

# Do you know SAP HANA multi-model?

Witalij Rudnicki, SAP

PUBLIC



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- 24 - 15 years **tech consultant** in SAP BI/BW  
25 - SAP **Developer Advocate**  
in **SAP Community & Developer Relations**  
- **All things Data**  
<http://bit.ly/SAPDevsData>
- 27 - Based in **Wrocław**, Poland  
28 - Organizer of local SAP Community  
meetups and **SAP Inside Track**



Vitaliy Rudnytskiy

Vitaliy focuses on all ways developers are collecting data and turning it into value using the SAP Business Technology Platform. His main interests are in big data and fast data technologies, IoT, analytics, and data visualization. Before joining SAP, he worked as a technology consultant in Europe and in the U.S. Vitaliy is a visiting lecturer at WSB University in Wrocław.

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SAP Developers channel: <https://www.youtube.com/@sapdevs>

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The image shows a YouTube video player interface. The main video frame displays two men in a video conference. On the left, a man with a beard and glasses, identified as Thomas Jung, is smiling. On the right, another man with glasses and a beard, identified as DJ Adams, is speaking. The background of the video frame features a blue radial burst graphic and the SAP logo. The video player interface includes a search bar at the top, a top chat replay window, and a control bar at the bottom with icons for play, volume, and settings. The video progress bar shows 0:45 / 1:01:20. Below the video frame, the text "Let's test drive Joule's generative AI features in SAP Build Code together! 1 of 2 (EMEA / APJ)" is displayed, along with a "PUBLIC" label, the SAP Developers channel logo, and a "Subscribed" button. The SAP logo and "Powered by Zoom" text are also visible.

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Never heard of Wrocław?

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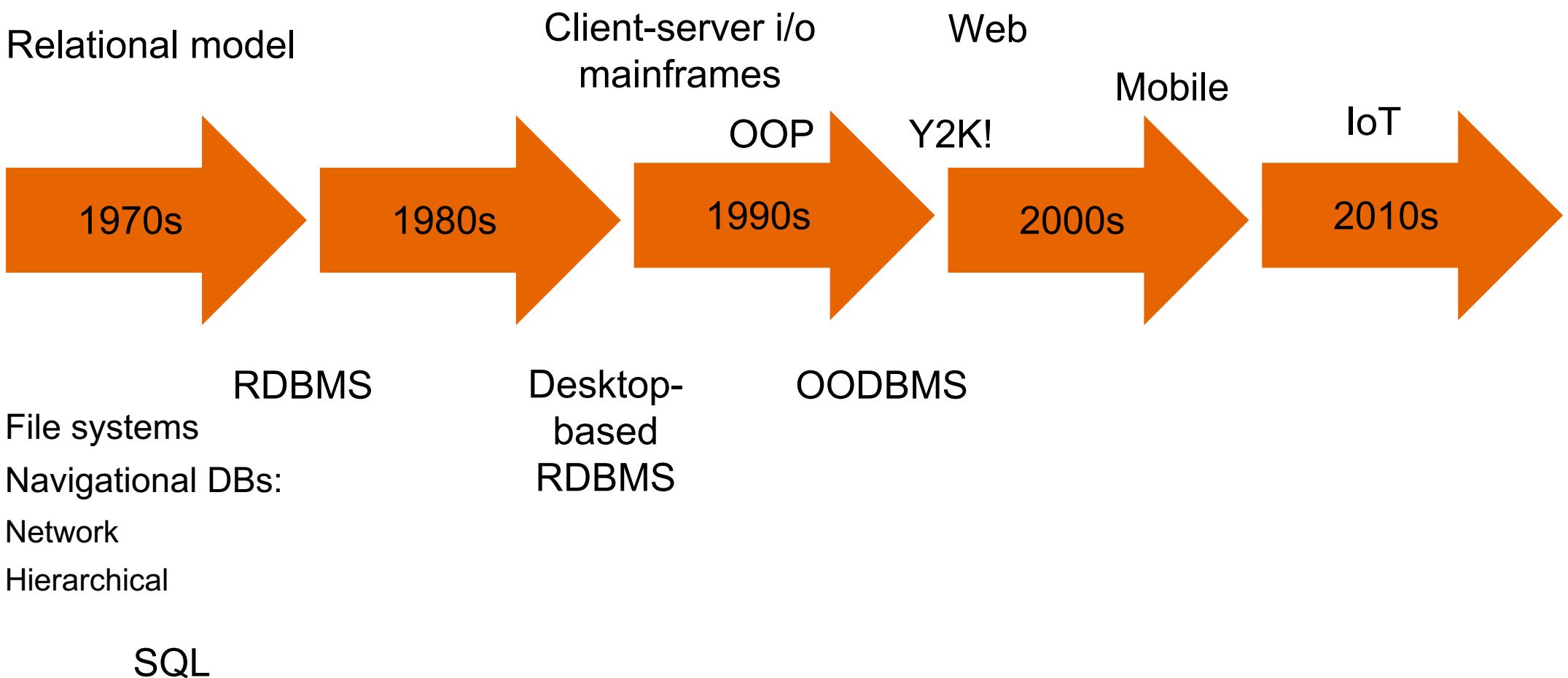
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## TOP 10 MID-SIZED EUROPEAN CITIES OF THE FUTURE 2023 – OVERALL

RANK	CITY	COUNTRY
1	Wrocław	Poland
2	Zürich	Switzerland
3	Vilnius	Lithuania
4	Edinburgh	UK
5	Belfast	UK
6	Bratislava	Slovakia
7	Utrecht	Netherlands
8	Bristol	UK
9	Gdańsk	Poland
10	Tallinn	Estonia

# How did we get where we are?



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# The Forrester Wave™: Translytical Data Platforms, Q4 2017

