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SAP HANA Platform 2.0
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What's New in the SAP HANA Platform 2.0 (Release Notes)

Content

1 What's New in the SAP HANA Platform 2.0 (Release Notes)

Use this document to find out about new and enhanced features of SAP HANA Platform 2.0 in support package stacks (SPSs).

Table 1:

Support Package Stack (SPS)	First Released with Revision...	Release Note
00	2.00.000	SAP Note 2380257

The document *What`s New in the SAP HANA Platform 2.0 (Release Notes)* accumulates the features of all SAP HANA 2.0 support package stacks (SPS) and corresponding revisions. You will find all SAP HANA Platform features starting with SAP HANA Platform 2.0 (Revision 2.00.000) up to the current SAP HANA Platform 2.0 support package stack and revision. For information about the SAP HANA release strategy and for a detailed explanation of SAP HANA revisions, support package stacks, maintenance revisions and datacenter service points and their frequency, see the document *SAP HANA 2.0 Revision Strategy* on SAP Service Marketplace.

To find out about issues that have been fixed in a specific revision, see the SAP Note of that revision on SAP Service Marketplace.

Related Information

SAP HANA Platform documentation set on SAP Help Portal

SAP Note 2378962 - SAP HANA 2.0 Revision Strategy

SAP HANA 2.0 Revision Strategy

SAP Notes search

2 SAP HANA Platform 2.0 SPS 00 Features

2.1 Installation and Update

2.1.1 Documentation Changes

As of SAP HANA Platform 2.0 SPS 00, the SAP HANA installation and update documentation has been changed.

SAP HANA Master Guide (Changed)

The information in the *SAP HANA Master Update Guide* is now available in the section *Updating an SAP HANA System Landscape*. This section also contains information about updating from SAP HANA Platform 1.0 to SAP HANA Platform 2.0 SPS 00.

Parts of the information in the *SAP HANA Technical Operations Manual* is now available in the section *Operating SAP HANA*.

Only an introduction into network-related information is now available in the *SAP HANA Master Guide*. The *SAP HANA Administration Guide* now includes a new section called *Landscape Management and Network Administration*.

SAP HANA Master Update Guide (Deleted)

The *SAP HANA Master Update Guide* is no longer available. The information contained in this document is now available in the *SAP HANA Master Guide*.

SAP HANA Server Installation and Update Guide (Changed)

The *Troubleshooting* section has been updated. The chapter *Importing Delivery Units Manually* was added.

The section *Updating the SAP HANA System* was re-structued.

SAP HANA Cockpit Installation and Update Guide (New)

The SAP HANA Cockpit Installation and Update Guidel is now available. This guide describes how to install and update the SAP HANA cockpit. The SAP HANA cockpit provides core system and database administration features, for example, database monitoring, user management, and data backup.

SAP HANA Platform Lifecycle Management in SAP HANA Cockpit (New)

The SAP HANA database lifecycle manager (HDBLCM) Web user interface now includes a link to the SAP HANA Platform Lifecycle Management documentation.

2.1.2 SAP HANA Server Installation and Update (New and Changed)

Integrated Download, Extract and Update with HDBLCM Web User Interface (New)

The SAP HANA database lifecycle manager (HDBLCM) Web user interface now allows you to download, extract and update SAP HANA components and XS advanced applications.

Worker Host Grouping (New)

To implement a multi-temperature memory strategy, you can assign hosts to worker groups.

Uninstall component with existing component-specific hosts/roles in one step (Changed)

In previous versions of SAP HANA, you had to remove component-specific host roles and hosts first before you could uninstall additional components. Components including their host roles and hosts can now be uninstalled in one step.

SUSE Linux Enterprise Server (SLES) 12 SP1 and Red Hat Enterprise Linux (RHEL) 7.2 as Minimal Operating System Versions (Changed)

The SAP HANA database lifecycle manager performs a check to see if the minimal operating system requirements are fulfilled. SAP HANA 2.0 SPS 00 is supported on SUSE Linux Enterprise Server (SLES) 12 SP1 and Red Hat Enterprise Linux (RHEL) 7.2.

2.1.3 SAP HANA Cockpit Installation and Update (New)

As of SAP HANA Platform 2.0 SPS 00, a new and enhanced implementation of SAP HANA cockpit is available for installation.

The new SAP HANA cockpit unifies the administration of single, multiple and tenant databases. It replaces both the SAP HANA cockpit and the SAP DB Control Center that were available with SAP HANA 1.0. The new cockpit can be used for the administration of systems running SAP HANA 2.0 or SAP HANA 1.0 SPS12.

The new cockpit represents a separate administration environment from the managed production databases. The SAP HANA database lifecycle manager (HDBLCM) is used to install and update the SAP HANA cockpit in a graphical user interface or the command-line interface.

Related Information

SAP HANA Cockpit Installation and Update Guide
SAP HANA Administration Guide

2.2 Security

2.2.1 Documentation Changes

As of SAP HANA Platform 2.0 SPS 00, the SAP HANA security documentation has been changed.

- The *SAP HANA Security Guide* contains a new chapter on data protection.
- The *SAP HANA Security Checklists and Recommendations* document contains a new chapter on SAP HANA XS advanced.

Related Information

SAP HANA Security Guide
SAP HANA Security Checklists and Recommendations

2.2.2 SAP HANA Database Security (New and Changed)

As of SAP HANA Platform 2.0 SPS 00, new and changed security-related features are available in the SAP HANA database.

Encryption (New and Changed)

- The SAP HANA database now supports redo log encryption.
- The management of the encryption root keys used for data volume encryption, redo log encryption, and the internal application encryption service has been enhanced:
  - All root keys can be conveniently changed by SQL statement.
  - The new system privilege ENCRYPTION ROOT KEY ADMIN is required to change all root keys. A user with RESOURCE ADMIN can no longer change the data volume encryption root key and the internal application encryption root key.
  - You can create a dedicated password-protected root key backup to a secure location.

Authorization (New and Changed)

- If you use an LDAP-compliant identity management server to manage users and their access to resources, you can now leverage LDAP group membership to authorize SAP HANA users.
  The new system privilege LDAP ADMIN is required to configure LDAP group authorization.
- A user administrator can now convert a restricted user into a standard user, and vice versa. It is possible to grant and revoke both the PUBLIC role as well as authorization to create objects in a user's own schema.
- A new and enhanced implementation of the SAP HANA cockpit is available with SAP HANA 2.0. The delivery units used to deploy the original implementation of the SAP HANA cockpit in SAP HANA 1.0 as auto content exist for downward compatibility reasons, but they no longer contain any content. The following roles delivered in the these DUs are therefore no longer available:
  - `sap.hana.admin.roles::*`
  - `sap.hana.admin.cockpit.sysrep.roles::SysRepAdmin`
  - `sap.hana.backup.roles::*`
  - `sap.hana.security.base.roles::*`
  - `sap.hana.security.cockpit.roles::*`
  - `sap.hana.admin.cockpit.sysdb.roles::SysDBAdmin`

Security Administration with SAP HANA Cockpit (New and Changed)

A new and enhanced implementation of the SAP HANA cockpit is available with SAP HANA 2.0.

The new cockpit continues to support the monitoring of critical security settings, the granting of roles to database users, as well as tasks related to auditing, data volume encryption, and certificate management.

In addition, the new SAP HANA cockpit supports the creation and management of database users.

Related Information

SAP HANA Security Guide
SAP HANA Administration Guide

2.3 Administration

2.3.1 Documentation Changes

As of SAP HANA Platform 2.0 SPS 00, the SAP HANA administration documentation has been changed.

SAP HANA Technical Operations Manual (Deleted)

The *SAP HANA Technical Operations Manual* is no longer available. The information contained in this document is now available in the *SAP HANA Master Guide* and the *SAP HANA Administration Guide*.

SAP DB Control Center Guide (Deleted)

The *SAP DB Control Center Guide* is no longer available. With SAP HANA 2.0, SAP DCC is replaced by the SAP HANA cockpit, which is documented in the *SAP HANA Administration Guide*.

SAP HANA Administration Guide (Changed)

The *SAP HANA Administration Guide* now includes a new section called *Landscape Management and Network Administration*. This section consolidates the documentation for landscape management tasks such as copying and moving SAP HANA systems. It also includes information required to integrate SAP HANA into your network environment, for example ports and connections. In the SAP HANA 1.0 documentation, network-related information was primarily available in the *SAP HANA Master Guide*.

The section *SAP HANA Platform Lifecycle Management* has also been restructured.

2.3.2 SAP HANA System Administration (New and Changed)

As of SAP HANA Platform 2.0 SPS 00, new and changed features are available for the administration of SAP HANA.

SAP HANA 2.0 Cockpit (New)

A new and enhanced implementation of SAP HANA cockpit is now available. In SAP HANA 1.0, the cockpit was used to manage a single resource while SAP DB Control Center was used to manage multiple systems. The functionalities of both have now been rolled into one comprehensive tool that unifies individual, multiple, and tenant database management.

You can use the SAP HANA 2.0 cockpit to monitor and manage systems running SAP HANA 2.0 or SAP HANA 1.0 SPS 12.

The new SAP HANA cockpit continues to provide database administrators with a single point of access to a range of Web-based tools for the administration and detailed monitoring of SAP HANA databases, including system resource monitoring, alerting, and tenant database administration. In addition, it provides the following new and enhanced features:

- Creation of groups of systems so that specific cockpit users can monitor aggregate information
- Enhanced monitoring of alert information, across multiple databases, and within a single system
- Configuration of system properties, (*.ini files), an administration task which was previously accomplished only through the SAP HANA studio
- Monitoring of system health metrics for multi-host systems, including indicators for the resource utilization of hardware components (CPU, memory, network, and storage)
- The ability to start or stop a system through *Manage Services* app
- The ability to browse your database catalogs by using the newly integrated SAP HANA database explorer. This database explorer is similar in functionality and appearance to the database explorer provided with the SAP Web IDE for SAP HANA. The database explorer includes:
  - An SQL console for executing SQL queries and SQLScript procedures
  - An SQL analyzer for viewing query plans and analyzing the performance of SQL queries
  - An MDX console for executing MDX queries
  - A trace feature for viewing diagnostic files

The SAP HANA cockpit also provides new and enhanced features for:

- Performance monitoring and analysis
- Security administration
- Backup and recovery
- System replication

For more information about these feature enhancements, see the relevant section in this document.

See also SAP Note 2380291.

SAP HANA 1.0 Cockpit (Deleted)

The delivery units used to deploy the original implementation of the SAP HANA cockpit in SAP HANA 1.0 as auto content exist for downward compatibility reasons, but they no longer contain any content. This includes the following DUs:

- `HANA_ADMIN`
- `HANA_BACKUP`
- `HANA_HDBLCM`
- `HANA_SEC_BASE`
- `HANA_SEC_CP`
- `HANA_SYS_ADMIN`

SAP DB Control Center (Deleted)

SAP HANA 2.0 does not support SAP DB Control Center (SAP DCC). The SAP HANA 2.0 cockpit replaces SAP DCC.

If you're upgrading a system running SAP DCC to SAP HANA 2.0, SAP recommends that you remove the SAP DCC delivery unit, as described in SAP Note 2385193.

Multitenant Database Containers (New and Changed)

- A backup of a single database (single-container system) can be recovered into a tenant database in an MDC system and retains the backup history. Backups can be located in the file system as well as in a third-party backup tool using the HANA BACKINT API.
- The standard copy/move process of tenant databases requires an initial certificate configuration in order to enable communication between systems. In non-production setups or isolated environments, it may be reasonable to allow a process without the need for trusted communication. The internal communication of the copy/move processes may now also run unencrypted.
- The performance trace can be enabled for multiple tenant databases at the same time to analyze cross-database queries.

Workload Management (New)

In the area of Workload Management the admission control feature gives administrators the option to apply processing limits and to decide how to handle new requests if the system is close to the point of saturation.

User-defined thresholds can be applied using configuration parameters to define an acceptable limit of activity in terms of the percentage of memory usage or percentage of CPU capacity. Administrators can then configure the system so that, for example:

- if the system approaches this limit then new requests will be queued until processing capacity is available
- if the system exceeds the load thresholds then new requests will be rejected and a message returned to the client that the server is temporarily overloaded.

A query timeout feature has now been implemented which can be used to apply a maximum time limit to process any SQL statement. This is available through client programming interfaces (for example for JDBC: java.sql.statement.setQueryTimeout). The timeout is not active by default (set to 0 seconds for no timeout). This feature can be used as a way of automatically canceling client queries which are hanging or looping indefinitely.

Extension Node for Scaled-Out SAP Business Warehouse (New)

For scaled-out SAP Business Warehouse systems (version 7.50 and above) where a multi-temperature storage strategy is required, the extension node feature is now available which makes it possible to use a different (heterogeneous) type of host in the server landscape which is used exclusively for warm data.

In this case, the normal hardware sizing guidelines for storage can be relaxed: whereas normally a 2:1 ratio of RAM to hot data is required, the extension node supports significantly more storage capacity for warm data.

The configuration for this type of node is based on a new host sub role and a location value in the TABLE_PLACEMENT system view. Once the data has been correctly modeled it is then distributed by the landscape redistribution process to the appropriate server node.

