

The Developer Advocates present

# SAP CodeJam

2025

>— Getting Started with  
Machine Learning using SAP HANA



Kolkata, India

Mar 4, 2025



Bangalore, India

Mar 10, 2025

**SAP TechEd**

# Witalij Rudnicki aka @Sygyzmundovych aka Vitaliy Rudnytskiy aka Віталій Рудницький

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

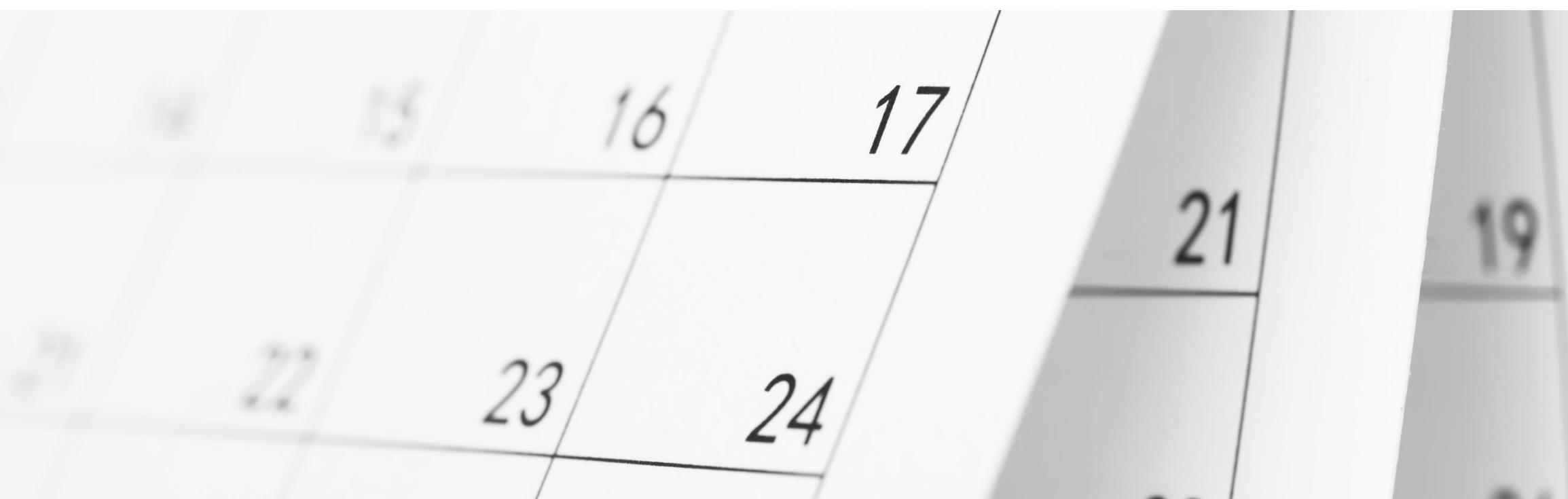


Never heard of Wrocław?

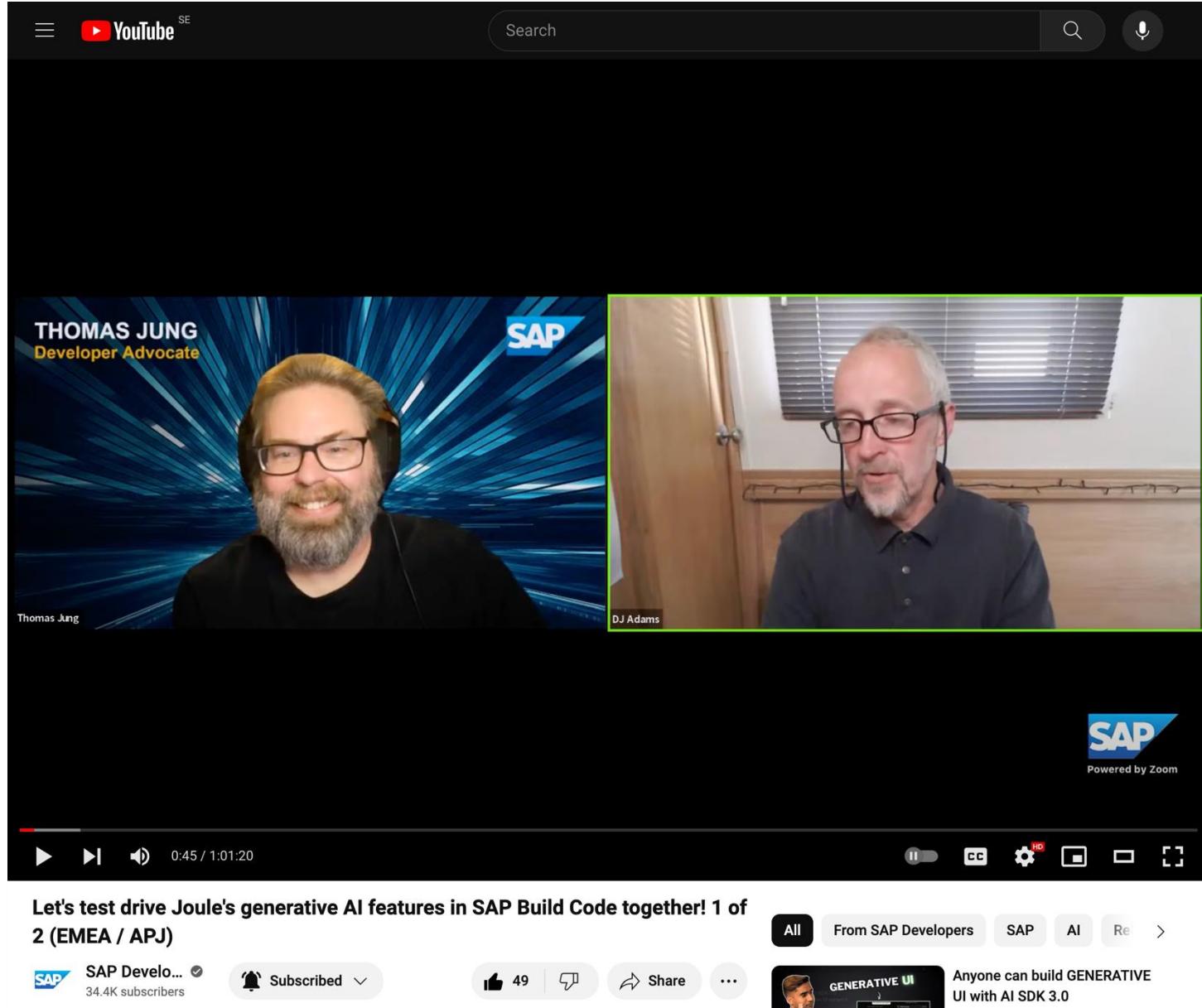
## TOP 10 MID-SIZED EUROPEAN CITIES OF THE FUTURE 2023 – OVERALL

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

# **Events not be missed**



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



Code Connect:

<https://code-connect.dev/>

The image shows the header section of the Code Connect website. It features a background with vertical stripes in purple, yellow, and blue. On the left, there's a logo consisting of three interlocking circles in pink, white, and light blue. To its right, the words "CODE CONNECT" are written in large, bold, pink capital letters. Below this, there are three circular icons: an orange one with "UI5", a blue one with a white head icon, and a pink one with a white chip icon. Further down, the event details "July 8–10, 2025" and "St. Leon-Rot, Germany" are displayed. To the right of these details are three navigation links: "Sponsoring", "Location", and "FAQ". At the bottom of the header, a white callout box contains the text: "Ride the rails to UI5con, reCAP, and HANA Tech Con – three days, three conferences, one streamlined journey."

**CODE  
CONNECT**

UI5

July 8–10, 2025

St. Leon-Rot, Germany

Sponsoring   Location   FAQ

Ride the rails to UI5con, reCAP, and HANA Tech Con – three days, three conferences, one streamlined journey.

## Devtoberfest:

<https://www.youtube.com/playlist?list=PL6RpkC85SLQDHz97qsNTNAE2jnUKj8X5d>

1. ABAP and SAP Cloud Application Programming Model
2. Tooling
3. Integration
4. MAD  
(Machine Learning, AI, and Data)
5. Frontend



Devtoberfest

SAP TechEd

# SAP TechEd

Where ideas get real

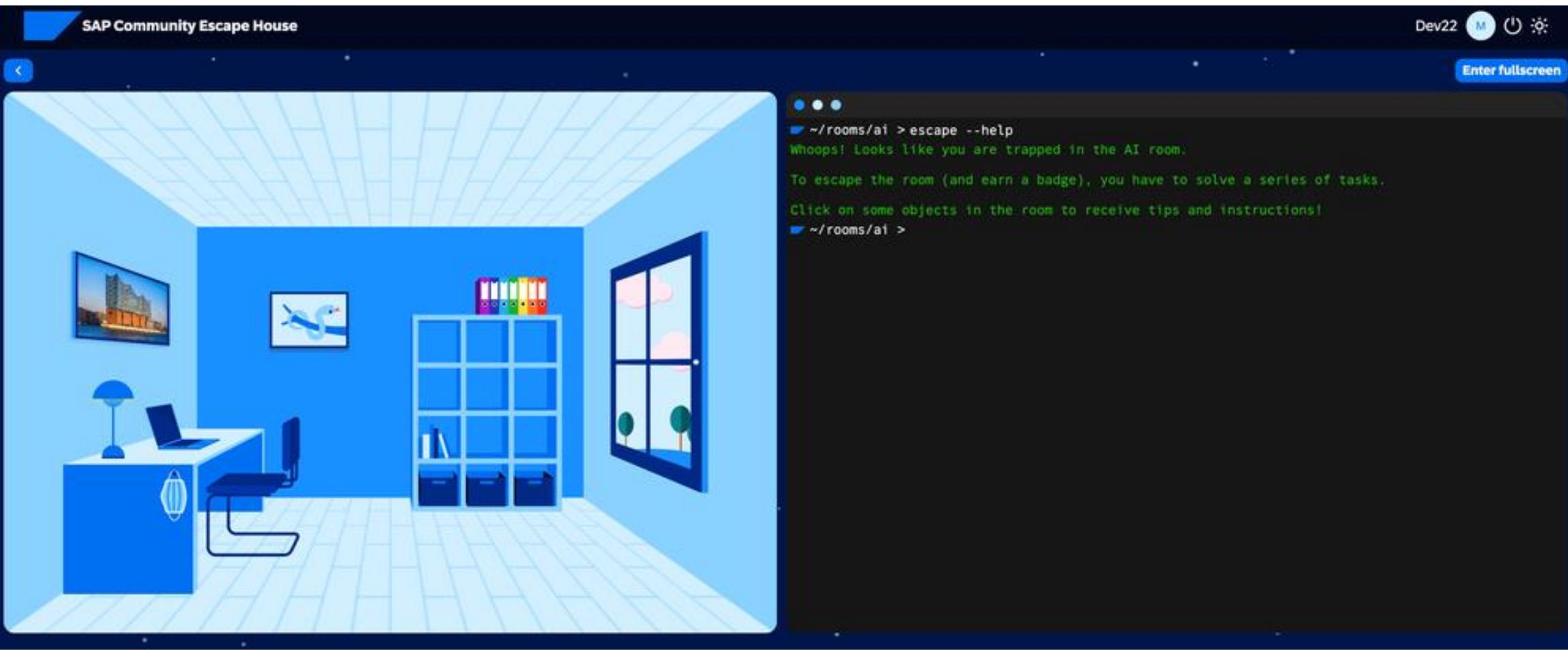
The SAP TechEd event brings together developers, practitioners, enterprise architects, and global IT leaders. Joined by SAP experts and partners, they'll unite to explore innovations in app development tools, generative AI, clean core for cloud ERP, and much more.