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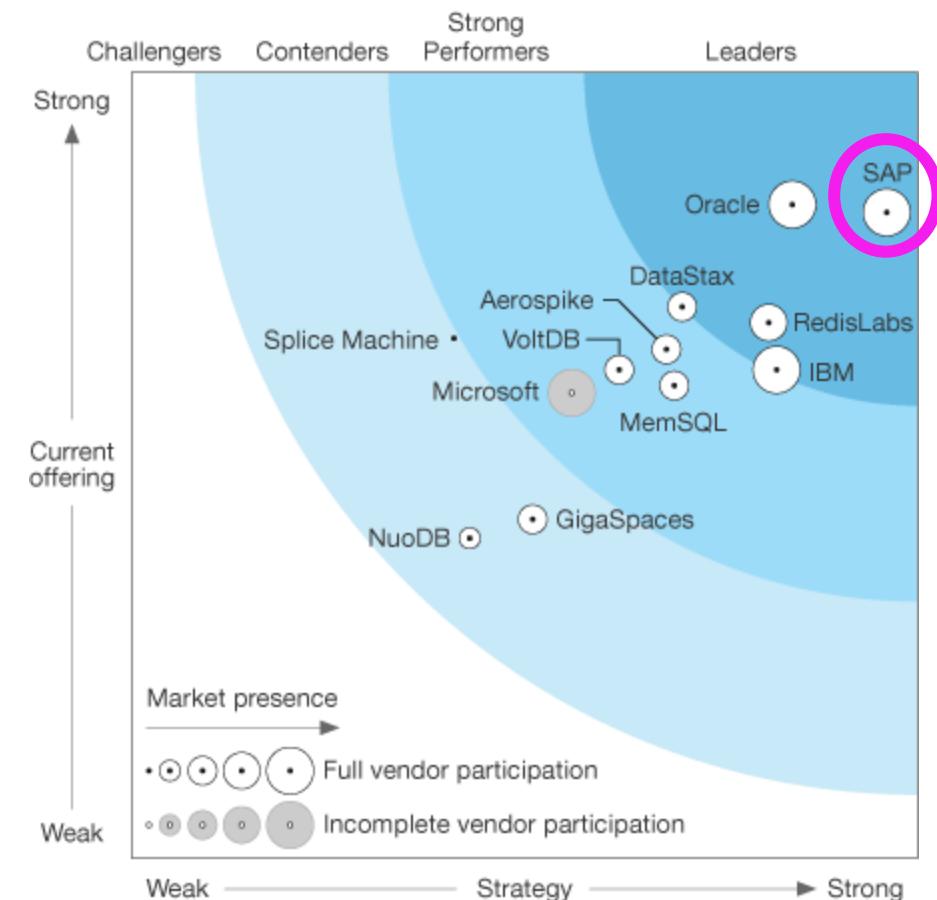
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“...Translytical data platforms, an emerging technology, deliver faster access to business data to support various workloads and use cases. EA pros can use them to drive new business initiatives...”

**SAP crushes translytical workloads.** SAP HANA is a shared-nothing, in-memory data platform, the core of SAP's translytical platform, which supports many use cases, including real-time applications, analytics, translytical apps, systems of insight, and advanced analytics...”



source: <https://reprints.forrester.com/#/assets/2/308/'RES134282'/reports>

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# Forrester's Study on Multi-model Analytics

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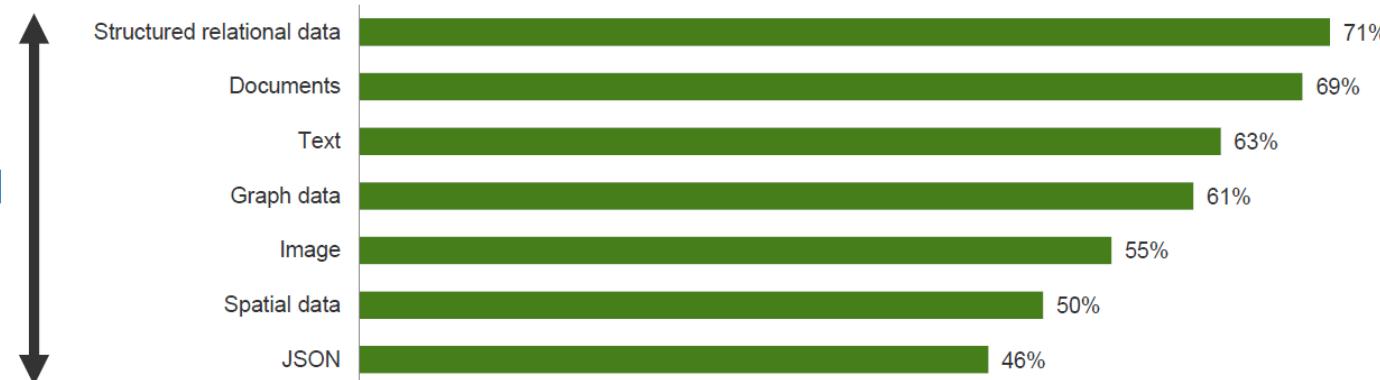
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**Most Organizations use multiple types of data formats to support various use cases ....**

Respondents in this survey manage an average of four types of data

Question: Which of the following types of data does your organization leverage on a regular basis to support various types of operational, analytical and transactional workloads?

**MultiModel**



Base: 107 analytics platforms and business applications decision-makers in IT or EA at US companies 5000+ employees

Source: A commissioned study conducted by Forrester Consulting on behalf of SAP HANA, July 2018

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# The Forrester Wave™: Multimodel Data Platforms, Q3 2021