Client-Side Statement Routing (New)

- Client-side routing now routes statements for range-partitioned tables.
- Client-side routing for hash-partitioned tables now routes batches, as well as prepared statements.

SAP HANA HDBSQL (New and Changed)

- Use the new `-V` configuration option in SAP HANA HDBSQL to define a substitution variable.
- The default for the `-b` option is now 32 bytes. You can now use `-b all` to always display the whole binary length.
- The new `-quiet` option hides the SAP HANA HDBSQL welcome banner.
- The new `-oldexectimes` option uses SAP HANA 1.0 execution-only timing. SAP HANA HDBSQL in SAP HANA 1.x only reports time for client and server executions, not fetches for result sets. As of SAP HANA 2.0, SAP HANA HDBSQL includes times for executions and fetches by default.

Related Information

SAP Note 2380291
SAP Note 2385193
SAP HANA Administration Guide

2.3.3 SAP HANA Database Backup and Recovery (New and Changed)

As of SAP HANA 2.0 Platform SPS 00, new and changed features are available for SAP HANA backup and recovery.

Enhancements for Log Backups

- To improve the performance of log backups, SAP HANA can write all the log segments of a service that are ready to be backed up at a particular time to a single log backup. You can define the maximum size of this single log backup.
  This option is supported for both file-based log backups and third-party tools.
  More information: *Writing Multiple Log Segments to One Log Backup* in *Related Information*
- With SAP HANA 2.0, you can define events to trigger a log backup.
  By default, a log backup is created immediately after a log segment becomes full, or when the service-specific timeout has been reached for a log segment.
  Alternatively, you can specify that a log backup is created only after a service-specific timeout has been reached.
  This option is supported for both file-based log backups and third-party tools.
  More information: *Set the Interval Mode for Log Backups* in *Related Information*

Encryption and Backup and Recovery

SAP HANA 2.0 supports data encryption in the persistence layer.

A database administrator must ensure that the encryption root keys are backed up. If a recovery is performed, a database administrator must also ensure that the root keys are imported before the recovery is started.

More information: *Points to Note: SAP HANA Backups and Encryption*, *Root Key Backup*, and *Import Backed-up Root Keys* in *Related Information*

Location of the Backups of the Backup Catalog

The location of the log backups is configured separately from the location of backups of the backup catalog.

Before you recover SAP HANA, you are prompted to specify path to search for the backup catalog.

More information: *Destination for Backups of the Backup Catalog* in *Related Information*

SAP HANA Multitenant Database Containers

It is now possible to use a data backup of an SAP HANA single-container system to recover to a tenant database.

More information: *Points to Note: Copying a Database Using Backup and Recovery*, *Points to Note: SAP HANA Multitenant Database Containers and Backup*, *Points to Note: SAP HANA Multitenant Database Containers and Recovery* in *Related Information*

Extension Node for Business Warehouse

Database recovery with SAP HANA 2.0 supports extension node for Business Warehouse.

More information: *Points to Note: SAP HANA Recovery* and *Data Temperature: Extension Node for Business Warehouse* in *Related Information*

SAP HANA on IBM Power Systems: Release Compatibility

SAP HANA 2.0 supports only IBM Power Little Endian (LE) systems.

Backups created with SAP HANA 2.0 are compatible with both supported hardware platforms (Intel and IBM Power). You can recover SAP HANA 2.0 using backups created with SAP HANA 2.0 on either an Intel-based system or an IBM Power-based system.

Backups created with SAP HANA 1.0 SPS 10 or newer running on an Intel-based system can be used to recover SAP HANA 2.0 to both Intel-based and IBM Power-based systems. Backups created with SAP HANA 1.0 on an IBM Power-based system **cannot** be used to recover SAP HANA 2.0.

More information: *Points to Note: SAP HANA on IBM Power Systems* in *Related Information*

SAP HANA Cockpit (Changed)

A new and enhanced implementation of the SAP HANA cockpit is now available.

The SAP HANA Administration Guide has been updated to reflect the changed procedure to recover SAP HANA and to schedule SAP HANA backups using SAP HANA cockpit.

More information: *SAP HANA System Administration (New and Changed)*, *Schedule Data Backups (SAP HANA Cockpit)*, and *Recover a Database (SAP HANA Cockpit)* in *Related Information*

Related Information

SAP HANA System Administration (New and Changed) [page 9]

2.3.4 SAP HANA High Availability (New and Changed)

As of SAP HANA Platform 2.0 SPS 00, new and changed features are available for SAP HANA High Availability.

Active/Active (Read Enabled) (New)

Starting with SAP HANA 2.0 active/active (read enabled) is integrated into the System Replication solution and allows read-only access on the secondary system.

For more information on this new feature, see the following topics in the SAP HANA Administration Guide:

- Active/Active (Read Enabled)
- High Availability for SAP HANA
- Configure the Secondary System
- System Replication with Operation Mode Logreplay
- Log Retention
- System Replication Configuration Parameters
- System Replication Command Line Reference
- System Replication Details

Required Configuration Step for SAP HANA System Replication Authentication (New)

Starting with SAP HANA 2.0 a new configuration step is required to setup SAP HANA System Replication. The secondary system needs to be prepared for authentication by copying the system PKI SSFS .key and the .dat file from the primary system to the secondary system.

For more information, see*Set up System Replication with hdbnsutil* in the SAP HANA Administration Guide.

SAP HANA Cockpit (Changed)

A new and enhanced implementation of SAP HANA cockpit is now available.

The following administration activities are possible:

- Performing the initial set-up, that is enabling system replication and establishing the connection between two identical systems

- Monitoring the status of system replication to ensure that both systems are in sync
- Performing a takeover to the secondary system in the event of a disaster and failback once the primary system is available again
- Disabling system replication

For more information about these feature enhancements, see *Managing System Replication in the SAP HANA Cockpit* in the SAP HANA Administration Guide.

2.3.5 SAP HANA Performance Monitoring and Analysis (New and Changed)

As of SAP HANA Platform 2.0 SPS 00, new and changed features are available for SAP HANA Performance Monitoring and Analysis.

Starting with SAP HANA 2.0 the following tools provide new and enhanced features:

Capture and Replay (Changed)

With SAP HANA 2.0 new features are available for the capture and replay tool in the SAP HANA cockpit:

- When configuring new captures it is possible to set the conditions under which the capture is overwritten based on two criteria:
  - The duration of the capture
  - The disk usage of the capture

  For more information, see *Capture a Workload* in the Related Links section.
- When replaying the workload it is possible to compare replays based on the same capture with each other. For more information, see *Compare Replayed Workloads* in the Related Links section.
- After replaying the workloads it is possible to compare results of queries in the *Replay Report*. Furthermore, the tab *Load* visualizes the system load during the replay process.
  For more information, see *Replay a Preprocessed Workload* in the SAP HANA Administration Guide.

Workload Analyzer (Changed)

With SAP HANA 2.0 the workload analyzer tool available in the SAP HANA cockpit has two versions. The workload analyzer from SAP HANA 1.0 is now called "workload analyzer based on thread samples". The new version of the workload analyzer is called "workload analyzer based on engine instrumentation". The following changed and new features are available for the workload analyzer tool:

- Workload analyzer based on thread samples (changed)
  The chart visualizing the system resource usage displays both a real-time and a historical analysis.
  It is possible to visualize the system load using a timeline view mapped to the load graph.
- Workload analyzer based on engine instrumentation (new)
  This is a feature for analyzing captured workloads. Similar to the sampling-based workload analyzer it includes load graph visualization, as well as a timeline view with application and statement hierarchy.

For more information, see *Analyzing Workloads* in the SAP HANA Administration Guide.

SQL Analyzer (New)

With SAP HANA 2.0 SPS 00, the SQL Analyzer is available in the SAP HANA cockpit and the SAP HANA Database Explorer.

With this tool it is possible to analyze and understand query execution and performance aspects of the SAP HANA database. It can be used to view detailed information on each query and can help evaluate potential bottlenecks for these queries. The tool is similar to the Plan Visualizer tool in the SAP HANA studio.

The following features are available for the SQL Analyzer:

- Overview
- Operator list
- Tables used
- Statement statistics

For more information, see *Analyzing Statement Performance* in the SAP HANA Administration Guide.

Other Performance Management Tools (Changed)

The following performance management tools in the SAP HANA cockpit have been enhanced:

- Performance Monitor
  For more information, see *Monitor and Analyze Past Performance* and *Collecting Performance Monitor Data for SAP Support* in the SAP HANA Administration Guide.
- Monitor Statements
  For more information, see *Monitor and Analyze Critical Statements* in the SAP HANA Administration Guide.
- Threads
  For more information, see *Monitor and Analyze Threads* in the SAP HANA Administration Guide.
- Sessions
  For more information, see *Monitor and Analyze Sessions* in the SAP HANA Administration Guide.
- Expensive Statements
  For more information, see *Monitoring and Analyzing Expensive Statements* in the SAP HANA Administration Guide.
- SQL Plan Cache
  For more information, see *Monitoring and Analyzing Statements with SQL Plan Cache* in the SAP HANA Administration Guide.

2.3.6 SAP HANA Smart Data Access (New and Changed)

SAP HANA Platform 2.0 SPS 00 introduces new and changed features for SAP HANA smart data access.

SELECT FOR UPDATE on Virtual Tables (New)

The FOR UPDATE clause on the SELECT statement is extended to include virtual tables.

Refresh Virtual Tables Metadata (New)

When the metadata in a remote table is changed, use the ALTER VIRTUAL TABLE statement to refresh the virtual table to reflect the change.

Support for SAP SDA Adapter for SAP MII (Deprecated)

As of SAP HANA 2.0, the SAP HANA Smart Data Access (SDA) adapter for SAP Manufacturing Integration and Intelligence (MII) is no longer supported.

2.3.7 SAP HANA Hadoop Integration (New and Changed)

SAP HANA Platform 2.0 SPS 00 introduces new features for the SAP HANA and Hadoop integration.

Create Custom Virtual Procedures

Create custom Spark procedures in SAP HANA to perform compilation and execution on a Hadoop cluster. You can easily access Spark libraries from SAP HANA, then compile and execute the procedures on Spark Controller. The new `CREATE VIRTUAL PROCEDURE` syntax supports Scala, providing a method for simple, and strongly typed code. Use these custom procedures to access Hadoop's distributed file system (HDFS) libraries, such as the machine learning libraries, and return the data model to SAP HANA for prediction.

Enable Remote Caching Using Spark Controller

When using the Spark controller to connect SAP HANA and Hadoop, you can enable remote caches in Spark for queries with complex calculations. This allows you to use materialized data for the repetitive execution of the same query.

SAP HANA Vora ODBC Connectivity (Requires SAP HANA Vora 1.3)

A more direct connectivity method between Hadoop and Vora has been implemented. You can establish a connection between SAP HANA and Hadoop using the SAP HANA Vora remote source adapter `voraodbc` and Vora's Wire protocol. With this new implementation you can join data by creating a remote source, then use virtual tables to represent the SAP HANA Vora remote source tables you want to access.

Kerberos Authentication Support in Spark Controller

You can now set up a Hadoop cluster with Kerberos authentication for SparkSQL using Spark Controller.

Support for Spark Controller Installation and Configuration Through the Cloudera Manager

Support for installing and configuring Spark Controller using Cloudera Manager has been added. Using the Cloudera Manager Web UI you can:

- Install Spark Controller.
- Distribute the Spark Controller package to each hosts on your Cloudera cluster.
- Start and stop Spark Controller.
- Change or add Spark Controller configuration parameters.

2.4 Development

2.4.1 SAP HANA XS Advanced Development (New and Changed)

For SAP HANA Platform 2.0 SPS 00 SAP HANA supports development and deployment of SAP HANA extended application services (XS) advanced model applications.

Application Run-Time Environment

SAP HANA XS advanced provides the following run-time environments for your application:

- JavaScript/Node.js
  JavaScript run time to which you can deploy your Node.js and XS JavaScript applications.

  > **Note**
  >
  > The XS JavaScript (XSJS) run time is a compatibility layer that runs on top of Node.js, which enables you to execute your existing code base, for example, `.xsjs` and `.xsjslib` files.

- Java (Tomcat 8/TomEE)
  SAP HANA XS advanced model provides a Java run time to which you can deploy your Java applications. The Java run time for SAP HANA XS advanced provides a Tomcat or TomEE run time to deploy your Java code.
- Custom run time
  You can also create and run a custom run-time environment of your own in XS advanced, so that you can deploy applications written using languages such as Python or PHP, which are not supported by any of the default run-time environments included in the XS advanced run-time store.

  > **Restriction**
  >
  > SAP does not provide support for custom language, buildpack, or run-time scenarios.

