

PUBLIC
2026-02-20

SAP HANA Automated Predictive Library Installation Guide

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Content

1 SAP HANA Automated Predictive Library Installation Guide. 3

1.1 Basic Requirements. 4

2 Download the SAP HANA APL Software Package. 6

2.1 Package Contents. 6

2.2 Delivery Unit. 9

3 Installing SAP HANA APL. 11

3.1 Install SAP HANA APL Using the GUI. 12

3.2 Install SAP HANA APL Using the Command Line. 12

4 Running Admin Scripts. 14

4.1 Start the SAP HANA Script Server. 14

4.2 Check the Installation. 15

4.3 Grant User Privileges. 16

5 Sample Code and Datasets. 18

5.1 Importing Sample Datasets. 18

5.2 Sample Code Call Techniques. 19

6 Managing the Cache. 20

6.1 Grant Privileges to Use the Cache. 20

6.2 Customize the Cache Schema. 21

6.3 Purge the Cache. 21

7 Activate the Traces. 22

8 Audit SAP HANA APL. 23

9 Upgrade SAP HANA APL. 24

10 Uninstall SAP HANA APL. 25

1 SAP HANA Automated Predictive Library Installation Guide

This guide describes how to install the SAP HANA Automated Predictive Library (APL) on the SAP HANA database server using the resident version of the SAP HANA Lifecycle Management tools.

> **Note**
>
> This guide is not relevant for SAP HANA Cloud. For information about setting up the SAP HANA Automated Predictive Library (APL) in SAP HANA Cloud, see Using the Machine Learning Libraries (APL and PAL) in SAP HANA Cloud.

This guide includes the following:

- An installation section about downloading the SAP HANA APL software package and installing SAP HANA APL on the SAP HANA database server.
- Information about performing the configuration and administration tasks necessary before using the SAP HANA APL function library.
- Additional setup information, such as importing sample datasets and setting up the cache, traces, and auditing.
- Procedures for upgrading and uninstalling SAP HANA APL.

Related Information

Download the SAP HANA APL Software Package [page 6]
Installing SAP HANA APL [page 11]
Running Admin Scripts [page 14]
Administrator and Developer Tasks
Blog: Installing the Automated Predictive Library (APL) on SAP HANA Express 2.0

1.1 Basic Requirements

Before installing SAP HANA APL, make sure your SAP HANA system meets the basic requirements, including the supported SAP HANA versions based on your hardware platform, Linux operating system, disk space, memory requirement, and root privileges.

Software Requirements

The following table contains supported SAP HANA versions based on your hardware platform.

Supported Platform	Supported SAP HANA Versions
Linux or Intel	SAP HANA 2.0 SPS03 SAP HANA 2.0 SPS04 SAP HANA 2.0 SPS05 SAP HANA 2.0 SPS06 SAP HANA 2.0 SPS07 SAP HANA 2.0 Express Edition
Linux or IBM Power Systems (little endian)	SAP HANA 2.0 SPS03 SAP HANA 2.0 SPS04 SAP HANA 2.0 SPS05 SAP HANA 2.0 SPS06 SAP HANA 2.0 SPS07

> **Note**
>
> The version of your SAP HANA **resident** lifecycle management tool, `hdblcm`, must be the same as the version of your SAP HANA server.

Environment Requirements

Adhere to the following environment requirements:

- Linux operating system
- 35 MB of disk space
- Memory requirement: The memory requirement of an SAP HANA database depends on the size of the datasets and the number of concurrent users. The minimum requirement is 64 GB of memory.

User Requirements

You must have root privileges (sudo) to run the installer.

Sizing Information

The properties of the datasets and the type of predictive models used influence the performance of SAP HANA APL. For detailed sizing information, see Sizing SAP Automated Analytics, APL Version 3.1. This guide is also valid for later versions (3.2, 3.3, 18xx, 19xx, and 20xx).

2 Download the SAP HANA APL Software Package

The SAP HANA APL installation package is available for download from the SAP Software Download Center.

1. Log on to the SAP Software Download Center.
2. On the *Software Downloads* page, click *Software Downloads in SAP for Me*.

   The *Download Software* page opens.
3. In the *Search in Software Downloads* search field, enter **SAP HANA APL** to search for the APL package.
4. In the *Software Categories* section of the result list, choose the category *APL 4 FOR HANA 2 SP03+*.

