of CreateConfiguredModelAlgorithm requests	10 TPS	Maximum number of CreateConfiguredModelAlgorithm API calls per second.
Rate of CreateConfiguredModelAlgorithmAssociation requests	10 TPS	Maximum number of CreateConfiguredModelAlgorithmAssociation API calls per second.
Rate of PutMLConfiguration requests	10 TPS	Maximum number of PutMLConfiguration API calls per second.
Rate of CreateTrainedModel requests	1 TPS rate, 3 TPS burst	Maximum number of CreateTrainedModel API calls per second.
Rate of StartTrainedModelExportJob requests	10 TPS	Maximum number of StartTrainedModelExportJob API calls per second.
Rate of StartTrainedModelInferenceJob requests	1 TPS rate, 3 TPS rate	Maximum number of StartTrainedModelInferenceJob API calls per second.
Rate of GetConfiguredModelAlgorithm request	50 TPS	Maximum number of GetConfiguredModelAlgorithm API calls per second.

Resource	Rate limit	Description
Rate of GetConfiguredModelAlgorithmAssociation request	50 TPS	Maximum number of GetConfiguredModelAlgorithmAssociation API calls per second.
Rate of GetTrainedModel requests	50 TPS	Maximum number of GetTrainedModel API calls per second.
Rate of GetMLConfiguration requests	50 TPS	Maximum number of GetMLConfiguration API calls per second.
Rate of GetTrainedModelInferenceJob requests	50 TPS	Maximum number of GetTrainedModelInferenceJob API calls per second.
Rate of ListConfiguredModelAlgorithm requests	50 TPS	Maximum number of ListConfiguredModelAlgorithm API calls per second.
Rate of ListConfiguredModelAlgorithmAssociations requests	50 TPS	Maximum number of ListConfiguredModelAlgorithmAssociations API calls per second.
Rate of ListTrainedModels requests	50 TPS	Maximum number of ListTrainedModels API calls per second.
Rate of ListCollaborationTrainedModelExportJobs requests	50 TPS	Maximum number of ListCollaborationTrainedModelExportJobs API calls per second.

Resource	Rate limit	Description
Rate of ListCollaborationTrainedModelInferenceJobs requests	50 TPS	Maximum number of ListCollaborationTrainedModelInferenceJobs API calls per second.
Rate of DeleteConfiguredModelAlgorithm requests	2 TPS rate, 10 TPS burst	Maximum number of DeleteConfiguredModelAlgorithm API calls per second.
Rate of DeleteConfiguredModelAlgorithmAssociation requests	2 TPS rate, 10 TPS burst	Maximum number of DeleteConfiguredModelAlgorithmAssociation API requests per second.
Rate of DeleteMLConfiguration requests	2 TPS rate, 10 TPS burst	Maximum number of DeleteMLConfiguration API requests per second.
Rate of DeleteTrainedModelOutput requests	2 TPS rate, 10 TPS burst	Maximum number of DeleteTrainedModelOutput API requests per second.

Document history for the AWS Clean Rooms User Guide

The following table describes the documentation releases for AWS Clean Rooms.

For notification about updates to this documentation, you can subscribe to the RSS feed. To subscribe to RSS updates, you must have an RSS plug-in enabled for the browser you are using.

Change	Description	Date
ML input channel supports Parquet file type	Customers can now choose the Parquet file type as the data format the ML input channel can use.	July 17, 2025
Support for differential privacy on Spark SQL analytics engine	Customers can now use differential privacy with the Spark SQL analytics engine. In addition, the maximum text length for a SQL query statement using differential privacy is now 90 KB.	July 16, 2025
End of support timeline for AWS Clean Rooms SQL analytics engine	Support for new collaborations using the Clean Rooms SQL analytics engine ends on July 16, 2025. As of July 17, 2025, you can't create new collaborations with the legacy Clean Rooms SQL analytics engine. AWS Clean Rooms ends support for the Clean Rooms SQL analytics engine on December 17, 2025.	July 16, 2025
Support for incremental and distributed training	Customers can now use incremental training and	July 1, 2025

distributed training for their custom models.