  Applications deployed to a custom run-time environment in XS advanced do not have automatic access to (or use of) some important features that are built into and supported by the XS advanced framework, including (but not limited to): authentication and security, logging and auditing, and connections to the database. If you deploy an application to a custom run-time environment in XS advanced, you must configure these components manually for the custom application

JavaScript Run Time

SAP HANA XS advanced provides the following updates and new features for the SAP HANA Platform 2.0 SPS 00 JavaScript run-time environment:

- `sap-hdbext`
  `sap-hdbext` is included in the `XS_JAVASCRIPT` software component for XS advanced and extends the functionality of the `hdb` package, which is a JavaScript client for SQLDBC. With this realease, `sap-hdbext` supports SAP HANA DB connection pooling for Node.js applications.
- XS JavaScript (XS classic compatibility layer in XS advanced)
  - Support for `$.util.Zip` (with limitations)

- Support for `$.util.SAXParser` (with limitations)
- Support for `$.text.mining`

Java Run Time

SAP HANA XS advanced provides the following updates and new features for the SAP HANA Platform 2.0 SPS 00 Java run-time environment:

- A central audit-log service
- A new Java API for the audit log
- A graphical user interface to manage the audit logs
- Support for Apache Tomcat 8.0.36
- Support for Apache TomEE 1.7.4
- A personalized database connection, for example, including: the application name, the organization, and the space
- Configuration of the maximum header size for incoming HTTP requests

Application Router

For SAP HANA Platform 2.0 SPS 00, SAP HANA XS advanced provides the following updates and new features for the Node.js application router (`approuter.js`):

- Routes are matched by both URL path and HTTP methods
- Use of the `Content-Security-Policy` header as a "best practice"
- CSRF token is generated once per session
- Route sources can be matched in a case-insensitive way
- Configure a maximum client-connection timeout
- The application router supports extensions, for example, custom middleware
- CSRFs tokens can be fetched with the `HEAD` request
- Support for configuring the `Cache-Control` header in the application-router descriptor (`xs-app.json`); the header is used when serving static resources.

Deployment Service

For SAP HANA Platform 2.0 SPS 00, SAP HANA XS advanced provides the following updates and new features for the deployment service (`xs deploy`):

- List the last "n" MTA operations
- Broaden support for the MTA specification:
  - Support for partial MTA specification version values
  - Support for metadata for properties and parameters
  - Support for "`!sensitive`" parameter (property tag)
  - Support for MTA-Module multiple entries
  - Support for the proper merging of structured parameters

  - Support for context-path routing (new MTA module parameter)
  - Allow references from resources to “`modules`” or “`resources`”
- CTS+ Integration: Adaptation of deploy process
- Provide blue-green (`bg-deploy`) command in the XS CLI plug-in
- Enable the deployment of a Multi-Target Application (MTA) from a Git repository
- Provide support for the management of the XS advanced Service Broker

SAP HANA Deployment Infrastructure

For SAP HANA Platform 2.0 SPS 00, SAP HANA XS advanced provides the following updates and new features for SAP HANA Deployment Infrastructure (HDI):

- HDI Configuration Parameter Reference
- HDI Parameter Reference
- HDI Build Plug-ins and File Formats Reference 2.0
- HDI Admin Documentation
- HDI Deployer
  Support for many new features in the deployment service. For more information, see *Deployment Service* above.
- New design-time artifacts:
  - Result Cache
- Updated design-time artifacts:
  - Synonym
    Support for "database" field (Cross-Database Access)

Core Data Services

For SAP HANA Platform 2.0 SPS 00, SAP HANA XS advanced provides the following updates and new features for Core Data Services (CDS):

- Support for subqueries
- Support for `LIMIT/OFSET` in queries
- Support for the clause `GENERATED ALWAYS AS <expression clause>` in an entity definition
- Support for the clause `GENERATED [ALWAYS | BY DEFAULT] AS IDENTITY` in an entity definition
- Java OData support for CDS
- The CDS text editor now includes a “beautify” (pretty-print) feature that formats code for easier scanning.

Gerrit-Git Service for XS Advanced

As of SPS12, SAP HANA includes a Gerrit server that is integrated with the XS advanced run time. Gerrit for XS advanced is an optional component of the XS Advanced platform which can be used to store and manage versions of the source code for XS Advanced applications, for example SAPUI5 and JavaScript or Java

applications, in Git repositories. Gerrit for XS Advanced is attached to the user account and authentication (UAA) service in the XS Advanced platform.

XS Advanced Command-Line Interface

For SAP HANA Platform 2.0 SPS 00, SAP HANA XS advanced provides the following updates and new features for the XS command-line interface:

- Numerous improvements and additions to the parameters and options already available with existing commands

OData Services

For SAP HANA Platform 2.0 SPS 00, SAP HANA XS advanced provides the following updates and new features for the OData services:

- Support for annotations in metadata
- Java OData support for CDS annotations (for example, `@OData.publish : true`)

Tools

For SAP HANA Platform 2.0 SPS 00, SAP HANA XS advanced provides the following new and updated development tools:

- CDS:
  - Beautify (a.k.a. "pretty-print") feature for code formatting in the CDS text editor
  - Code completion for tables and views in same HDI container
  - Report syntax errors in the new *Problems View* in SAP Web IDE for SAP HANA
- Node.js:
  - Testing: the plain Node.js template now contains a sample Jasmine test
  - Testing: improvements to the design of the *Test Result* pane
  - Debugger: on-demand debugging of already running applications
  - Debugger: improvements to the design of the UI
  - New and improved run configuration for the Node.js run time
- Java:
  - Support for the building of Java Modules in the SAP Web IDE for SAP HANA
  - Support for the building of Java modules (Web ARchives) with Maven
  - Support for the running of Java modules (WARs) with TomEE buildpack on XS advanced, including:
    - Creation of Java Modules
    - Tighter integration with the SAP HANA Deployment Infrastructure (HDI)
    - Java OData support for CDS
- Migration (XS classic to XS advanced)

New tool to help migrate legacy XS classic applications to run in the new XS advanced run-time environment

> **Note**
>
> The new *SAP HANA XS Migration Guide* is also available to guide you through the migration process.

Documentation

This section contains information about the following new or changed development-related documents:

- *SAP HANA Developer Guide for SAP HANA XS advanced model*
- *SAP HANA XS Migration Guide*
- *SAP HANA Analytics Catalog (BIMC) Reference*

SAP HANA Developer Guide for SAP HANA XS advanced model

The *SAP HANA Developer Guide for SAP HANA XS advanced model* describes the recommended process to follow when building and deploy applications that run in the SAP HANA extended application services, advanced model (XS advanced) run time; it also describes the required technical structure of applications that can be deployed to the XS advanced run-time platform using either the SAP Web IDE for SAP HANA or the XS command line tools.

The following areas in the SAP HANA Developer Guide for XS advanced model have been added, updated, or improved :

- Getting Started
  New and updated tutorials for the SAP HANA Run time Tools (a.k.a SAP HANA Database Explorer)
- Maintaining Application Development and Deployment Descriptors
  Improved and more comprehensive descriptions of the configuration files used to define and describe the build and deployment of a Multi-Target Application (MTA)
- Defining the Data Model in XS Advanced
  - Improved and more comprehensive explanations of how to create and deploy the database artifacts used to store and provision data for your application's back end and user interface.
  - New section describing how to configure the HDI deployer
  - New section describing how to configure access policies in CDS, for example, with Data Control Language (DCL) “aspects” and role definitions
  - New and updated sections describing how to use new CDS features, for example, support for subqueries or element modifiers such as “`GENERATED ALWAYS`”
- Defining OData Services for XS Advanced Applications
  Improved and more comprehensive explanations of how to create and deploy OData services in XS advanced, for example: changes and additions to the service-definition syntax and many some examples of working service definitions.
- Writing the XS Advanced Application Code
  - JavaScript/Node.js Run-Time Environment
    Improved and more comprehensive explanations of how to make use of the features available in the JavaScript/Node.js run-time environments, for example, which Node.js packages are available by default and how you can consume them with your MTA. There is also some new information about the unit-test framework, which you can use from within SAP Web IDE for SAP HANA.

- Java Run-Time Environment
  Improved and more comprehensive explanations of how to make use of the features available in the Java run-time environments, for example, how to set up connections to the SAP HANA database, how to configure logging and tracing, how to set up audit logs, how to configure authentication and authorization, how to debug your Java application, and how to enable Java Data Services (a native Java client for using Core Data Services functionality in the XS advanced Java run time).
- Maintaining XS Advanced Application Routes and Destinations
  Improvements to and extension of existing information as well as new information about features and functionality added with SAP HANA Platform 2.0 SPS 00.
- SAP Web IDE
  A complete reference for SAP Web IDE for SAP HANA, a browser-based integrated development environment (IDE) for the development of SAP-HANA-based applications comprised of web-based or mobile UIs, business logic, and extensive SAP HANA data models. SAP Web IDE works in conjunction with the SAP HANA Run-time Tools (HRTT), the SAP HANA deployment infrastructure (HDI), the Application Lifecycle Management tools (ALM) and the XS advanced run-time platform
- XS Command-Line Interface
  Numerous improvements and additions to the parameters and options already available with existing commands as well as important additions to the installation and deployment functions including more control of the application version deployed and the services bound to the deployed application.

SAP HANA XS Migration Guide

The *SAP HANA XS Migration Guide* describes the process of migrating legacy applications running in the XS classic run-time environment to the new XS advanced run-time environment. The guide describes the tools and provides an example migration using the SAP HANA Interactive Education (SHINE) demo application available with SAP HANA XS classic model.

SAP HANA Analytics Catalog (BIMC) Reference

The *SAP HANA Analytics Catalog (BIMC) Reference* lists and describes the tables and views with the prefix `BIMC` located in the schema `_SYS_BI`. It contains metadata required by analytic clients such as Analysis Office and Business Cloud. The metadata is also required for access by Multi-Dimensional Expressions (MDX). The SAP HANA Analytic Catalog is an analytic extension of the database catalog (schema `SYS`).

Related Information

SAP HANA Developer Guide for SAP HANA XS Advanced Model

2.4.2 SAP Enterprise Architecture Designer, edition for SAP HANA (New)

As of SAP HANA Platform 2.0 SP00, SAP Enterprise Architecture Designer, edition for SAP HANA is available.

SAP Enterprise Architecture Designer (SAP EA Designer) lets you capture, analyze, and present your organization's landscapes, strategies, requirements, processes, data, and other artifacts in a shared environment. Using industry-standard notations and techniques, organizations can leverage rich metadata

and use models and diagrams to drive understanding and promote shared outcomes in creating innovative systems, information sets, and processes to support goals and capabilities.

SAP EA Designer supports consuming your content through:

- Browsing diagrams and model objects online.
- Exporting diagrams as SVG images or printing them.
- Generating reports on your diagrams and model objects.
- Running an impact analysis.
- Posting comments to diagrams and model objects.

SAP EA Designer supports the creation and editing of the following kinds of diagrams:

- *Business Process* - Business process diagrams help you identify, describe, and decompose business processes. SAP EA Designer supports:
  - BPMN 2.0 Descriptive, which provides a small subset of objects suitable for business process design and analysis.
  - BPMN 2.0 Executable, which includes all the standard BPMN 2.0 objects, and is aimed at technical modelers and those who are reverse-engineering from SAP BPM or Eclipse BPMN2 Modeler.
- *Database* - Physical data models help you analyze and optimize the structure of your database. You can reverse-engineer any supported database to create a physical data model. Generation to SAP HANA, directly to the catalog, or to Web IDE via HDI is also supported.
- *Enterprise Architecture Diagram* - Enterprise architecture diagrams help you analyze and document your organization, its functions and processes, the applications and systems that support them, and the physical architecture on which they are implemented.
- *Process Map* - A process map provides a graphical view of your business architecture, and helps you identify your business functions and high-level processes, independent of the people and business units who fulfill them.
- *Requirements List* - Requirements documents display a hierarchical list of written requirements.

2.4.3 SAP Web IDE for SAP HANA (New and Changed)

As of SAP HANA Platform 2.0 SP00, the following new features and changes are available in SAP Web IDE and integrated SAP HANA tools.

SAP Web IDE for SAP HANA is a browser-based integrated development environment (IDE) for the development of SAP HANA-based applications comprised of web-based or mobile UIs, business logic, and extensive SAP HANA data models. SAP Web IDE works in conjunction with the SAP HANA deployment infrastructure (HDI), the Application Lifecycle Management tools (ALM), the XS Advanced runtime platform, and various SAP HANA tools.

SAP Web IDE

Table 2:

Feature	Description
Git Features (new)	The Git tools have been enhanced with new capabilities. Now you can: • Set up Git • Configure Git repositories • Use multiple branches • View the History pane
HTML5 Module Templates (new)	Two new templates are now available for HTML5 modules: • SAPUI5 application with a basic project structure • SAP Fiori Master-Detail application
Layout Editor (new)	A visual designer is now available for the development of SAPUI5-based HTML5 modules.
Problems View (new)	A new pane is available to view and analyze information about problems in the modules and projects in your workspace.
Run Console (changed)	The enhanced Run console provides a holistic view of all running modules in a project and a quick access to their logs.
Runtime Performance Improvements (changed)	Performance improvements when building and running HTML5 and Node.js modules.
Selective Build (changed)	You can selectively build artifacts in an HDB module rather than build the entire module. This supports incremental development and shortens the processing time.
User-defined Schema Names (new)	You can now define the name of the database schema that is automatically created for an HDB module.
SAP HANA Tools (new and changed)	Various SAP HANA tools are now available in SAP Web IDE. For details, see below.