<https://www.sap.com/events/teched/virtual.html>:

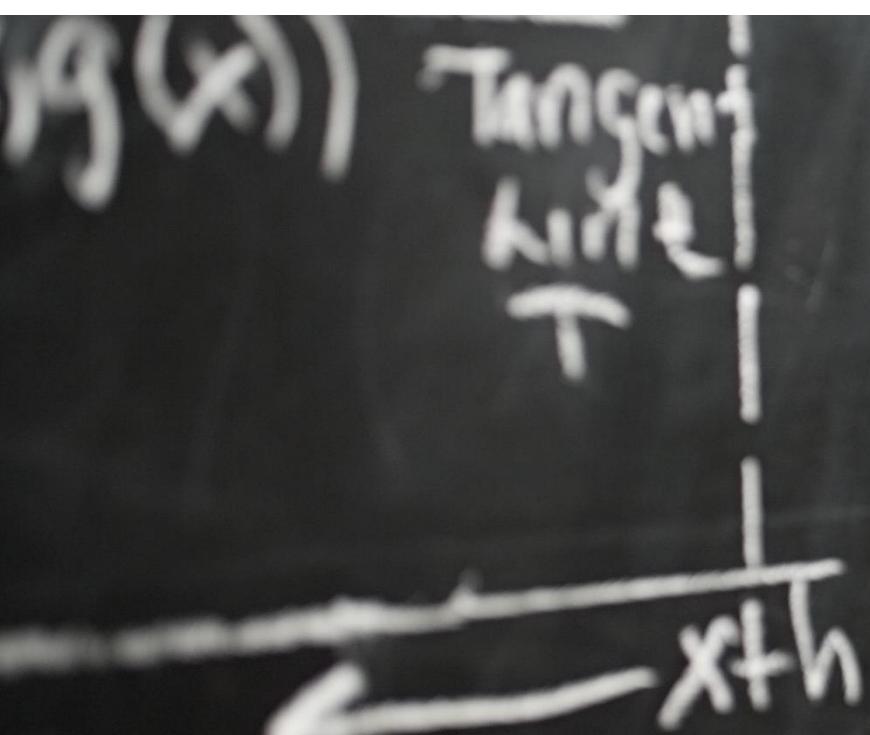
Berlin and Virtual: November 4-6, 2025

# SAP Developer Challenge March - Community Escape House - AI



source: <https://community.sap.com/t5/artificial-intelligence-and-machine-learning-blogs/sap-developer-challenge-march-sap-community-escape-house-ai/ba-p/14030669>

# A bit of theory before we start



$$\begin{aligned}f(x) &= \lim_{h \rightarrow 0} \frac{(x+h)^2 - x^2}{h} = 1 \\&= \lim_{h \rightarrow 0} \frac{x^2 + 2xh + h^2 - x^2}{h} = 2x\end{aligned}$$

$f(x) = \lim_{\Delta x \rightarrow 0} \frac{f(x+\Delta x) - f(x)}{\Delta x}$

## How many of you are familiar with...

...ChatGPT?

...or any other GenAI consumer chatbots?

...Machine Learning / Artificial Intelligence?

...SAP HANA database?

...SAP HANA embedded ML (PAL)?

...SAP Business Technology Platform?

...SAP Business Application Studio? ...VS Code?

...Python?

...Jupyter notebooks?

...Python ML libraries, like `sklearn`?

...GitHub?

...Generative AI?

# Programming



# Machine Learning



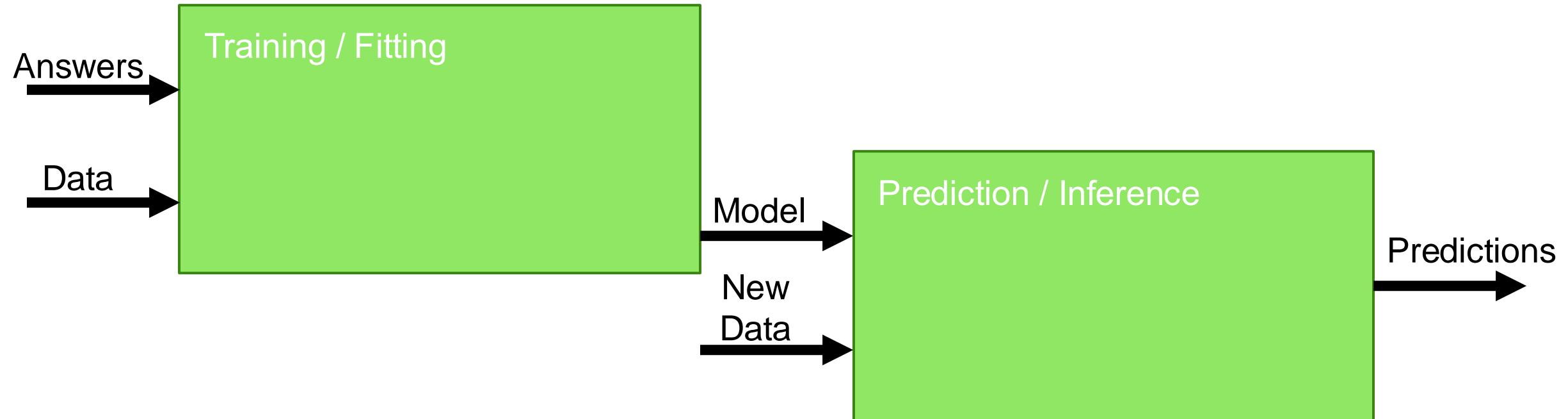
# Machine Learning



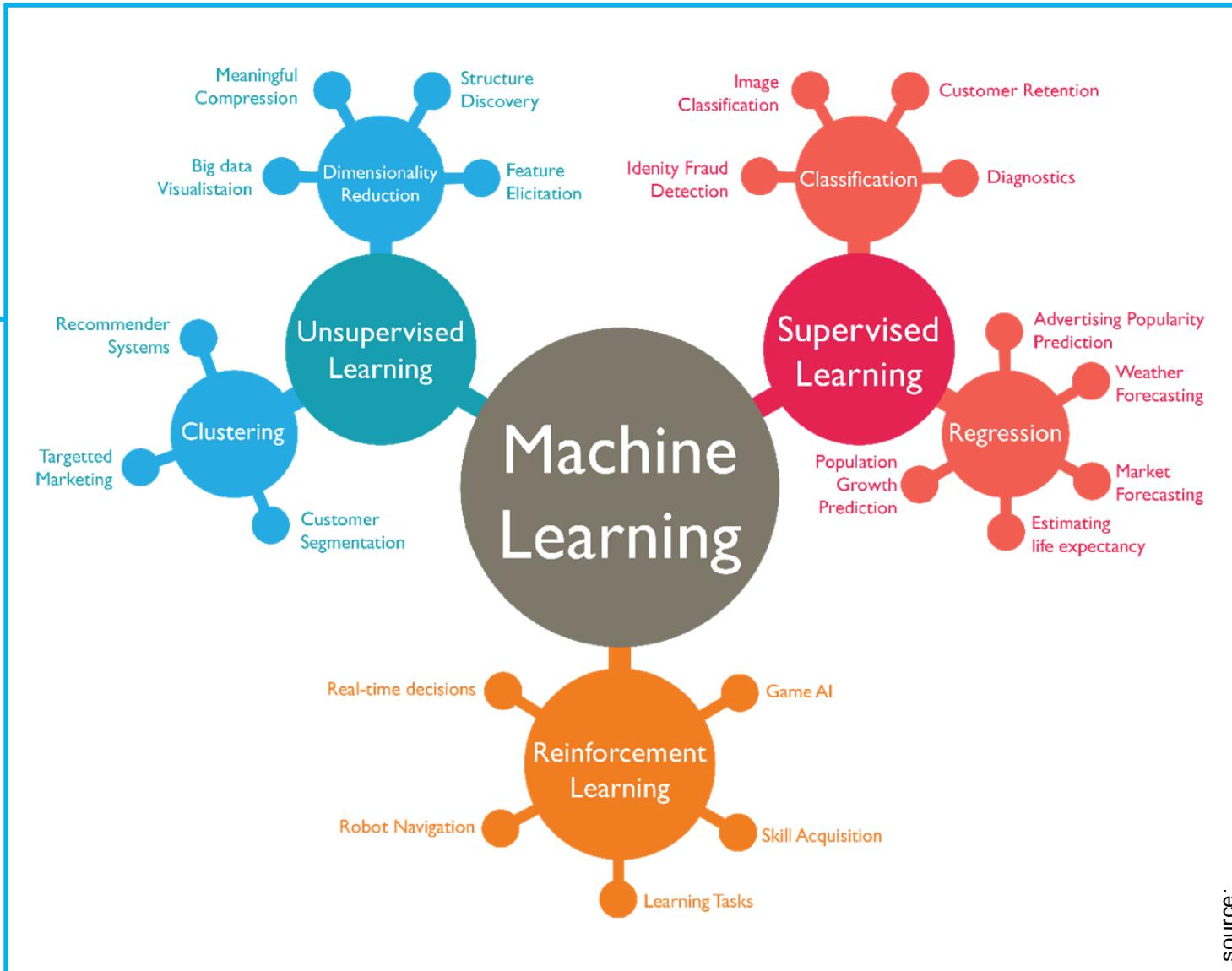
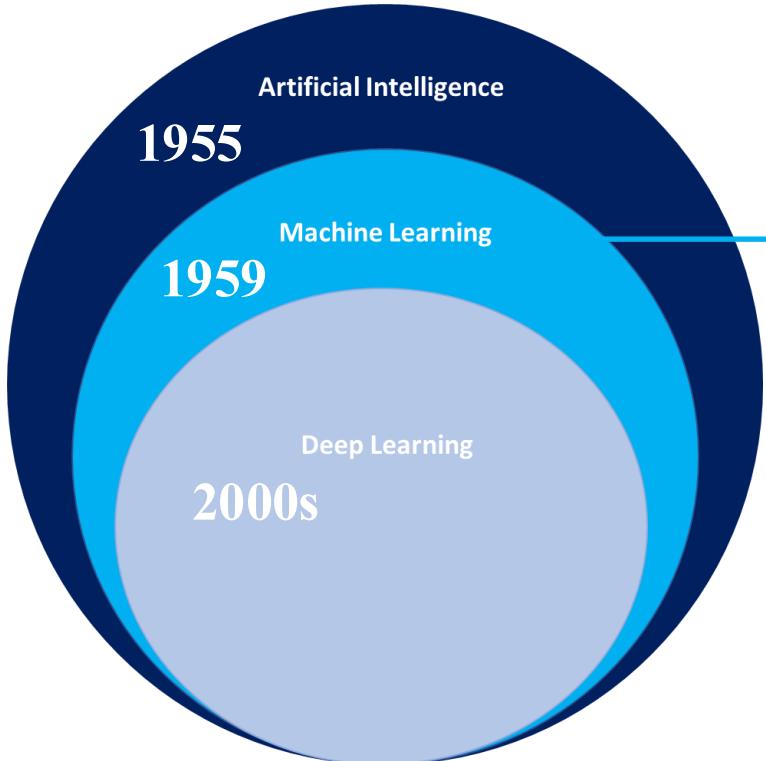
# Machine Learning



