



SAP Esri Spatial Hackathon – GeoML

Palm Springs, California, March 3rd - 5th, 2018



Hinnerk Gildhoff / February 6, 2018

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Agenda

- AFL & PAL (ML)
- EML & TensorFlow (DL)
- Demo



SAP HANA Architecture

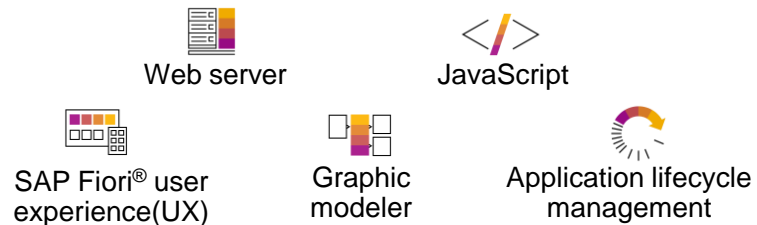
— All Devices —

— SAP, ISV and Custom Applications —

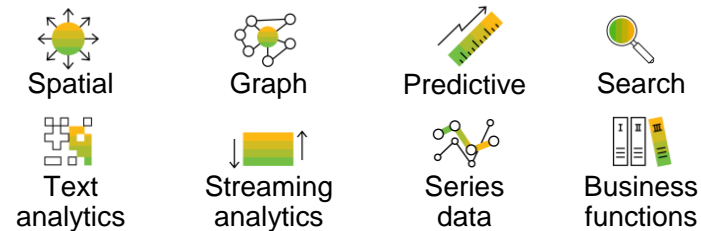
SAP HANA® Platform

On premise | Cloud

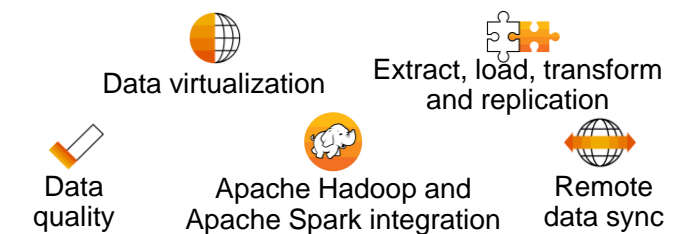
Application development



Advanced analytical processing



Data integration and quality



Database management



ONE Open Platform

OLTP + OLAP

ONE Copy of the Data

The SAP HANA Predictive Analysis Library (PAL)

- SAP HANA embeds multiple advanced analytics function libraries, designed and optimized for **massive parallel** in-memory processing of predictive algorithms on largest **multi-core** and **terabyte-scale memory** hardware platforms

Predictive Analysis Library

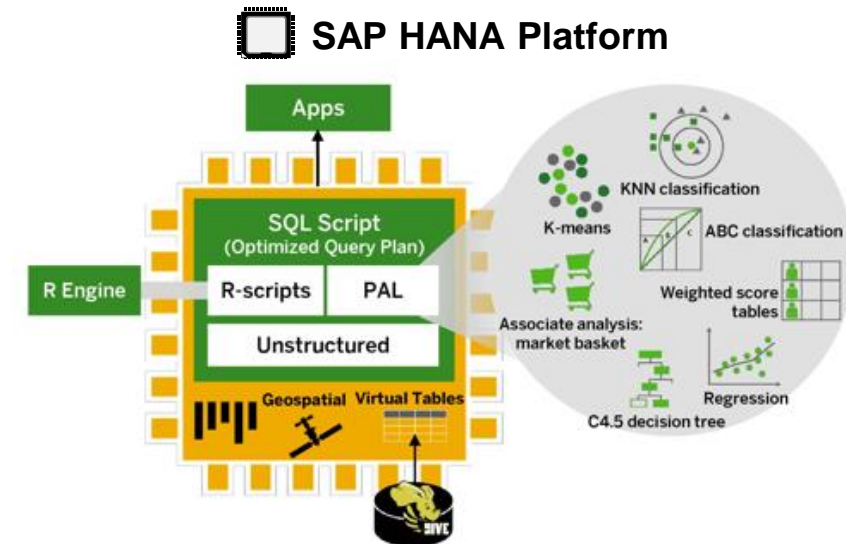
- The SAP HANA core of numerous powerful, **native** predictive algorithms for in-database & **in-memory processing** that fully exploit the power and speed of SAP HANA, resulting in quicker insight and faster implementations.