SAP HANA Tools

Calculation View Editor (Modeler)

Table 3:

Feature	Description
Rank Node (enhanced)	You can now generate an additional output column for rank nodes to store rank values.
Assigning Semantics (enhanced)	In addition to the existing support for assigning semantics to measures, you can now also assign semantics to attributes in a calculation view.
Column Lineage (enhanced)	Column lineage support is now extended to trace source of columns used in calculated column expressions, and also for base measures used in restricted columns.
Cache Invalidation (enhanced)	Transaction-based cache invalidation is performed whenever the underlying data is modified.
Restricted Columns (new)	You can create restricted columns as an additional measure based on attribute restrictions. For example, you can choose to restrict the value for the REVENUE column only for REGION = APJ, and YEAR = 2016.
Support to Convert Attribute Values to Required Formats (new)	You can assign conversion functions to attribute columns. These functions help maintain conversion from any internal to external format and from any external to internal format.
Support for Debugging Calculation Views (new)	You can execute debug queries on calculation views and analyze the runtime performance of views. For example, based on the query that you execute, you can identify pruned and unpruned data sources in calculation views and at design-time.
Handling Null Values in Columns (new)	Define default values for columns (both attributes and measures). The system uses these default values in the reporting tools to replace any null values in columns.
Support for Virtual Tables (new)	In addition to the already supported data source types, you can now also use virtual tables as a data source for modeling calculation views.
Hierarchies (new)	You can use graphical modeling tools to create and define hierarchies. The tool supports both level hierarchies and parent-child hierarchies.
Support for Generating Time Data and Creating Calculation Views with Time Dimension (new)	You can generate time data into default time-related tables present in the _SYS_BI schema and use these tables in calculation views to add a time dimension.
Spatial Joins (new)	You can create spatial joins to query data from database tables that contain spatial data.
Time Travel Queries (new)	Calculation views now support time travel queries, which help query the past state of data. You can use input parameters to specify the timestamp in time travel queries.

Feature	Description
Validation Rules to Validate Performance of Calculation Views (new)	The tool supports certain validation rules, which when executed, validate the calculation view and help identify whether there are any design-time factors that could impact the performance of calculation views at runtime.
Time-Dependent Hierarchies (new)	You can create parent-child hierarchies with time dependency. If elements in the hierarchy are changing elements (time-dependent elements), then enabling the parent-child hierarchy as a time-dependent hierarchy helps display different versions of that hierarchy at runtime.
Currency Conversion and Unit Conversion (enhanced)	You can reuse the currency conversion or unit conversion definition of a selected measure in multiple other measures at a time. You can also now associate measures with currency code or unit values in any aggregation node (not only the default aggregation node) in the calculation view.
Additional Features for Calculation Views	You can now do the following: • Create input parameters derived from scalar functions. • Use improved user interface for creating synonyms. • Use improved user interface for creating analytic privileges. • Create dynamic analytic privileges and hierarchy analytic privileges. • Generate calculation view documentation. • Prune data in union nodes to optimize query execution. • Preview data for intermediate nodes in calculation views. • Perform pattern matching and pattern matching with Cypher query in graph nodes. (Cypher is a registered trademark of Neo Technology, Inc.). • Group related measures.

CDS Graphical Editor

Table 4:

Feature	Description
Creating CDS Views (new)	You can use the graphical modeling tools in SAP Web IDE for SAP HANA to create a design time CDS view. A CDS view is a virtual table based on the dynamic results returned in response to a SQL statement.
Creating Calculated Columns (new)	You can create additional columns in a CDS View. The values of these columns are calculated at runtime based on the result of an expression.
Creating Associations Using Graphical Tools (new)	You can create associations using graphical modeling tools in SAP Web IDE for SAP HANA to define the relationship between entities.

Feature	Description
Import Entity Definitions (new)	You can import elements from other entities and use the definition of imported elements to define the elements of a selected entity.
Support for additional types of data types (new)	• Scalar Types You can create and use scalar types for defining the data types of elements. Scalar types are user-defined scalar data types that reference existing structured types (for example, user-defined) or the individual types (for example, field, type, or context) used in another data-type definition. • Entity Elements For defining the data type of elements in an entity or structure, you can use the data type of elements in other entities. • Structure Elements For defining the data type of elements in an entity or structure, you can use the data type of elements in other structure.

Database Explorer

Table 5:

Feature	Description
The SAP HANA Runtime Tools application is no longer a separate application. It has been integrated into SAP Web IDE for SAP HANA as a perspective that is named the database explorer.	The database explorer contains the same functionality as the old runtime tools application, with the addition of several new features and enhancements. These additions include: • Connecting to SAP HANA databases in addition to HDI containers. With this feature you can view tracing files for your SAP HANA databases. • Analyzing the performance of SQL queries with the SAP HANA SQL analyzer. This new tool, available from the SQL console, allows you to analyze and understand query execution and performance aspects of your SAP HANA database. It can be used to view detailed information on each query and can help evaluate potential bottlenecks for your queries. • Importing and exporting catalog objects to and from HDI containers and databases. • Executing MDX queries using the new MDX console. • Adding generated time data into default, time-related tables to help test and model applications. Also, improvements have been made to the navigation of catalog objects in the database browser tree. A second pane has been added, which lists the items for a chosen database object.

Flowgraph Editor

Table 6:

Feature	Description
Flowgraph Editor (new)	The Flowgraph Editor is now available in SAP Web IDE. It is a modeling tool for assessing, transforming, cleansing, and enriching data.

Feature	Description
Available nodes	The following nodes are available: • Aggregation • Cleanse • Case • Data Mask • Data Source • Data Target • Date Generator • Geocode • History Preserving • Join • Lookup • Map Operation • Procedure (Stored) • Projection (Filter) • Row Generator • Table Comparison • Union
Additional features	Additional features include: • Quick View • More intuitive prompts and messages • License validation • Improved navigation between views • Separate input/output ports • Better recovery from invalid state • Better security based on user rights

Java and Node.js Development

Table 7:

Feature	Description
CDS textual editor	You can now: • Beautify sources, also known as **pretty-print**. • Use code completion for tables and views in the same HDI container. • Report syntax errors in Problems View (see SAP Web IDE features above).

Feature	Description
Node.js development	Includes the following improvements: • The template for new plain node.js modules now contains a sample Jasmine test. • Slight redesign of the Test Results pane and Debugger pane. • On-demand debugging of already running applications (no need to start in debug mode first).
Java Development (new)	You can now create, build, and run Java (WAR) modules.

Text Analysis

Table 8:

Feature	Description
Extensions for Text Analysis	SAP Web IDE now supports developing custom text analysis dictionaries and rules, including: • Creating and maintaining custom text analysis dictionaries and rule sets within SAP Web IDE. • Snippets feature simplifies editing of text analysis dictionaries. • Interactively test custom text analysis dictionaries and rules within SAP Web IDE using text analysis run configurations.

SAP HANA Smart Data Streaming Plugin

Table 9:

Feature	Description
CCL editor	Simplified CCL text editing with new smart data streaming-specific features: • Automatic code completion • Case-insensitive syntax highlighting • Error validation and syntax checking • Code snippets
CCL graphical viewer	You can now view CCL elements in a data flow diagram, and see a list of all elements in your smart data streaming project in an outline view.
Closer connection to the streaming runtime tool	Smart data streaming projects from SAP Web IDE are deployed to the streaming runtime tool for testing, management, and monitoring. You can open the streaming runtime tool directly from the Tools dropdown in the main menu.

For more information, see What's New in SAP HANA Smart Data Streaming (Release Notes).

2.4.4 SAP HANA Spatial (New)

As of SAP HANA Platform 2.0 SPS 00, new features are available in the SAP HANA Spatial.

The following method is new:

- `ST_IntersectsRectPlanar`

Related Information

SAP HANA Spatial Reference

2.4.5 SAP HANA Graph (New and Changed)

As of SAP HANA Platform 2.0 SPS 00, new and changed features are available for the administration of SAP HANA Graph:

- SAP HANA Graph provides two options for executing graph pattern queries. Besides using a graphical pattern editor of the Graph Viewer tool, SAP HANA Graph also allows you to describe the pattern in Cypher query language (Cypher is a registered trademark of Neo Technology, Inc.). The action for pattern matching is MATCH_SUBGRAPHS. With SAP HANA Platform 1.0 SPS 12, the name of the action for pattern matching is GET_ISOMORPHIC_SUBGRAPHS.
- GraphScript has been added to SQLScript. GraphScript is a high-level, domain-specific language. GraphScript is specifically designed to ease the development and integration of complex graph algorithms into the existing data management workflow. At the same time, GraphScript provides competitive execution performance for manually written and tuned graph algorithm implementations in a low-level programming language.

Related Information

SAP HANA Graph Reference

2.4.6 Hierarchy Functions (New)

Hierarchy functions are available as of SAP HANA Platform 2.0 SPS 00:

- SAP HANA provides a public hierarchy SQL interface.
- Core elements are table functions for hierarchy generation and navigation.
- Hierarchy enables ad hoc hierarchical queries accelerated by internal caching.

SAP HANA provides the following table functions:

- HIERARCHY creates a (partial) hierarchy based on parent-child source data, an optional maximum recursion depth input parameter and an orphan handling directive.
- The following functions are provided for navigation inside a hierarchy:
  - HIERARCHY_DESCENDANTS returns all descendants of a set of origin nodes, pre-filtered (optional) by a distance window.
  - HIERARCHY_ANCESTORS returns all ancestors of a set of origin nodes, pre-filtered (optional) by a distance window.
  - HIERARCHY_SIBLINGS returns all siblings of a set of origin nodes.

Related Information

SAP HANA SQL and System Views Reference

2.4.7 Search, Text Analysis, and Text Mining

2.4.7.1 Enabling Search (New)

Batch Processing for Search Rules

Search rules support a batch processing mode. This batch mode allows to compare a set of records given in an input table with a reference set of records with a single call to the search rule set procedure to find any duplicates within these two sets of data. The batch mode is described in section Search Rule Sets in Batch Mode.

The Search Rule Sets Batch mode is introduced to provide the possibility to do mass data processing based on Search Rule Sets.

Dynamic Search Rule Sets

With this feature, you can use the functionality of search rule sets without having the need to first activate the search rule set via the SAP HANA repository or SAP HANA HDI. Within the XML-Tag <ruleset>, you can store a complete rule set definition.

Filtering on Date Data Type

You can now filter on a date data type, be it partial (e.g. 2016/09), decimal or string in faceted navigation applications.

New Similarity Calculation Modes

The fuzzy search option `similarCalculationMode` offers two more modes: `typeAhead` and `searchCompare`. The mode `typeAhead` is used when the user enters the beginning of a string and all strings starting with the user input will be returned. The mode `searchCompare` combines the strength of modes `compare` and `search` while eliminating some of the shortcomings of search mode `search`.

New CDS Annotation

The new `Semantics` annotation contains a subset of the semantic annotations defined as CDS core annotations. The annotations on element level define language codes and dates or time stamps.

Related Information

SAP HANA Search Developer Guide

2.4.7.2 Text Analysis (New and Changed)

Web IDE Extensions for Text Analysis

SAP Web IDE now includes support for developing custom text analysis dictionaries and rules.

- Create and maintain custom text analysis dictionaries and rule sets within the Web IDE.
- Snippets feature simplifies editing of text analysis dictionaries.
- Interactively test custom text analysis dictionaries and rules within the Web IDE using text analysis run configurations.

See chapter *Managing Custom Text Analysis Configurations with XS Advanced* inside the *SAP HANA Text Analysis Developer Guide* for details.

XS Advanced Integration

The standard Node.js packages for the SAP HANA XS Advanced Model now include an API for text analysis. This API provides a convenient JavaScript interface to the text analysis functionality in SAP HANA, and also allows you to perform text analysis on any data, not just data stored in the SAP HANA database for which a full-text index is being created. In addition, the XSJS compatibility layer has been extended to include the XS Classic API for text analysis, making it easier to migrate your existing applications to the XS Advanced Model.

Refer to the SAP HANA Developers Guide for SAP HANA XS Advanced Model for information on how to obtain and deploy these optional Node.js packages.

Text Analysis SQL API

The new `TA_ANALYZE SQL` procedure allows text analysis functions to be performed on arbitrary inputs, not just data stored in the SAP HANA database. The procedure accepts both plain text and binary document input, and provides access to all of the text analysis capabilities in SAP HANA.

Voice of the Customer for Arabic

Voice of the customer (sentiment analysis) functionality is supported for text in Arabic.

Neutral Language Support

Text analysis can now be performed in a "language-neutral" manner on whitespace-delimited languages. This allows text analysis and text mining to be used, at least in a limited manner, with whitespace-delimited languages for which SAP does not currently provide full support (e.g., Irish Gaelic). The language-neutral processing can be requested using the new "UD" language code. This code can be used with the `LANGUAGE`, `LANGUAGE COLUMN`, and `LANGUAGE DETECTION` parameters on the `CREATE FULLTEXT INDEX` SQL statement.

Refer to the SAP HANA Search Developer Guide for more information on how to use the neutral ("UD") language code.