# Machine Learning



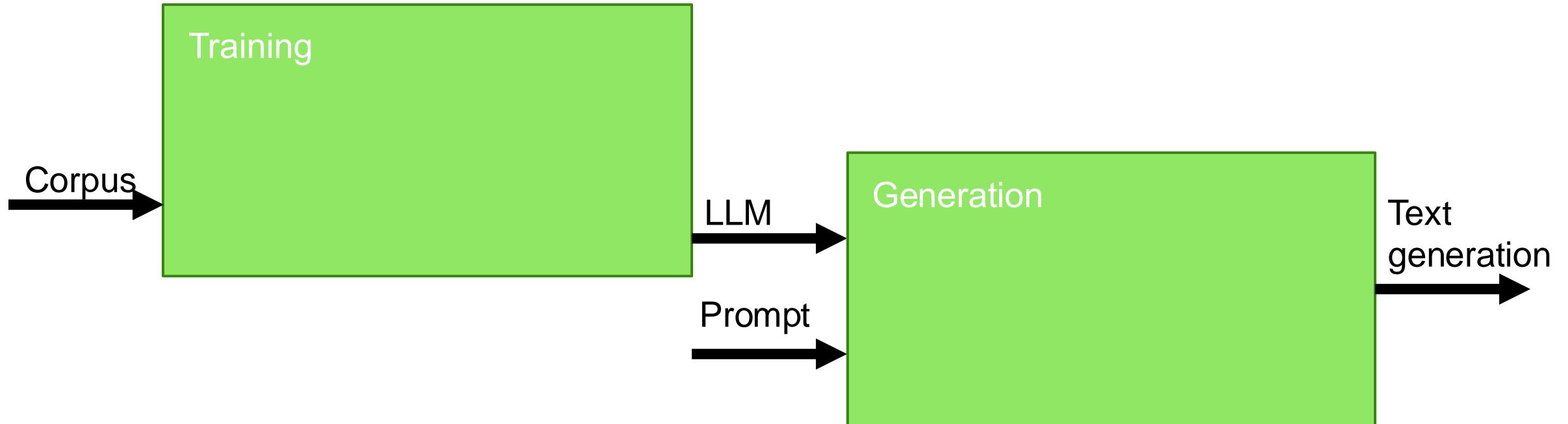
# Machine Learning Terminology



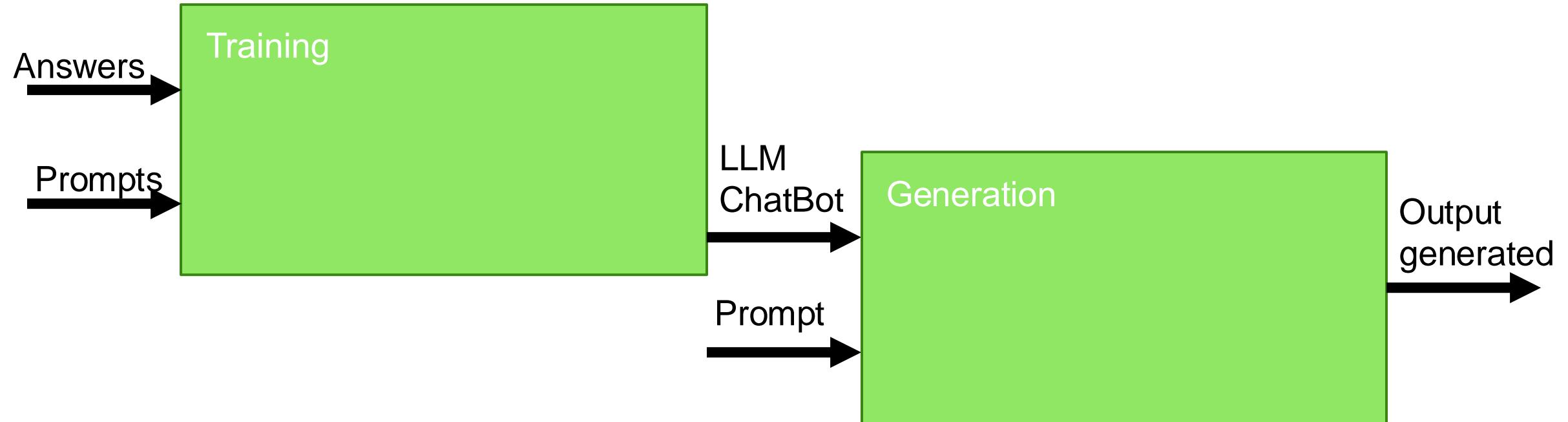
source:

[https://www.researchgate.net/publication/337958773\\_A\\_Novel\\_Approach\\_for\\_Improving\\_Breast\\_Cancer\\_Risk\\_Prediction\\_using\\_Machine\\_Learning\\_Algorithms\\_A\\_Survey](https://www.researchgate.net/publication/337958773_A_Novel_Approach_for_Improving_Breast_Cancer_Risk_Prediction_using_Machine_Learning_Algorithms_A_Survey)