[End of support timeline for Clean Rooms SQL analytics engine](#)

Starting now through July 16, 2025, new collaborations using the legacy Clean Rooms SQL analytics engine require a limit increase. Starting July 17, 2025, you can't create new collaborations with this engine. AWS Clean Rooms ends support for the Clean Rooms SQL analytics engine on December 17, 2025.

May 22, 2025

[Update to PySpark analysis templates](#)

Customers can now name a user script file with any valid Python filename.

May 15, 2025

[Support for multiple result receivers](#)

Customers can now select multiple members to receive query results from a single query.

April 30, 2025

[Support for migrating collaborations to Spark SQL](#)

AWS Clean Rooms SQL now supports aggregation and list analysis rules, in addition to custom analysis rules. Additionally, customers can update an existing collaboration to use the Spark analytics engine which powers Spark SQL.

April 2, 2025

[Support for PySpark jobs](#)

Customers can now analyze data by running jobs using approved PySpark analysis templates.

March 18, 2025

Update to existing policies	The following new permission has been added to the <code>AWSCleanRoomsMLReadOnlyAccess</code> managed policy: <code>PassCleanRoomsResources</code> . The following new permissions have been added to the <code>AWSCleanRoomsMLFullAccess</code> managed policy: <code>PassCleanRoomsResources</code> and <code>ConsoleDescribeECRRepositories</code> .	January 10, 2025
Support for multiple compute workers	Customers can now specify what type of compute workers and how many to provision when creating a lookalike segment.	December 17, 2024
Support for multiple data sources and clouds	Customers can now use multiple data sources and clouds, such as Amazon Athena and Snowflake, to collaborate with their partners' datasets.	December 1, 2024
Clean Rooms ML Custom Modeling is now available	Customers can now use their own custom ML models in a collaboration.	November 7, 2024
New analytics engine	Customers who have large datasets can now run complex queries using SQL functions supported by the Spark SQL analytics engine.	October 29, 2024

[Enhanced privacy protection, build lookalike audiences, choose multiple result receivers](#)

You can protect your data while also allowing complex activation queries using **Additional analyses** and the **collaboration analysis rule**. You can build lookalike audience models from SQL queries or analysis templates. You can choose multiple members to receive results.

July 24, 2024

[Entity resolution in AWS Clean Rooms](#)

With AWS Entity Resolution in AWS Clean Rooms, you can create an ID mapping table between two ID namespaces to query events data across disparate identity spaces.

July 23, 2024

[Update to existing policy](#)

The following new permission has been added to the `AWSCleanRoomsFullAccessNoQuerying` managed policy: `cleanrooms:BatchGetSchemaAnalysisRule`.

May 13, 2024

[AWS Clean Rooms ML is now fully available](#)

AWS Clean Rooms ML provides a privacy-enhancing method for two parties to identify similar users in their data without the need to share their data with each other.

April 3, 2024

Update to existing policy	The Statement ID in the <code>AWSCleanRoomsFullAccess</code> managed policy has been updated from <code>ConsolePickQueryResultsBucket</code> to <code>SetQueryResultsBucket</code> to better represent the permissions since the permissions.	March 21, 2024
New managed policies for AWS Clean Rooms ML	Two new managed policies have been added: <code>AWSCleanRoomsMLReadOnlyAccess</code> and <code>AWSCleanRoomsMLFullAccess</code> .	November 29, 2023
AWS Clean Rooms ML (preview)	AWS Clean Rooms ML provides a privacy-enhancing method for two parties to identify similar users in their data without the need to share their data with each other.	November 29, 2023
AWS Clean Rooms Differential Privacy (preview)	Customers can now use AWS Clean Rooms Differential Privacy to help protect the privacy of their users.	November 29, 2023
Payment configuration	The collaboration creator can now configure either the member who can run queries or a different member in the collaboration to be billed for query compute costs.	November 14, 2023

[Query run time - update](#)

The maximum duration a query is run before timeout has been updated from 4 hours to 12 hours.

October 6, 2023

[AWS CloudFormation resources - update](#)

AWS Clean Rooms has added the following new resources : `AWS::CleanRooms::MembershipProtectedQueryOutputConfiguration` , `AWS::CleanRooms::MembershipProtectedQueryResultConfiguration` , and `AWS::CleanRooms::MembershipProtectedQueryS3OutputConfiguration` .