   The *APL 4 FOR HANA 2 SP03+ (SUPPORT PACKAGES AND PATCHES)* page opens.
5. On the *DOWNLOADS* tab, choose *SUPPORT PACKAGE PATCHES*.

   The APL packages available for download are listed.
6. Select the package of your choice and choose *(Add selected items to download basket)*.
7. Choose *Download Basket*.

   The *DOWNLOAD BASKET* tab opens.
8. On the *DOWNLOAD BASKET* tab, click the file name to download the ZIP file.
9. To extract the downloaded installation package, run the following command:

```
unzip <file_name>.ZIP
```

Related Information

Installing SAP HANA APL [page 11]

2.1 Package Contents

The SAP HANA APL package includes an installer folder and a samples folder.

Installer Folder

The installer folder contains the SAP HANA APL setup program, which deploys the function library on an SAP HANA instance.

The setup performs the following tasks with the installer folder:

- Installs the function library in the appropriate SAP HANA folder.
- Deploys a delivery unit.

Samples Folder

Datasets and Scripts

The samples folder contains datasets and scripts to use with the functions from the installer folder.

> **Note**
>
> The content of the samples folder is also available in the SAP HANA APL GitHub Repository .

The following table describes the sample datasets and scripts contained in the samples folder.

Folder	Content
`samples/data/index/APL_SAMPLES`	Sample datasets that you import into SAP HANA. The datasets are ordered alphabetically by the first two letters of the sample name. **Note** The SQL scripts require that you use these datasets.
`samples/sql/direct`	SQL scripts that show how to call the functions through regular AFL wrappers: • `apl_admin.sql` Turns on the SAP HANA script server, checks the installation status, creates a sample user, and sets the user privileges. • `apl_create_table_types.sql` Creates the table types expected by the function library and used by the samples. The table types are for the sample APL user. • `apl_samples`, `apl_scenarii`, and `apl_formats` Scripts that show how to use the functions. Most of these sample scripts rely on the provided sample datasets. • `apl_insurance_fraud` Sample scripts demonstrating a typical use case. See Sample Use Case: Predicting Auto Insurance Fraud.

Folder	Content
`samples/sql/procedure`	SQL scripts that show how to call the functions through the stored procedures of the delivery unit: • `apl_admin_ex.sql` Similar to `apl_admin.sql`, with additions related to stored procedures, including cache schema. • `apl_samples` Subset of samples adapted to leverage the stored procedures. • `apl_insurance_fraud` Sample scripts demonstrating a typical use case and adapted to stored procedures. • `apl_enable_scriptserver.sql` Turns on the SAP HANA script server in MDC environments. • `check_apl_install.sql` Checks that SAP HANA APL functions respond correctly.
`samples/sql/any`	SQL scripts that show how to call the functions as an ANY procedure: • `apl_admin_ex.sql` Similar to `apl_admin.sql`, with additions related to stored procedures, including cache schema. • `apl_samples` Subset of samples adapted to leverage the ANY procedure.

Samples/Runtimes Folder

The `samples/runtimes` folder contains reference implementations of the runtime files that execute some code types exported by SAP HANA APL.

The following table contains a simplified overview of the structure of the `samples/runtimes` folder.

Folder	Content
`samples/runtimes/cpp`	Source files of the C++ runtime: `Sample` A full sample of a scoring executable using exported C++ code and a C++ runtime.
`samples/runtimes/java`	Java runtime and a sample of exported Java code: • `KxJRT.jar` Compiled Java runtime. • Javadoc Documentation of the Java runtime (`KxJRT.jar`). • `src` Source files of the Java runtime.
`samples/runtimes/javascript`	Source files of the JavaScript runtime.

Related Information

Download the SAP HANA APL Software Package [page 6]
SAP HANA APL GitHub Repository - Samples and Runtimes

2.2 Delivery Unit

The HCO_PA_APL delivery unit is included in the SAP HANA APL package and is deployed automatically when you run setup. The purpose of this delivery unit is to improve the usability of the function library and provide performance enhancements.

Improved usability of the function library and performance enhancements are achieved through SQL stored procedures. The SQL stored procedures provide the same API as the library but hide the complexity of the regular Application Function Library (AFL) call mechanism. The delivery unit also manages the lifecycle of transient database objects by implementing a cache in the database.

