How SAP C/4HANA and SAP Leonardo Machine Learning Enable the Intelligent Enterprise

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Agenda

- Machine Learning by SAP Leonardo
- Why Machine Learning Impacts SAP C/4HANA Suite Architecture
- How SAP Leonardo Transforms Data Into Customer Value
- What Makes Customer Experience Intelligent
Machine Learning by SAP Leonardo
Many of us help to train **Machine Learning** models on a daily basis without knowing...
SAP Leonardo powers enterprises with *intelligent technologies* for every *business process*, to create better *outcomes*.
Machine Learning will reinvent Businesses

- **60%**
  Of human tasks will be automated by 2025

- **97%**
  Image recognition accuracy today (better than human rate 95%)

- **95.1%**
  Speech recognition accuracy today (better than human rate 94.1%)

- **$18B**
  Enterprise Machine Learning Market by 2020

### Process Automation
Full automation of business processes, from HR to payments processing, to workflow approvals for purchase orders and sales execution

### Next-gen UX
User experience based on voice, vision and messaging will replicate how people interact in real life and increase business productivity

### Dynamic Analytics
Proactive analysis of new data types and discovery of unfamiliar patterns that provide a new level of insights

Source: SAP CSG analysis, McKinsey Quarterly Report July 2016, Google PR, Microsoft PR, SAP Market Model
How SAP Leonardo ML helps to deliver the Intelligent Enterprise

Open and flexible building blocks

Intelligent Applications

Conversational AI
Intelligent Process Automation
ML & Data Science Platform

On SAP Cloud Platform & SAP HANA

Business Outcomes

Increase revenue
Re-imagine processes
Quality time at work
Customer satisfaction
Enabling innovations

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SAP Leonardo Machine Learning Foundation
enabling customers and partners to build the intelligent enterprise
ML Services Portfolio

Image

Speech

Text

User

Image Processing APIs

- Customizable image classification
- Customizable image object detection
- Human detection; Face detection
- Customizable image feature extraction
- Face feature extraction
- Optical character recognition (OCR); Scene text recognition
- Image segmentation

Which objects are shown in the image?

What is the text displayed in an image?

Which pictures show identical persons?
ML Services Portfolio

Image | Speech | Text

How can I convert speech to written text and vice versa?

User

Speech Processing APIs

Speech-to-Text*

Text-to-Speech*

* Planned to be available in November 2018

*Roadmap - subject to change
ML Services Portfolio

How can I classify or match text contents?

What are the key words and topics of text documents?

User

Text Processing APIs

Customizable text classification
Text feature extraction
Topic detection
Language detection
Translation
Customizable similarity scoring*

*not directly applicable to images, but vectors of e.g. image/text contents
Planned innovations and roadmap for 2018

Data Scientist support for ML experimentation, including Jupyter notebooks

Create and run custom ML trainings (TensorFlow-based)

Leverage data pipelines to orchestrate ML services as well as data pre- and post-processing

Further data centers as deployment options
Why Machine Learning Impacts SAP C/4HANA Suite Architecture
SAP C/4HANA End-To-End Machine Learning Process Vision

Closed-loop performance across all channels

INTELLIGENT COMMERCE
- Personalized CX & Adaptive Commerce
- Conversational Commerce

INTELLIGENT MARKETING
- Real-time Customer Profile and Intelligent Scores
- Customer Retention
- Lead Conversion Propensity
- Brand Impact
- Product / Offer Recommendation
- Buying & Customer Propensity

INTELLIGENT SALES
- Conversational User Interface
- Lead Intelligence
- Next-best Action, Recommendation
- Account Intelligence
- Deal Intelligence
- Smart Campaigns / ABM
- Intelligent Target Planning
- Predictive Forecasting
- Intelligent Compensation

INTELLIGENT SERVICE
- Conversational Service
- Ticket Intelligence
- Field Service Intelligence
- Deal Intelligence