Turkish Parts of Speech for Negated Verbs

The Turkish language modules now define unique part-of-speech tags to identify negated verbs. For example, one form of the first person singular English verb *to like* is *seviyorum* in Turkish. The negated form (*to not like*) is *sevmiyorum*. The new part of speech tag for *sevmiyorum*, which is unique to Turkish, is V-Sg1-Neg, first person singular negated verb.

Expanded Part of Speech Tags in the $TA Table

Expanded part-of-speech information can now be requested from text analysis and accessed via the `$TA` table. This expanded information is not generated by default; it must be explicitly requested using a custom text analysis configuration. The expanded information is provided in a new `$TA` table column called `TA_TYPE_EXPANDED`. (The `TA_TYPE` column continues to provide simplified part-of-speech names for backward-compatibility.)

For example, the English words *run*, *runs*, *running*, and *ran* have the same value in `TA_TYPE`: verb. In the `TA_TYPE_EXPANDED` column however, the respective values are V-Pres, V-Pres-3-Sg, V-PrPart, and V-Past.

Related Information

SAP HANA Text Analysis Developer Guide

2.4.7.3 Text Mining (New and Changed)

XS Advanced Integration

The standard Node.js packages for the SAP HANA XS Advanced Model now include an API for text mining. This API provides a convenient JavaScript interface to the text mining functionality in SAP HANA. In addition, the XSJS compatibility layer has been extended to include the XS Classic API for text mining, making it easier to migrate your existing applications to the XS Advanced Model.

Refer to the SAP HANA Developers Guide for SAP HANA XS Advanced Model for information on how to obtain and deploy these optional Node.js packages.

New DEFAULT Keyword for Text Mining SQL functions

The `NEAREST NEIGHBORS` and `TOP` parameters in the SQL functions for text mining can specify the value as `DEFAULT`, instead of a numeric value. Using `DEFAULT` causes the function to use the same value that was used at text mining initialization (either the original value from the text mining configuration, or an override value specified using the `TEXT MINING CONFIGURATION OVERLAY` parameter or the `initialize` function in the text mining XS classic or advanced APIs).

Related Information

SAP HANA Text Mining Developer Guide

2.4.7.4 SAP File Processing (New)

SAP File Processing is an optional capability of SAP HANA 2.0 that provides a set of HTTP services to extract structured information (text and metadata) from unstructured files.

The rich set of HTTP APIs enables application programmers to integrate SAP File Processing features in client applications.

Before you can start, you have to deploy SAP File Processing with the SAP HANA Database Lifecycle Manager `hdblcm` to your SAP HANA system that is running XS Advanced.

Related Information

SAP File Processing For SAP HANA

2.4.7.5 File Loader (Changed)

The File Loader component was introduced with SAP HANA SPS09. It can be used under SAP HANA 2.0 as well.

> **Note**
>
> However, if you start the development of new projects on SAP HANA 2.0, we recommend the use of the new HTTP services that are delivered with *SAP File Processing for SAP HANA*.

Related Information

SAP File Processing For SAP HANA

2.4.8 SAP HANA Interactive Education (SHINE) for XS Advanced (New and Changed)

SHINE for XSA is a demo content that makes it easy to learn how to build applications on SAP HANA Extended Application Services Advanced Model. This demo content is delivered as a package containing sample data and design-time developer objects for application database tables, views, OData and user interfaces.

As of SAP HANA Platform HANA 2.0 SPS00, the following new features are available in SAP HANA Interactive Education (SHINE) for XS Advanced:

- Java Runtime: the Java implementation has been added to SHINE to showcase Create Read Update Delete (CRUD) operations on oData V4 services implemented by using the new Java OData support for CDS annotations in XS Advanced . This scenario is a part of the new User CRUD tile.
- Automated Role Collection Creation: a role collection needs to be created via XS Advanced Administration tool to access SHINE Data Generator. This procedure now be performed automatically within the SHINE application.
- Cross-Container Access: cross-container access is required to access database artifacts in another HANA Deployment Infrastructure (HDI) container or in a foreign schema(for example, SYS or _SYS_BI). SHINE now has two HDI containers (core-db and user-db) and it showcases how to access user-db artifacts in core-db by defining and granting roles . SHINE also showcases how to access foreign schema objects (for example, view within a SYS schema) via a User-Provided Service (CUPS) in the core-db container.
- Service Replacement: service replacements in the MTA deployment descriptor (mtad.yaml) are required to map real services to logical services. This feature is used in SHINE to map the User-Provided Service (CUPS) to logical service names.
- Schema Config: the Schema Config MTA Deployment Descriptor in allows you to provide an actual schema name for a container instead of the default guid assigned by HDI. This feature is used in SHINE to provide a schema name for the user-db HDI container.
- MTA Deployment Extension Descriptor: it allows you to provide system-specific information only known to the system administrator. MTA Deployment Extension Descriptor (mtaext) is used in SHINE to pass the parameters required for CUPS creation.
- oData Batch: batch requests allow grouping of multiple operations. This implementation in nodejs oData v2 is used in SHINE for creation of multiple users with one request.
- oData Metadata Caching: allows the caching of a metadata document in the browser for a defined time period and the browser no longer needs to make repeated requests to the $metadata document.

2.5 References

2.5.1 SAP HANA SQL and System Views Reference (New and Changed)

As of SAP HANA Platform 2.0 SPS 00, the following new features and changes are available in the SAP HANA SQL syntax and are documented in the SAP HANA SQL and System Views Reference.

SQL Statements (New and Changed)

ALTER DATABASE Statement (changed)	You can now cancel a replica to clean up the system.
ALTER ROLE Statement (new)	Adds or drops the mapping of LDAP groups for a role.
ALTER STATISTICS Statement (new)	Alters existing data statistics objects.
ALTER SYSTEM APPLICATION ENCRYPTION Statement (new)	Manages encryption keys for applications by using the internal data encryption service.
ALTER SYSTEM CLEAR TIMEZONE CACHE Statement (new)	Removes cached timezone definitions.
ALTER SYSTEM CLEAR RESULT CACHE Statement (changed)	Clears the result cache.
ALTER SYSTEM LOG ENCRYPTION Statement (new)	Manages encryption keys for logs by using the internal data encryption service.
ALTER SYSTEM PERSISTENCE ENCRYPTION Statement (new)	Controls whether persistent data is stored on disk in an encrypted or non-encrypted format.
ALTER SYSTEM REFRESH RESULT CACHE Statement (changed)	You can now specify static or dynamic caching.
ALTER SYSTEM REFRESH RESULT CACHE ENTRY Statement (changed)	You can now refresh the result cache entry.
ALTER SYSTEM REMOVE RESULT CACHE ENTRY Statement (changed)	You can now remove the result cache entry.
	Removes any user-defined hints from the system that are associated with the specified statement.ALTER SYSTEM REMOVE STATEMENT HINT Statement (new)

ALTER SYSTEM SET ENCRYPTION ROOT KEYS BACKUP PASSWORD Statement (new)	Creates a password for root key backups.
ALTER SYSTEM STOP DATABASE Statement (new)	Stops all of the services that belong to a database on all hosts.
ALTER TABLE Statement (changed)	You can now apply the midsizelob_threshold system property to a specified column or to all columns of a specified table.
ALTER VIEW Statement (changed)	• You can now specify static or dynamic caching. • ALTER SYSTEM REMOVE STATEMENT HINT Statement (new)The existing ADD CACHE RETENTION clause now supports virtual tables.
ALTER VIRTUAL TABLE Statement (changed)	You can now update a virtual table to reflect metadata changes in the corresponding remote table.
BACKUP DATA Statement (changed)	You can now add a comment to a backup using the COMMENT clause.
CREATE | ALTER FUNCTION Statement (changed)	You can now specify static or dynamic caching.
CREATE | ALTER | VALIDATE | DROP LDAP PROVIDER Statements (new)	Create, alter, validate, and drop LDAP providers.
CREATE AUDIT POLICY Statement (changed)	The following new audit actions have been added: • ALTER APPLICATION ENCRYPTION • ALTER APPLICATION ENCRYPTION ROOT KEY • ALTER LOG ENCRYPTION • ALTER LOG ENCRYPTION ROOT KEY • ALTER ROOT KEYS BACKUP PASSWORD • CREATE GRAPH WORKSPACE • DROP GRAPH WORKSPACE
CREATE FUNCTION Statement (changed)	For scalar functions, you can now specify the DETERMINISTIC keyword to indicate that the function always returns the same value (when using the same input parameters). Deterministic functions are advantageous because they only need to be calculated once; the cached value can be used for subsequent calls to the function.
CREATE PROCEDURE Statement (changed)	• The new MAP_MERGE operator allows you to use the mapper function to unite intermediate result tables. • You can now use the graph script programming language in procedures by specifying the GRAPH option of the LANGUAGE clause.
CREATE ROLE Statement (changed)	You can now create a role and associate it with an LDAP DN.
CREATE STATISTICS Statement (changed)	The enhancements listed below are also available in the new ALTER STATISTICS Statement as well.

	• New REFRESH TYPE clause allows you to control the refresh behavior for a data statistics object. • New ENABLE clause allows you to control whether the data statistics object is used by the optimizer. • New TOPK data statistics object type. • New ACCURACY and PREFIXBITS properties for data statistics objects.
CREATE | ALTER USER Statement (changed)	• You can now configure LDAP group authorization for a user. • ALTER USER statement only: a new GRANT | REVOKE CREATE ANY ON OWN SCHEMA clause allows a user with USER ADMIN to control another user's ability to create objects in their own schema. • ALTER USER statement only: a new GRANT | REVOKE ROLE PUBLIC clause allows a user with USER ADMIN to control whether another user has PUBLIC role.
CREATE VIEW Statement (changed)	• You can now specify static or dynamic caching. • Use association propagation by specifying the WITH ASSOCIATIONS clause.
CREATE VIRTUAL PROCEDURE Statement (new)	You can now create virtual procedures.
EXPORT Statement (changed)	Two new export options, STATISTICS ONLY and NO STATISTICS, allow you to control the export of data statistics objects.
GRANT Statement (changed)	• The new CREATE VIRTUAL PROCEDURE object privilege authorizes access to create custom virtual procedures. • The new ENCRYPTION ROOT KEY ADMIN system privilege authorizes all commands related to management of root keys.
IMPORT Statement (changed)	Two new import options, STATISTICS ONLY and NO STATISTICS, allow you to control the import of data statistics objects.
IMPORT FROM Statement (changed)	Two new import options, STATISTICS ONLY and NO STATISTICS, allow you to control the import of data statistics objects.
MERGE INTO Statement (new)	Merges data into an existing column store table.
RECOVER DATABASE Statement (changed)	You can now specify a distinct destination for backups of the backup catalog.
SELECT Statement (changed)	The FOR UPDATE clause now supports virtual tables.
UNLOAD Statement (changed)	A new PARTITION clause unloads the specified partition(s) from memory.

SQL Functions (New and Changed)

ADD_MONTHS_LAST Function (new)	Computes the specified date plus the specified number of months, with the output date being the last day of the month if the input date is the last day of the month, even if those two dates differ.
ENCRYPTION_ROOT_KEYS_EXTRACT_KEYS Function (new)	Extracts root keys and sends them to a client session as a CLOB.
GRANT Statement (changed)	Support has been added for the new ENCRYPTION ROOT KEY ADMIN system privilege.
HIERARCHY Function (new)	Generates a hierarchy.
HIERARCHY_ANCESTORS Function (new)	Returns all ancestors of a set of start nodes from a hierarchy.
HIERARCHY_DESCENDANTS Function (new)	Returns all descendants of a set of start nodes from a hierarchy.
HIERARCHY_SIBLINGS Function (new)	Returns all siblings of a set of start nodes, including the start nodes, from a hierarchy.
JSON_QUERY Function (new)	Extracts a JSON text from a JSON text using a SQL/JSON path expression.
JSON_TABLE Function (new)	Queries a JSON text and presents it as a relational table.
JSON_VALUE Function (new)	Extracts an SQL value of a predefined type from a JSON value.
NEWUID Function (new)	Creates a unique identifier within the database.
XMLEXTRACT Function (new)	Returns an XML element matching the specified XPath query.
XMLEXTRACTVALUE Function (new)	Returns an XML value matching the specified XPath query.

System Views (New and Changed)

APPLICATION_ENCRYPTION_KEYS System View (new)	Provides information about encryption keys used by applications.
AUDIT_LOG System View (changed)	• The new XS_APPLICATION_USER_NAME column specifies the name of the XS application user. • Previously, the AUDIT_ACTION column was VARCHAR(40). Now, it is VARCHAR(64).

