# Learn HANA in 1 Day

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# Chapter 1: What is Sap HANA?

## What is Sap HANA?

SAP HANA is the latest ERP Solution from SAP, which is a combination of Hardware and Software. HANA has unprecedented adoption by the SAP customers.

SAP HANA is latest, in-memory database, and platform which can be deployed on-premises or cloud. SAP HANA is a combination of hardware and software, which integrates different components like SAP HANA Database, SAP SLT (System Landscape Transformation) Replication server, SAP HANA Direct Extractor connection and Sybase replication technology

# SAP HANA Database & Platform

1. SAP HANA Database – SAP HANA Database is a hybrid in– memory database. SAP HANA Database is the heart of SAP in- memory technology. In SAP HANA, Database table are of two types –

- Row Store
- Column Store

2. SAP HANA Platform – SAP HANA Platform is a development platform with an in-memory data store which allows the

customers to analyze a large volume of data in real time. SAP HANA Platform works as a development platform, which provides infrastructure and tools for building a high-performance application based on SAP HANA Extended Application Services (SAP HANA XS).

# SAP HANA Edition

There are different types of SAP HANA edition, some of them as below-

- SAP HANA Platform Edition – It provides Core database technology. It Integrate SAP component like SAP HANA database, SAP HANA Studio and SAP HANA clients. It is for customers who want to use ETL-based replication and already have a license for SAP Business Objects Data Services.
- SAP HANA Enterprise Edition – It contains data provisioning (SLT, BODS, DXC) component including core database technology. It is for customers who want to use either trigger- based replication or ETL-based replication and do not have all of the necessary license for SAP Business Objects Data Services.
- SAP HANA Extended Edition – It contains data provisioning (Sybase) features more than Platform and Enterprises edition. It is for customers who want to use the full potential of all available replication scenarios including log-based replication.

The following diagram shows difference between all editions –

| Components | Platform Edition | Enterprise Edition | Extended Edition |
|---|---|---|---|
| SAP HANA Client | ✓ | ✓ | ✓ |
| SAP HANA Studio | ✓ | ✓ | ✓ |
| SAP HANA Database | ✓ | ✓ | ✓ |
| SAP Host Agent | ✓ | ✓ | ✓ |
| SAP HANA Information Composer | ✓ | ✓ | ✓ |
| Diagnosis agent | ✓ | ✓ | ✓ |
| SAP HANA UI for Information access | ✓ | ✓ | ✓ |
| SAP HANA Client package for MS -Excel | ✓ | ✓ | ✓ |
| SAP HANA SLT | | ✓ | ✓ |
| SAP HANA Business Object Data Service | | ✓ | ✓ |
| SAP HANA Direct Extractor Connection | | ✓ | ✓ |
| Sybase Replication server | | | ✓ |
| SAP HANA Load Controller | | | ✓ |

# Why to choose SAP HANA?

SAP HANA is a next-generation in-memory business platform. It accelerates analytics and application on a single and in-memory platform.

Mentioned below are the few reasons why to choose SAP HANA –

- **Real Time –** SAP HANA Provides Real-Time Data Provisioning and Realtime Reporting.
- **Speed –** SAP HANA provide high speeds processing on massive data due to In-Memory Technology.
- **Any Data/Source-** SAP HANA can access various data source including Structured and Un-Structured data from SAP or Non- SAP data source.
- **Cloud-** SAP HANA database and application can be deployed to the Cloud environment.
- **Simplicity –** SAP HANA reduce efforts behind ETL process, Data Aggregation, Indexing, and Mapping.