September 7, 2023

[AWS CloudFormation resources - update](#)

AWS Clean Rooms has added the following new resources : `AWS::CleanRooms::AnalysisTemplate` and `AWS::CleanRooms::ConfiguredTableAnalysisRuleCustom` .

August 31, 2023

Separate member abilities	The collaboration creator can now designate one member as the member who can query and another member as the member who can receive results. This gives the collaboration creator the ability to make sure that the member who can query doesn't have access to the query results.	August 30, 2023
AWS Clean Rooms Glossary	Documentation-only update to add a glossary of AWS Clean Rooms terms.	August 30, 2023
Support for Apache Iceberg tables (preview)	AWS Clean Rooms now supports Apache Iceberg tables (preview).	August 25, 2023
Quotas update	The Quotas section has been updated to reflect the new default quota for memberships per account.	August 9, 2023

[Update to existing policy](#)

The following new permissions have been added to the `AWSCleanRoomsFullAccessNoQuerying` managed policy: `cleanrooms:CreateAnalysisTemplate`, `cleanrooms:GetAnalysisTemplate`, `cleanrooms:UpdateAnalysisTemplate`, `cleanrooms>DeleteAnalysisTemplate`, `cleanrooms>ListAnalysisTemplates`, `cleanrooms:GetCollaborationAnalysisTemplate`, `cleanrooms:BatchGetCollaborationAnalysisTemplate`, and `cleanrooms:ListCollaborationAnalysisTemplates`.

July 31, 2023

[Analysis templates and Custom analysis rule](#)

AWS Clean Rooms now supports analysis templates and the **Custom** analysis rule. Analysis templates enable collaborators to build or import their own custom SQL query to use in the collaboration. With the **Custom** analysis rule, the table owner can approve custom SQL queries on their configured tables.

July 31, 2023

Analysis rules support the OR logical condition	AWS Clean Rooms analysis rules now support the OR logical condition in the JOIN clause.	June 29, 2023
CloudFormation integration	AWS Clean Rooms now integrates with AWS CloudFormation.	June 15, 2023
Analysis builder	Members who can query and receive results now have the ability to run queries on some tables without writing SQL code by using the Analysis builder UI .	June 15, 2023
SQL functions	Documentation-only update to clarify supported SQL functions.	May 5, 2023
Troubleshooting	Documentation-only update to add a Troubleshooting section for common issues.	April 27, 2023
Supported data types for AWS Clean Rooms	Documentation-only update to add a new section that lists supported AWS Glue Data Catalog data types.	April 26, 2023
Examples of AWS CloudTrail events	Documentation-only update to add examples of CloudTrail events for StartProtectedQuery (successful) and StartProtectedQuery (failed).	April 20, 2023

Update to existing policy	The following new permissions have been added to the AWSCleanRoomsFullAccessNoQuerying managed policy: cleanrooms:ListTagsForResource , cleanrooms:UntagResource , and cleanrooms:TagResource . For more information, see AWS managed policies .	March 21, 2023
General availability	AWS Clean Rooms is now generally available.	March 21, 2023
Preview release	Preview release of the AWS Clean Rooms User Guide	January 12, 2023

AWS Clean Rooms Glossary

Consult this glossary to become familiar with terminology that is used for AWS Clean Rooms.

Aggregation analysis rule

The query restriction that allows queries that aggregate analysis using COUNT, SUM, or AVG functions along optional dimensions. These queries won't reveal row-level information.

Supports use cases such as campaign planning, media reach, frequency, and conversion measurement.

Other types of analysis rules are [custom](#) and [list](#).

Analysis rules

The query restrictions that authorize a specific type of query.

The analysis rule type determines what kind of analysis can be run on the configured table. Each type has a predefined query structure. You control how your table columns can be used in the structure through the query controls.

The types of analysis rules are [aggregation](#), [list](#), and [custom](#).

Analysis template

A collaboration-specific, pre-approved query that can be reused.

Supported formats: SQL code or Python code for Spark.

If using SQL, the analysis template can contain parameters wherever a literal value could typically appear in a SQL query. For more information about supported parameter types, see [Data types](#) in the *AWS Clean Rooms SQL Reference*.

Analysis templates only work with the [custom analysis rule](#).