INTELLIGENT SCENARIOS & APPS
POWERED BY SAP LEONARDO

SAP Cloud Platform
- SAP Leonardo Machine Learning Foundation
- SAP Leonardo Conversational AI / Recast
- SAP Data Hub (Data Science Platform)
- SAP Leonardo Predictive Analytics (PAi)
- 3rd Party / Non-SAP AI/ML Technologies & Algorithms

SAP C/4HANA®
- SAP MARKETING CLOUD
- SAP COMMERCE CLOUD
- SAP SALES CLOUD
- SAP SERVICE CLOUD
- SAP CUSTOMER DATA CLOUD
- EXTENSIONS & CUSTOM APPS
- NON-SAP / 3RD PARTY

SAP S/4HANA®

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SAP C/4HANA Designed for New Customer Experience with SAP Leonardo

SAP C/4HANA®

SAP Marketing Cloud
Market with Intelligence in the Moment

SAP Commerce Cloud
Personalized Shopping Experience across Touchpoints

SAP Sales Cloud
Build Relationships and guide Customers throughout their journey

SAP Service Cloud
Make Customers happy

SAP Leonardo Machine Learning & Predictive Analytics

SAP Customer Data Cloud
Build Customer Trust and Loyalty

SAP® Cloud Platform

SAP S/4HANA®
Success Factors of Enterprise Machine Learning Development

SCENARIOS
Strong use cases adding significant value to an exceptional customer experience.

DATA
High-quality data across multiple domains Sales, Service, Marketing, Commerce

ARCHITECTURE
Sustainable architecture satisfying defined architecture qualities i.e. performance efficiency, reliability, portability, maintainability
Hidden Technological Complexity of Enterprise Machine Learning

- Large volume of data records created at high velocity.
- Multi-dimensional input spread across multiple data sources.
- Workload of complex algorithms for preprocessing, training and inference.
- Performance efficiency of inference.

Machine learning architecture required, which is easy-to-consume and efficient at runtime.
Productizing Machine Learning is More Than Data Science

SAP Leonardo Machine Learning Technologies to Unlock the Intelligent C/4HANA Suite
How SAP Leonardo Transforms Data Into Customer Value
### Transforming Data into Customer Value with SAP Leonardo Machine Learning Foundation

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<th>Training</th>
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<td>Data Preparation</td>
<td>Training Execution</td>
<td>Model Publishing</td>
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<tr>
<td>Explore and analyze data</td>
<td>Clean and label data</td>
<td>Alternatively, re-train existing models with custom data</td>
<td>Deploy model and make it available for inference</td>
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<td>Prepare your data</td>
<td>Train your own model</td>
<td>Re-trainable Models</td>
<td>Use ML capabilities integrated in SAP solutions.</td>
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<td>Leonardo Machine Learning Foundation</td>
<td>Bring your own Model</td>
<td>Ready-to-use Apps</td>
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**Data Preparation:**
- Explore and analyze data
- Prepare your data
- Pre-processing

**Training:**
- Data Preparation
- Upload training script and data to create custom model
- Train your own model

**Deployment:**
- Training Execution
- Re-trainable Models
- Bring your own Model

**Inference:**
- Model Publishing
- Integrated ML Capabilities
- Ready-to-use Apps

**Leonardo Machine Learning Foundation**
- C/4, S/4, …

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Consuming Machine Learning Services on SAP Cloud Platform

SAP Marketing Cloud
- Lead Conversion Propensity UI
- ML Common OData
- Contacts & Interactions API
- Score API
- SAP HANA DB

SCP Cloud Foundry
- SAP UAA
- SAP Leonardo ML (CF Space)
- Service Broker

Middleware Services
- Scheduler
- Training
- Inference

ML MKT Service
- Data
- Job
- Model
- Inference

ML Foundation
- TYOM
  - Job Submission API
  - Kubernetes Clustering

BYOM
- Model Repo/Deployment API
  - Model Repo
  - Model Container

Authentication/Token
- Data Lifecyle Management
- Data Upload
- Job Management
- Model Management
- Inference Payload

Data Streaming/Data Lifecyle Management
- Trigger ML Training/Job Management
- Model Lifecycle/Get Model Matrix
- Get Prediction Results
# Exposed Interfaces of SAP Leonardo Machine Learning Foundation