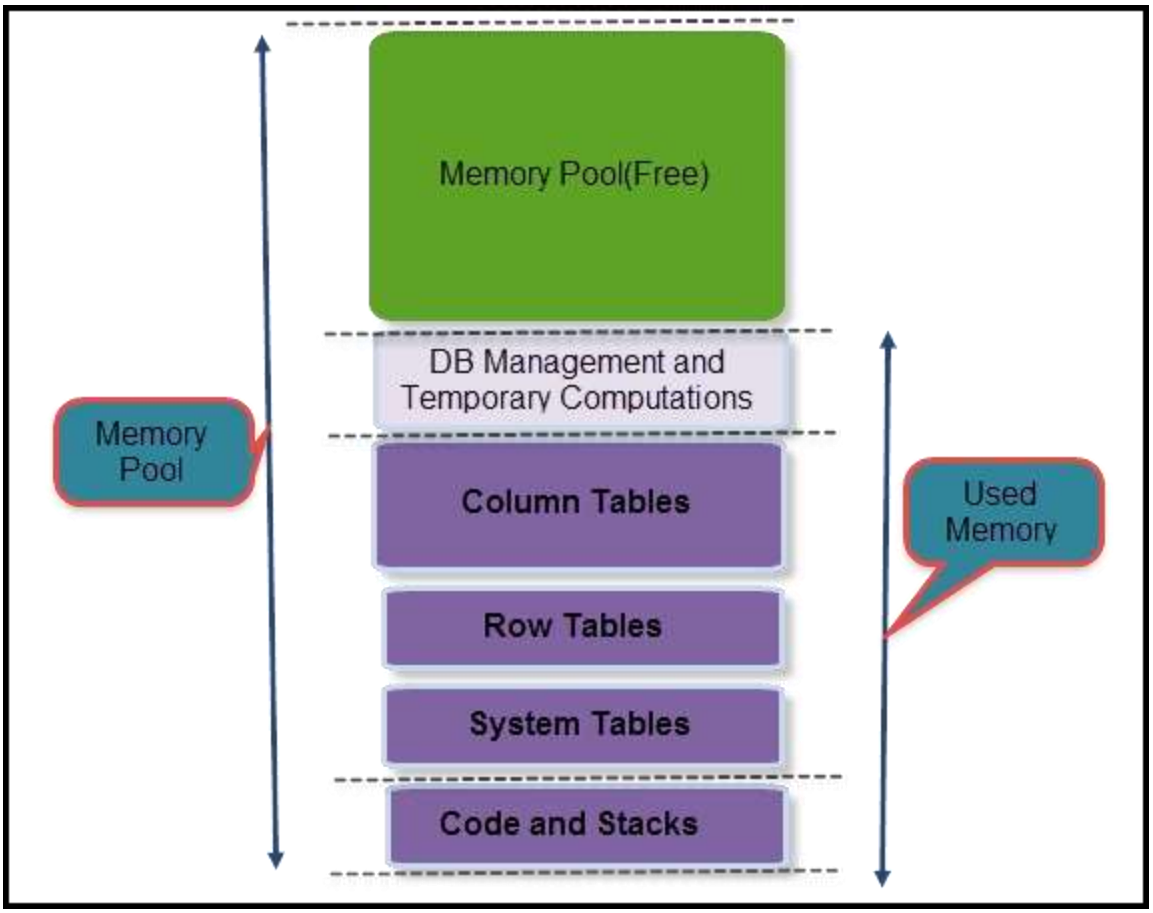
- **Cost –** SAP claims that SAP HANA Software can reduce Total IT cost of a company.
- **Choice Option –** SAP HANA is supported by different hardware vendor and Software provider, so based on the requirement, the user can choose the best option.

# SAP HANA In-Memory Strategy

SAP HANA has many processes running on the SUSE Linux Server. SUSE Linux server manages the reservation of memory to all process.

When SAP HANA starts up, Linux OS reserves memory for the program code, program stack, and static data. OS can dynamically reserve additional data memory upon request from the SAP HANA Server.

SAP HANA create a memory pool for managing and tracking the consumption of memory. The memory pool is used to store all the in-memory data and system tables, thread stack, temporary computations and all other data structure required for managing the database.




When more memory is required for table growth or temporary computations, the SAP HANA memorymanager obtains this from the pool.

For an overview, check out the **Memory Overview** feature of the SAP HANA studio. To access it, right-click on a System - >Configuration and Monitoring -> Open Memory Overview in the context menu, as follows:

# SAP HANA Advantages

Below are advantages of SAP HANA -

- By In-Memory Technology user can explore and analyze all transactional and analytic data in real time from virtually any data source.
- Data can be aggregated from many sources.
- Real-time replication services can be used to access and replicate data from SAP ERP.
- SQL and MDX interface from third party support.
- It provides information modeling and design environment.