Characteristics

The following table lists the characteristics of the HCO_PA_APL delivery unit.

Name	HCO_PA_APL
Main Root Schema	SAP_PA_APL
Main Root Package Name	sap.pa.apl

Contents

The HCO_PA_APL delivery unit contains the following items:

- Stored procedures that provide easier access to the API and implement a cache.
- Table types required by the stored procedures.
- Database role to use to grant the appropriate privileges to users.

Database Role

The database role, sap.pa.apl.base.roles::APL_EXECUTE, grants privileges for the following tasks:

- Execute the stored procedures.

- Execute the functions.
- Read and write to the root schema.

3 Installing SAP HANA APL

You install SAP HANA APL on the SAP HANA database server using the SAP HANA resident lifecycle management tool `hdblcm` or `hdblcmgui`.

The installation process does the following:

- Stops the SAP HANA database.
- Installs SAP HANA APL.
- Restarts the SAP HANA database.
- Deploys the delivery unit.

Prerequisites

Before you install SAP HANA APL, ensure that you comply with the following requirements:

- Install SAP HANA APL on Linux only.
- You have root privileges (sudo) to run the installer.
- You use the SAP HANA **resident** lifecycle management tool `hdblcm` or `hdblcmgui`, which is located at `<SAP_HANA_install_dir>/<SID>/hdblcm/`.
  The following code snippet shows a typical `hdblcm` command line:

  ```
  /hana/shared/HA0/hdblcm/hdblcm --action=update_components --component_dirs=
  <path of APL installer>
  ```

  > ⚠ Caution
  >
  > Do not use the `hdbinst` installer directly.

Related Information

Download the SAP HANA APL Software Package [page 6]

3.1 Install SAP HANA APL Using the GUI

You can install SAP HANA APL on the SAP HANA database server using the SAP HANA resident lifecycle management tool `hdblcmgui`.

1. Start the graphical user interface of the SAP HANA Lifecycle Management tool:

   ```
   ./hdblcmgui
   ```

2. Select *Install or Update Additional Components* and then click *Next*.
3. Click *Add Software Locations* and browse to the `apl<version>/installer/` folder.
4. Select the SAP HANA APL that appears in the list of components and click *Next*.
5. Check *Install Automated Predictive Library*.
6. When prompted, enter the system administrator password, the database user name, and password, and then click *Next*.
7. Click *Update* after confirming that the summary is correct.

Restart your SAP HANA database instance.

3.2 Install SAP HANA APL Using the Command Line

You can install SAP HANA APL on the SAP HANA database server using the SAP HANA resident lifecycle management tool `hdblcm`.

Choose an installation mode:

Option	Description
Interactive Mode	1. Run the following command: `./hdblcm --action=update_components --component_dirs=<Extracted_APL_folder_path>/installer` 2. Follow the instructions on screen.

Batch Mode	1. Run the following command to generate a template configuration file if necessary:
	`./hdblcm --dump_configfile_template=<Template_file_path>`
	2. Open the file for editing and make the following entries:
	`action=update_components`
	`component_dir=<Extracted_APL_folder_path>/installer`
	`components=sap_afl_sdk_apl`
	`password=<System_administrator_password>`
	`system_user=<Database_user_name> (default: SYSTEM)`
	`system_user_password=<Database_user_password>`
	Also edit any other fields that are necessary for the configuration.

Option	Description
	3. Run the following command to start the installation: `./hdblcm --batch --configfile=<Template_file_path>`

Restart your SAP HANA database instance.

4 Running Admin Scripts

SAP HANA APL comes with scripts that perform the configuration and administration tasks required before using the function library.

Run the scripts listed below for the techniques that you want to apply to use the functions:

Technique	Script	Description
Direct	samples/sql/direct/apl_admin.sql	The script does the following: • Starts the SAP HANA script server • Checks the installation • Creates an SAP HANA user • Grants privileges to create, execute, and delete the AFL wrappers
Stored procedure	samples/sql/procedure/apl_admin_ex.sql	The script does the following: • Starts the SAP HANA script server • Checks the installation • Creates an SAP HANA user • Creates the cache • Grants privileges to use the stored procedures and the cache • Purges the cache
ANY	samples/sql/any/apl_admin_ex.sql	

The topics in this section describe the individual tasks and the SQL statements that can be used.