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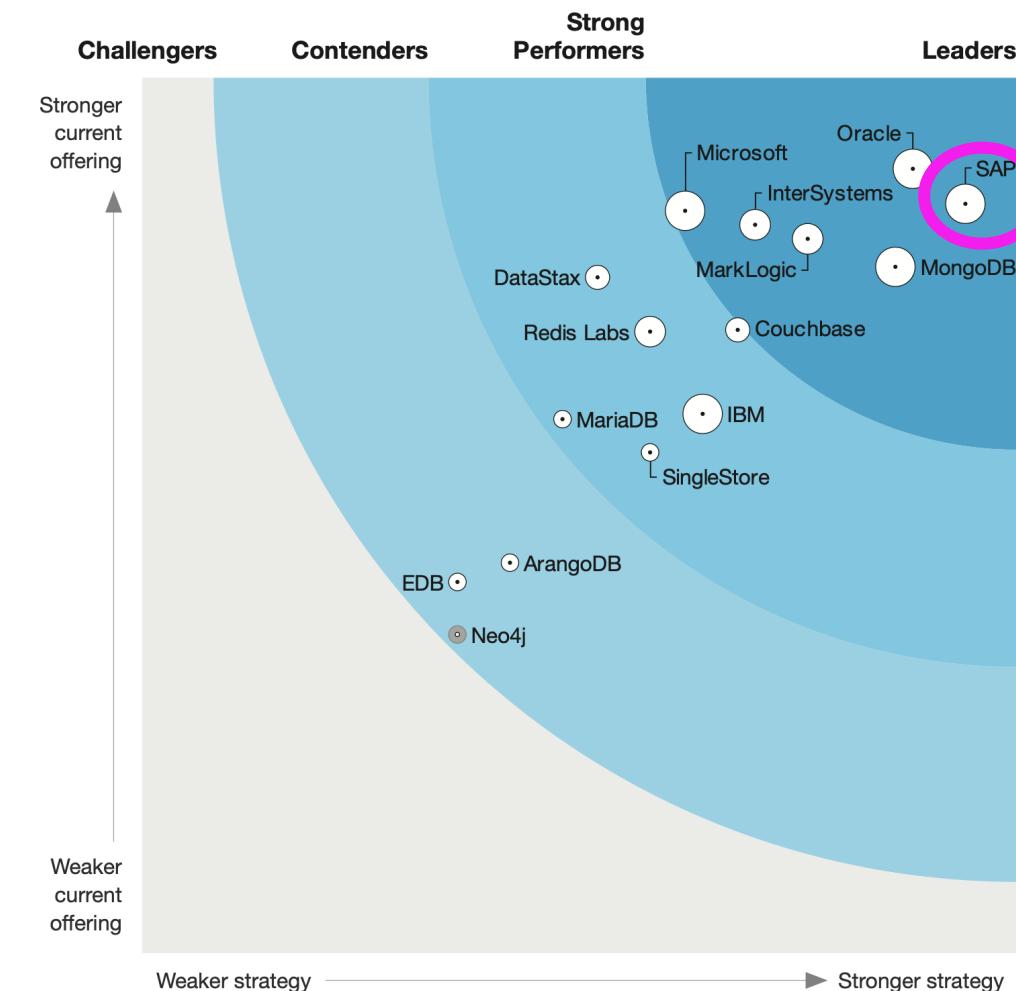
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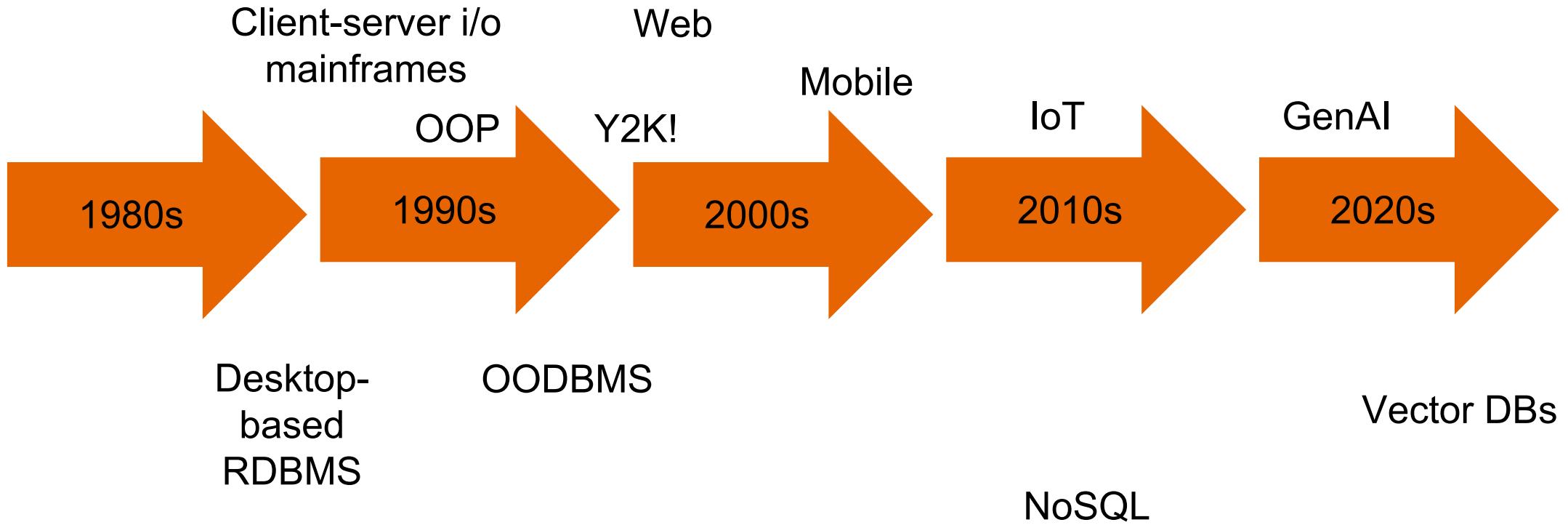
“Multimodel data platforms represent the intersection of multiple data models such as document, graph, and relational in a single data platform, offering speed, scale, performance, integration, and security over the polyglot persistence model.”

**“SAP leverages a mature in-memory platform to support any multimodel workload.** SAP HANA supports multiple data models — relational, graph, document, spatial, and text — leveraging its mature, distributed in-memory technology.”



source: <https://www.forrester.com/report/the-forrester-wave-multimodel-data-platforms-q3-2021/RES161621>

# How did we get where we are?



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# SAP HANA Cloud Multi-model Overview

## SAP HANA Cloud Spatial

- Spatial data types and reference systems
- Spatial functions, predicates, and algorithms
- Esri and open source GIS integration

## SAP HANA Cloud Graph

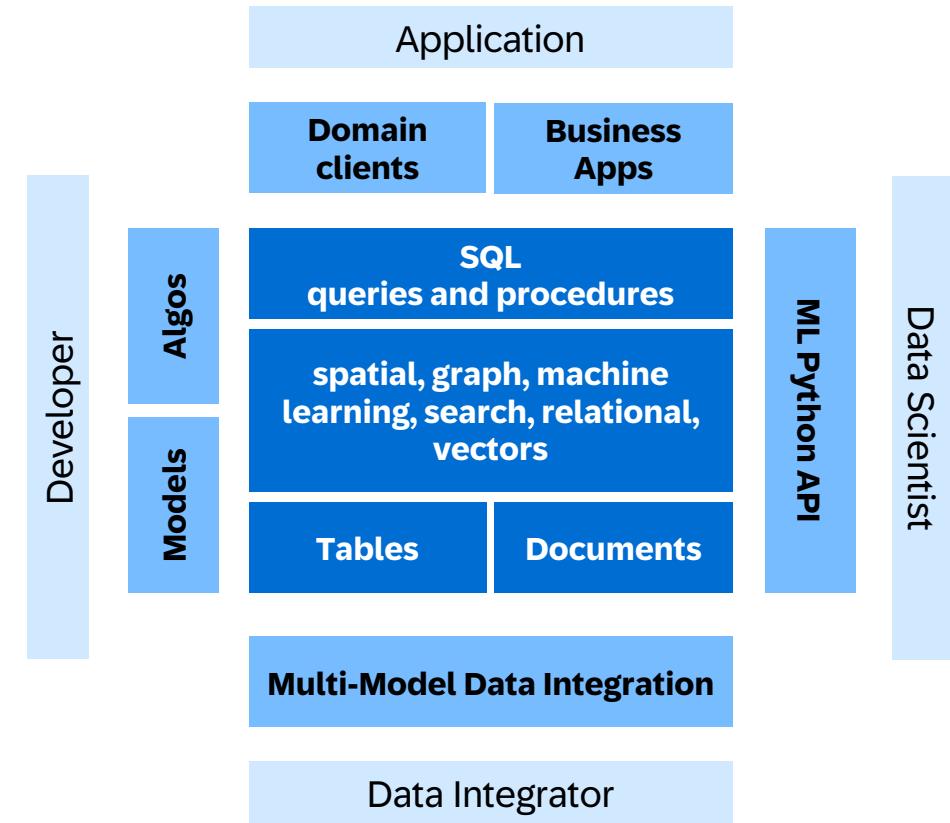
- Relational data as graph/network
- Pattern matching queries
- Built-in graph algorithms and custom network processing