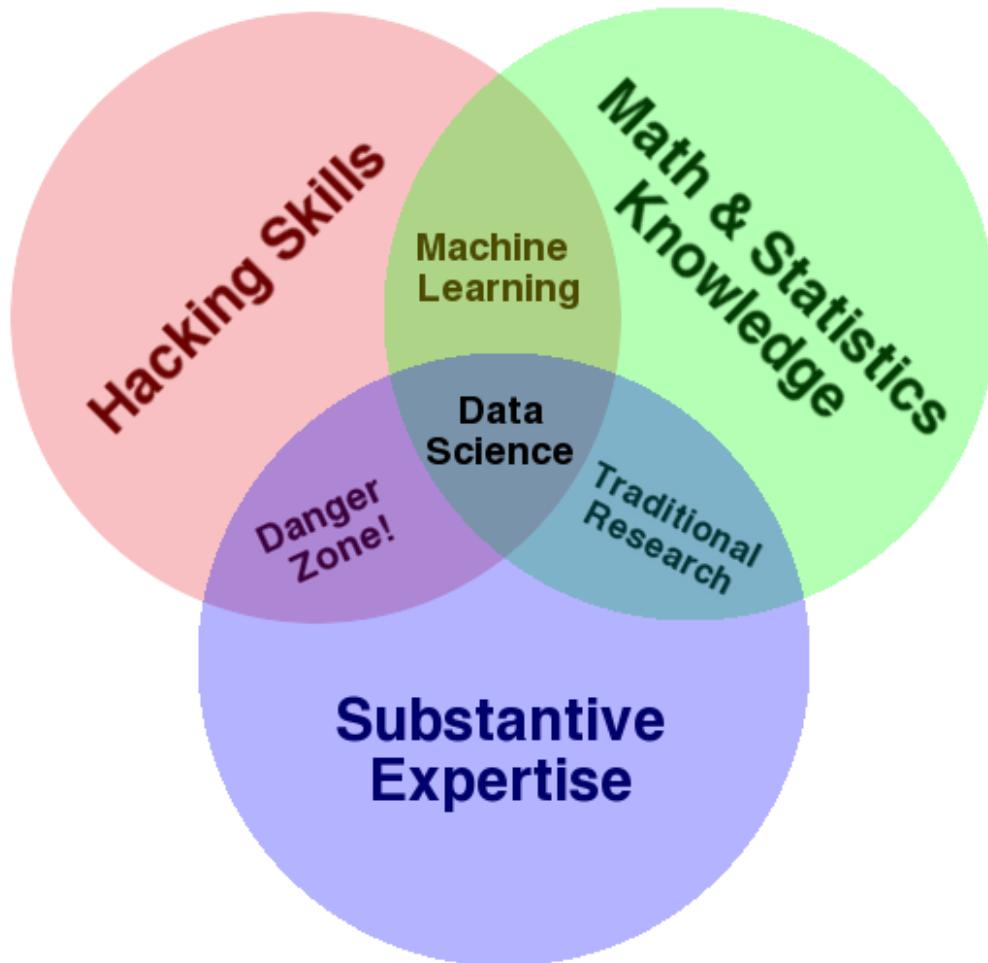
# Gen AI – unsupervised phase



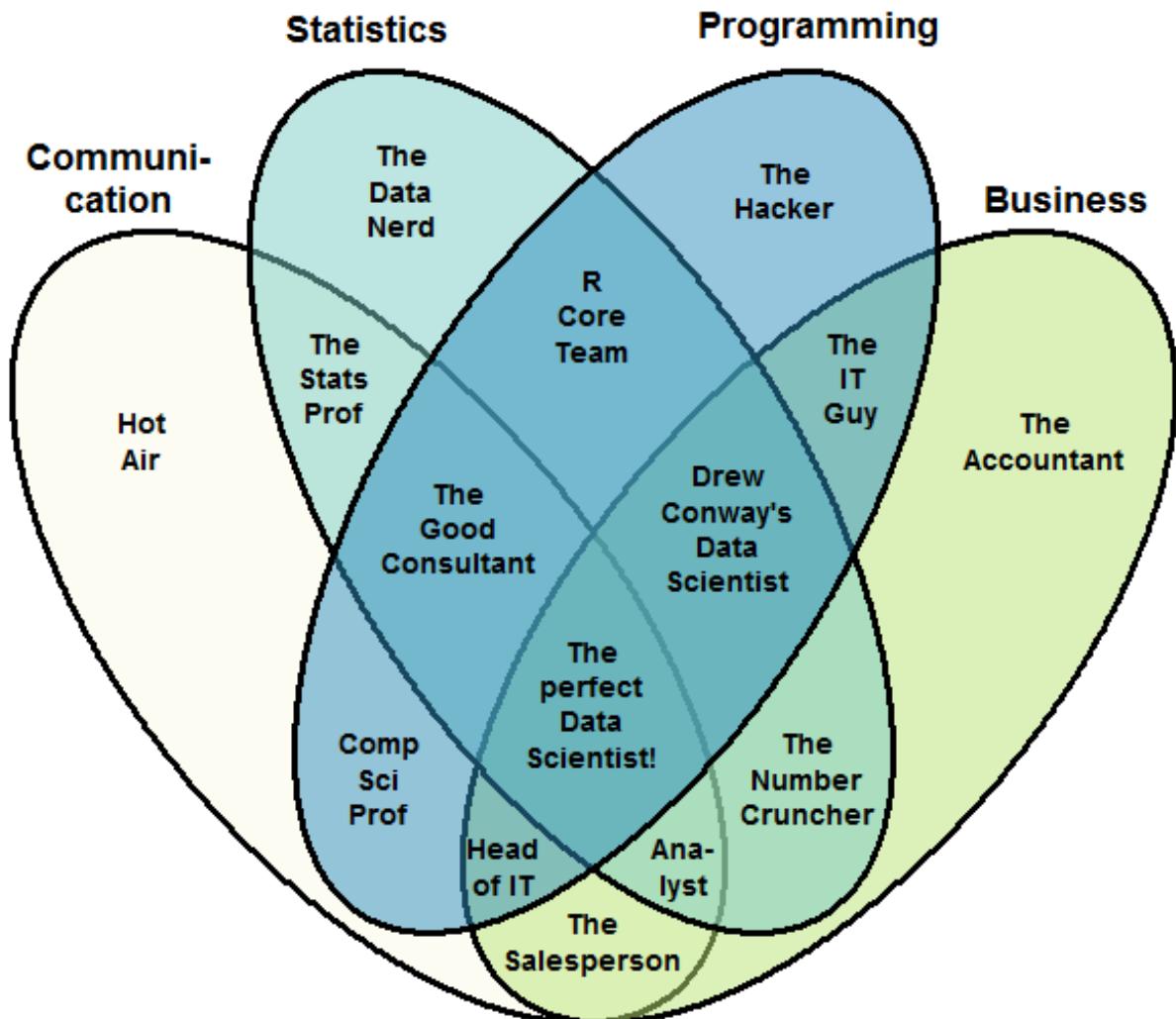
# Gen AI – supervised phase



# Who is the Data Scientist?

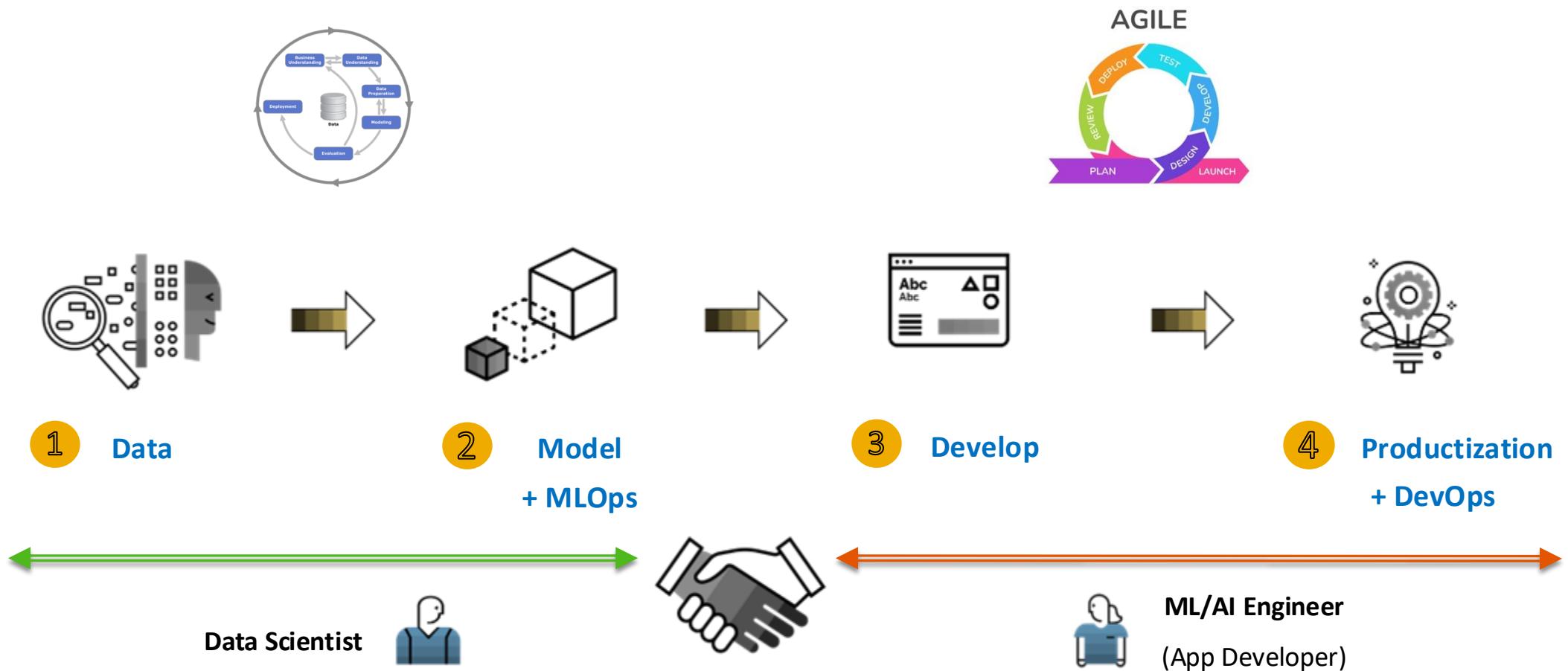


Drew Conway's Data Scientist Venn Diagram

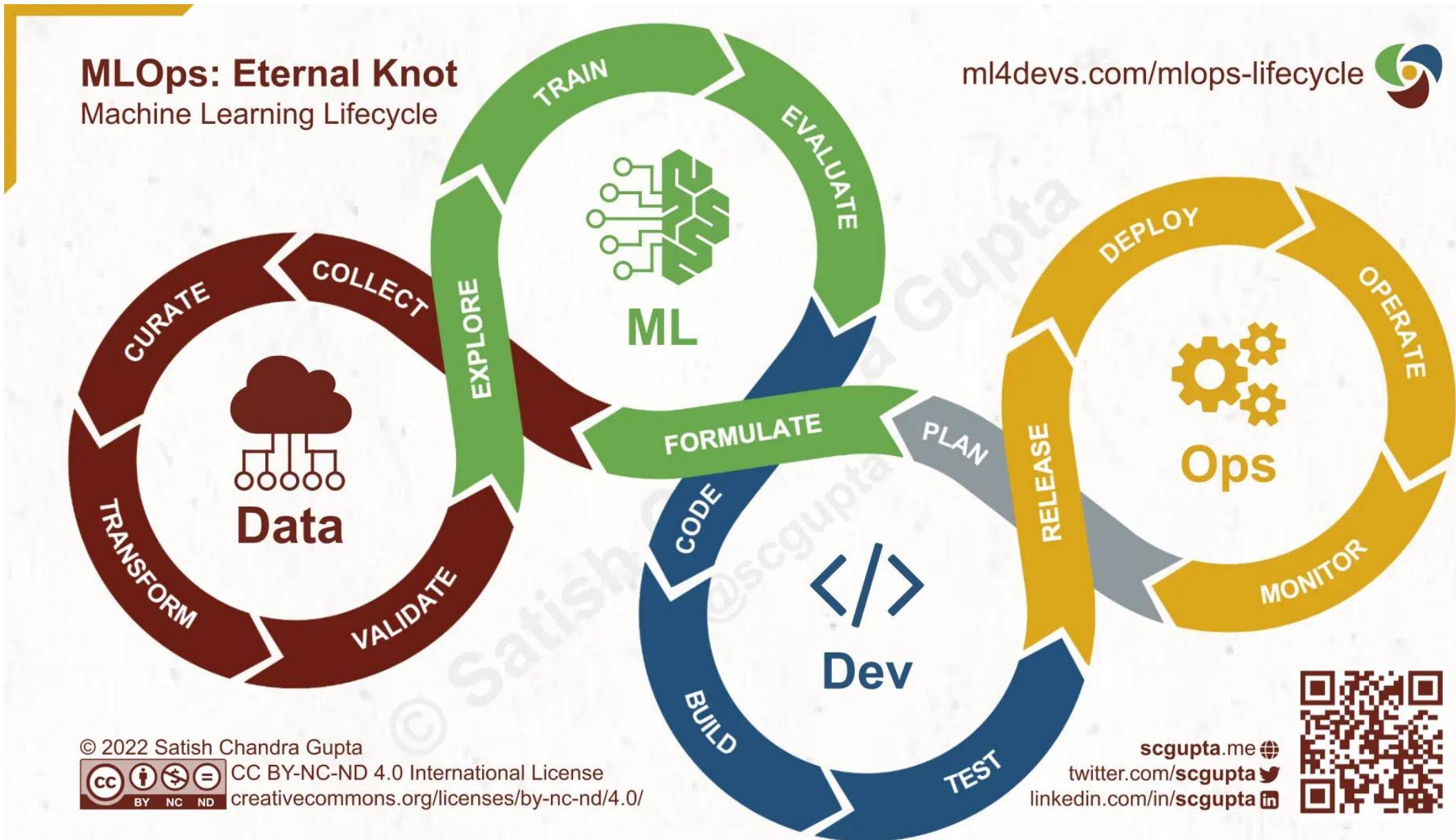


Stephan Kolassa's Data Scientist Venn Diagram

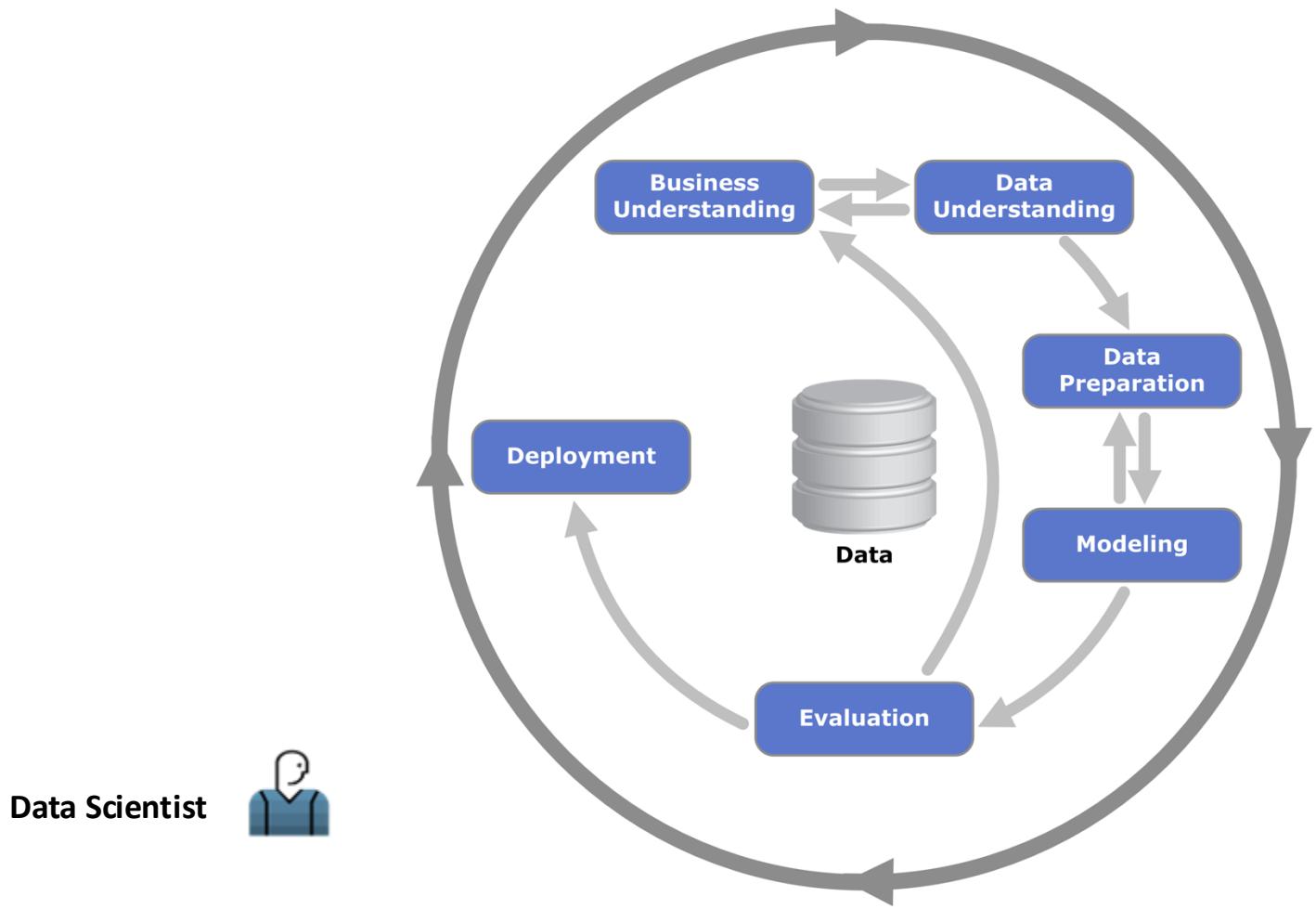
# Development Approach | Building an Intelligent Data Application