AWS Clean Rooms SQL analytics engine

A built-in query processing system within AWS Clean Rooms that allows users to query data stored in Amazon S3 using SQL functions supported by AWS Clean Rooms. It supports various

data formats and provides capabilities for running SQL queries on collaborative datasets while maintaining data privacy and control, including features like differential privacy. This engine is tailored for AWS Clean Rooms use cases, offering a balance of SQL functionality, data privacy features, and integration with other AWS Clean Rooms capabilities, making it suitable for users who don't require the advanced capabilities or scale of the [Spark SQL analytics engine](#).

When you create a collaboration using the [CreateCollaboration API](#), the value of the AWS Clean Rooms SQL analytics engine is `CLEAN_ROOMS_SQL`.

C3R encryption client

The Cryptographic Computing for Clean Rooms (C3R) encryption client.

Used to encrypt and decrypt data, C3R is a client-side encryption SDK with a command line interface.

Cleartext column

A column that isn't cryptographically protected for either a JOIN or SELECT SQL construct.

Cleartext columns can be used in any part of the SQL query.

Collaboration

A secure logical boundary in AWS Clean Rooms in which members can perform SQL queries on configured tables.

Collaborations are created by the [collaboration creator](#).

Only members who have been invited to the collaboration can join the collaboration.

A collaboration can have only one [member who can query](#) data or one [member who can run queries and jobs](#).

A collaboration can have only one [member who can receive results](#).

A collaboration can have only one [member paying for query compute costs](#) or one [member paying for query and job compute costs](#).

All members can see the list of invited participants in the collaboration before they join the collaboration.

Collaboration creator

The member who creates a collaboration.

There is only one collaboration creator per collaboration.

Only the collaboration creator can remove members from the collaboration or delete the collaboration.

Configured table

Each configured table represents a reference to an existing table in the AWS Glue Data Catalog that has been configured for use in AWS Clean Rooms. A configured table contains an analysis rule that determines how the data can be used.

Currently, AWS Clean Rooms supports associating data stored in Amazon Simple Storage Service (Amazon S3) that is cataloged through AWS Glue.

For more information about AWS Glue, see the [AWS Glue Developer Guide](#).

Configured tables can be associated to one or more collaborations.

Note

AWS Clean Rooms doesn't currently support Amazon S3 bucket locations that are registered with AWS Lake Formation.

Custom analysis rule

The query restriction that allows a specific set of pre-approved queries ([analysis templates](#)) or allows a specific set of accounts that can provide queries or jobs that use your data.

Supports use cases such as first-touch attribution, incremental analyses, and audience discovery analyses.

Supports differential privacy.

Other types of analysis rules are [aggregation](#) and [list](#).

Decryption

The process of transforming encrypted data back to its original form. Decryption can only be performed if you have access to the secret key.

Differential privacy

A mathematically-rigorous technique that protects the collaboration data from the member who can receive results learning about a specific individual.

Encryption

The process of encoding data into a form that appears random using a secret value called a key. It's impossible to determine the original plaintext without access to the key.

Fingerprint column

A column that is cryptographically protected for a JOIN SQL construct.

ID mapping workflow method

How you want the ID mapping to be performed.

There are two ID mapping workflow methods:

- Rule-based ID mapping – The method by which you use matching rules to translate first-party data from a source to a target in an ID mapping workflow.
- Provider services ID mapping – The method by which you use a provider service to translate third party-encoded data from a source to a target in an ID mapping workflow.

AWS Clean Rooms currently supports LiveRamp as the provider services-based ID mapping workflow method. You must have a subscription to LiveRamp through AWS Data Exchange to use this method. For more information, see [Subscribe to a provider service on AWS Data Exchange](#) in the *AWS Entity Resolution User Guide*.

ID mapping table

A resource in AWS Clean Rooms that enables either first-party matching rules or multi-party identity transcoding in a collaboration.

A ID mapping table is a reference to an existing table in the AWS Glue Data Catalog. It contains an [ID mapping table analysis rule](#) that determines how the data can be queried in AWS Clean Rooms. ID mapping tables can be associated to one or more collaborations.

ID mapping table analysis rule

A type of analysis rule managed by AWS Clean Rooms and used to join disparate identity data to facilitate querying. It's automatically added to [ID mapping tables](#) and can't be edited. It inherits the behaviors of the other analysis rules in the collaboration – as long as those analysis rules are homogeneous.