# SAP HANA Compare to BWA (Business Warehouse Accelerator)

- **SAP BW Accelerator:** It is an in-memory accelerator for BW. BWA is focused on improving the query performance of SAP NetWeaver BW. BWA is specifically designed to accelerate BW queries reducing the data acquisition time by persisting copies of the infocube.
- **SAP HANA:** SAP HANA is in-memory database and platform for high-performance analytic reports and application. In SAP HANA data can be loaded from SAP and non-SAP Source System through SLT, BODS, DXC, and Sybase and can be viewed using SAP BO/BI, Crystal Reports, and Excel, etc.

Currently, SAP HANA also work as in-Memory database for SAP BW, so in this way SAP HANA able to improve the overall performance of SAP Net weaver BW.

**Summary:**

- SAP HANA is an in-memory database and application, which runs on SAP authenticated hardware and Software.
- SAP HANA have three version – platform, enterprises and extended.
- SAP HANA can load data from SAP and Non-SAP data source through SLT, BODS, DXC, and Sybase.
- SAP HANA provide real-time provisioning and reporting. SAP
- HANA provide high-performance real-time analytic reporting.
- SAP HANA reduces Total IT cost.

# Chapter 2: SAP HANA Architecture, LandScape, Sizing

SAP HANA Database is Main-Memory centric data management platform. SAP HANA Database runs on SUSE Linux Enterprises Server and builds on C++ Language.

SAP HANA Database can be distributed to multiple machines. SAP

HANA Advantages are as mentioned below -

- SAP HANA is useful as it's very fast due to all data loaded in- Memory and no need to load data from disk.
- SAP HANA can be used for the purpose of OLAP (On-line analytic) and OLTP (On-Line Transaction) on a single database.

SAP HANA Database consists of a set of in-memory processing engines. Calculation engine is main in-memory Processing engines in SAP HANA. It works with other processing engine like Relational database Engine(Row and Column engine), OLAP Engine, etc.

Relational database table resides in column or row store. There

are two storage types for SAP HANA table.

1. **Row type storage (For Row Table).**
2. **Column type storage (For Column Table).**

Text data and Graph data resides in Text Engine and Graph Engine

respectively. There are some more engines in SAP HANA Database. The data is allowed to store in these engines as long as enough space is available.

# SAP HANA Architecture

Data is compressed by different compression techniques (e.g. dictionary encoding, run length encoding, sparse encoding, cluster encoding, indirect encoding) in SAP HANA Column store.

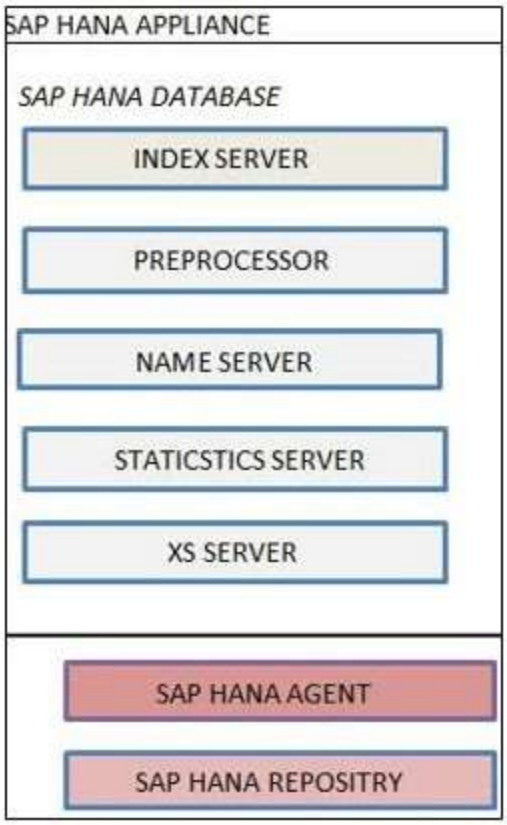
When main memory limit is reached in SAP HANA, the whole database objects (table, view,etc.) that are not used will be unloaded from the main memory and saved into the disk.