## SAP HANA Cloud JSON Document Store

- Native store for JSON documents
- JSON operations via SQL

## SAP HANA Cloud Vector Engine (QRC1 2024)

- Vector data type
- Vector distance functions



**Ok, time to see it in action**

**Demos**

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# SAP HANA Cloud Multi-model Spatial

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## Spatial data types

- Native storage for vector data types such as points, lines, polygons...
- 2D and 3D objects supported
- Choice to use a specific spatial reference system

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## Spatial function and predicates

- Boolean operations, e.g. union, intersect
- Relationship determination, e.g. contains, touches
- Property computation, e.g. length, area
- Transformation and inspection, e.g. SRS, lin. referencing

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## Consumption and ecosystem

- SQL, ABAP
- Esri ArcGIS, Esri geodatabase, GeoTools/GeoServer, QGIS
- Python client for machine learning (hana-ml)

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**GIS integration**

**Python Environment**  
Python ML API

**Applications**  
Augmented Processes



**SAP HANA Database**

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DBeaver 24.0.3 - <DBAdmin@CodeJam - hna0.prod-us1> 094 - Google Locations JSON Tracking - 202404.sql

Database Navi Projects

Enter a part of object name here

```
> awclp0538.devint.net.sap - awclp0538
> DBAdmin@CodeJam - hna0.prod-us1 -
> DBAdmin@my.hana.trial-us - acd3b84c
> hxhost - hxhost:39015
```

--Reproduce the route in Vilnius

```
SELECT ST_MakeLineAggr("POINT" ORDER BY "TIMESTAMP") AS "path"
FROM "MultiModel"."LOC_HISTORY"
WHERE TO_DATE("TIMESTAMP") = '2024-04-26';
```

JDBC\_CURSOR\_9de20100c01a0300 1 ×

SELECT ST\_MakeLineAggr("POINT" ORDER BY "TIME" Enter a SQL expression to filter results (use Ctrl+Space)

Distance  
2.57 km

Steps  
2,912

Moving Time  
32:38

Elevation Gain  
21 m

Calories  
234 Cal

Avg Heart Rate  
96 bpm

View Analysis

EPSG:4326 OpenStreetMap Hide labels

Refresh Save Cancel Export data 200 1 1 row(s) fetched - 0.230s, on 2024-04-27 at 13:54:29

EET en\_PL Writable Smart Insert 118 : 41 : 3642 Sel: 0 | 0

Home Walk

Witalij R Yesterday at 8:11 PM · Vilnius, Lithuania

Beer pub crawl 🍺

Leaflet © OpenStreetMap contributors

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# SAP HANA Cloud Multi-model Graph

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## Graph model

- Labeled property graph embedded into SQL/relational

## Graph queries and algorithms

- Cypher for pattern matching
- Built-in algorithms, e.g. shortest path, page rank, link prediction
- In-database Graph procedures (“GraphScript”)

## Consumption

- SQL, ABAP (via AMDP)
- Python client for machine learning (hana-ml)
- HANA Database Explorer, Cytoscape (preview)

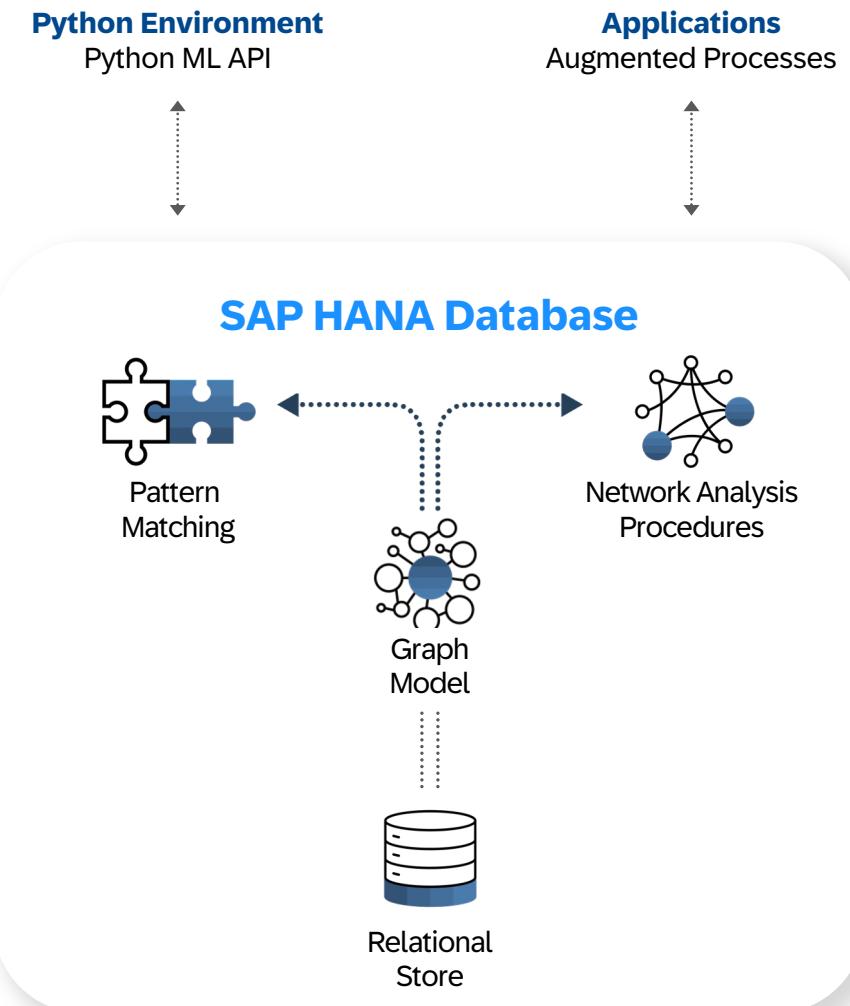
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SAP Database Explorer

central-hana-cloud-instance-us-77belmsm.hana-tooling.ingress.orchestration.prod-us10.hanacloud.ondemand.com/hrtt/sap/hana/cst/catalog/cockpit-index.html