ID mapping workflow

A data processing job that maps data from a source to a target based on the specified [ID mapping workflow method](#). It produces an [ID mapping table](#).

ID namespace

A resource in AWS Clean Rooms that contains metadata explaining datasets across multiple AWS accounts and how to use these datasets in an [ID mapping workflow](#).

ID namespace association

An association of an ID namespace resource that helps you discover inputs into their [ID mapping workflow](#).

Job

A method to access and analyze configured tables in a collaboration using a supported set of functions, classes, and variables.

AWS Clean Rooms currently supports the PySpark job type.

AWS Clean Rooms currently supports running jobs using a PySpark analysis template.

List analysis rule

The query restriction that allows queries that output row-level attribute analysis of the overlap between this table and the tables of the member who can query.

Supports use cases such as enrichment and audience building or suppression.

Other types of analysis rules are [aggregation](#) and [custom](#).

Lookalike model

A model of a training data provider's data that allows a seed data provider to create a [lookalike segment](#) of training data provider's data that most closely resembles their [seed data](#).

Lookalike segment

A subset of the training data that most closely resembles the [seed data](#).

Member

An AWS customer who is a participant in a [collaboration](#).

A member is identified using their AWS account.

All members can contribute data.

Member who can query

The member who can query data in the [collaboration](#).

There is only one member who can query per collaboration, and that member is immutable.

An administrative user can use AWS Identity and Access Management (IAM) permissions to control which of their IAM principals (such as users or roles) can query data in the collaboration. For more information, see [Create a service role to read data from Amazon S3](#).

Member who can run queries and jobs

The member who can run queries and jobs on the data in the [collaboration](#).

There is only one member who can run queries and jobs per collaboration, and that member is immutable.

An administrative user can use AWS Identity and Access Management (IAM) permissions to control which of their IAM principals (such as users or roles) can run queries and jobs in the collaboration. For more information, see [Create a service role to read data from Amazon S3](#).

Member who can receive results

A member who can receive query results. A member who can receive results specifies query results settings for the Amazon S3 destination and the query result format (CSV or Parquet).

For analyses with the Spark analytics engine, a member who can receive results also specifies whether files should be output as a single file or as multiple files.

There can be more than one member who can receive results in a collaboration.

Member paying for query compute costs

The member who is responsible for paying for query compute costs.

There is only one member who is responsible for paying for query compute costs per collaboration, and that member is immutable.

If the collaboration creator hasn't specified anyone as the member paying for query compute costs, then the [member who can query](#) is the default payer.

The member paying for query compute costs receives a bill for the queries that have been run in the collaboration.

Member paying for query and job compute costs

The member who is responsible for paying for query and job compute costs.

There is only one member who is responsible for paying for query and job compute costs per collaboration, and that member is immutable.

If the collaboration creator hasn't specified anyone as the member paying for query and job compute costs, then the [member who can query](#) is the default payer.

The member paying for query and job compute costs receives a bill for the queries that have been run in the collaboration.

Membership

A resource created when a [member](#) joins a [collaboration](#).

All resources that the member associates to a collaboration are a part of the membership or are associated with the membership.

Only the member that owns the membership can add, remove, or edit resources in that membership.

Sealed column

A column that is cryptographically protected for a SELECT SQL construct.

Seed data

The seed data provider's data, which is used to create a [lookalike segment](#). The seed data can be provided directly or it can come from the results of an AWS Clean Rooms query. The lookalike segment output is a set of users from the training data that most closely resembles the seed users.

Spark analytics engine

An analytics option in AWS Clean Rooms that enables customers to run complex queries on large datasets stored in Amazon S3, Amazon Athena, or Snowflake using Apache Spark SQL functions. It serves as an alternative to the [AWS Clean Rooms SQL analytics engine](#), and also supports PySpark analysis in AWS Clean Rooms.

When you create a collaboration using the [CreateCollaboration API](#), the value of the Spark analytics engine is SPARK.

Query

A method to access and analyze configured tables in a collaboration, using a supported set of functions, classes, and variables.

AWS Clean Rooms currently supports the SQL query language.

AWS Clean Rooms currently supports running direct SQL queries or running queries using a SQL analysis template.