These objects names are defined by application semantic and reloaded into main memory from the disk when required again. Under normal circumstances SAP HANA database manages unloading and loading of data automatically.

However, the user can load and unload data from individual table manually by selecting a table in SAP HANA studio in respective Schema- by right-clicking and selecting the option "Unload/Load".

**SAP HANA Server consists of**

1. Index Server
2. Preprocessor Server
3. Name Server
4. Statistics Server
5. XS Engine

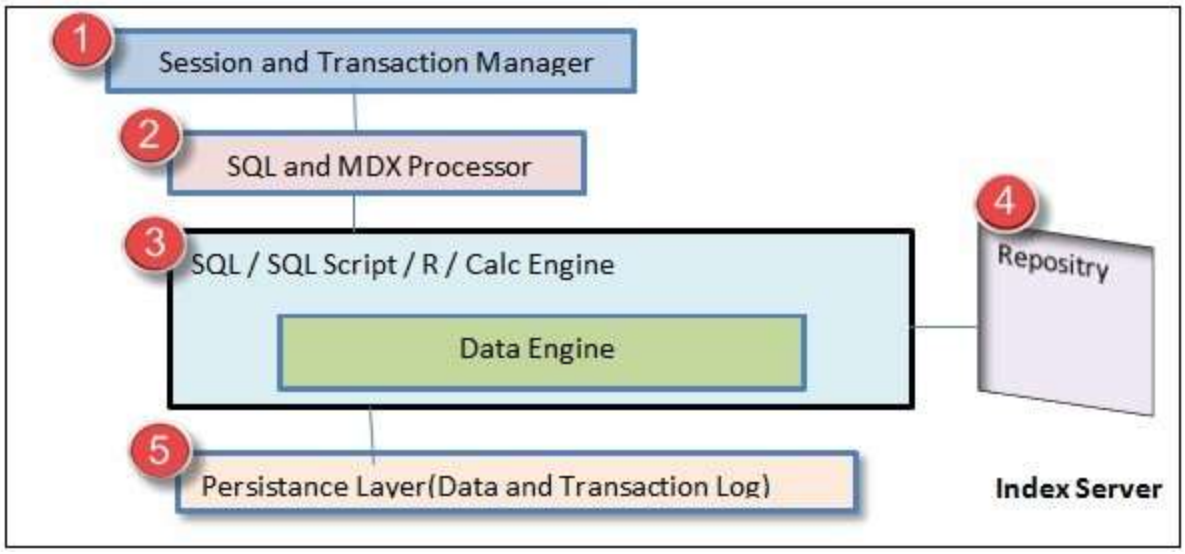



1. **SAP HANA Index Server**

   SAP HANA Database Main server are index server. Detail of each server is as below-

- It's the main SAP HANA database component
- It contains actual data stores and the engine for processing the data.
- Index Server processes incoming SQL or MDX statement.

Below is the architecture of Index Server.




SAP HANA Index Server overview

- **Session and Transaction Manager:** Session Component manage sessions and connections for SAP HANA database.
  Transaction Manager coordinates and control transactions. **SQL and**
- **MDX Processor:** SQL Processor component queries data and send to them in query processing engine i.e. SQL/SQL
  Script / R / Calc Engine. MDX Processor queries and manipulates Multidimensional data (e,g. Analytic View in SAP HANA).
- **SQL / SQL Script / R / Calc Engine:** This Component executes SQL / SQL script and calculation data convert in calculation model.
- **Repository:** Repository maintain the versioning of SAP HANA metadata object e.g.(Attribute view, Analytic View, Stored procedure).
- **Persistence layer:** This layer uses in-built feature "Disaster Recovery" of SAP HANA database. Backup is saved in it as save points in the data volume.

2. **Preprocessor Server**

This server is used in Text Analysis and extracts data from a text when the search function is used.

3. **Name Server**

This Server contains all information about the system landscape. In distributed server, the name server contains information about each running component and location of data on the server. This server contains information about the server on which data exists.

4. **Statistic Server**

Statistic server is responsible for collecting the data related to status, resource allocation / consumption and performance of SAP HANA system.