**SAP SAP HANA Database Explorer**

heros\_network

Filter Instances

- DevAdvocacy
- CodeJamHANAML (CODEJAM30)
- Catalog
  - Adapters
  - Agent Groups
  - Agents
  - Column Views
  - Cubes
  - Functions
  - Graph Workspaces
  - Indexes

CODEJAM30

Search Graph Workspaces

heros\_network

Quick Actions

Cypher

Neighborhood

Shortest Path

Algorithm: Shortest Path

\*Start Vertex: MORLAK, MARIS

\*End Vertex: GUARDIAN/JAMES MACDO

Direction: Incoming

Weight Column: Select Column

Apply Close

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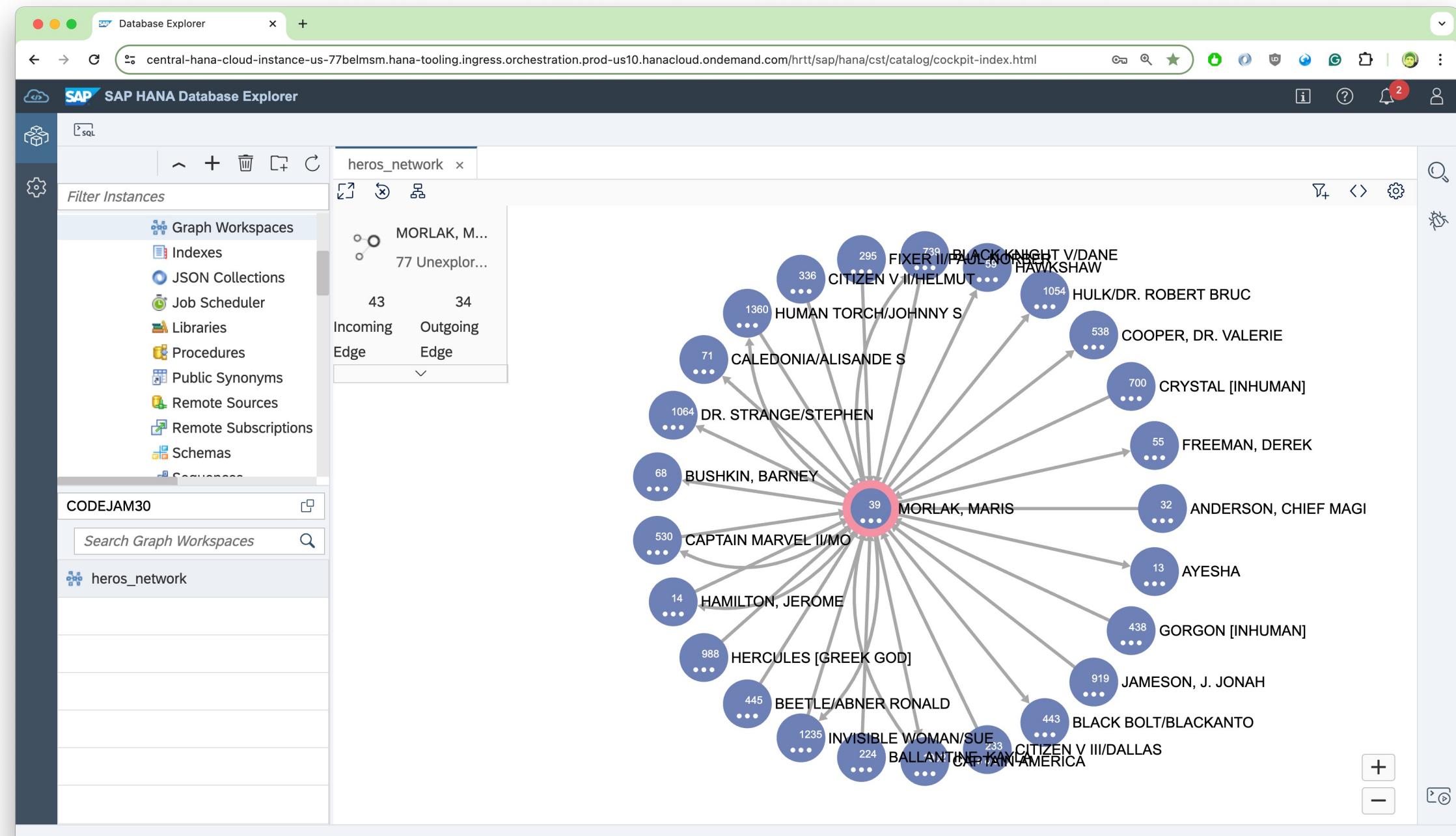
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# SAP HANA Cloud Multi-model Machine Learning

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## Embedded Machine Learning Libraries

- Predictive Analysis Library (PAL) for experts
- Automated Predictive Library (APL)

