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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 Installing SAP HANA APL. 6

2.1 Download the SAP HANA APL Software Package. 6

Package Contents. 7

Delivery Unit. 9

2.2 Install SAP HANA APL Using the GUI. 10

2.3 Install SAP HANA APL Using the Command Line. 11

3 Running Admin Scripts. 12

3.1 Start the SAP HANA Script Server. 12

3.2 Check the Installation. 13

3.3 Grant User Privileges. 14

4 Importing Sample Datasets. 16

5 Managing the Cache. 17

5.1 Grant Privileges to Use the Cache. 17

5.2 Customize the Cache Schema. 18

5.3 Purge the Cache. 18

6 Activate the Traces. 19

7 Audit SAP HANA APL. 20

8 Upgrade SAP HANA APL. 21

9 Uninstall SAP HANA APL. 22

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 (LCM) tools.

> **i 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 how to download the SAP HANA APL software package and install SAP HANA APL on the SAP HANA database server
- Information about how to perform 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 uprading und uninstalling SAP HANA APL

Related Information

Installing SAP HANA APL [page 6]
Running Admin Scripts [page 12]
Administrator and Developer Tasks
Blog: Installing the Automated Predictive Library (APL) on SAP HANA Express 2.0

1.1 Basic Requirements

Before you install SAP HANA APL, review the basic requirements that apply to your SAP HANA system.

Software Requirements

The following SAP HANA versions are supported depending on your hardware platform:

Supported Platform	Supported SAP HANA Versions
Linux / 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 Express Edition
Linux / 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

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

Environment Requirements

- Linux operating system
- ~35 MB of disk space
- 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 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

- You can install SAP HANA APL on Linux only.
- You must have root privileges (sudo) to run the installer.
- Make sure that you use the SAP HANA **resident** lifecycle management tool `hdblcm` or `hdblcmgui`. It is located at `<SAP_HANA_install_dir>/<SID>/hdblcm/`.
  A typical `hdblcm` command line looks like this:

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

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

2.1 Download the SAP HANA APL Software Package

Download and decompress the ZIP file of your choice.

1. Log on to the SAP Software Download Center and click *Access downloads*.
2. Find the installation package by searching directly for **`APL`**.
3. Select and download the package of your choice.
4. Run the following command to extract the package:

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

Related Information

Package Contents [page 7]
Delivery Unit [page 9]

2.1.1 Package Contents

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

Installer Folder

This folder contains the SAP HANA APL setup program, which is used to deploy the function library on an SAP HANA instance.

The setup does the following:

- Installs the function library in the appropriate SAP HANA folder
- Automatically deploys a delivery unit

Samples Folder

The `samples` folder contains the following sample datasets and scripts:

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

Folder	Content
`samples/data/index/APL_SAMPLES`	Contains sample datasets that you can import into SAP HANA. They are ordered alphabetically by the first two letters of the sample name. **i Note** The SQL scripts require the use of these datasets.

Folder	Content
`samples/sql/direct`	Contains SQL scripts that show how to call the functions through regular AFL wrappers • `apl_admin.sql` Enables 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 created for the sample APL user. • `apl_samples`, `apl_scenarii`, and `apl_formats` Various 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.
`samples/sql/procedure`	Contains 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` Enables the SAP HANA script server in MDC environments • `check_apl_install.sql` Checks that SAP HANA APL functions respond correctly
`samples/sql/any`	Contains SQL scripts that show how to call the functions as an ANY procedure • `apl_admin_ex.sql` Same as `apl_admin_ex.sql` above • `apl_samples` Subset of samples adapted to leverage the ANY procedure

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

A simplified overview of the structure of the `samples/runtimes` folder is shown below:

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

2.1.2 Delivery Unit

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

This is achieved through SQL stored procedures that provide the same API as the library but hide the complexity of the regular AFL call mechanism. This delivery unit also manages the lifecycle of transient database objects by implementing a cache in the database.

Characteristics

Name	`HCO_PA_APL`
Main Root Schema	`SAP_PA_APL`

Main Root Package Name	sap.pa.apl

Contents

The delivery unit contains the following:

- A set of stored procedures that provide easier access to the API and implement a cache
- Table types required by the stored procedures
- A database role that can be used to easily grant the appropriate privileges to users

Database Role

The database role `sap.pa.apl.base.roles::APL_EXECUTE` grants privileges to do the following:

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

2.2 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 Component Location* 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 along with the database user name and password and then click *Next*.
7. Click *Update* once you have confirmed that the summary is correct.

Restart your SAP HANA database instance.

2.3 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.
	3. Run the following command to start the installation:
	`./hdblcm --batch --configfile=<Template_file_path>`

Restart your SAP HANA database instance.