## Submission API
- **GET** Get Jobs
- **GET** Get Job Status by Id
- **DELETE** Delete Job by Id
- **POST** Schedule Job
- **GET** Get Job Log
- **GET** Get Storage Endpoint
- **POST** Create Initial Storage Endpoint

## Model API
- **GET** Get Models
- **GET** Get Model Versions
- **POST** Create Model Version
- **DELETE** Delete Model Version by Id
- **GET** Get Model Version by Id
- **PATCH** Patch Model Version by Id
- **GET** Get Model Version File

## Deployment API
- **GET** Get Model Runtimes
- **GET** Find Model Servers
- **POST** Create Model Server
- **DELETE** Delete Model Server
- **GET** Get Model Server
- **GET** Return Available Resource Plans
- **GET** Return Resource Plan

## Version API
- **GET** Get API Version
High-Level Sequence of Training and Inference based on SAP Machine Learning Foundation

Application
- Create Storage Endpoint
- Schedule Job
- Get Job Status
- Get Model Version
- Create Model Server
- Get Intelligent Score

Submission
- Create Model Version

Model

Deployment
- Get Model File

Inference
- Invoke Model
Ingest Data from Various Sources

SAP Data Hub Capabilities

- Apply machine learning and predictive algorithms to any data set combined from 1st party C/4HANA, 2nd party partner, and 3rd public data
- Operationalize machine learning intelligence rather than natively implement algorithms
- Distribute intelligent results to core business applications where value is added to business processes
Ingest Data from Various Source and Execute Intelligent Logic

Create powerful data pipelines
- Fast and Flexible program definition and execution
- Use distributed processing in a cluster environment
- Take advantage of serverless computing paradigms for radical scale
- Incorporate powerful third-party libraries, such as TensorFlow

Build data streams to enable data-driven processes
- Establish data streams to react to data changes instantly
- Embed complex algorithms into existing data flow by using any code or script
- Easy Reuse of existing coding and libraries
- Predefined machine learning operators
- Read and Store Data (File, HDFS, S3, SAP HANA, SAP Vora)
Outlook Combining SAP Data Hub with SAP Leonardo

SAP C/4HANA

- User Experience
  - Sales Cloud
  - Service Cloud
  - Marketing Cloud
  - Commerce Cloud
  - Customer Data Cloud

SAP Data Hub

- Data Discovery & Governance
- Data Pipelines & Orchestration
- Data Preparation
- Distributed Processing based on SAP VORA

SAP Leonardo Machine Learning Foundation

- Business Services
  - Inference (BYOM)
  - Training (TYOM)
- Functional Services
  - Model Repo
  - Run-time

SAP Leonardo Predictive Analytics

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

SAP HANA
Towards a unified ML & Data Science Platform

Components

- **SAP Data Hub**
  Data sharing, pipelining, and orchestration. Including data preparation and cleaning.

- **SAP Predictive Analytics**
  Operationalization and automation

- **SAP Leonardo ML Foundation**
  Deep Learning (text, image, video, audio)

- **SAP HANA ML**
  In-database Machine Learning

Solution

One integrated offering
One data science front end
Full lifecycle management
Integrated with SAP

Roadmap - subject to change
ML & Data Science Platform Overview

The foundation of the intelligent enterprise.

- Supporting the entire lifecycle of self-learning software.
- Enabling data scientists and developers to tightly integrate with SAP data and processes.
- All Machine Learning technologies.
- Scalable and secure cloud-based platform.
Overview of Integration Scenarios

REST: Invoke Machine Learning via APIs

SAP Predictive Analytics Integrator: Native Consumption out of ABAP*

SAP Data Hub: Combining different systems and data sources

* Roadmap - subject to change
Predictive Analytics Integrator to invoke Machine Learning APIs

- SAP S/4HANA
  - Business App
  - PA Integrator

- SAP HANA

- SAP Cloud Platform
  - ML Foundation Consumption API
  - ML Foundation Training API

- ML Unified API

Roadmap - subject to change
Powerful combination of SAP ML Foundation & SAP Data Hub

- Leverage deep learning out of the box by invoking SAP MLF services in SAP Data Hub pipelines
- Utilize heterogenous data managed by SAP Data Hub
- Orchestrate enterprise data with big data to feed ML models
What Makes Customer Experience Intelligent
Dear Sir/Madam,

Last Monday we were expecting your service engineers to arrive at our home between 8am and 12pm.