Content and Usage

- The library includes common as well as specialized algorithms targeting various **data mining** and **machine learning** areas
- Leveraged and embedded in native SAP applications and usage from within SAP HANA **development tools** as well as SAP Predictive Analytics.

Scenarios & Use Cases

- Various LoB / industry scenarios making use of Association Analysis, Time Series Forecasting, Link Prediction, Predictive Modeling, etc.



SAP HANA Predictive Analysis Library

Roadmap - New and enhanced Algorithms in SAP HANA 2 SPS0

■ Classification Analysis

- CART
- C4.5 *Decision Tree Analysis*
- CHAID *Decision Tree Analysis*
- *K Nearest Neighbour*
- Logistic Regression Elastic Net
- *Back-Propagation (Neural Network)*
- Naïve Bayes
- Support Vector Machine
- *Random Forests*
- Gradient Boosting Decision Tree (GBDT)
- Linear Discriminant Analysis (LDA)
- Confusion Matrix
- Area Under Curve (AUC)
- Parameter Selection / Model Evaluation

■ Regression

- Multiple Linear Regression Elastic Net
- *Polynomial, Exponential, Bi-Variate Geometric, Bi-Variate Logarithmic Regression*
- Generalized Linear Model (GLM)
- Cox Proportional Hazards Model

■ Cluster Analysis

- ABC Classification
- DBSCAN
- *K-Means*
- K-Medoid Clustering
- K-Medians
- Kohonen Self Organized Maps
- Agglomerate Hierarchical
- Affinity Propagation
- Latent Dirichlet Allocation (LDA)
- Gaussian Mixture Model (GMM)
- Cluster Assignment

■ Time Series Analysis

- Single/Double/ Brown /Triple Exp.Smoothing
- Forecast Smoothing
- Auto - ARIMA/ Seasonal ARIMA
- Croston Method
- Forecast Accuracy Measure
- Linear Regression with Damped Trend and Seasonal Adjust
- Test for White Noise, Trend, Seasonality
- *Fast Fourier Transform (FFT)*
- Correlation Function

■ Association Analysis

- Apriori
- Apriori Lite
- FP-Growth
- KORD – Top K Rule Discovery
- Sequential Pattern Mining

■ Probability Distribution

- Distribution Fit/ Weibull analysis
- Cumulative Distribution Function
- Quantile Function
- Kaplan-Meier Survival Analysis

■ Outlier Detection

- Inter-Quartile Range Test (Tukey's Test)
- Variance Test
- *Anomaly Detection*
- Grubbs Outlier Test

■ Link Prediction

- Common Neighbors
- Jaccard's Coefficient
- Adamic/Adar
- Katz β

■ Statistic Functions

- Mean, Median, Variance, Standard Deviation, Kurtosis, Skewness
- Covariance Matrix
- Pearson Correlations Matrix
- Chi-squared Tests:
 - Test of Quality of Fit
 - Test of Independence
- F-test (variance equal test)
- Data Summary