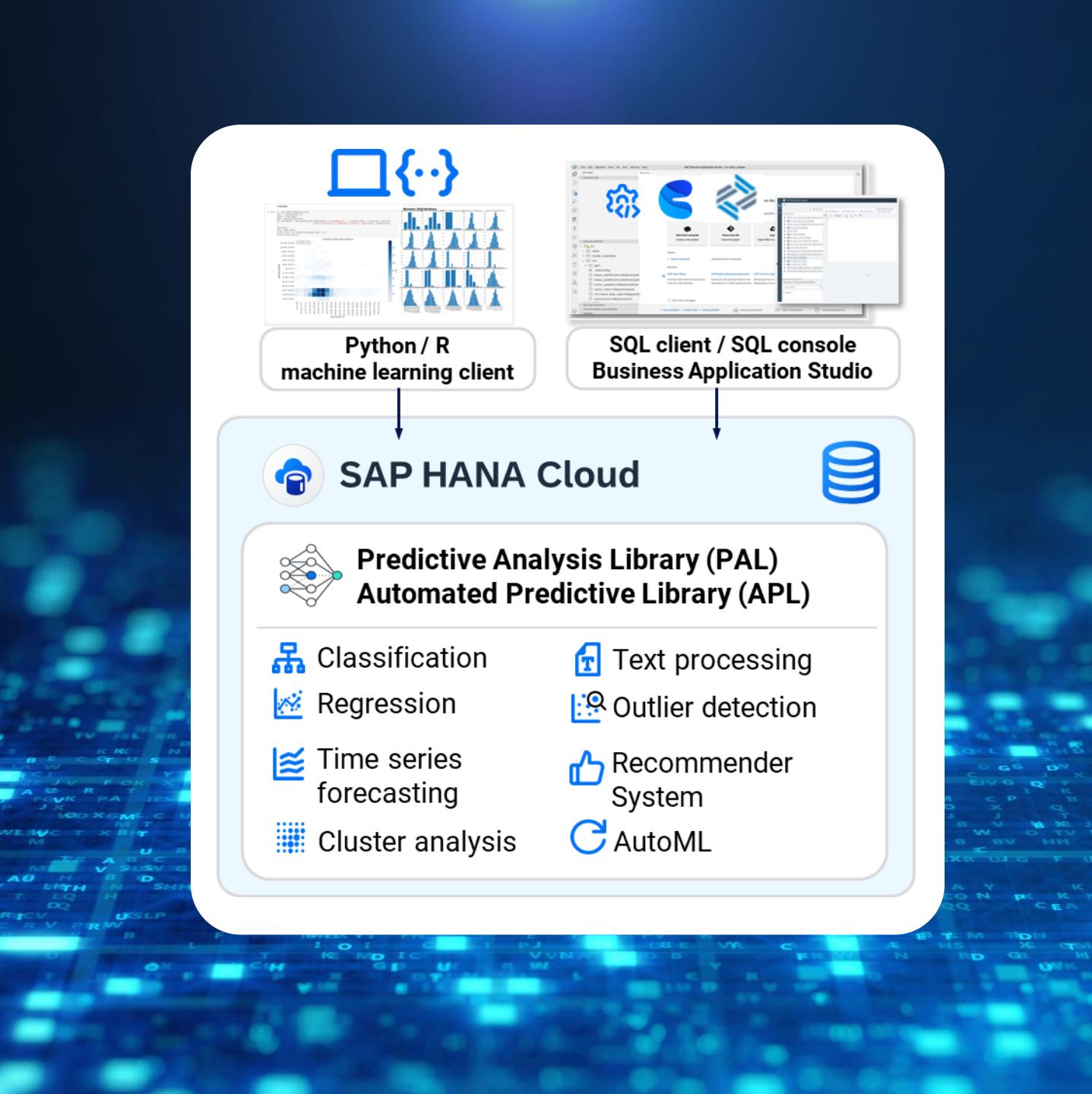
# MLOps: Machine Learning Life Cycle



## Development Approach | Training a Model



# AI and Machine Learning with SAP HANA Cloud database



<https://community.sap.com/t5/technology-blogs-by-sap/what-s-new-in-sap-hana-cloud-september-2024/ba-p/13873862>



# Let's get busy



# Your ML Challenge today:

The screenshot shows the Kaggle Competitions page. On the left is a sidebar with navigation links: kaggle, Create, Home, Competitions (which is selected), Datasets, Models, Code, Discussions, Learn, and More. The main content area has a header "Competitions". Below it is a sub-header "Grow your data science skills by competing in our exciting competitions. Find help in the [documentation](#) or learn about [Community Competitions](#)." A "Host a Competition" button is present. To the right is a cartoon illustration of a person holding a large yellow coin with the number "1" on it. Below the header is a search bar with placeholder "Search competitions" and a "Filters" button. A horizontal navigation bar includes categories: All Competitions (Everything, past & present), Featured (Premier challenges with prizes), Getting Started (Approachable ML fundamentals), Research (Scientific and scholarly challenges), Community (Created by fellow Kagglers), and Playground (Fun practice problems). A "Get Started" section features three competitions: "New to Kaggle?", "Titanic - Machine Learning from Disaster" (highlighted with a red box), "House Prices - Advanced Regression Techniques", and "Spaceship Titanic". Each card shows the competition name, a thumbnail image, a brief description, the number of teams, and status (Knowledge, Ongoing).

**Competitions**

Grow your data science skills by competing in our exciting competitions. Find help in the [documentation](#) or learn about [Community Competitions](#).

[Host a Competition](#)

Search competitions

Filters

All Competitions Everything, past & present

Featured Premier challenges with prizes

Getting Started Approachable ML fundamentals

Research Scientific and scholarly challenges

Community Created by fellow Kagglers

Playground Fun practice problems

Get Started

New to Kaggle?

These competitions are perfect for newcomers.

**Titanic - Machine Learning from Disaster**

Start here! Predict survival on the Titanic ...  
Getting Started  
16184 Teams

**House Prices - Advanced Regression Techniques**

Predict sales prices and practice feature ...  
Getting Started  
4328 Teams

**Spaceship Titanic**

Predict which passengers are transported...  
Getting Started  
2506 Teams

Knowledge Ongoing

Knowledge Ongoing

Knowledge Ongoing

# Exercises



# Vocabulary

- SAP BAS (based on the VS Code Open)
  - IDE
  - Extensions
  - Terminal
- Dev Space
- Workspace
- Project folder
- Python Virtual Environment:
  - Runtime binary
  - Modules / Dependencies

**Repo:** <https://github.com/SAP-samples/hana-ml-py-codejam/>

(→ [https://bit.ly/CJ\\_HANAML](https://bit.ly/CJ_HANAML))