No one came until 2pm and after calling your service desk, we were told that there are no more service appointment slots possible for us this week.

We are very disappointed as this would mean a whole week with no fridge for our family.

Regards,

Taylor Jones

Uses deep learning convolution neural networks for ticket category classification and ticket prioritization
Demo: Service Ticket Intelligence
SAP C/4HANA Marketing: Customer Retention

Continuously monitor the churn risk of customers. React on time for higher customer retention

Mine customer touchpoint data from various sources, identify unknown churn related behavioral patterns or events, and predict list of customers at risk of churning and estimate the time before they churn.

Take action on high risk customers by creating target lists automatically with follow-up campaigns.

Visualize all customer touchpoints/events to better understand a customer’s journey and experience.
SAP C/4HANA Marketing: Lead Conversion
Propensity Identifies Most Promising Customers

Use SAP Leonardo and customer behavior data to detect “hidden” behavior patterns and determine lead conversion.

The majority of all B2B generated leads are not sales ready. Time, costs and resources is optimized.

Identify leads with a high chance of conversion with the help of deep learning powered by SAP Leonardo.

Achieve campaign optimization and automation as well as focused customer engagement by addressing the right audience.

Increase conversion rates, revenue, and customer satisfaction while reducing marketing cost.
Leonardo Machine Learning Foundation in a nutshell

Enterprise-grade platform to augment business processes with Machine Learning

Easy-to-consume ML content targeted at non-ML experts

Tight integration with SAP’s software

Scalable and secure cloud-based platform

Supporting the entire lifecycle of self-learning software

Being open towards various Machine Learning technologies
SAP Leonardo Machine Learning Discovery Service

Service Description
Machine learning technology provides new solutions to existing and new business opportunities. We conduct an onsite workshop with you to define an approach for your business to benefit from the capabilities of machine learning. SAP machine learning experts provide guidance about the benefits of machine learning and intelligent application – for potential uses cases and line of businesses.

Delivery Approach

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<th>Prototyping</th>
<th>Action Plan</th>
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<td>Fundamentals &amp; SAP machine learning vision</td>
<td>Customer Vision, Goals and Needs</td>
<td>Imagination and Inspiration</td>
<td>Low fidelity prototypes</td>
<td>Summary, Prioritization &amp; Next Steps</td>
</tr>
</tbody>
</table>

Business Benefits
▪ Understand the business benefits of machine learning and intelligent applications
▪ Define a vision and value proposition for machine learning based on SAP Leonardo
▪ Validate a high level action plan to maximize business benefits

Applications
▪ SAP Leonardo Machine Learning Foundation
▪ S/4HANA and other backend systems

Key Deliverables
▪ Initial customer vision to machine learning
▪ Value proposition based on SAP Leonardo machine learning
▪ High level action plan

Variants & Duration
▪ Standard variant: 1 day onsite (3 person days effort based on T&M)
▪ Variant with extended prototyping: 2 days onsite (6 person days effort based on T&M)
Get Started

→ Developer website: sap.com/developer/topics/machine-learning.html

1. Select your Machine Learning technology
2. Get your SAP Cloud Platform developer account
3. Build your first app

Machine Learning for SAP

Machine learning enables computers to learn from large amounts of data without being explicitly programmed. With machine learning, you can now build intelligent business apps that can augment and automate repetitive tasks, optimize business operations and be easily integrated and consumed across your organization.
Learn More

ML overview website: sap.com/ML

Websites


Online Courses

SAP Leonardo Machine Learning Foundation – An Introduction
https://open.sap.com/courses/leo5

Enterprise ML in a Nutshell
https://open.sap.com/courses/ml1

Enterprise Deep Learning with TensorFlow
https://open.sap.com/courses/ml2/
Thank you.

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