5. **XS Server**

XS Server contains XS Engine. It allows external application and developers to use SAP HANA database via the XS Engine client. The external client application can use HTTP to transmit data via XS engine for HTTP server.

# SAP HANA Landscape

"HANA" mean **High Performance Analytic Appliance** is a combination of hardware and software platform.

- Due to change in computer architecture, the more powerful computer is available in terms of CPU, RAM, and Hard Disk.

- SAP HANA is the solution for performance bottleneck, in which all data is stored in Main Memory and no need to frequently transfer data from disk I/O to main memory.

Below are SAP HANA Innovation in the field of Hardware/Software.

| Hardware Innovation | Software Innovation |
|---|---|
| Multicore Architecture | Row and column store |
| 64 bit address space | Compression |
| Improvement of price /Performance | Partitioning |
| | No aggregate |

There are two types of Relational data stores in SAP HANA: Row Store and Column Store.

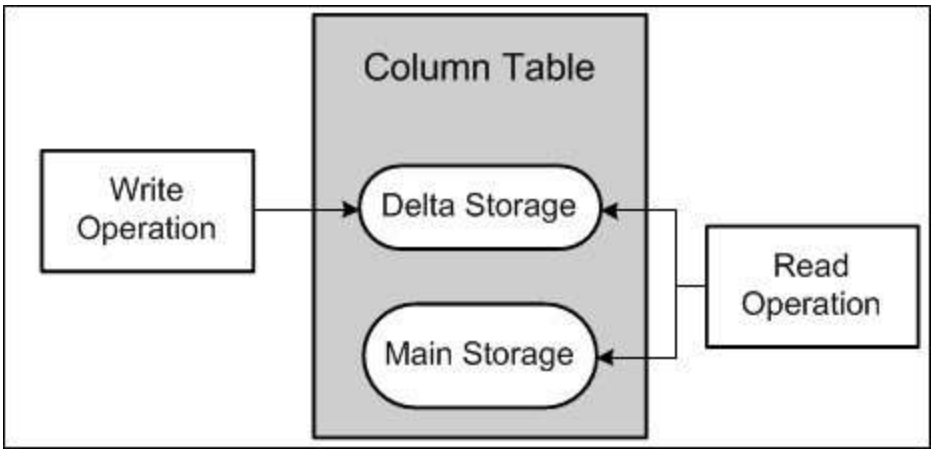
**Row Store**

- It is same as Traditional database e.g. (Oracle, SQL Server). The only difference is that all data is stored in row storage area in memory of SAP HANA, unlike a traditional database, where data is stored in Hard Drive.

**Column Store**

- Column store is the part of the SAP HANA database and manages data in columnar way in SAP HANA memory. Column tables are stored in Column store area. The Column store provides good performance for write operations and at the same time optimizes the read operation.

Read and write operation performance optimized with below two data structure.

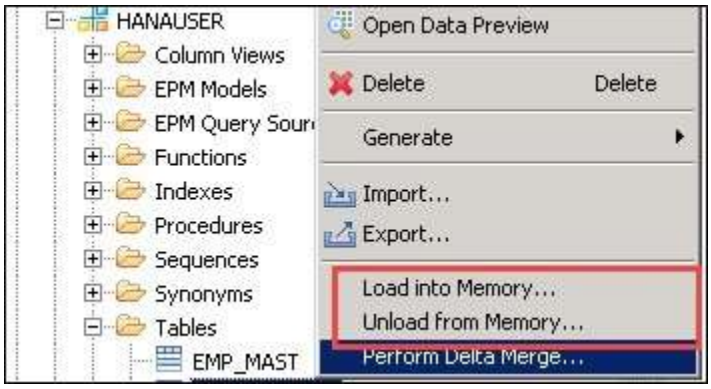



**Main Storage**

Main Storage contains the main part of data. In Main Storage, suitable data compression Method (Dictionary Encoding, Cluster Encoding, Sparse Encoding, Run Length encoding, etc.) is applied to compress data with the purpose to save memory and speed up searches.

- In main storage write operations on compressed data will be costly, so write operation do not directly modify compressed data in main storage. Instead, all changes are written in a separate area in column storage known as "Delta Storage."
- Delta storage is optimized for a write operation and uses normal compression. The write operations are not allowed on main storage but allowed on delta storage. Read operations are allowed on both storages.