■ Data Preparation

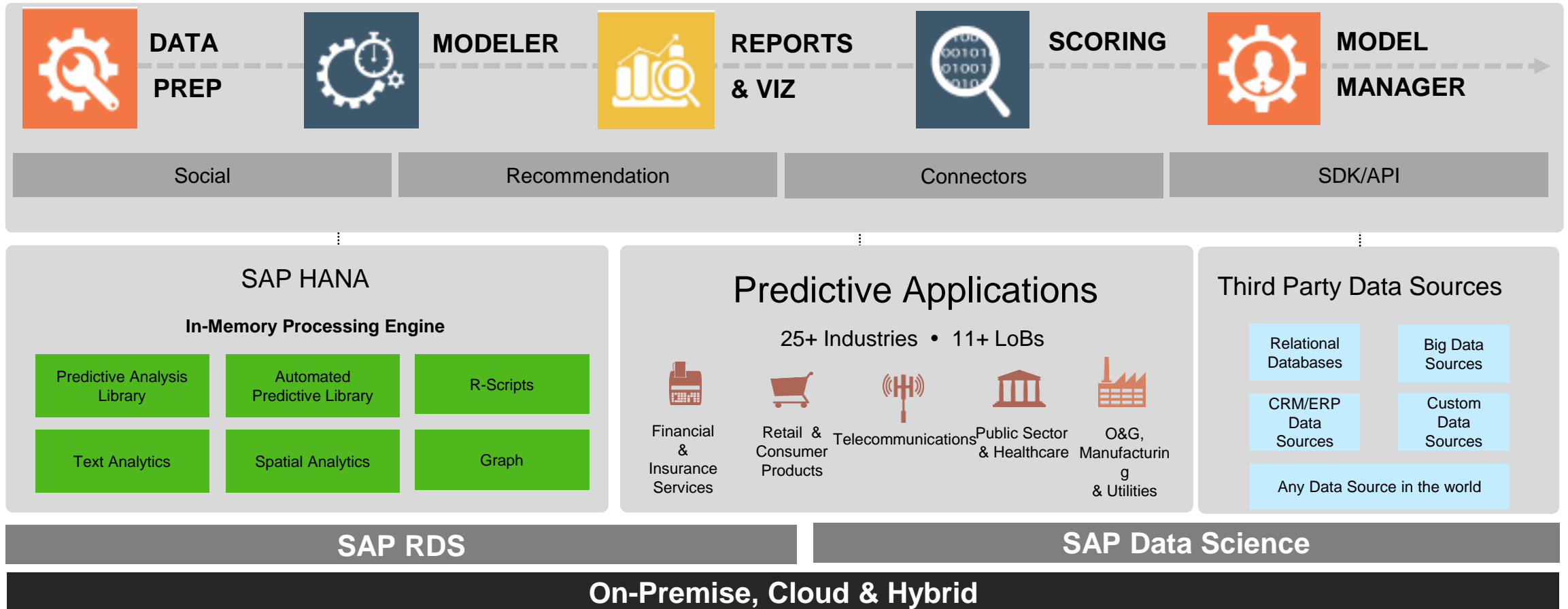
- Sampling
- Binning
- Scaling
- Partitioning
- Principal Component Analysis (PCA) / PCA Projection