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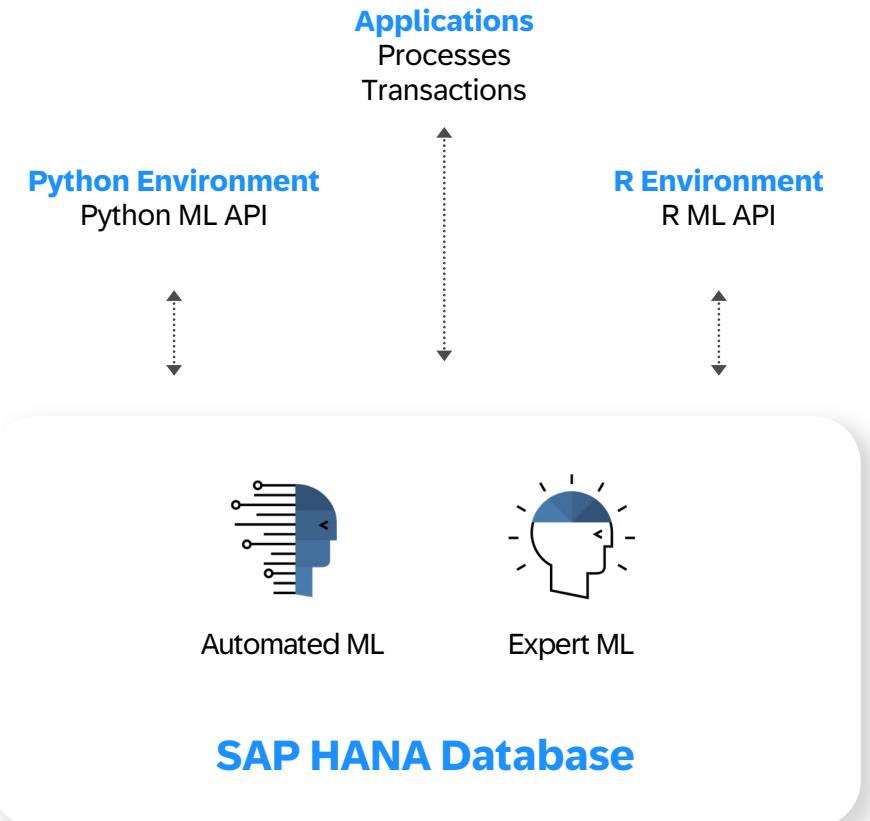
## Key Machine Learning Scenarios

- 100+ classic and trending ensemble algorithms
- Time series forecasting, classification, regression
- Machine learning functions optimized for massive parallel in-memory processing

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## Additional Features

- Native interfaces for data scientists in R and Python
- Improved data science in Python to development handshake for building an intelligent data application
- Simple ML scenario generation for SAP Business Application Studio
- New PAL AutoML framework supporting classification, regression, and time-series scenarios

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The screenshot shows a Jupyter Notebook interface with the title "hana-demos-multimodel". The left sidebar contains icons for file operations, search, variables, and other notebook functions. The main area displays a Python script for performing link prediction and proximity scores on a Marvel heroes network.

Code snippets:

```
lp = LinkPrediction(method='common_neighbors',      #{'common_neighbors', 'jaccard', 'adamic_adar', 'katz'}
                     min_score=2.225E-307, #2.225E-307 is the smallest positive DOUBLE
                     )
[20]    ✓ 0.0s Python
```

```
res = lp.proximity_score(data=mycc.table('heros_network_EDGES'), node1='hero1', node2='hero2')
[21]    ✓ 35.6s Python
```

```
hero="DRACULA/VLAD TEPES"
hero="MORLAK, MARIS"

res.filter(f'''
    "hero1" = '{hero}'
    ''').sort('SCORE', desc=True).head(10).collect()
[19]    ✓ 0.5s Python
```

Output:

	hero1	hero2	SCORE
0	MORLAK, MARIS	GUARDIAN/JAMES MACDO	5.017738

Bottom navigation bar:

main\* ⟲ ⌂ 0 ⌃ 19 ⌄ 0 ⌁ Spaces: 4 LF Cell 12 of 15 ⌚ { }

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# SAP HANA Cloud Multi-model JSON Document Store

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## Native store for JSON documents

- Schema-less, hierarchical, semi-structured data
- Arrays, objects, key-value pairs
- Complementary, fully integrated store
- ACID across all stores (row, column, document)
- Indexing, SQL parameters, paging to disk, import/export
- Backup/restore, encryption, failover

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## Native JSON operations via SQL

- Projection, filtering, aggregation
- Unnesting arrays
- Joins with relational data

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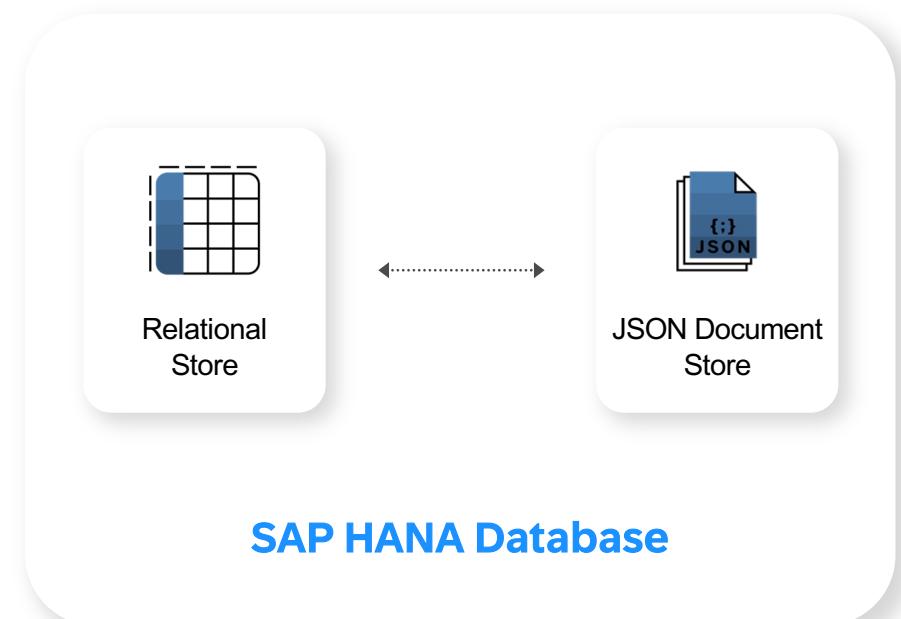
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**Relational Data**  
 Sales Numbers,  
 Master Data,  
 Accounting Reports

**JSON Data**  
 Product Catalogues,  
 Sensor Data, User  
 Profiles, etc.



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SAP Database Explorer

central-hana-cloud-instance-us-77belmsm.hana-tooling.ingress.orchestration.prod-us10.hanacloud.ondemand.com/hrrt/sap/hana/cst/catalog/cockpit-index.html