AUDIT_POLICIES System View (changed)	Previously, the EVENT_ACTION column was VARCHAR(32). Now, it is VARCHAR(64).
DATA_STATISTICS System View (changed)	New DATA_SOURCE_STORAGE_TYPE, REFRESH_TYPE, IS_ENABLED, and LAST_REFRESH_REASON columns to support additional data statistics functionality.
ENCRYPTION_ROOT_KEYS System View (changed)	New ROOT_KEY_STATUS column specifies the key state.
FUNCTIONS System View (changed)	The new CREATE_TIME column specifies the creation time of the function.
GRANTED_ROLES System View (changed)	New IS_GRANTED_BY_LDAP column specifies whether the role is granted by LDAP.
HINT Details (changed)	The new RESULT_LAG hint for Active/Active (read-enabled) routes a statement to a secondary system on an Active/Active (read-enabled) system.
LDAP_PROVIDER_URLS System View (new)	Lists all LDAP provider URLs.
LDAP_PROVIDERS System View (new)	Lists all LDAP providers.
LDAP_USERS System View (new)	Lists all LDAP users.
M_ASYNCHRONOUS_TABLE_REPLICAS (deprecated)	This view is now deprecated.
M_BACKUP_CATALOG_FILES System View (changed)	In the case of a log backup, the new LOG_SEGMENT_COUNT column specifies the number of log segments contained in the backup.
M_BACKUP_CONFIGURATION System View (changed)	• The new BACKINT_CATALOG_BACKUP_PATH column specifies the directory for backint-based catalog backups. • The new FILE_CATALOG_BACKUP_PATH column specifies the directory for file-based catalog backups. • The new LOG_BACKUP_TIMEOUT column specifies the log backup timeout. • The new LOG_BACKUP_INTERVAL_MODE column specifies the log backup interval mode.
M_CONNECTIONS System View (changed)	There is a new SOURCE_SITE_LOGICAL_CONNECTION_ID column, which is the logical connection ID of the origin site. Additionally, the IS_HISTORY_SAVED column is deprecated. Do not use this value.
M_CS_LOB_SPACE_RECLAIMS System View (new)	Provides information regarding executed LOB garbage collection runs.
M_DELTA_MERGE_STATISTICS System View (changed)	There is a new CRITICAL value, which is triggered based on a critical decision function, has been added to the MOTIVATION column.

M_DISKS System View (changed)	The data type for the USAGE_TYPE column has changed from VARCHAR(32) to VARCHAR(64) and a new usage type, CATALOG_BACKUP, has been added.
M_DYNAMIC_RESULT_CACHE System View (new)	Lists statistics for the dynamic result cache.
M_DYNAMIC_RESULT_CACHE_EXCLUSIONS System View (new)	Lists cache exclusions of the dynamic result cache.
M_ENCRYPTION_OVERVIEW System View (new)	Reports the encryption status for all data at rest where encryption is supported.
M_EXECUTED_STATEMENTS System View (changed)	The new SCHEMA_NAME column shows the name of the schema in whose context the statement is executed.
M_EXPENSIVE_STATEMENTS System View (changed)	The new SCHEMA_NAME column shows the name of the schema in whose context the statement is executed.
M_LANDSCAPE_HOST_CONFIGURATION System View (changed)	The new WORKER_CONFIG_GROUPS and WORKER_ACTUAL_GROUPS columns assign hosts to logical worker groups.
M_LOAD_HISTORY_SERVICE System View (changed)	The new MUTEX_COLLISION_COUNT column displays the number of collisions on mutexes while the new READ_WRITE_LOCK_COLLISION_COUNT column displays the number of collisions on read/write locks. Additionally, the TRANSACTION_ID_RANGE column has been removed.
M_MEMORY_OBJECTS System View (changed)	The following new columns have been added: • MOVE_IN_COUNT - The total number of objects moved in from a different statistic. • MOVE_IN_SIZE - The total size of objects moved in from a different statistic. • MOVE_OUT_COUNT - The total number of objects moved out to a different statistic. • MOVE_OUT_SIZE - The total size of objects moved out to a different statistic.
M_REMOTE_STATEMENTS System View (changed)	The new REMOTE_STATEMENT_DETAILS column specifies the statement details.
M_SECURESTORE System View (deprecated)	The M_SECURESTORE System View is now deprecated.
M_SQL_PLAN_STATISTICS System View (new)	Provides statistics of a live or evicted individual execution plan.
M_SYSTEM_REPLICATION_MVCC_HISTORY System View (new)	Displays the global MVCC timestamp history in the secondary site for system replication.
M_TABLE_LOB_STATISTICS System View (changed)	The new LOB_STORAGE_TYPE column returns a packed LOB container or file LOB.
M_TABLE_STATISTICS System View (changed)	The new MERGE_COUNT column returns the count of merge into statements for the table.

M_WORKLOAD_CAPTURES System View (changed)	The new PROGRESS column displays the progress of the load process used for Workload Analyzer based on engine instrumentation.
M_WORKLOAD_REPLAYS System View (changed)	The new REPLAY_NAME and REPLAY_DESCRIPTION columns display the user-specified name and description of the replayed workload.
PROCEDURES System View (changed)	The new CREATE_TIME column specifies the creation time of the procedure.
ROLE_LDAP_GROUPS System View (new)	Lists all of the LDAP group roles.
SCHEMAS System View (changed)	The new CREATE_TIME column specifies the creation time of the schema.
SEQUENCES System View (changed)	The new CREATE_TIME column specifies the creation time of the sequence.
STATEMENT_HINTS System View (changed)	New SYSTEM_HINT_STRING column displays when a system hint conflicts with an existing hint.
SYNONYMS System View (changed)	The new CREATE_TIME column specifies the creation time of the synonym.
TABLES System View (changed)	The new CREATE_TIME column specifies the creation time of the table.
USERS System View (changed)	New AUTHORIZATION_MODE column specifies the authorization mode of a user, which can be either local or LDAP.
VIEWS System View (changed)	• New cache types for HAS_CACHE column. • New CREATE_TIME column specifies the creation time of the view.

Privileges (New and Changed)

LDAP ADMIN privilege (new)	Authorizes administration of LDAP providers.
ENCRYPTION ROOT KEY ADMIN	Authorizes administration of encryption root keys.
CREATE VIRTUAL PACKAGE privilege (new)	Allows creation of virtual packages for objects such as functions and procedures. The CREATE VIRTUAL PACKAGE privilege replaces the CREATE VIRTUAL FUNCTION PACKAGE privilege, which is now deprecated.
CREATE VIRTUAL FUNCTION PACKAGE privilege (deprecated)	The CREATE VIRTUAL FUNCTION PACKAGE privilege is deprecated. Use its replacement, CREATE VIRTUAL PACKAGE, instead.

2.5.2 SAP HANA Client Interfaces (New and Changed)

As of SAP HANA Platform 2.0 SPS 00, the SAP HANA Client Interface Programming Reference Guide contains documentation for the following new and changed features.

BINTEXT_IS_NCLOB ODBC Connection Property (New)

Determines which SQL type is used to describe BINTEXT columns.

Client Support for Additional Operating Systems (New)

The SAP HANA client is now supported on Linux on PowerPC (Little Endian) and Windows Server 2016.

Client-Side Support for Active/Active (Read Enabled) (New)

Active/Active (read enabled) allows SAP HANA system replication to support read-only access to the secondary system. The SQL Console in the SAP HANA Database Explorer is unable to use Active/Active (read enabled).

Node.js Client (New)

A Node.js driver is available for download. See 2391549 for the download location. The Node.js JavaScript API can be used to connect to SAP HANA databases, issue SQL queries, and obtain result sets.

sessionVariable Option (New)

Use the new sessionVariable option to set session variables when connecting to your database via JDBC or ODBC.

API Support for Query Timeout (New)

You can set SQL_ATTR_QUERY_TIMEOUT on an ODBC Statement Handle via SQLSetStmtAttr(). The client now supports the Microsoft ADO.NET Command.CommandTimeout property. Additionally, SAP HANA HDBSQL now supports the -qto (/querytimeout) option to set a server-side timeout for all SQL operations.

New Default Value for SPATIALTYPES (Changed)

The SPATIALTYPES connection property has a new default value of 2.

New Default Value for emptyTimestampIsNull (Changed)

The emptyTimestampIsNull JDBC connection property now defaults to TRUE rather than FALSE.

Empty Timestamp Is Null Connection Property Supported for ODBC and ADO.NET

Support has been added for the Empty timestamp is null ADO.NET connection parameter, and the EMPTYTIMESTAMPISNULL ODBC connection property. When enabled, both these connection options specify that DAYDATE, SECONDTIME, SECONDDATE, and LONGDATE values inserted as empty strings are returned as NULLs.

SAP HANA Clients Only Support SPS 10 and Higher (Changed)

SAP HANA clients support connecting to SAP HANA 1.0 SPS 10 and higher servers. Connecting to SAP HANA 1.0 SPS 9 and earlier servers results in an error.

JDBC Driver Uses JDK 1.8 (Changed)

The SAP HANA JDBC driver now includes support for the Java Development Kit (JDK) 1.7 (JDBC 4.1) and JDK 1.8 (JDBC 4.2) APIs. Previously, support was limited to the JDK 1.6 (JDBC 4.0) APIs. The minimum JDK version supported by the SAP HANA JDBC driver is now JDK 1.6 (JDBC 4.0). Previously, it was JDK 1.4 (JDBC 3.0).

New ODBC Data Type SQL_TYPE_DST_GEOMETRY for SPATIALTYPES ODBC Connection Property

Both ST_POINT and ST_GEOMETRY columns are described with this type, by default.

2.5.3 SAP HANA Predictive Analysis Library (New and Changed)

As of SAP HANA Platform 2.0, new and changed features for the Predictive Analysis Library (PAL) are available.

General

In the new release of PAL, it is possible to run parallel execution of selected PAL functions with partition table as input from SAP HANA SQLScript using the "WITH HINT (PARALLEL_BY_PARAMETER_PARTITIONS ())" clause. The main scenario is to run scoring function with a trained model from PAL supervised learning algorithms, such as decision trees and random forest. Given a partitioned data table, the parallel execution of the scoring function will be initiated on each data partition, sharing the same trained model and other function parameters from the other unpartitioned tables. This feature works on both single-node and multiple-node SAP HANA environment. An example is illustrated below:

```
CREATE COLUMN TABLE PAL_C45_DATA_TBL (
    ...
)
GROUP TYPE "MULTI_NODE"
GROUP NAME "NODE_ALL"
PARTITION BY 'ROUNDROBIN 8';
...
CALL PAL_DT_SCORING_PROC(PAL_C45_DATA_TBL, PAL_C45_CONTROL_TBL,
PAL_C45_TREEMODEL_TBL, ?) WITH HINT (PARALLEL_BY_PARAMETER_PARTITIONS(p1));
```

New Algorithms

Generalized Linear Models

Generalized linear models (GLM) is used to regress responses satisfying exponential distributions, for example, Normal, Poisson, Binomial, Gamma, inverse Gaussian, etc. Compared with the classical linear regression, GLM regresses a linear predictor η instead of the response itself. The linear predictor and the expected response μ is connected via link function, $\eta=g(\mu)$ or $\mu=g^{-1}(\eta)$, which guarantees that the regressed responses are in the valid range. Possible link functions are identity, log, reciprocal, logit, probit, complementary log-log, and inverse square.

Given observations y_i, $i=1,2,\cdots,n$ of response, and covariates x_i, $i=1, 2,\cdots, n$, where x_i is a p-dimensional vector, the coefficients are to estimated,

$$g(y_i)=\beta_0+x_i^T\beta$$

where β_0 is the intercept, and β is a p-dimensional vector, corresponding to the coefficients with respect to the covariates.

Cox Proportional Hazard Model

Cox proportional hazard model (CoxPHM), a special generalized linear model, is a well-known realization of survival model demonstrating the failure/death at some time. It has the following generalization:

$$h(t,x)=h_0(t,\alpha)\exp(x^T\beta)$$

where h_0 is called baseline hazard function, and α is a parameter influencing the baseline hazard function. In contrast to standard generalized linear models, CoxPHM does not have an intercept, as it is eliminated by division.

Sequential Pattern Mining

Given a database of sequences each of which consists of a list of transactions ordered by timestamp, sequential pattern mining problem is to discover all frequent sequential patterns with a user-defined threshold (i.e. support). For example, 7% of customers buy travel insurance two days after they buy international flight ticket. In PAL, state-of-the-art algorithm is implemented which is efficient for large search space and long pattern dense dataset.

Gradient Boosting Decision Tree

Gradient boosting and decision tree (GBDT) is an ensemble machine learning technique for regression and classification problems. GBDT builds the model in a stage-wise fashion and allows optimization of some loss functions. For each iteration/week model, negative gradient (e.g. residual) is the training sample for new classification/regression tree to fit and sum up the output values of all trees to get the final score. In the first version, PAL GBDT supports mixed feature types, both classification and regression, square loss and logistic loss, L1 and L2 regularization, and model evaluation and cross-validation.

Linear Discriminant Analysis

Suppose that you are given an $N\times D$ (dataset) matrix X with an $N\times 1$ (label) vector Y, each row $x^{(i)}$ of X is a D-dimensional sample belonging to class y_i and the total number of classes is C. Linear discriminant analysis (LDA) assumes that the samples within each class k obey normal distribution with different means μ_k but same covariance matrix Σ:

$$P(x|y=k)\sim N(\mu\_k,\Sigma),$$

i.e. $$P(x|y=k)=\frac{1}{(2\pi)^{D/2}|\Sigma|^{1/2}}\exp\left\{-\frac{1}{2}(x-\mu_k)^T\Sigma^{-1}(x-\mu_k)\right\}$$

Under this modeling assumption, you can fit the model parameters $\mu_1,\ldots,\mu_C$ and Σ by estimating the training dataset.