■ Other

- Weighted Scores Table
- Substitute Missing Values

Advanced Analytics Solution from SAP

Developing fast predictive models that deliver fast results

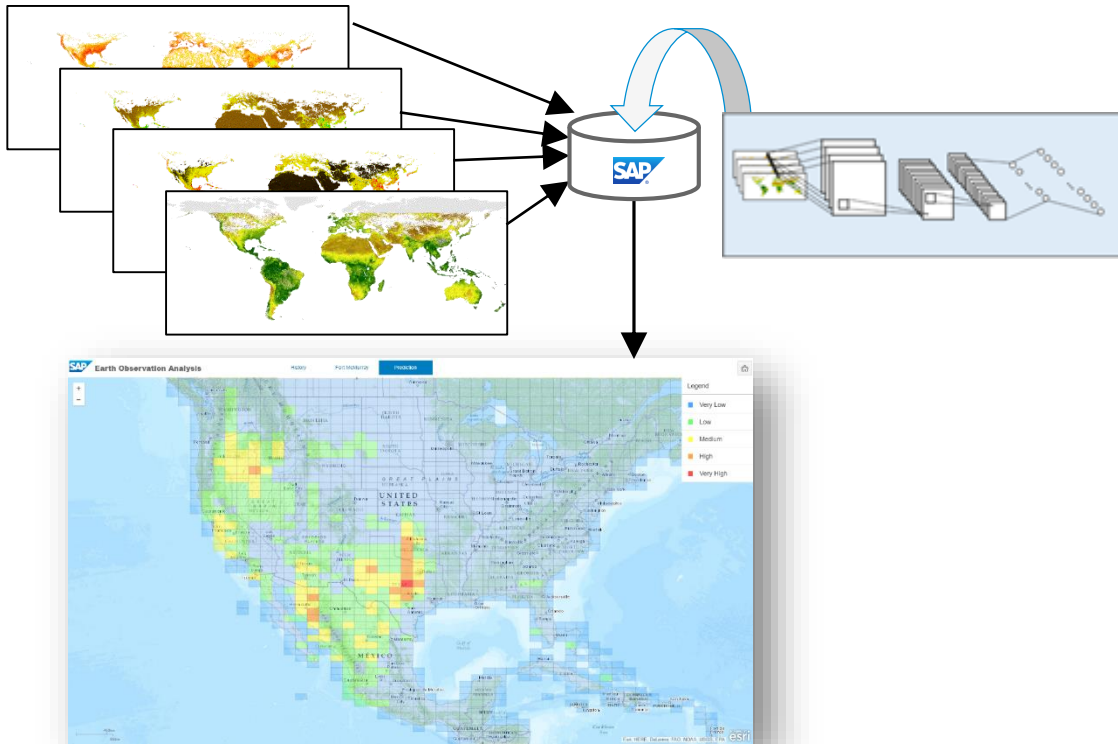


Geo-ML

Extracting Business Information

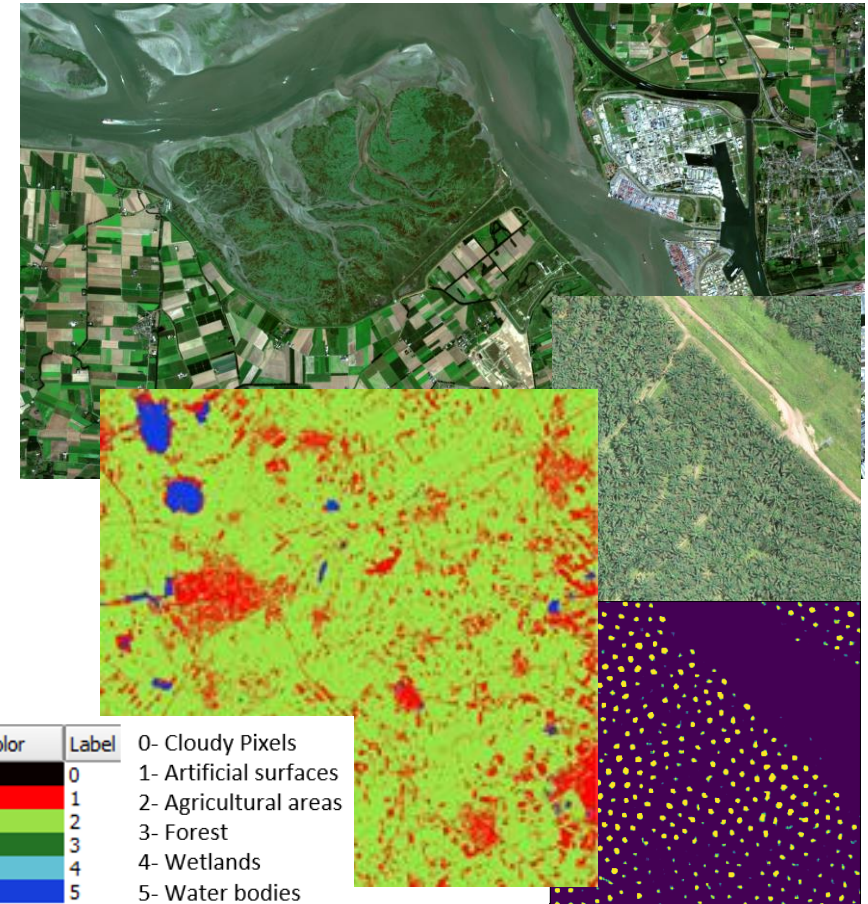
Risk Prediction & Anomaly Detection

(wildfire, landslide, drought, flood, crop disease, ...)



Classification

(land cover, land usage, object, ...)



Landslide Risk Prediction

Model Inputs



Digital Elevation Model
Elevation, Aspect, Slope



Lithology
Physical & geochemical properties of ground material



Terrain Displacement
Earthquakes as trigger for landslides
Detection of slow landslides