## **1. Pre-requisites:**

<https://github.com/SAP-samples/hana-ml-py-codejam/blob/main/prerequisites.md>

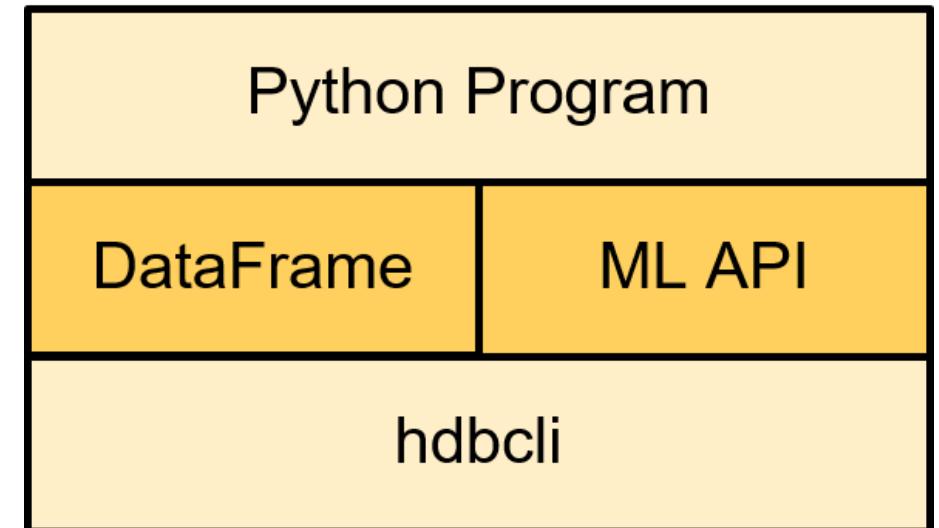
## **2. Exercises:**

<https://github.com/SAP-samples/hana-ml-py-codejam#the-exercises>

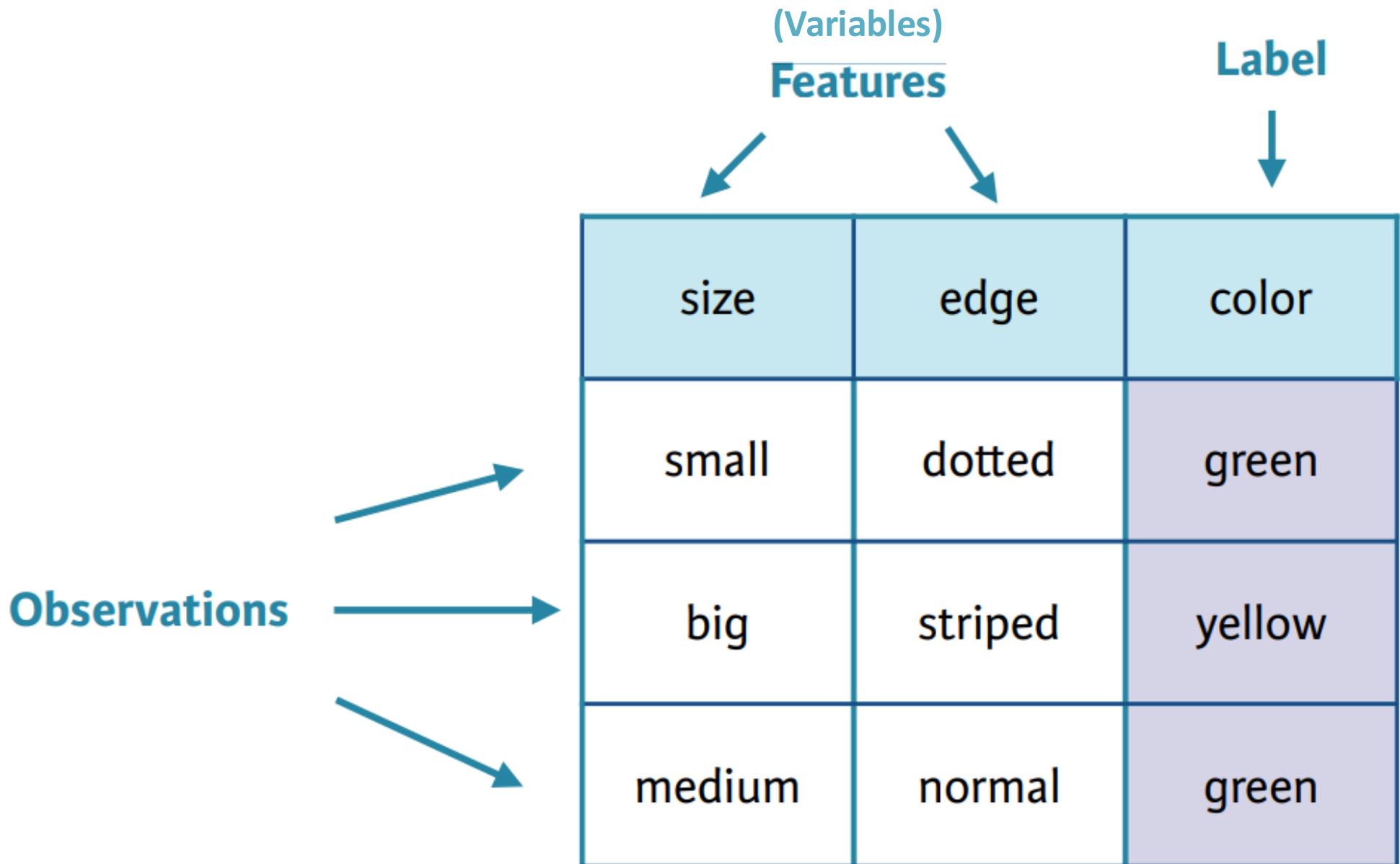
## Understand DataFrame(s)

# Data Scientist using Python

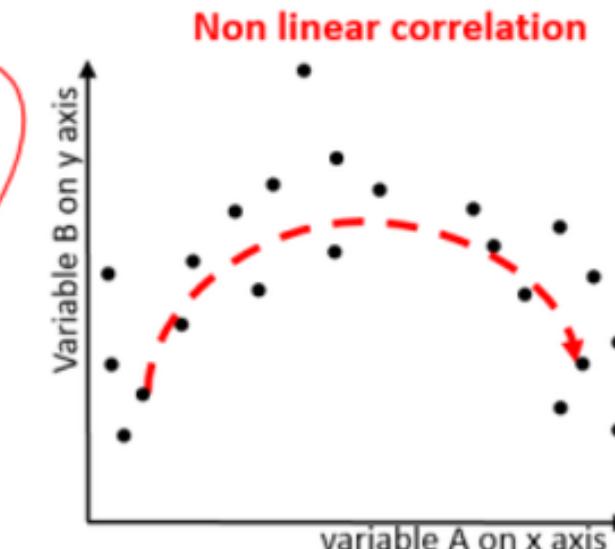
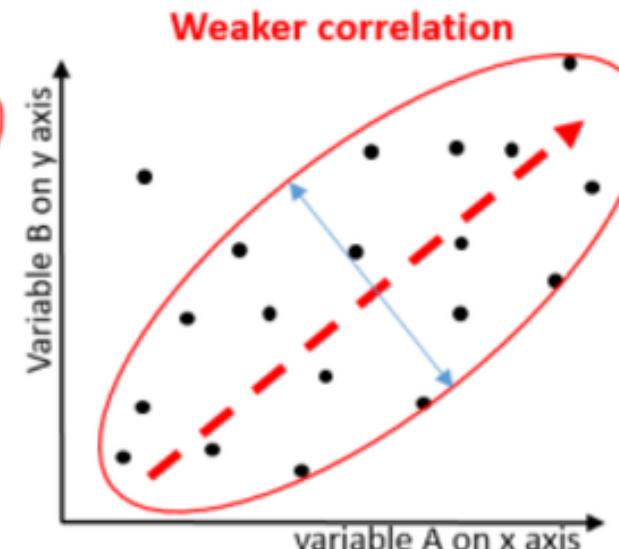
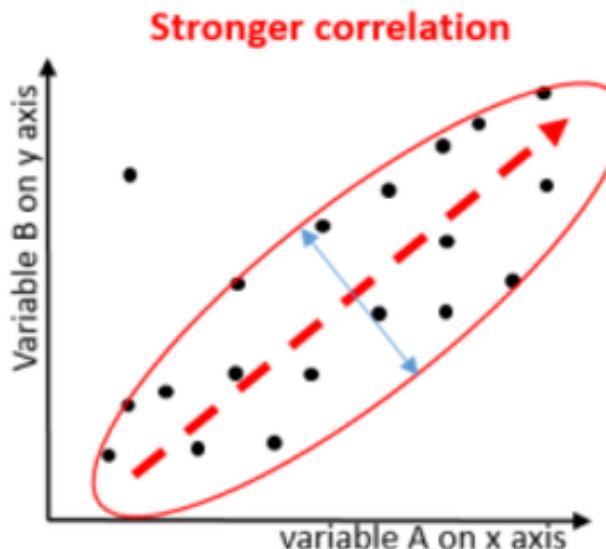
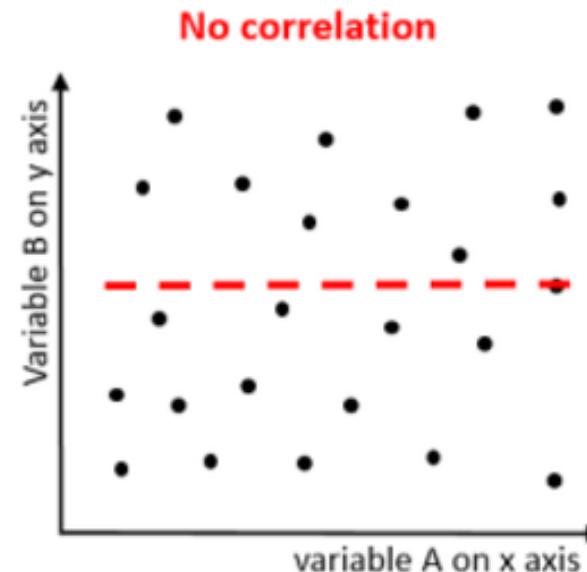
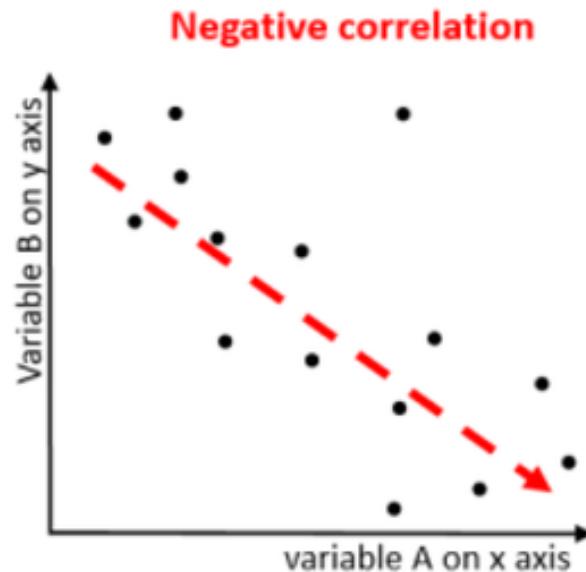
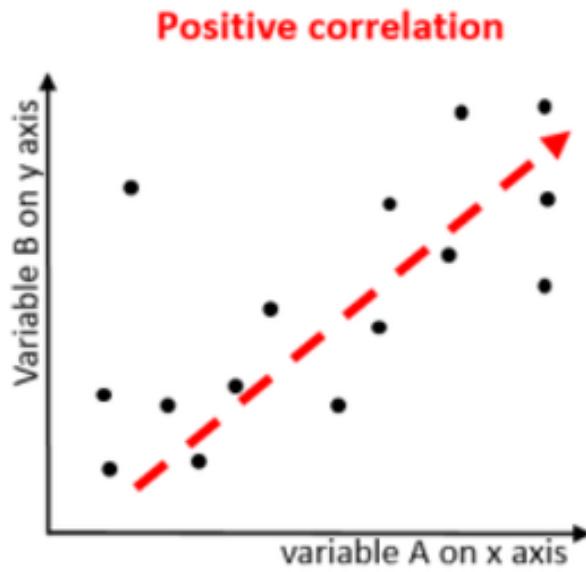
Pandas DataFrame <-> HANA DataFrame