The implementation of LDA in PAL includes three functions: LDAFIT, LDACLASSIFY and LDAPROJECT, where the main function is LDAFIT. It performs LDA of a given dataset X with label Y and returns:

- A classifier which can be used in LDACLASSIFY to classify further unlabeled data;
- A projection model which can be used in LDAPROJECT to reduce the dimension of dataset X by projection. The projected data can be used for visualization or further classification.
- Empirical prior of each class and some other basic information.

Fast Fourier Transform

This function realized discrete Fourier transform (DFT). Consider that a sequence of N complex elements $x_0, x_1, \cdots, x_{N-1}$, can be transformed into an N-periodic sequence of complex numbers,

$$X_k=F(x)[k]=\sum_{n=0}^{N-1} x_n \cdot \exp(-i2\pi kn/N), \quad k\in\mathbb{Z}$$

which is the so-called discrete Fourier transform (DFT). For simplicity, as it is N-periodic, $k=0,1,\cdots,N-1$ is often adopted.

Likewise, x_n can be transformed back from X_k via inverse discrete Fourier transform (IDFT),

$$x_n=F^{-1}(X)[n]=\frac{1}{N}\sum_{k=0}^{N-1} X_k \cdot \exp(i2\pi nk/N), n\in\mathbb{Z}$$

Also, the inverse transform is N-periodic, and generally $n=0,1,\cdots,N-1$ is used.

Executing DFT straightforwardly will take a time complexity of $O(N^2)$. Danielson-Lanczos formula shows that the discrete Fourier transform can be computed in $O(N\log_2 N)$, which is the so-called fast Fourier transform (FFT).

However, this formula requires that the length of sequence is of order of 2, which is not satisfied generally. In PAL, chirp z-transform algorithm is employed to deal with the situation that length of sequence is not exactly power of 2, taking advantage of convolution, which assures $O(N\log_2 N)$ time complexity.

Data Summary

Data summary provides an overview of the data set, which reveals the most important information of each variable. It is able to handle both continuous and categorical variables even with null value in the data set.

For any continuous variable, if one denotes the data in one column as $x_i\,(i=1,\ldots,n)$, data summary returns the following statistical quantities of x_i. It is worth noting that these statistical quantities are calculated assuming that the data is a sample instead of a population.

For a categorical variable, this algorithm returns the occurrence and the percentage of each category. Note that null is also treated as a category for the categorical variable.

Correlation Function for Time Series

A correlation function gives the statistical correlation between random variables. If one considers the correlation function between random variables and itself at different time points, then this is often referred to as an auto-correlation function (ACF). Correlation functions of different random variables are sometimes called cross-correlation functions (CCF). Correlation functions used in astronomy, financial analysis, econometrics, and statistical mechanics differ only in the particular stochastic processes they are applied to.

PAL considers the sample correlation function only. Given a variable with observations $x_1, x_2, \cdots, x_n$, the sample auto-covariance function (ACVF) at lag h is

$$\hat{\gamma}(h):=\frac{1}{n}\sum_{t=1}^{n-|h|}\left(x_{t+|h|}-\bar{x}\right)\left(x_t-\bar{x}\right), \quad -n<h<n$$

And its corresponding auto-correlation function is

$$\hat{\rho}(h)=\frac{\hat{\gamma}(h)}{\hat{\gamma}(0)}, \quad -n<h<n$$

Evidently, $\hat{\gamma}(h)=\hat{\gamma}(-h)$ and $\hat{\rho}(h)=\hat{\rho}(-h)$.

In contrast with auto-correlation function, partial auto-correlation function (PACF) measures the relationship between x_t and x_{t-k} after removing the effects of other time lags 1,2,⋯,k-1, which is very useful in time series forecast. PACF can be solved iteratively with Durbin-Levinson algorithm.

The cross-covariance function and cross-correlation function between series x and y, likewise, has definitions

$$\gamma_{XY}(h)=E[(x_t-\mu_X)(y_{t+h}-\mu_Y)]$$

$$\rho_{XY}(h)=E[(x_t-\mu_X)(y_{t+h}-\mu_Y)]/(\sigma_X\sigma_Y)=\gamma_{XY}(h)/(\sigma_X\sigma_Y)$$

where μ_X and σ_X are the mean and the standard deviation of the process x_t, which are constant over time due to stationary; and similarly for y_t, respectively.

Condition Index

Condition index is used to detect collinearity problem between independent variables which are later used as predictors in a multiple linear regression model. This method firstly employs the principle component analysis (PCA) to find out the eigenvalues and the corresponding eigenvectors of the matrix formed by independent variables, then calculates the condition index and variance decomposition proportion. For example, if you feed in a data matrix $(X_{ij})_{n\times p}$, this function gets singular values $\sigma_i \ (i=1,\ldots,p)$ and the V matrix $(V_{kj})_{p\times p}$ from the singular value decomposition, then proceeds to calculate condition index

$$CI_i=\sigma_{max}/\sigma_i,$$

and the condition number

$$CN=\sigma_{max}/\sigma_{min},$$

which is the largest value of condition indices. Note that a diagonal matrix $D=diag(\sigma_1,\ldots,\sigma_p)$, you can calculate variance decomposition proportions $\pi_{jk}=\phi_{jk}/\phi_k$, where $\phi_{kj}=V_{kj}^2/\sigma_j^2$ and $\phi_k=\sum_{j=1}^{p}V_{kj}^2/\sigma_j^2$. This quantity illustrates how much variance of the estimated coefficient for a variable can be explained by the k-th principle component.

Generally speaking, a dataset with condition number larger than 30 indicates the existence of a possible collinearity. Variables which are involved in collinearity have variance decomposition proportions greater than 0.5.

Enhanced Algorithms

Multiple Linear Regression

- Added Cholesky decomposition as the new algorithm to solve the linear equation.
- Added ADMM (alternating direction method of multipliers) as the new algorithm to solve elastic net regularization problem.
- Enabled categorical variable support.
- Added optional statistical tests: Durbin-Watson test, Ramsey RESET test, Breusch-Pagan test, and Kolmogorov-Smirnov normality test.
- Enhanced multi-thread strategy when using QR decomposition.

Principal Component Analysis (PCA)

- Significant performance enhancement

Latent Dirichlet Allocation (LDA)

- Significant performance enhancement

Random Distribution Sampling

- Added Poisson distribution.

Random Forest

- Added parameter NODE_SIZE to control the minimum number of records in leaf node.
- Added parameter CALCULATE_OOB to control if OOB error is calculated.
- Added parameter SPLIT_THRESHOLD to set the threshold for Gini index to control tree growing.
- Exposed parameter THREAD_NUMBER to allow explicit control over the multi-threading setting.
- Exposed parameter SEED to set the seed for random number generator.

Forecast Smoothing

- Enhanced model selection logic.
- Added range limit of tuning parameters (e.g. ALPHA, BETA, GAMMA).
- Added prediction interval of forecast.

C4.5 Decision Tree

- Default value of parameter SPLIT_THRESHOLD changed to 1e-5.

CART Decision Tree

- Default value of parameter SPLIT_THRESHOLD changed to 1e-5.

Seasonality Test

- Outputs seasonal and trend components in additional to random component for seasonality test.
- Enabled multi-threading.

Trend Test

- Added additional statistics as output.

K-means, K-medians, K-medoids

- Default value of parameter EXIT_THRESHOLD changed to 1.e-6.

Auto ARIMA

- Enabled multi-threading for exhaustive parameter search.

Support Vector Machine (SVM)

- Default value of parameter RBF_GAMMA changed to 1.0 / number of features.

2.5.4 SAP HANA SQLScript Reference (New and Changed)

As of SAP HANA Platform 2.0 SP00, the following new features and changes are available in SAP HANA SQLScript and are documented in the SAP HANA SQLScript Reference.

- Enhancement of SQLScript Query Export: nested calls, DMLs, DDLs and dynamic SQL can be now exported as well
- Support of explicit parallelization of read-write procedure calls
- Size operator for tabular arguments
- Initialization of declared table variables
- Scalar UDF result cache
- Support for synonyms in HEADER ONLY-artifacts
- MAP_MERGE operator for evaluating each input in parallel and union all intermediate results
- BIND_AS functions for parameterization control.

2.5.5 SAP HANA Core Data Services (CDS) Reference (New and Changed)

As of SAP HANA Platform 2.0 SP00, the following new features and changes are documented in the SAP HANA Core Data Services (CDS) Reference.

The *SAP HANA Core Data Services (CDS) Reference* for SAP HANA 2.0 SPS 00 includes information for CDS support in both the XS classic **and** the XS advanced run-time environments.

For SAP HANA Platform 2.0 SPS 00, SAP HANA XS advanced provides the following updates and new features for Core Data Services (CDS), which are documented in the *SAP HANA Core Data Services (CDS) Reference*:

- Support for subqueries
- Support for `LIMIT/OFSET` in queries
- Support for the clause `GENERATED ALWAYS AS <expression clause>` in an entity definition
- Support for the clause `GENERATED [ALWAYS | BY DEFAULT] AS IDENTITY` in an entity definition
- Java OData support for CDS
- Support for DCL-based access policies in CDS
  CDS access-policy documents are coded in the Data Control Language (DCL). In a CDS access-policy document, you can create CDS roles and CDS aspects for instance-based authorizations.
- Support for CDS aspects
  CDS aspects associate an attribute with permitted values of a user.
- Support for CDS roles
  CDS access-policy documents contain a set of CDS role definitions coded in the Data Control Language (DCL). You can use CDS roles to create instance-based authorizations.

2.5.6 SAP HANA Analytics Catalog (BIMC Views) Reference (New)

As of SAP HANA Platform 2.0 SP00, the new SAP HANA Analytics Catalog (BIMC Views) Reference is available in the reference library.

The *SAP HANA Analytics Catalog (BIMC Views) Reference* describes the SAP HANA Analytics Catalog, which consists of tables and views with the prefix "`BIMC`" located in the schema `_SYS_BI`. The catalog contains metadata required by analytic clients such as Analysis Office and Business Objects Cloud. The metadata is also required for access via Multi-Dimensional Expressions (MDX).

The SAP HANA Analytics Catalog is populated with metadata when the following analytic models are deployed:

- Calculation views
- Analytic views
- Attribute views (the column `CUBE_NAME` is filled in with the '`$ATTRIBUTE`' value for these models)

3 Related Information

Here you find related information like important SAP HANA SAP Notes.

3.1 Important SAP Notes

Read the following SAP Notes before you start the installation. These SAP Notes contain the latest information about the installation, as well as corrections to the installation documentation.

Make sure that you have the most up-to-date version of each SAP Note, which you can find on SAP Service Marketplace at https://service.sap.com/notes.

SAP Note Number	Title
1514967	SAP HANA: Central Note
2380229	SAP HANA Platform 2.0 - Central Note
2380257	SAP HANA Platform 2.0 SPS 00 Release Note
2363299	SAP HANA 2.0 SPS 00 Database Revision 2.00.000
2372809	Guideline for upgrading a HANA 1 system into HANA 2
1948334	SAP HANA Database Update Paths for Maintenance Revisions
2378962	SAP HANA 2.0 Revision and Maintenance Strategy
2380291	SAP HANA 2.0 Cockpit Central Release Note
2374310	HANA Cockpit
2380264	SAP Web IDE for SAP HANA 2.0 SPS 00 - Central Release Note
2078425	Troubleshooting note for SAP HANA platform lifecycle management tool hdblcm
2000003	FAQ: SAP HANA
1944799	SAP HANA Guidelines for SLES Operating System
2009879	SAP HANA Guidelines for Red Hat Enterprise Linux (RHEL)

SAP Note Number	Title
2292690	SAP HANA DB: Recommended OS settings for RHEL 7.2
2055470	HANA on POWER Planning and Installation Specifics - Central Note
2218464	Supported products when running SAP HANA on IBM Power Systems
2235581	SAP HANA: Supported Operating Systems
52505	Support after end of mainstream/extended maintenance
1681092	Support for multiple SAP HANA databases on a single SAP HANA appliance
1976729	Application Component Hierarchy for SAP HANA
1661202	Support for multiple applications on SAP HANA
1828400	SAPUI5 tools disappeared after updating HANA Studio
1927949	Standard Behavior for SAP Logon Tickets
1577128	Supported clients for SAP HANA
1514966	SAP HANA: Sizing SAP HANA Database
1637145	SAP BW on HANA: Sizing SAP HANA Database
1793345	Sizing for Suite on HANA
1597355	Swap space recommendation for Linux For the SAP HANA system there are no special requirements regarding swap space.