Vegetation Changes
NDVI time series, Forest loss



Weather forecasts
Heavy rainfall as trigger for landslides



Infrastructure
Distance to roads and drainage

Landslide Risk Prediction

Model inference

Prediction system based on

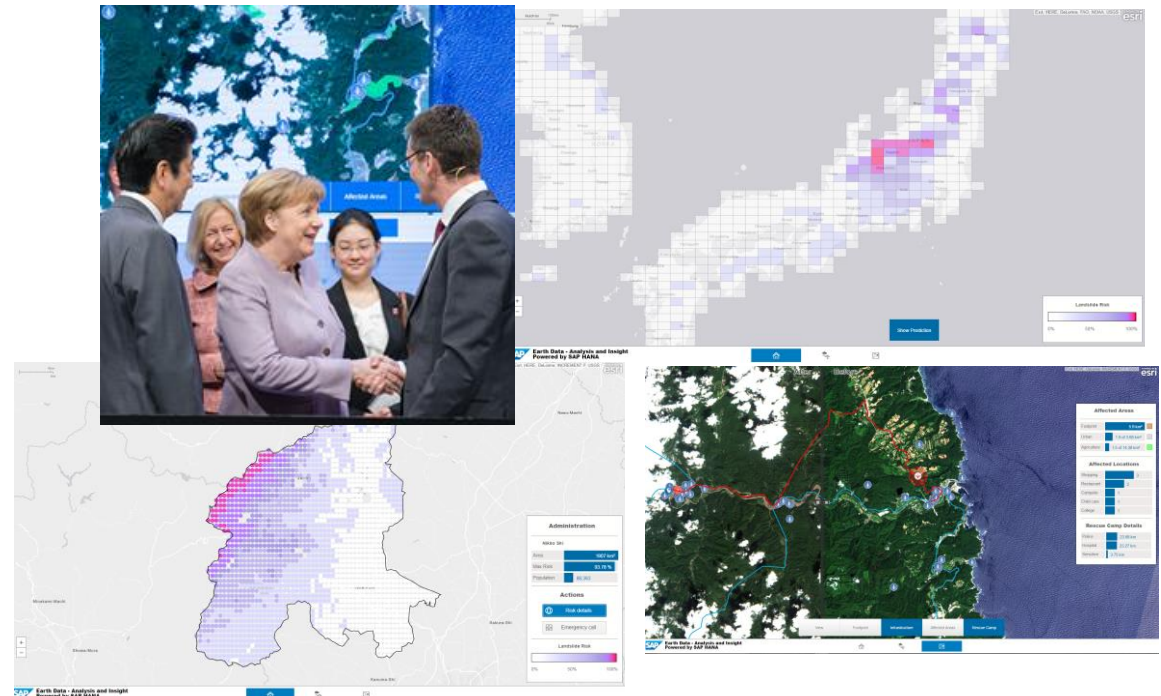
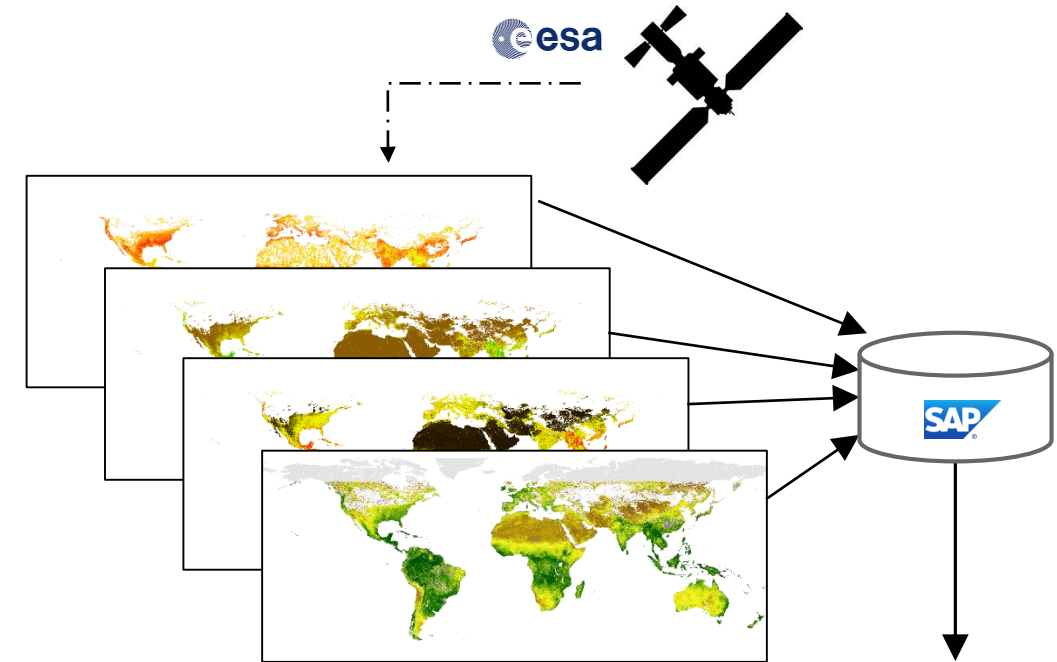
- Radar and optical EO data with gridded data
- Supervised deep learning (CNN, LSTM)