Related Information

SAP HANA APL GitHub Repository - Samples and Runtimes

4.1 Start the SAP HANA Script Server

You must have at least one SAP HANA script server instance running on the database where the function library is installed.

Run the following SQL statement as the SYSTEM user in the system database:

```
ALTER DATABASE <DBID> ADD 'scriptserver';
```

`<DBID>` is the ID of the tenant server on which the script server will be started.

You can also start the SAP HANA script server from the SAP HANA cockpit.

Related Information

Add Services in a Tenant Database (SAP HANA Cockpit)

4.2 Check the Installation

Verify that the SAP HANA APL function library has been installed successfully.

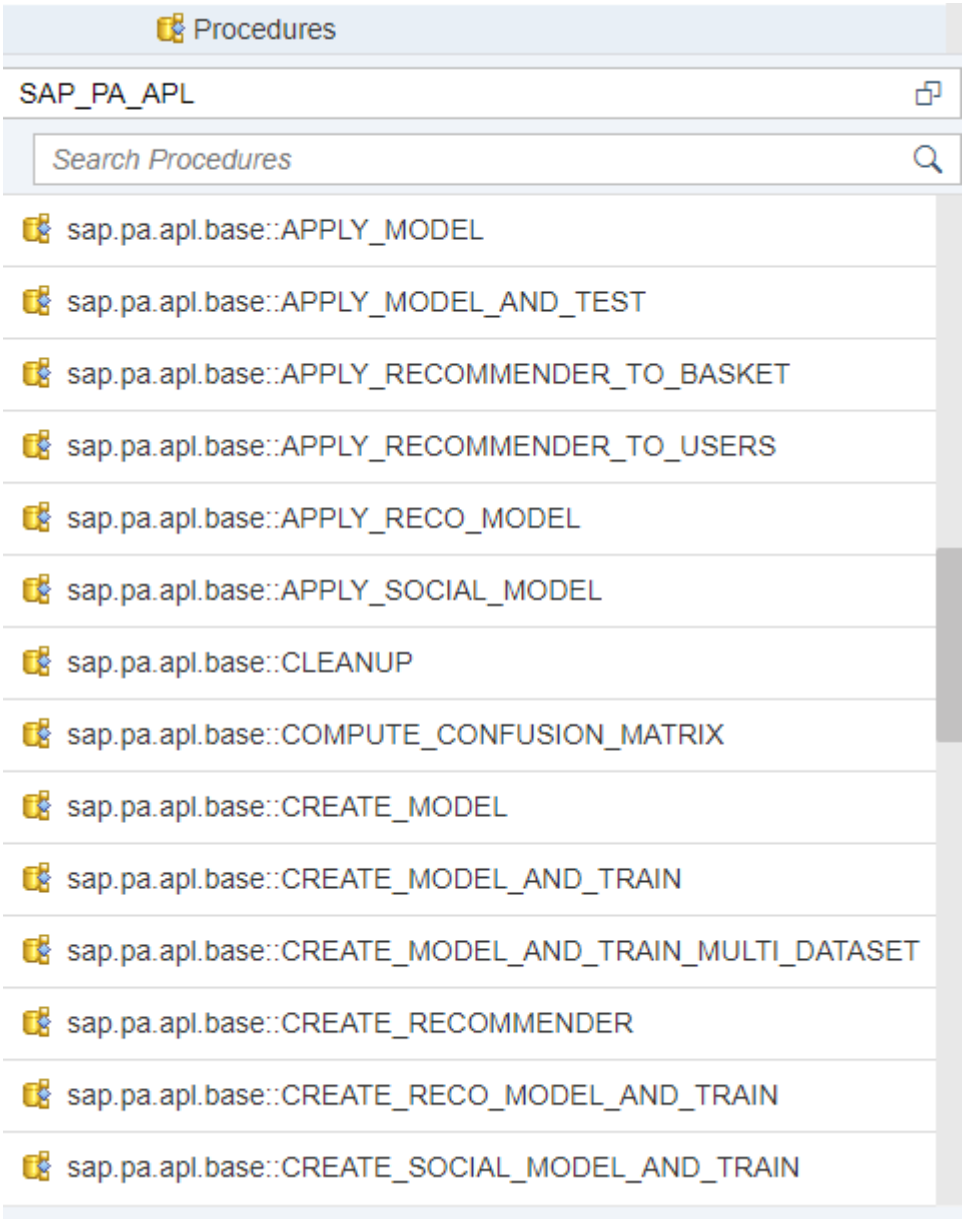
To confirm that the APL functions were installed successfully, you can check the following public views:

- `sys.afl_areas`
- `sys.afl_packages`
- `sys.afl_functions`

1. Run the following SQL statements to check that the views contain SAP HANA APL entries:

```
-- check the APL functions are there
select * from "SYS"."AFL_AREAS";
select * from "SYS"."AFL_PACKAGES";
select * from "SYS"."AFL_FUNCTIONS" where AREA_NAME='APL_AREA';
select "F"."SCHEMA_NAME", "A"."AREA_NAME", "F"."FUNCTION_NAME",
"F"."NO_INPUT_PARAMS", "F"."NO_OUTPUT_PARAMS", "F"."FUNCTION_TYPE",
"F"."BUSINESS_CATEGORY_NAME"
from "SYS"."AFL_FUNCTIONS_" F,"SYS"."AFL_AREAS" A
where "A"."AREA_NAME"='APL_AREA' and "A"."AREA_OID" = "F"."AREA_OID";
select * from "SYS"."AFL_FUNCTION_PARAMETERS" where AREA_NAME='APL_AREA';
```

   The result will indicate whether the APL functions were successfully installed on your system.
2. To verify that the APL stored procedures were installed, open the SAP_PA_APL schema in the SAP HANA Catalog, as shown below:



4.3 Grant User Privileges

Grant the privileges required to work with the SAP HANA APL function library.

Like other application function libraries (AFLs), SAP HANA APL includes database roles that grant the privileges needed to run the APL functions through the direct technique:

- `AFLPM_CREATOR_ERASER_EXECUTE` to create and delete the AFL wrappers
- `AFL__SYS_AFL_APL_AREA_EXECUTE` to run the AFL wrappers

The delivery unit HCO_PA_APL provides the `sap.pa.apl.base.roles::APL_EXECUTE` database role, which grants privileges to do the following:

- Execute the stored procedures
- Read and write to their root schema
- Use the cache
- Execute the functions

Run the following commands to grant the roles to a user, replacing `USER_APL` with the appropriate SAP HANA user name:

- For SAP HANA on premise:
  - For the direct technique:

    ```
    grant AFL__SYS_AFL_APL_AREA_EXECUTE to USER_APL;
    grant AFLPM_CREATOR_ERASER_EXECUTE to USER_APL;
    ```

  - For the procedure technique:

    ```
    call _SYS_REPO.GRANT_ACTIVATED_ROLE ('sap.pa.apl.base.roles::APL_EXECUTE',
    'USER_APL');
    ```

- For SAP HANA Cloud, SAP HANA database:

  ```
  GRANT "sap.pa.apl.base.roles::APL_EXECUTE" TO USER_APL
  ```

Related Information

Grant Privileges to Use the Cache [page 20]

5 Sample Code and Datasets

When you install SAP HANA APL, the installer provides code and dataset samples to demonstrate the use of APL functions.

SAP HANA On Premise

After installation, find the sample code and datasets in the following locations:

- `<APL_Install_folder>/samples/data/<index of sample datasets>`
- `<APL_Install_folder>/sample scripts`

SAP HANA Cloud

After installation, find the APL samples and runtimes in the SAP HANA APL GitHub Repository .

> **Note**
>
> The examples in the Function Reference (*SAP HANA Automated Predictive Library Developer Guide*) require the sample datasets.

Prerequisites

Before you use the sample code and datasets, ensure that you perform the following tasks:

- Import the sample datasets into SAP HANA tables. For instructions, see Import Data into a New or Existing Table, in the *SAP HANA Database Explorer*.
- To use the direct technique for the code samples, run the following helper file: `sql/direct/apl_create_table_types.sql`. For details, see Creating Table Types in the *SAP HANA Automated Predictive Library Developer Guide*.

5.1 Importing Sample Datasets

Before you use the APL functions with sample code, you must first import the sample datasets into SAP HANA tables.