SAP HANA Database Explorer

All\_Locations x All\_Locations x

CodeJamHANAML (DBADMIN): MultiModel.All\_Locations

SQL

All\_Locations x All\_Locations x

Filter Instances

Starts from row: 1 To: 100

```

1 [
2   {
3     "latitudeE7": 510463801,
4     "longitudeE7": 162005935,
5     "accuracy": 165,
6     "source": "UNKNOWN",
7     "deviceTag": 98432794,
8     "timestamp": "2014-06-20T10:00:13.151Z"
9   },
10  {
11    "latitudeE7": 510463804,
12    "longitudeE7": 162005901,
13    "accuracy": 165,
14    "source": "UNKNOWN",
15    "deviceTag": 98432794,
16    "timestamp": "2014-06-20T10:02:18.155Z"
17  },
18  {
19    "latitudeE7": 510466004,
20    "longitudeE7": 162007596,
21    "accuracy": 65,
22    "source": "UNKNOWN",
23    "deviceTag": 98432794,
24    "timestamp": "2014-06-20T10:04:23.158Z"
25  },
26  {
27    "latitudeE7": 510466649,
28    "longitudeE7": 162007676,
29    "accuracy": 65,
30    "source": "UNKNOWN",
31    "deviceTag": 98432794,
32    "timestamp": "2014-06-20T10:05:40.830Z"
33  },
34  {

```

Filter Instances

- Functions
- Graph Workspaces
- Indexes
- JSON Collections**
- Job Scheduler
- Libraries
- Procedures
- Public Synonyms
- Remote Sources
- Remote Subscriptions
- Schemas

CHESSBOARD,MultiModel

Search JSON Collections

MultiModel

All\_Locations

Locations

Settings

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# SAP HANA Cloud Multi-model Full-text Search

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## In-database search

- Column store data types: string, date, numeric
- Fuzzy search index
- Speed up fuzzy searches and enable text search

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## Search models

- SQL views (joins, w/ parameters), table functions
- Search configuration via built-in procedure or HDI
- Entity type and property annotations
- Multi-value, sub-objects, multilingual texts

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## Search

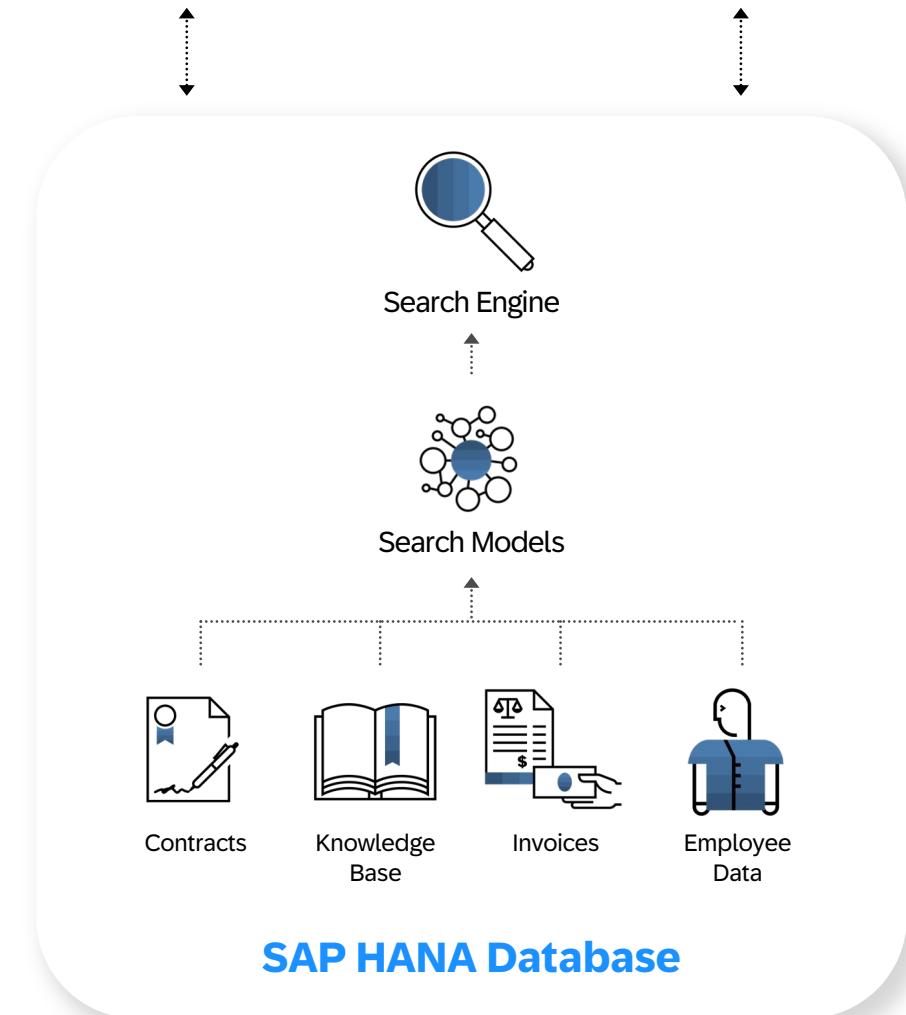
- SQL contains predicate
- Federated search using built-in procedure
- OData, Enterprise Search SDK

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**In-Database Search**  
SQL

**Applications**  
Federated search, OData



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# SAP HANA Cloud Multi-model Vector

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## Vector data type

- REAL\_VECTOR
- Natively store high dimensional vectors

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## Vector functions

- Combine vector functions with other SQL operations
- L2DISTANCE()
- COSINE\_SIMLARITY()

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## Consumption

- SQL
- python (hana-ml)

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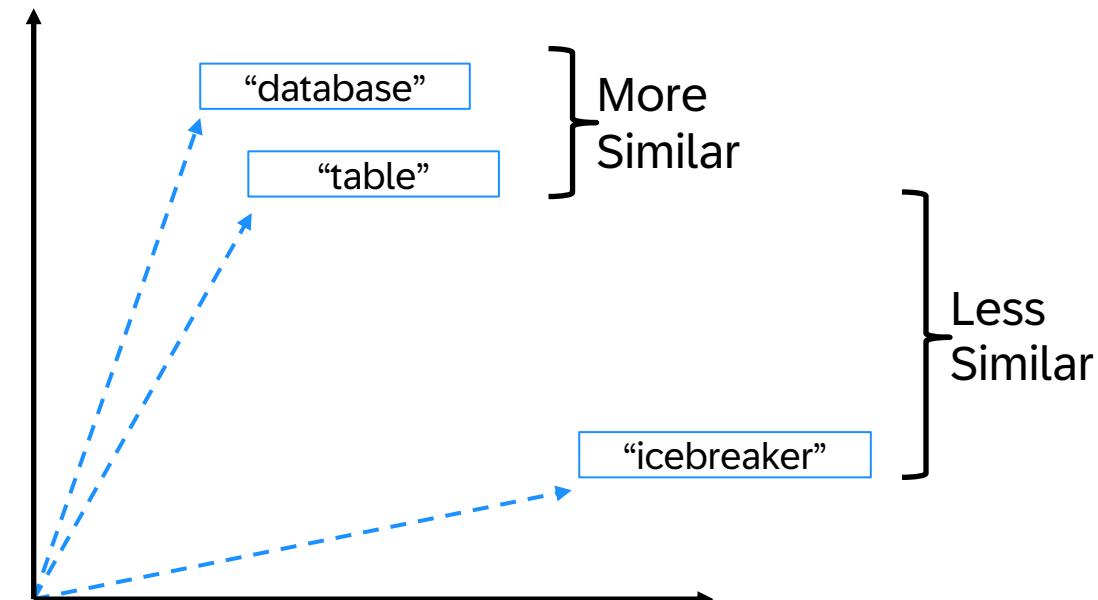
## Roadmap & Vision