3 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

3.1 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 script as the SYSTEM user:

```
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 in the SAP HANA cockpit. See the *SAP HANA Administration Guide* on the SAP Help portal.

3.2 Check the Installation

Check 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:

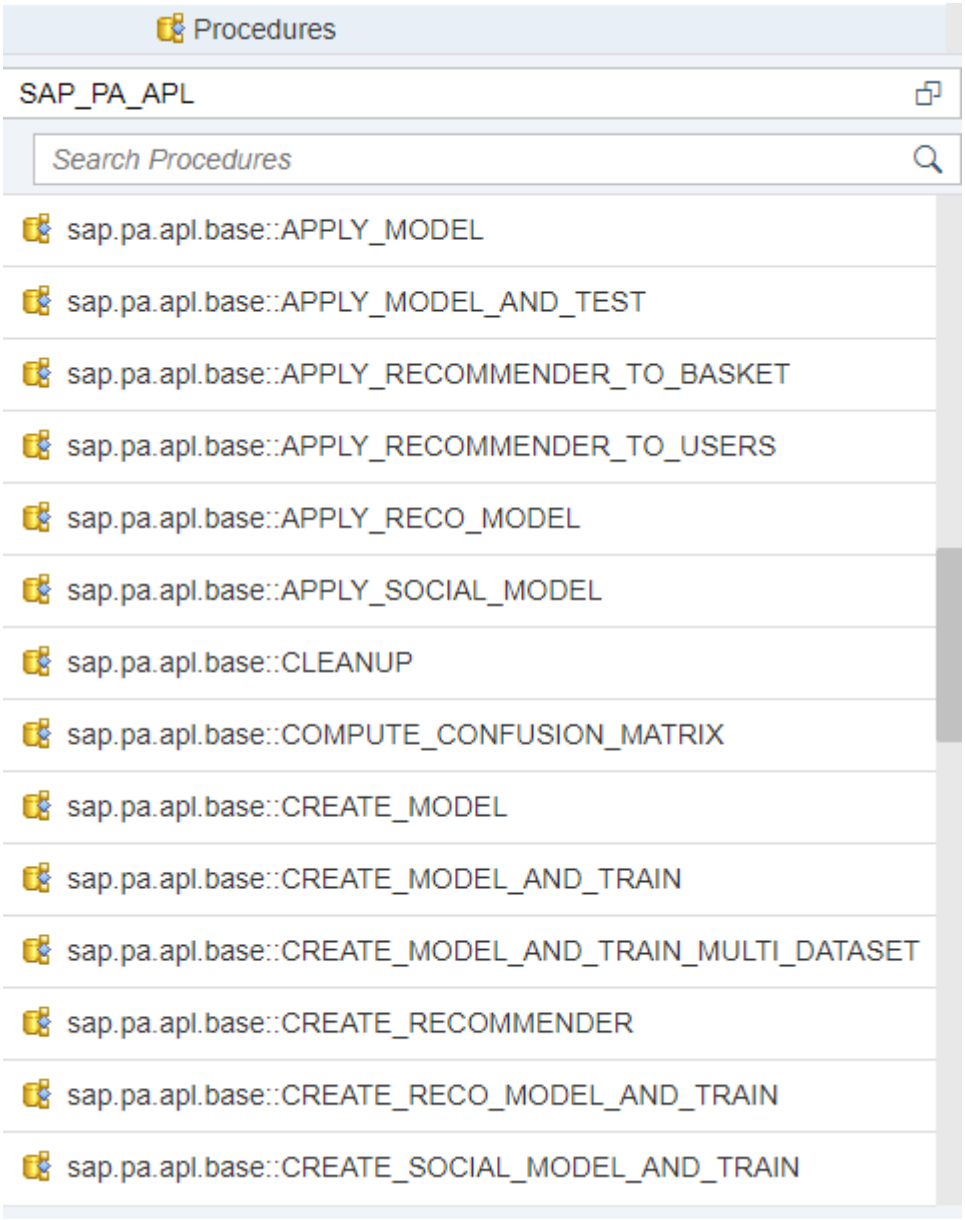
- `sys.afl_areas`
- `sys.afl_packages`
- `sys.afl_functions`

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:



3.3 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 the 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 17]

4 Importing Sample Datasets

The `samples/data/index` folder in the SAP HANA APL package contains a series of sample datasets.

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

To try out an APL function using a sample script, you must first import the sample datasets into SAP HANA tables. The dataset schema is named `APL_SAMPLES`. The admin script grants access to this schema. The examples shown in the function reference use these sample datasets.

For information about how to import data using the SAP HANA database explorer, see *Import Data Into a New or Existing Table*.

Related Information

Package Contents [page 7]
Function Reference
Import Data Into a New or Existing Table
SAP HANA APL GitHub Repository - Samples and Runtimes

5 Managing the Cache

The stored procedures provided by the delivery unit bring performance enhancements thanks to a cache mechanism. This cache mechanism is used to store and reuse database objects that are transient, but also take time to create and delete.

The database objects that are managed in this cache are the following:

- The generated AFL wrappers
- The table types related to the input and ouput datasets, that is, all the non-fixed table types that depend on the use case and workflow, for example training datasets, apply-in datasets, and apply-out datasets.

The default schema for this cache is `SAP_PA_APL`. The contents of this cache can be browsed.

Related Information

Delivery Unit [page 9]

5.1 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 the SAP HANA Cloud, SAP HANA database

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

5.2 Customize the Cache Schema

You can customize the cache schema by setting the session variable `APL_CACHE_SCHEMA`. You also need to give the appropriate privileges for the custom cache schema to the user.

Run the following commands:

```
-- We use a common "APL_CACHE" schema for the HCO_PA_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 cache for the HCO_PA_APL Stored Procedures
connect <APL_user> password <password>;
SET SESSION 'APL_CACHE_SCHEMA' = 'APL_CACHE';
```

5.3 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,?);
```

> **i** 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 21]

6 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 AFL 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.

   > **i 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

7 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 the function availability matrix.

> **i** 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)

8 Upgrade SAP HANA APL

To upgrade the SAP HANA APL function library, you need to 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 the delivery unit

Note that the delivery unit is also upgraded automatically.

1. Use the SAP HANA lifecycle management tool `hdblcm` or `hdblcmgui` to install SAP HANA APL.

   > **i Note**
   >
   > In order to do a direct upgrade from a version prior to 1903 (for SAP HANA 2+), you need to 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 need to perform an uninstall/install instead.

2. Purge the cache after the reinstallation or upgrade.

Related Information

Installing SAP HANA APL [page 6]
Purge the Cache [page 18]

9 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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