Application

- SAP Cloud Platform service
- SAP HANA advanced analytics (spatial & graph)
- Combination of EO-, open- and weather-data

Save lives and optimize rescue management

- Risk forecast for the next ten days
- Detailed emergency reports
- Improved decision making (emergency call)
- Reduce risk for humanitarian disaster

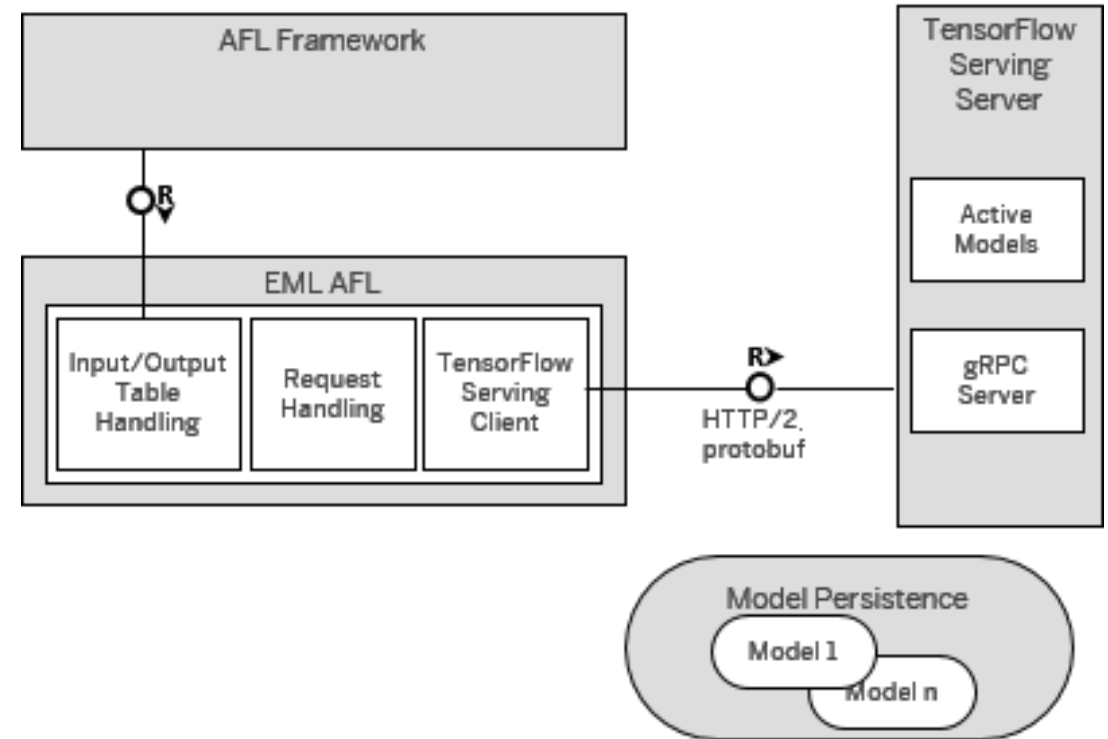


SAP HANA Extended Machine Learning Library (EML)