# Train datasets in Supervised Machine Learning

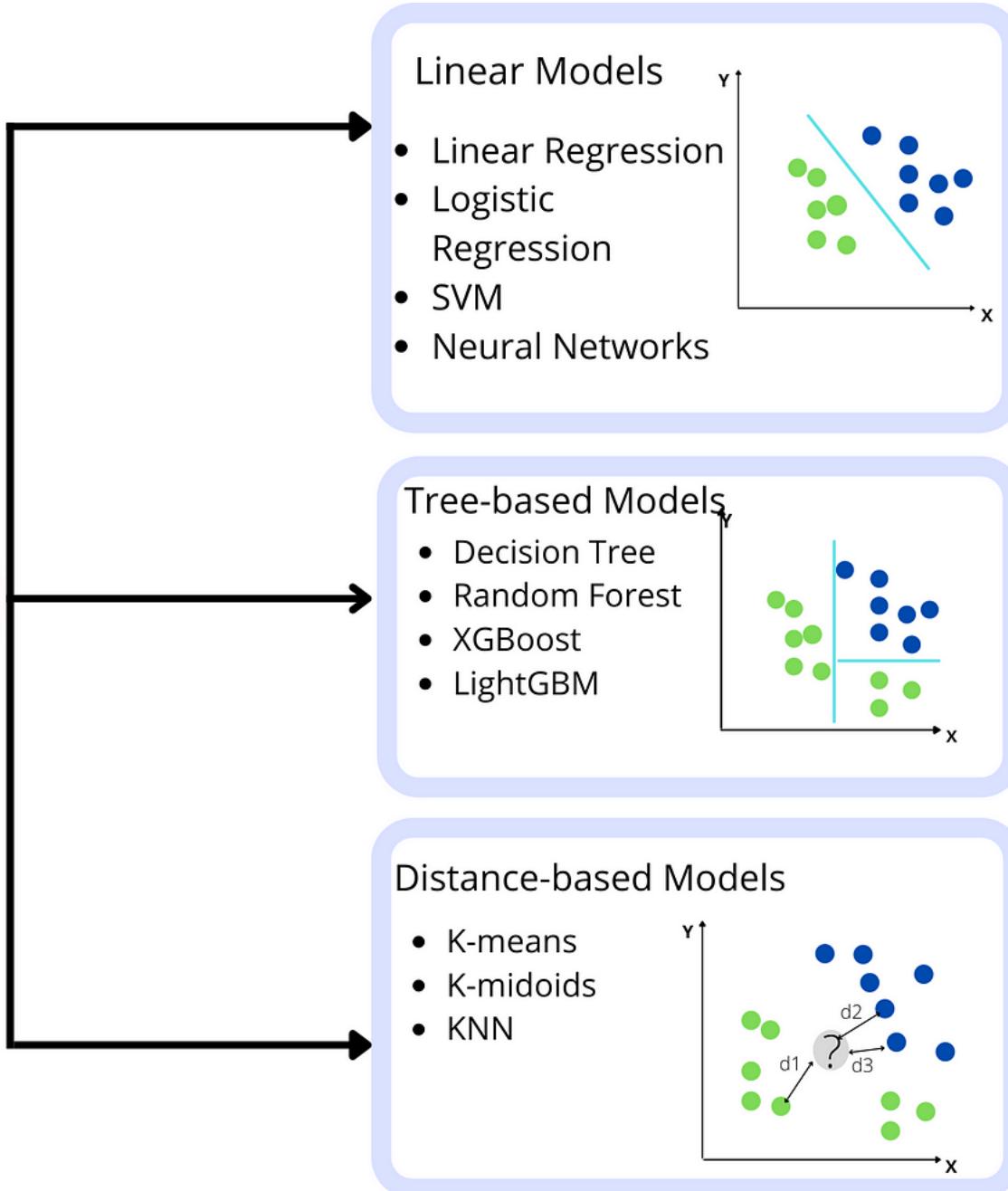


# Correlation based on direction, form, and dispersion strength

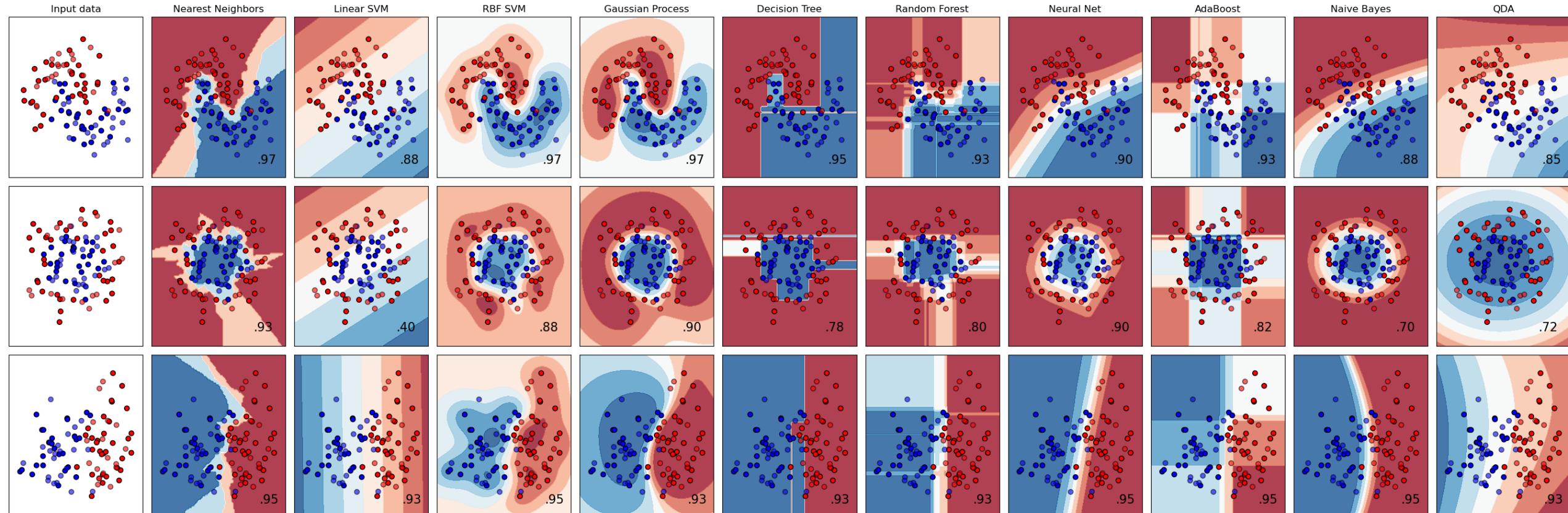


# Decision Boundary

Decision  
Boundary

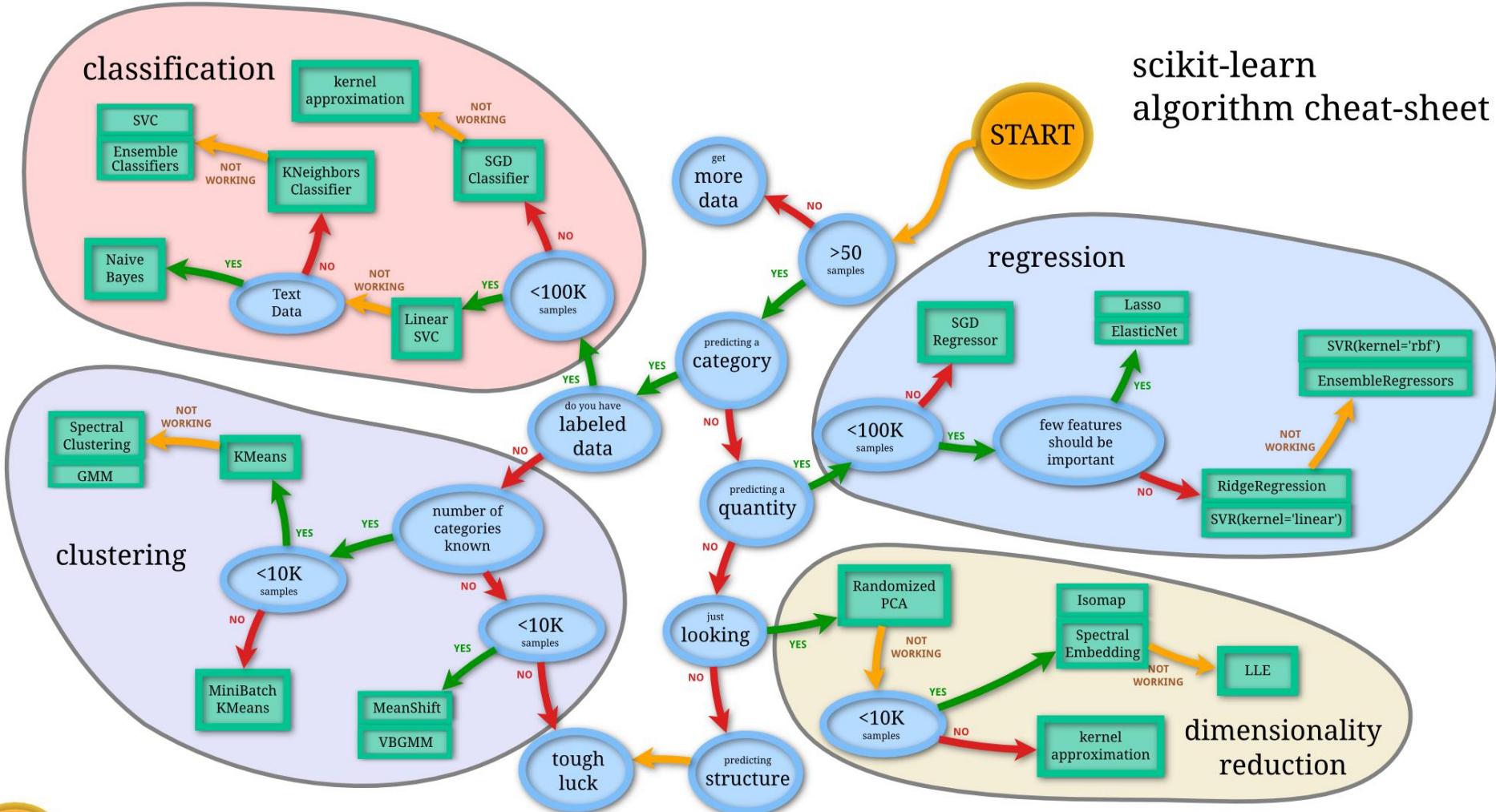


# Decision Boundary (different classification algorithms)

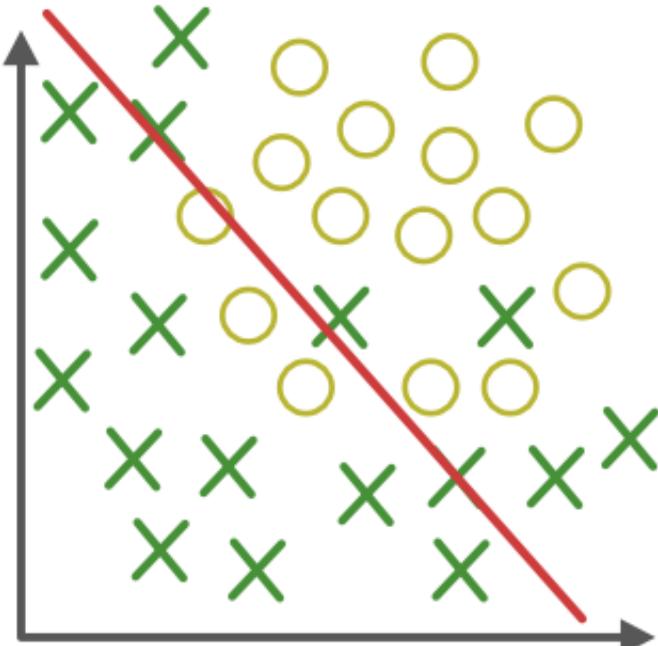


source: [https://scikit-learn.org/stable/auto\\_examples/classification/plot\\_classifier\\_comparison.html](https://scikit-learn.org/stable/auto_examples/classification/plot_classifier_comparison.html)