The sample datasets are in `<APL_Install_folder>/samples/data/<index of sample datasets>` or in the SAP HANA APL GitHub Repository .

After importing, ensure that you have *read* access to the dataset schema named `APL_SAMPLES`. To gain *read* access, use the following code:

```
GRANT SELECT ONSCHEMA "APL_SAMPLES" TO <USER_NAME>
```

For information about importing data using SAP HANA database explorer, see Import Data into a New or Existing Table.

5.2 Sample Code Call Techniques

Use the direct, procedure, or ANY technique to call SAP HANA APL functions. See the *SAP HANA Automated Predictive Library Developer Guide* for details.

> **Note**
>
> Before you use the sample code, you must import the sample datasets into your SAP HANA tables.

The following table provides a brief description of each technique.

Technique	Description
Direct	Insert the APL function into an AFL wrapper. To call the function, invoke the wrapper. **Note** Before you use sample code using the direct technique, you must first run the file `sql/direct/apl_create_table_types.sql` to create all necessary types. For details, see Creating Table Types.
Procedure	Use the stored procedures and table types provided by the SAP HANA APL installer in the `sap.pa.apl` package.
ANY procedure	Call any APL function as an `ANY AFLLANG` procedure from the `_SYS_AFL` schema (SAP HANA 2.0 SPS03 or higher). Call APL functions without managing wrappers.

Related Information

Working with SAP HANA APL Functions
Calling a Function with the Direct Technique
Calling a Function with the Procedure Technique
Calling a Function as an ANY Procedure

6 Managing the Cache

The procedure technique, provided by the APL delivery unit, allows you to call APL functions without managing the life cycle of AFL wrappers. The procedure technique also provides a cache mechanism, which enhances performance by storing and reusing transient database objects and creating and deleting database objects.

The cache mechanism manages the following database objects:

- Generated AFL wrappers.
- Nonfixed table types related to the input and output datasets. Nonfixed table types depend on the use case and workflow, such as training datasets, apply-in datasets, and apply-out datasets.

The default schema for this cache is SAP_PA_APL, which is created by the APL installer. You can browse and purge the contents of this cache.

Related Information

Delivery Unit [page 9]
Calling a Function with the Procedure Technique

6.1 Grant Privileges to Use the Cache

The cache is based on the SAP_PA_APL default database schema. The appropriate privilege to use this cache and schema is part of the role `sap.pa.apl.base.roles::APL_EXECUTE`. Therefore, every function consumer that needs to leverage the stored procedures must be granted this privilege.

Run the following procedure, replacing `<APL_user>` with the appropriate user name:

- For SAP HANA on premise:

```
call _SYS_REPO.GRANT_ACTIVATED_ROLE
('sap.pa.apl.base.roles::APL_EXECUTE','<APL_user>');
```

- For SAP HANA Cloud, SAP HANA database:

```
GRANT "sap.pa.apl.base.roles::APL_EXECUTE" TO USER_APL
```

6.2 Customize the Cache Schema

Whether you have one or multiple technical users calling APL functions, they use the same APL cache. To enhance security and allow closer management of the APL cache, create a customized APL cache schema for each user.

Customize the cache schema by setting the session variable `APL_CACHE_SCHEMA`. Then assign the applicable privilege to each technical user and their individual APL cache schema.

To customize the APL cache schema, run the following commands:

```
-- We customize the APL cache to be stored in schema named 'APL_CACHE', and the
appropriate privilege needs to be set for the <APL_user> user.
drop SCHEMA "APL_CACHE";
create SCHEMA "APL_CACHE";
grant create any on SCHEMA "APL_CACHE" to <APL_user>;

-- Set the custom place cache for the APL cache for each SQL session
connect <APL_user> password <password>;
SET SESSION 'APL_CACHE_SCHEMA' = 'APL_CACHE';
```

6.3 Purge the Cache

You must purge the cache regularly because its size increases whenever new types of datasets are used. You also need to purge the cache after reinstalling or upgrading SAP HANA APL.

Run the following procedure:

```
call "SAP_PA_APL"."sap.pa.apl.base::CLEANUP"(1,?);
```

> **Note**
>
> To browse the cache, call the stored procedure `sap.pa.apl.base::CLEANUP` as above but set the parameter to `0`.