- LangChain plug-in, CAP support, SAP Generative AI Hub integration
- Vector indexes, approximate nearest neighbor (ANN) search
- In-database text embedding

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TechEd\_2023 - SAP Business

central-hana-cloud-instance-us-77belmsm.us10cf.applicationstudio.cloud.sap/index.html#ws-fp7q8

SAPTechEd2023\_DevKeynote\_HANAVector

HANAVec\_Tokens3MM-2Query.ipynb M X

scripts > HANAVec\_Tokens3MM-2Query.ipynb > M+Query HANA table with REAL\_VECTOR > M+Closest neighbours > word='Vilnius'

+ Code + Markdown | Run All | Restart | Clear All Outputs | Variables | Outline | ... | env (Python 3.11.2) | Python

[12] 4.1s

```
... SELECT TOP 10 *
FROM
    (SELECT *
     FROM
        (SELECT "B"."WORD" AS "WORD",
               "A"."WORD" AS "RELATED_WORD",
               "COSINE_SIMILARITY"("A"."WV",
                                    "B"."WV") AS "SIMILARITY_SCORE"
        FROM
            (SELECT *
             FROM
                (SELECT *
                 FROM "DEV_KEYNOTE"."TOKENS3MM") AS "DT_11"
                 WHERE "WORD"='Vilnius' ) AS "B"
            INNER JOIN
                (SELECT *
                 FROM "DEV_KEYNOTE"."TOKENS3MM") AS "A" ON "A"."WORD" <> "B"."WORD" ) AS "DT_13"
        ORDER BY "SIMILARITY_SCORE" DESC) dt
```

... WORD RELATED\_WORD SIMILARITY\_SCORE

	WORD	RELATED_WORD	SIMILARITY_SCORE
0	Vilnius	Riga	0.749187
1	Vilnius	Kyiv	0.746866
2	Vilnius	Tallinn	0.721646

main\* 3↓ 0↑ 1△ 0 Ln 2, Col 43 Spaces: 4 Spaces: 4 LF Cell 8 of 13 Layout: U.S.

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# SAP HANA Cloud Multi-model Further Learning

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## SAP HANA Cloud Basic Trial

- 30-days own-schema shared-instance
- <https://www.sap.com/products/technology-platform/hana/guided-experience.html>

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## SAP HANA Cloud Trial

- 3x30-days own-instance in SAP BTP Trial
- 16GB RAM, 1 vCPU
- <https://developers.sap.com/tutorials/hana-trial-advanced-analytics.html>

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## SAP HANA Cloud Free Tier

- 30 GB RAM, 2 vCPUs
- <https://developers.sap.com/mission.hana-cloud-database-get-started.html>

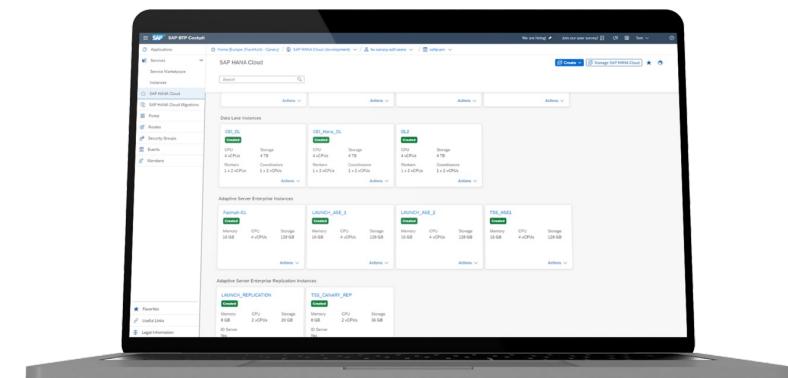
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## SAP TechEd 2023 exercises

- DAT285v - Building Intelligent Data Applications with SAP HANA Cloud: <https://github.com/SAP-samples/teched2023-DA285v>
- DA263 - Build Innovative Business Applications with Database Services: <https://github.com/SAP-samples/teched2023-DA263>

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Please, support Ukrainian defenders 💙💛

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<https://zrzutka.pl/en/c5jw4x>

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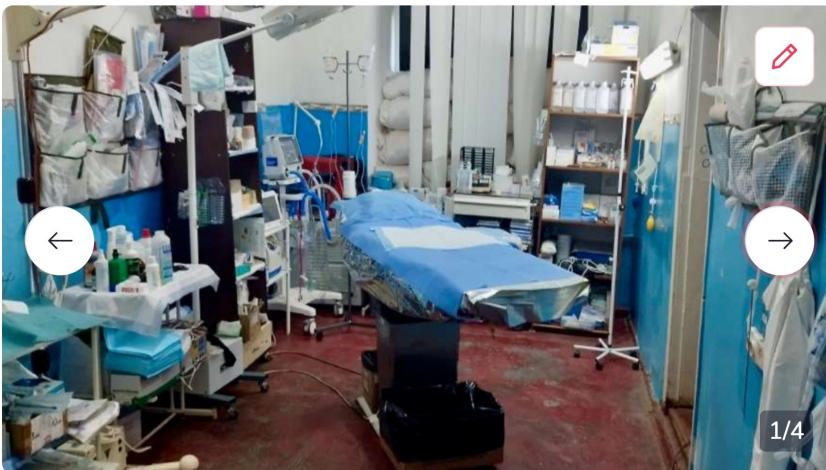
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## Front line emergency medicine for wounded Ukrainian soldiers



Witalij Rudnicki

✓ Verified by bank transfer and ID



PLN 7,403 of PLN 9,600

77%

1 day left

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Please, support Ukrainian business 💙💛 eg. Ugears Mechanical Models

<https://ugearsmodels.com/>

Free shipping on all orders of €60 or more!

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Mechanical Models

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Witalij Rudnicki, SAP