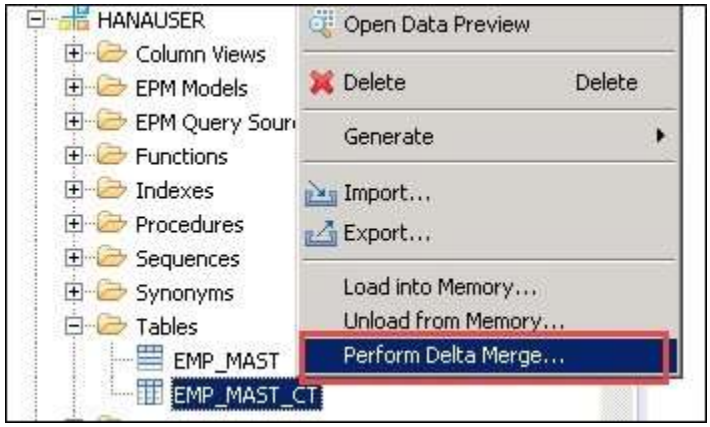
We can manually load data in Main memory by option "Load into Memory" and Unload data from Main memory by "Unload from Memory" option as shown below.




**Delta Storage**

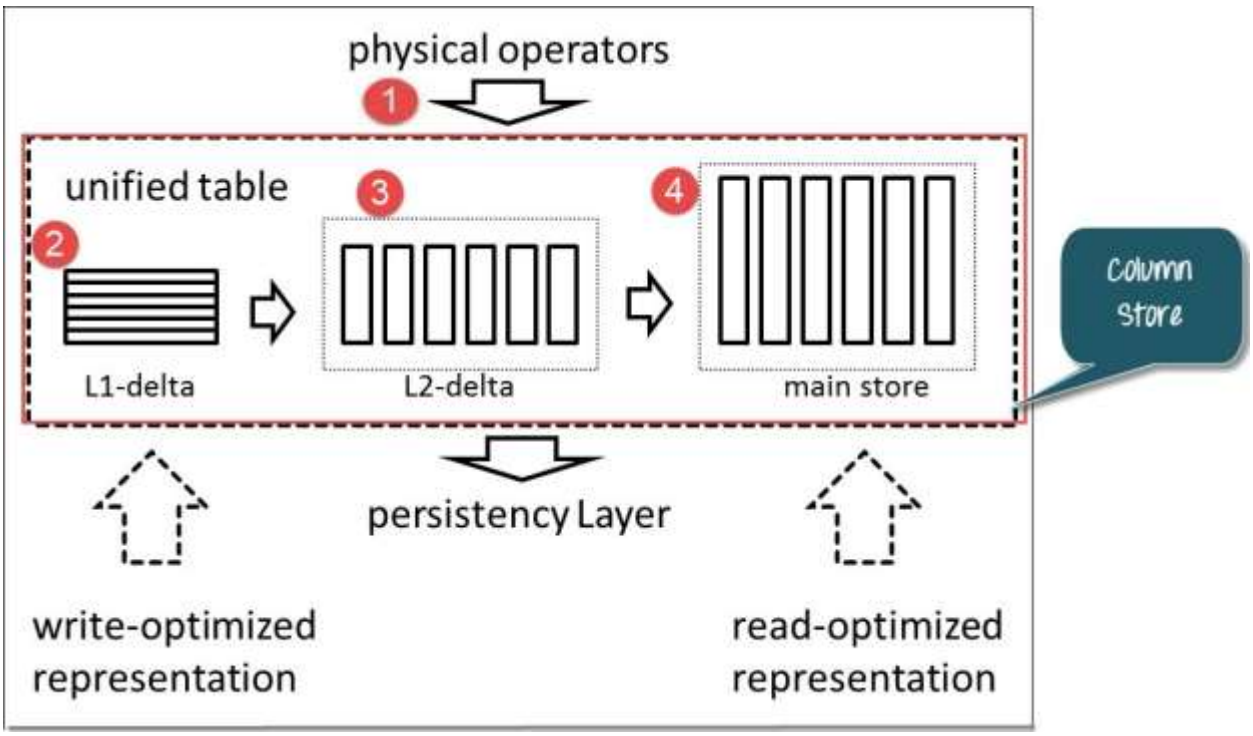
Delta storage is used for a write operation and uses basic compression. All uncommitted modification in Column table data stored in delta storage.