Related Information

Upgrade SAP HANA APL [page 24]

7 Activate the Traces

SAP HANA APL logs its activity in the SAP HANA traces. You need to enable the trace for the AFLX component, which is the common tracing component for all Application Function Library (AFL) software development kit (SDK) libraries available in SAP HANA.

To configure tracing, you must have the TRACE ADMIN system privilege.

You can enable the trace in the SAP HANA database explorer.

1. Open the SAP HANA database explorer.
2. Select your database and from the context menu choose *Trace Configuration*.
3. Click *Edit* in the *Database Trace* section.
   The *Database Trace Configuration* dialog box opens.
4. Enter **AFLX** for the component name and choose *Search*.

   The AFLX component should appear for INDEXSERVER and SCRIPTSERVER.
5. Set the tracing level according to your needs.

   > ### Note
   >
   > The DEBUG level can be extremely verbose when the function library is performing training operations. It should be enabled only for troubleshooting issues.

The new tracing level will now be used when functions are executed. You do not need to restart the database.

Related Information

Configure Tracing in the SAP HANA Database Explorer

8 Audit SAP HANA APL

You can use SAP HANA audit policies to audit and log the usage of SAP HANA APL functions.

- You have the system privilege AUDIT ADMIN.
- You have enabled auditing in SAP HANA.

Use the CREATE AUDIT POLICY statement to create a new policy. For example, the following policy audits all executions (successful and unsuccessful) of the audit action EXECUTE on the specified target objects CREATE_MODEL_AND_TRAIN, TRAIN_MODEL, and RETRAIN_MODEL:

```
CREATE AUDIT POLICY my_apl_audit_train
AUDITING ALL
EXECUTE ON
    "SAP_PA_APL"."sap.pa.apl.base::CREATE_MODEL_AND_TRAIN",
    "SAP_PA_APL"."sap.pa.apl.base::TRAIN_MODEL",
    "SAP_PA_APL"."sap.pa.apl.base::RETRAIN_MODEL"
LEVEL INFO
```

For a list of APL functions that you can audit, see Function Availability.

> **Note**
>
> You can also create an audit policy using the SAP HANA cockpit.

The SAP HANA APL training functions are logged. You can view the logs in *Catalog* > *Public Synonyms* > *ALL_AUDIT_LOG*.

Related Information

Function Availability
Activate and Configure Auditing (SAP HANA Platform)
Create an Audit Policy (SAP HANA Platform)
Creating an Audit Policy (SAP HANA Cloud, SAP HANA Database)
CREATE AUDIT POLICY Statement (Access Control)

9 Upgrade SAP HANA APL

To upgrade the SAP HANA APL function library, you repeat the installation procedure.

As in the initial installation, the installation process does the following:

- Stops the SAP HANA database
- Installs SAP HANA APL
- Restarts the SAP HANA database
- Deploys and upgrades the delivery unit

1. Use the SAP HANA Lifecycle Management tool `hdblcm` or `hdblcmgui` to install SAP HANA APL.

   > ⓘ Note
   >
   > To directly upgrade from a version prior to 1903 (for SAP HANA 2+), you must add the parameter `--ignore=check_version`. This is due to a change to the software component version of SAP HANA APL 1903. If you do not use the parameter, you must uninstall and reinstall instead.

2. Purge the cache after the reinstallation or upgrade.

Related Information

Installing SAP HANA APL [page 11]
Purge the Cache [page 21]

10 Uninstall SAP HANA APL

To completely uninstall SAP HANA APL, you need to uninstall the APL function library and delete the delivery unit.

1. Use the SAP HANA resident lifecycle management tool `hdblcm` or `hdblcmgui` to uninstall the APL function library. Run the following command:

   ```
   ./hdblcm --uninstall
   ```

   The library has now been uninstalled, but not the `HCO_PA_APL` delivery unit.
2. Delete the delivery unit using the application lifecycle management tool:
   a. Open the application lifecycle management tool:

      `http://<WebServerHost>:80<SAPHANAinstance>/sap/hana/xs/lm`

      In SAP HANA studio, you can also right-click your SAP HANA instance and choose *Lifecycle management* > *Application lifecycle management* > *Home*.
   b. Log in as the **SYSTEM** user.
   c. Click *Delivery Units*.
   d. Select *HCO_PA_APL*.
   e. Click *Delete* and check *Including objects and packages*.

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