Check the current SAP Notes for the various parts of SAP HANA by searching for any of the following application areas:

SAP HANA Native Applications

- *HAN-APP* SAP HANA Native Applications
- *HAN-APP-DCI* SAP HANA Data Center Intelligence
- *HAN-APP-DWS* SAP HANA Data Warehouse Services
- *HAN-APP-DWS-DDO* SAP HANA Data Distribution Optimizer
- *HAN-APP-DWS-DLM* SAP HANA Data Lifecycle Manager
- *HAN-APP-IOA* SAP IT Operations Analytics

SAP HANA Application Services

- *HAN-AS* SAP HANA Application Services
- *HAN-AS-INA* SAP HANA InA Tools and Infrastructure

- *HAN-AS-INA-FL* SAP HANA InA File Loader
- *HAN-AS-INA-SVC* SAP HANA InA Service
- *HAN-AS-INA-UI* SAP HANA InA Toolkit, Fiori Search UI
- *HAN-AS-MDS* SAP HANA Multidimensional Service
- *HAN-AS-RPO* SAP HANA Repository
- *HAN-AS-RST* SAP HANA Development Environment REST API
- *HAN-AS-RUL* SAP HANA Rules Framework
- *HAN-AS-XS* SAP HANA Extended Application Services
- *HAN-AS-XS-ADM* SAP HANA XS Administration
- *HAN-AS-XS-JOB* SAP HANA XS Scheduled Jobs
- *HAN-AS-XSA* SAP HANA XS Basis Applications
- *HAN-AS-XSA-LIB* Please use HAN-AS-XS
- *HAN-AS-XSA-SHN* SAP HANA Interactive Education (SHINE Model)
- *HAN-AS-XSA-TM* SAP HANA Task management
- *HAN-AS-XSA-WF* SAP HANA Workflow

SAP HANA Accelerator for SAP ASE

- *HAN-ASE* SAP HANA Accelerator for SAP ASE

SAP HANA Adaptive Transaction Processing

- *HAN-ATP* SAP HANA Adaptive Transaction Processing

SAP HANA Cockpit

- *HAN-CPT* SAP HANA Cockpit
- *HAN-CPT-ADM* SAP HANA Administration Core
- *HAN-CPT-ASE* SAP HANA Accelerator for SAP ASE Administration
- *HAN-CPT-BAC* SAP HANA Backup and Recovery
- *HAN-CPT-CNR* SAP HANA Workload Capture and Replay
- *HAN-CPT-CPT1* SAP HANA Cockpit version 1
- *HAN-CPT-CPT2* SAP HANA Cockpit version 2
- *HAN-CPT-CPT2-ADM* SAP HANA Administration Core (Cockpit Version 2)
- *HAN-CPT-CPT2-ASE* SAP HANA Accelerator for SAP ASE Administration (Cockpit 2)
- *HAN-CPT-CPT2-BAC* SAP HANA Backup and Recovery (Cockpit Version 2)
- *HAN-CPT-CPT2-CNR* SAP HANA Capture and Replay (Cockpit Version 2)
- *HAN-CPT-CPT2-DYT* SAP HANA Dynamic Tiering Administration (Cockpit Version 2)
- *HAN-CPT-CPT2-PM* SAP HANA Performance Monitoring (Cockpit Version 2)
- *HAN-CPT-CPT2-SA* SAP HANA SQL Analyzer (Cockpit Version 2)
- *HAN-CPT-CPT2-SDA* SAP HANA Smart Data Access (Cockpit Version 2)
- *HAN-CPT-CPT2-SDS* SAP HANA Smart Data Streaming Administration (Cockpit 2)
- *HAN-CPT-CPT2-SEC* SAP HANA Cockpit Security (Cockpit Version 2)
- *HAN-CPT-CPT2-SR* SAP HANA System Replication (Cockpit Version 2)
- *HAN-CPT-CPT2-SYN* SAP HANA remote data sync (Cockpit Version 2)
- *HAN-CPT-CPT2-WA* SAP HANA Workload Analyzer(Cockpit Version 2)
- *HAN-CPT-DCC* SAP DB Control Center
- *HAN-CPT-DP* Please use HAN-DP-SDI

- *HAN-CPT-DYT* SAP HANA Dynamic Tiering Administration
- *HAN-CPT-SDS* SAP HANA Smart Data Streaming Administration
- *HAN-CPT-SEC* SAP HANA Cockpit Security
- *HAN-CPT-SYN* SAP HANA remote data sync Cockpit
- *HAN-CPT-WA* HANA Workload Analyzer
- *HAN-CPT-XS* Please use HAN-AS-XS-ADM

SAP HANA Database

- *HAN-DB* SAP HANA Database
- *HAN-DB-AFL* Please use subcomponents, see SAP Note 2198403
- *HAN-DB-AFL-DQ* SAP HANA Data Quality Library
- *HAN-DB-AFL-GEN* SAP HANA AFL Shipment and general AFL topics
- *HAN-DB-AFL-HIE* SAP HANA AFL Hierarchies
- *HAN-DB-AFL-PAL* SAP HANA Predictive Analysis Library
- *HAN-DB-AFL-POS* SAP HANA On-Shelf Availability
- *HAN-DB-AFL-SAL* SAP HANA Self Service Analytics Library
- *HAN-DB-AFL-SCA* SAP HANA Supply Chain Algorithm Library
- *HAN-DB-AFL-SOP* SAP HANA Sales and Operations Planning
- *HAN-DB-AFL-TEC* SAP HANA AFL Technology and SDK
- *HAN-DB-AFL-UDF* SAP HANA Unified Demand Forecast
- *HAN-DB-BAC* SAP HANA Backup and Recovery
- *HAN-DB-CDS* SAP HANA Activation of HDBDD-files (CDS Definitions)
- *HAN-DB-CLI* SAP HANA Clients (JDBC, ODBC)
- *HAN-DB-DI* HANA Deployment Infrastructure (HDI)
- *HAN-DB-ENG* SAP HANA DB Engines
- *HAN-DB-ENG-BW* SAP HANA BW Engine
- *HAN-DB-ENG-GPH* SAP HANA Graph Engine
- *HAN-DB-ENG-IM* Please use HAN-DB-SDQ
- *HAN-DB-ENG-PLE* SAP HANA Planning Engine
- *HAN-DB-ENG-SPA* SAP HANA Spatial Engine
- *HAN-DB-ENG-TXT* SAP HANA Text Engine
- *HAN-DB-EPM* SAP HANA Enterprise Performance Management Platform
- *HAN-DB-EPM-PLT* SAP HANA EPM Platform
- *HAN-DB-EPM-XSL* SAP HANA EPM XSJS library
- *HAN-DB-HA* SAP HANA High Availability
- *HAN-DB-LVC* SAP HANA integrated liveCache
- *HAN-DB-MDX* SAP HANA MDX Engine/Excel Client
- *HAN-DB-MON* SAP HANA Monitoring
- *HAN-DB-PER* SAP HANA Database Persistence
- *HAN-DB-R* SAP HANA Integration with R
- *HAN-DB-SCR* SAP HANA SQL Script
- *HAN-DB-SDA* SAP HANA Smart Data Access
- *HAN-DB-SDQ* Information Mgmt Platform smart data quality
- *HAN-DB-SEC* SAP HANA Security and User Management

Dynamic Edge Processing

- *HAN-DEP* Dynamic Edge Processing
- *HAN-DEP-CTE* Core to Edge processing

SAP HANA Data Provisioning Services

- *HAN-DP* SAP HANA Data Provisioning Services
- *HAN-DP-DS* SAP Data Services
- *HAN-DP-DXC* SAP HANA Direct Extractor Connector
- *HAN-DP-ESS* SAP HANA Enterprise Semantic Services (ESS)
- *HAN-DP-LTR* SAP Landscape Transformation Replication Server
- *HAN-DP-REP* SAP Sybase Replication Server
- *HAN-DP-SDI* SAP HANA smart data integration

SAP HANA Dynamic Tiering

- *HAN-DYT* SAP HANA Dynamic Tiering

SAP HANA Lifecycle Management

- *HAN-LM* SAP HANA Lifecycle Management
- *HAN-LM-APP* SAP HANA Application Lifecycle Management
- *HAN-LM-INS* SAP HANA Installation
- *HAN-LM-INS-DB* Installation of HANA Database
- *HAN-LM-INS-SAP* Installation of SAP Systems on HANA
- *HAN-LM-PLT* SAP HANA Platform Lifecycle Management
- *HAN-LM-UPG* SAP HANA Upgrade
- *HAN-LM-UPG-DB* Upgrade of HANA Database
- *HAN-LM-UPG-SAP* Upgrade of SAP Systems on HANA

SAP HANA Smart Data Streaming

- *HAN-SDS* SAP HANA Smart Data Streaming

SAP HANA Studio (Eclipse)

- *HAN-STD* SAP HANA Studio (Eclipse)
- *HAN-STD-ADM* SAP HANA Administration
- *HAN-STD-ADM-BAC* SAP HANA Backup and Recovery (Studio)
- *HAN-STD-ADM-DBA* SAP HANA Database Administration and Monitoring
- *HAN-STD-ADM-PVZ* SAP HANA Plan Visualizer
- *HAN-STD-ADM-SEC* SAP HANA Security and User Management (Studio)
- *HAN-STD-DEV* SAP HANA Development Tools
- *HAN-STD-DEV-CDS* SAP HANA Core Data Services Tools
- *HAN-STD-DEV-CDS-GRA* Please use HAN-STD-DEV-CDS
- *HAN-STD-DEV-DP* SAP HANA Data Provisioning Modeler
- *HAN-STD-DEV-EPM* SAP HANA EPM Modeler
- *HAN-STD-DEV-MOD* SAP HANA Analytical Modeling
- *HAN-STD-DEV-MOD-CLT* SAP HANA Analytical Modeling Client Component
- *HAN-STD-DEV-MOD-SRV* SAP HANA Analytical Modeling Server Component

- *HAN-STD-DEV-REF* SAP HANA Tools for Where-used, Refactoring and Mass Copy
- *HAN-STD-DEV-RUL* SAP HANA Rules Editor
- *HAN-STD-DEV-SCR* SAP HANA SQL Script Editor/Debugger
- *HAN-STD-DEV-TP* SAP HANA Tools Platform / Team Provider
- *HAN-STD-DEV-TP-CM* SAP HANA Development Change Management
- *HAN-STD-DEV-UIS* SAP HANA UI Integration Services
- *HAN-STD-DEV-UIS-FLP* SAP HANA Fiori Launchpad
- *HAN-STD-DEV-XS* SAP HANA XS Editors and Wizards

SAP HANA remote data sync

- *HAN-SYN* SAP HANA remote data sync

SAP HANA Vora

- *HAN-VO* SAP HANA Vora
- *HAN-VO-EN* SAP HANA Vora Engine
- *HAN-VO-MO* SAP HANA Vora Modeler
- *HAN-VO-SE* SAP HANA Vora Spark Extension Library

SAP HANA Web IDE

- *HAN-WDE* SAP HANA Web IDE
- *HAN-WDE-BLD* SAP Web IDE for Hana building applications
- *HAN-WDE-CHE* SAP Web IDE for Hana CHE
- *HAN-WDE-DBG* SAP Web IDE for Hana debugging applications
- *HAN-WDE-DOC* SAP Web IDE for Hana documentation
- *HAN-WDE-EDT* SAP Web IDE for Hana editor
- *HAN-WDE-EDT-CDS* SAP Web IDE for Hana editor for Core Data Services
- *HAN-WDE-EDT-MOD* SAP Web IDE editor for HANA Analytical Modeling
- *HAN-WDE-EDT-NJS* SAP Web IDE for Hana Node.js Tools
- *HAN-WDE-EDT-UI5* SAP Web IDE for Hana editor for UI5 applications
- *HAN-WDE-EIM* Flowgraph, RepTasks and other SDA Tools
- *HAN-WDE-GIT* SAP Web IDE for Hana GIT
- *HAN-WDE-INS* Installation SAP Web IDE for HANA
- *HAN-WDE-MTA* Multi Targeted Application in Web IDE
- *HAN-WDE-PREF* SAP Web IDE for Hana user and project settings
- *HAN-WDE-RTT* SAP Web IDE for Hana Runtime and SQL Tools
- *HAN-WDE-RUN* SAP Web IDE for Hana running applications
- *HAN-WDE-SDS* Smart Data Streaming Tools
- *HAN-WDE-SRC* Search
- *HAN-WDE-TPL* Project creation, template and wizards
- *HAN-WDE-XSC* Old SAP HANA Web IDE
- *HAN-WDE-XSC-EIM* Flowgraph, RepTasks and other SDA Tools
- *HAN-WDE-XSC-MOD* Modeling
- *HAN-WDE-XSC-PVZ* Performance Visualization Plugin

SAP HANA XS Advanced

- *BC-XS* XS Engine (XS Advanced)
- *BC-XS-JAS* Java Runtime
- *BC-XS-JS* Javascript runtime
- *BC-XS-SEC* UAA and Security for XS engine
- *BC-XS-SRV* XS Engine Services and Administration

SAP HANA Database (CCMS, Porting and DB Interface)

- *BC-DB-HDB-CCM* CCMS for SAP HANA
- *BC-DB-HDB-POR* DB Porting for SAP HANA
- *BC-DB-HDB-SYS* SAP HANA database interface/DBMS

End User Clients

- *BI-BIP, BI-BIP-CMC* Business intelligence platform (formerly known as BOE)
- *BI-RA-EXP* SAP BusinessObjects Explorer
- *BI-RA-CR, BI-BIP-CRS* SAP Crystal Reports
- *BI-RA-XL* Dashboard Designer
- *BI-BIP-IDT* Information design tool
- *BI-RA-WBI* Web Intelligence
- *BI-RA-AO-XLA* MS Excel Add-In

The search also supports using the wildcard asterisk (*), so you can, for example, also search for BC-DB-HDB* or similar and you will get results for all sub-components.

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