When we want to move these changes into Main Storage, then use "delta merge operation" from SAP HANA studio as below –




- The purpose of delta merge operation is to move changes, which is collected in delta storage to main storage.
- After performing Delta Merge operation on sap column table, the content of main storage is saved to disk and compression recalculated.

**Process of moving Data from Delta to Main Storage during delta merge**




There is a buffer store (L1-Delta) which is row storage. So in SAP HANA, column table acts like row store due to L1-delta.

1. The user runs update / insert query on the table (Physical Operator is SQL statements.).
2. Data first go to L1. When L1 moves data further (L1-Uncommitted data)
3. Then data goes to L2-delta buffer, which is column oriented. (L2-Committed data)
4. When L2-delta process is complete, data goes to Main storage.

So, Column storage is both Write-optimized and Read-optimized due to L1-Delta and main storage respectively. L1-Delta contains all uncommitted data. Committed data moves to Main Store through L2- Delta. From main store data goes to the persistence layer (The arrow indicating here is a physical operator that send SQL Statement in

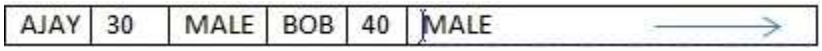
Column Store). After Processing SQL Statement in Column store, data goes to the persistence layer.

E.g. below is row-based table-

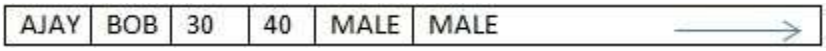
| Name | Age | Sex |
|---|---|---|
| AJAY | 30 | MALE |
| BOB | 40 | MALE |

Table data is stored on disk in linear format, so below is format how data is stored on disk for row and column table -

In SAP HANA memory, this table is stored in Row Store on disk as format –

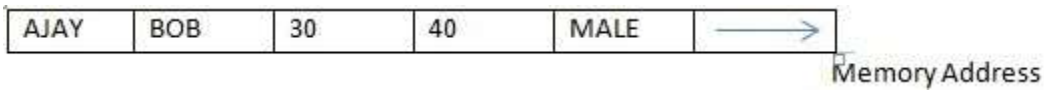



And in Column, data is stored on disk as –




Data is stored column-wise in the linear format on the disk. Data can be compressed by compress technique.

So, Column store has an advantage of memory saving.




# SAP HANA Sizing

Sizing is a term which is used to determine hardware requirement for SAP HANA system, such as RAM, Hard Disk and CPU, etc.

The main important sizing component is the Memory, and the second important sizing component is CPU. The third main component is a disk, but sizing is completely dependent on Memory and CPU.

In SAP HANA implementation, one of the critical tasks is to determine the right size of a server according to business requirement.

SAP HANA DB differ in sizing with normal DBMS in terms of –

- Main Memory Requirement for SAP HANA ( Memory sizing is determined by Metadata and Transaction data in SAP HANA) CPU
- Requirement for SAP HANA (Forecast CPU is Estimated not accurate).
- Disk Space Requirement for SAP HANA ( Is calculated for data persistence and for logging data)

The Application server CPU and application server memory remain unchanged.

For sizing calculation SAP has provided various guidelines and method to calculate correct size.

We can use below method-

1. Sizing using ABAP report.
2. Sizing using DB Script.
3. Sizing using Quicksizer Tool.

By using Quicksizer tool, Requirement will be displayed in below format-

| Result in Quick Sizer | Calculation Factors |
| --- | --- |
| Estimated database size | (DB size / compression factor)<br><br>* temporary memory usage<br><br>Compression factor: 4<br><br>Temporary memory usage: 2 |
| Estimated CPU requirements for the DB server | DB SAPS * 4 |
| Estimated database size | DB size / 2 |
| Estimated CPU requirements for the App server | - |
| Estimated memory requirements for the App server | - |

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