Deep Learning

Integration of Google TensorFlow with SAP HANA is based on

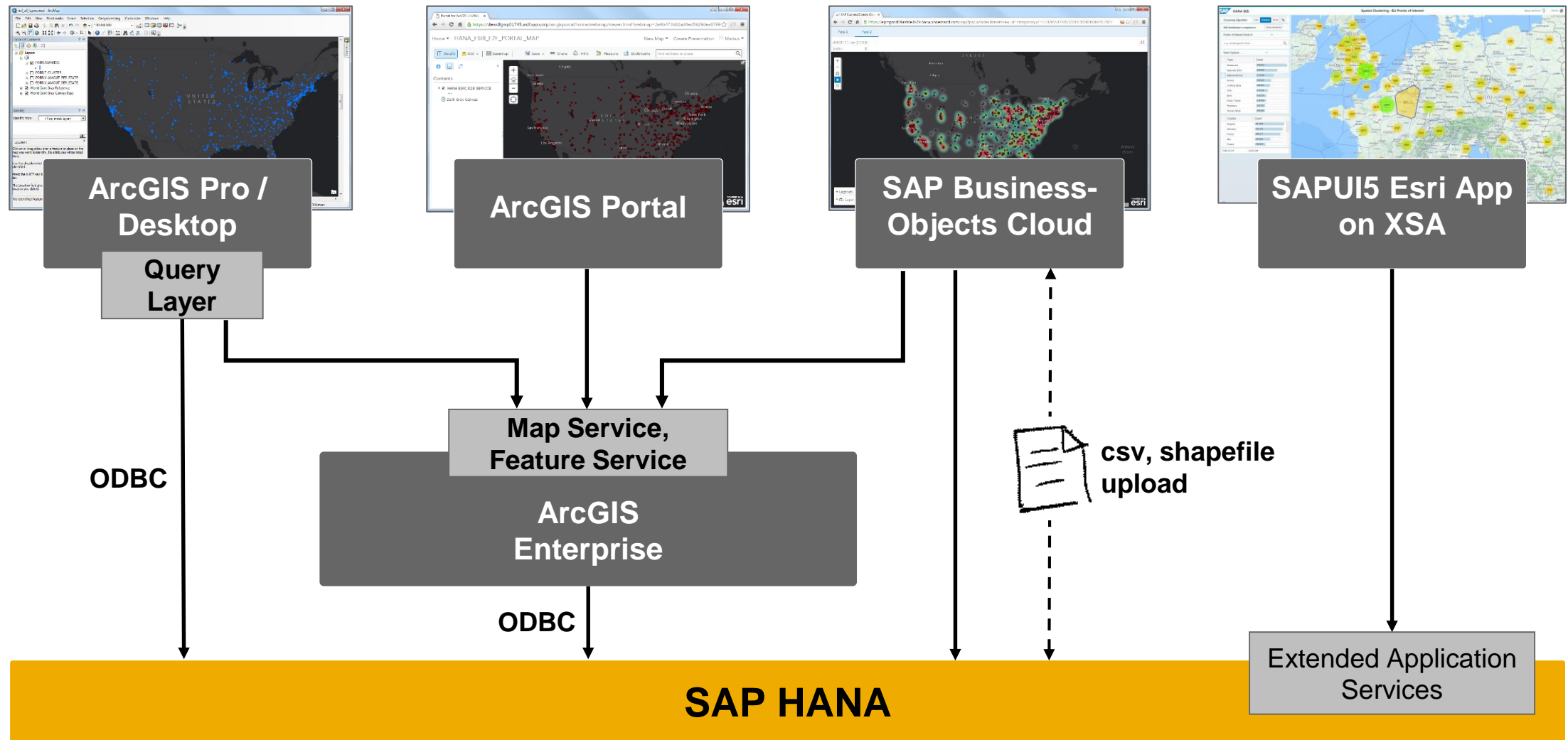
- SAP HANA Application Function Library (AFL)
- Google's gRPC remote procedure call package
- Separate server process that hosts the actual machine learning functionality



```
SELECT * FROM POI
WHERE location.ST_Intersects (
  landslide_risk('EU', 0.9) );
```

SAP HANA Spatial

Esri Applications



Software & License

How to get started

SAP HANA Application Function Library (AFL)

SAP HANA Predictive Analysis Library (PAL)

<https://help.sap.com/viewer/2cfbc5cf2bc14f028cfbe2a2bba60a50/2.0.01/en-US>

SAP HANA Extended Machine Learning Library (EML)

<https://help.sap.com/viewer/ab6b04eb12d3452aa904d5823416a065/2.0.02/en-US/abfc6b11fc3e41e98408df593a06ad16.html>

A satellite with large solar panels is shown in orbit above the Earth's cloud-covered surface. A green beam of light is projected from the satellite down to a specific location on the ground.

#SAPEsri

#DevSummit

#SAPHANA

#ESRI

Happy Mapping!

[SAP HANA Spatial Reference
Earth Observation Service](#)



[SAP HANA Academy
SAP HANA & Esri](#)

Thank You !

hinnerk.gildhoff@sap.com
[@HinnerkGildhoff](https://twitter.com/HinnerkGildhoff)