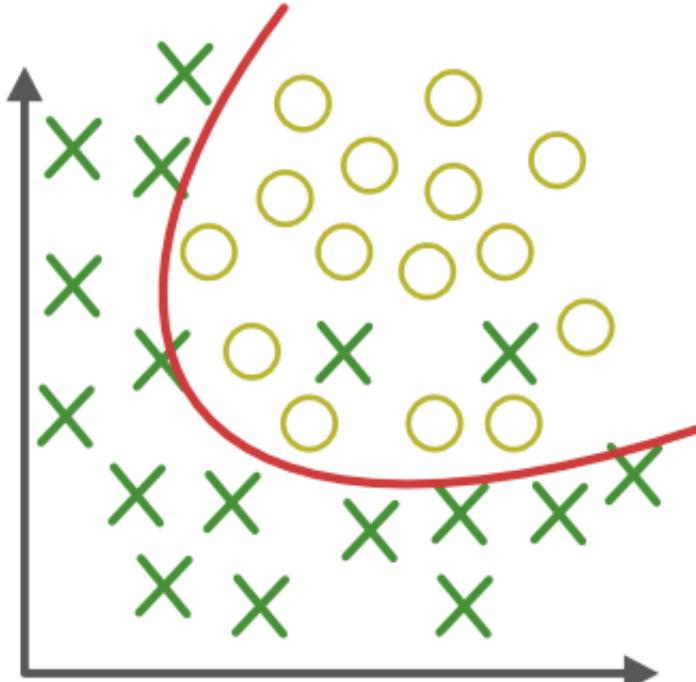
# Choosing the right estimator



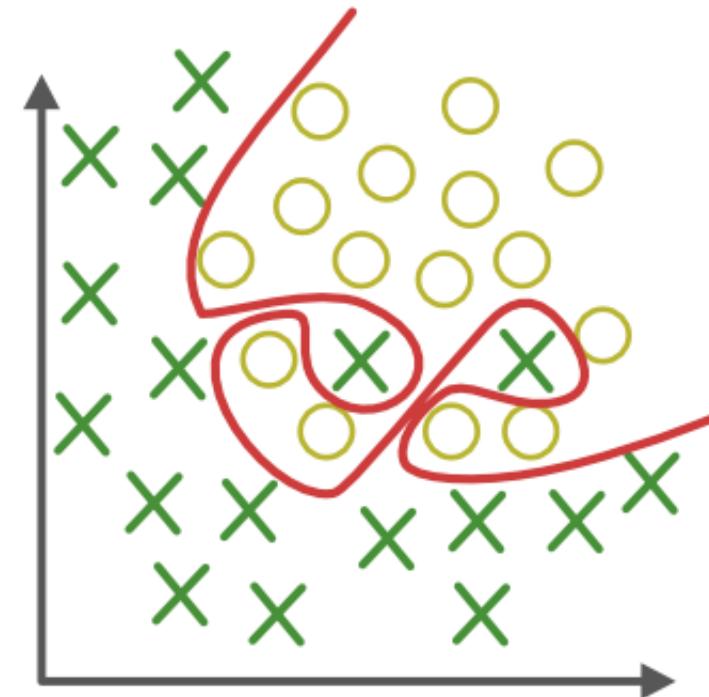
# Underfitting and Overfitting



**Under-fitting**  
(too simple to  
explain the variance)



**Appropriate-fitting**



**Over-fitting**  
(forcefitting--too  
good to be true)

DG

## From “black box”...



Predicted: **wolf**  
True: **wolf**



Predicted: **husky**  
True: **husky**



Predicted: **wolf**  
True: **wolf**



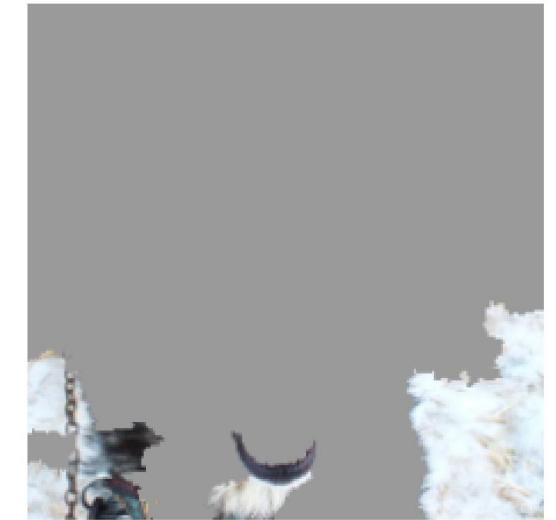
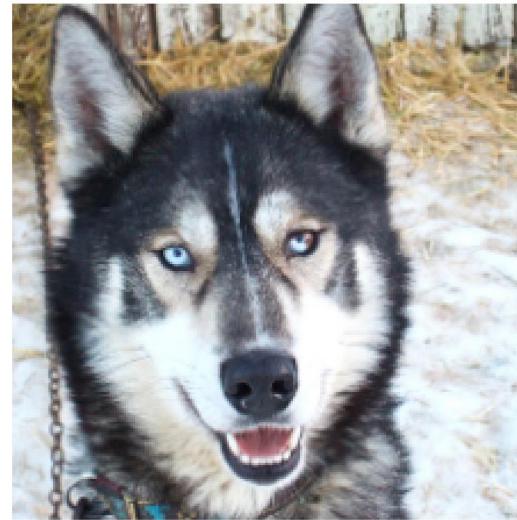
Predicted: **wolf**  
True: **husky**



Predicted: **husky**  
True: **husky**



Predicted: **wolf**  
True: **wolf**



...to **Explainable AI (XAI)**

### Level 1

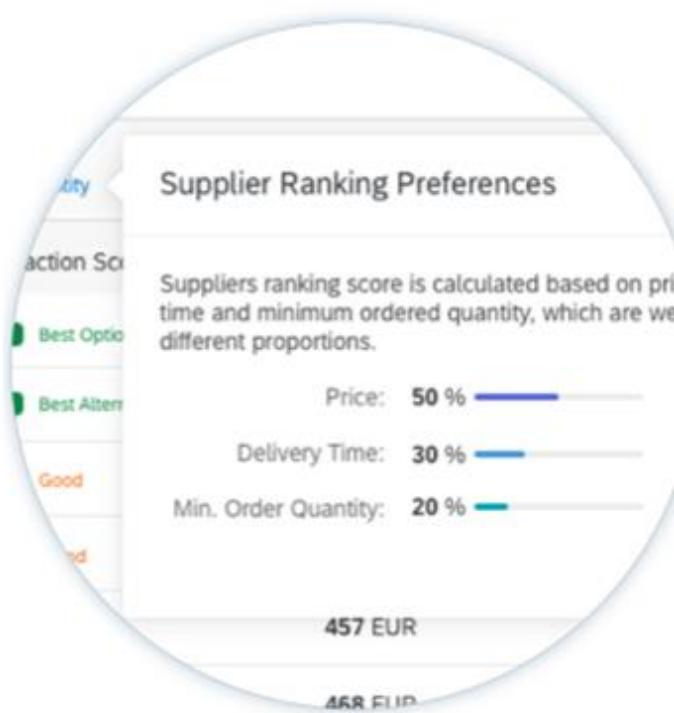
WHAT



Minimum

### Level 2

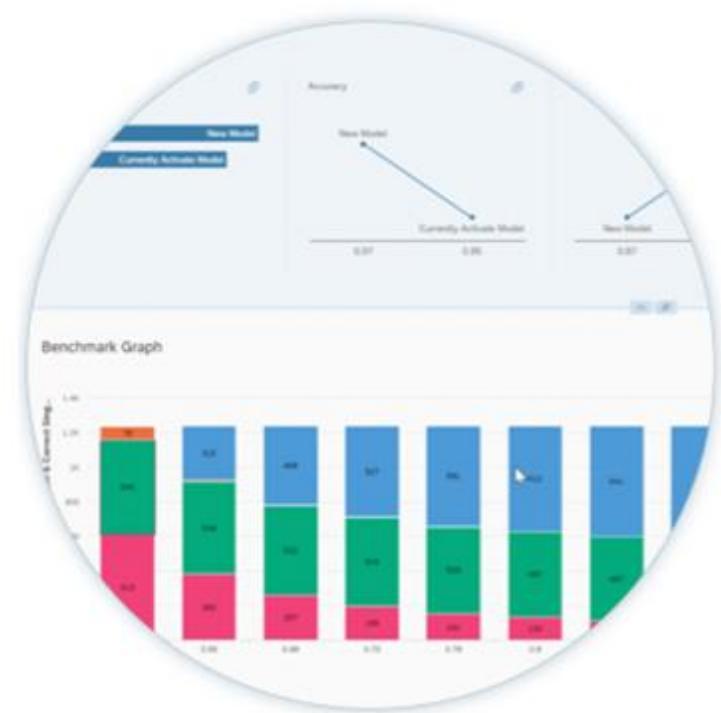
WHY



Simple

### Level 3

HOW



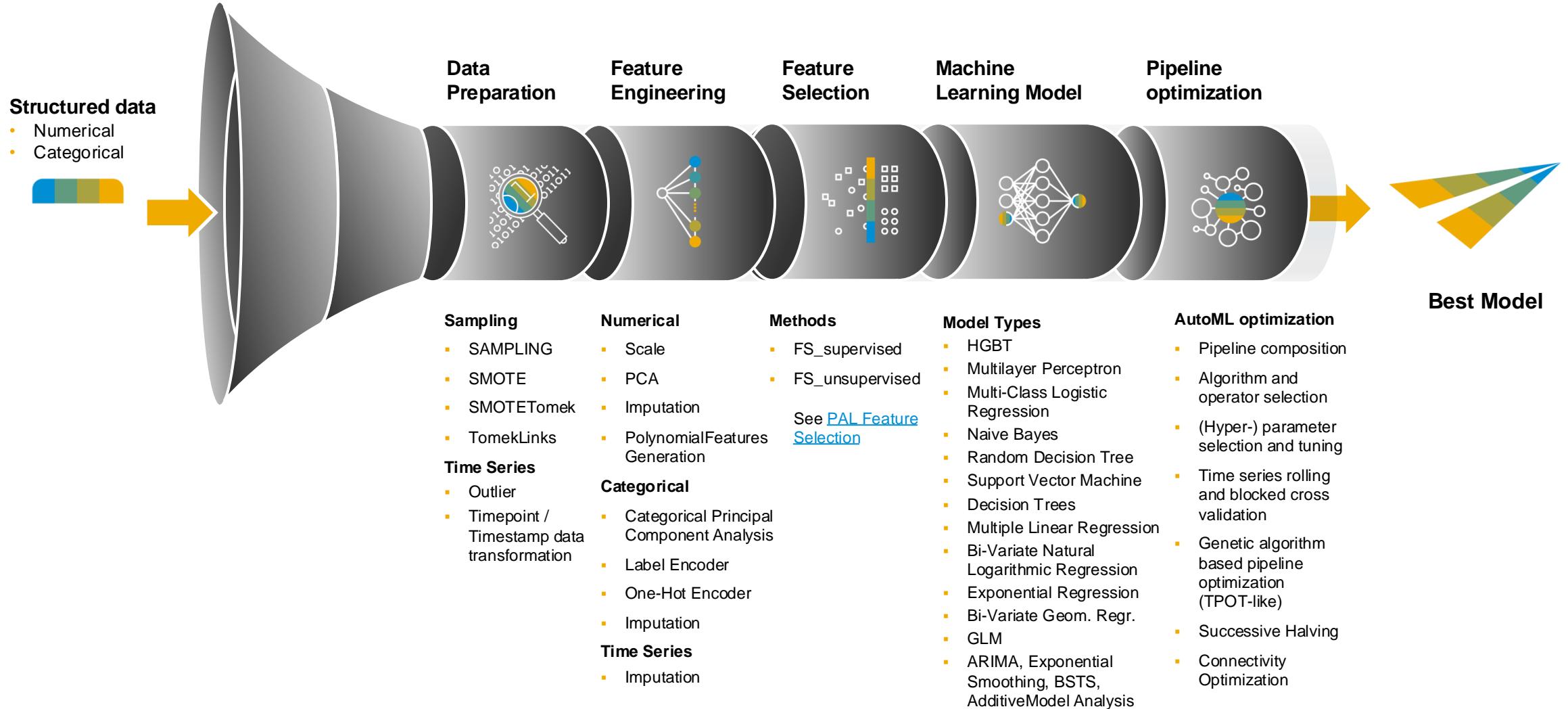
Expert

## Confusion matrix

In predictive analytics, a **table of confusion** (sometimes also called a **confusion matrix**) is a table that reports the number of true positives, false negatives, false positives, and true negatives.

		Predicted class
		$P$
		$N$
Actual class	$P$	True positives (TP)
	$N$	False negatives (FN)
	$N$	False positives (FP)
		True negatives (TN)

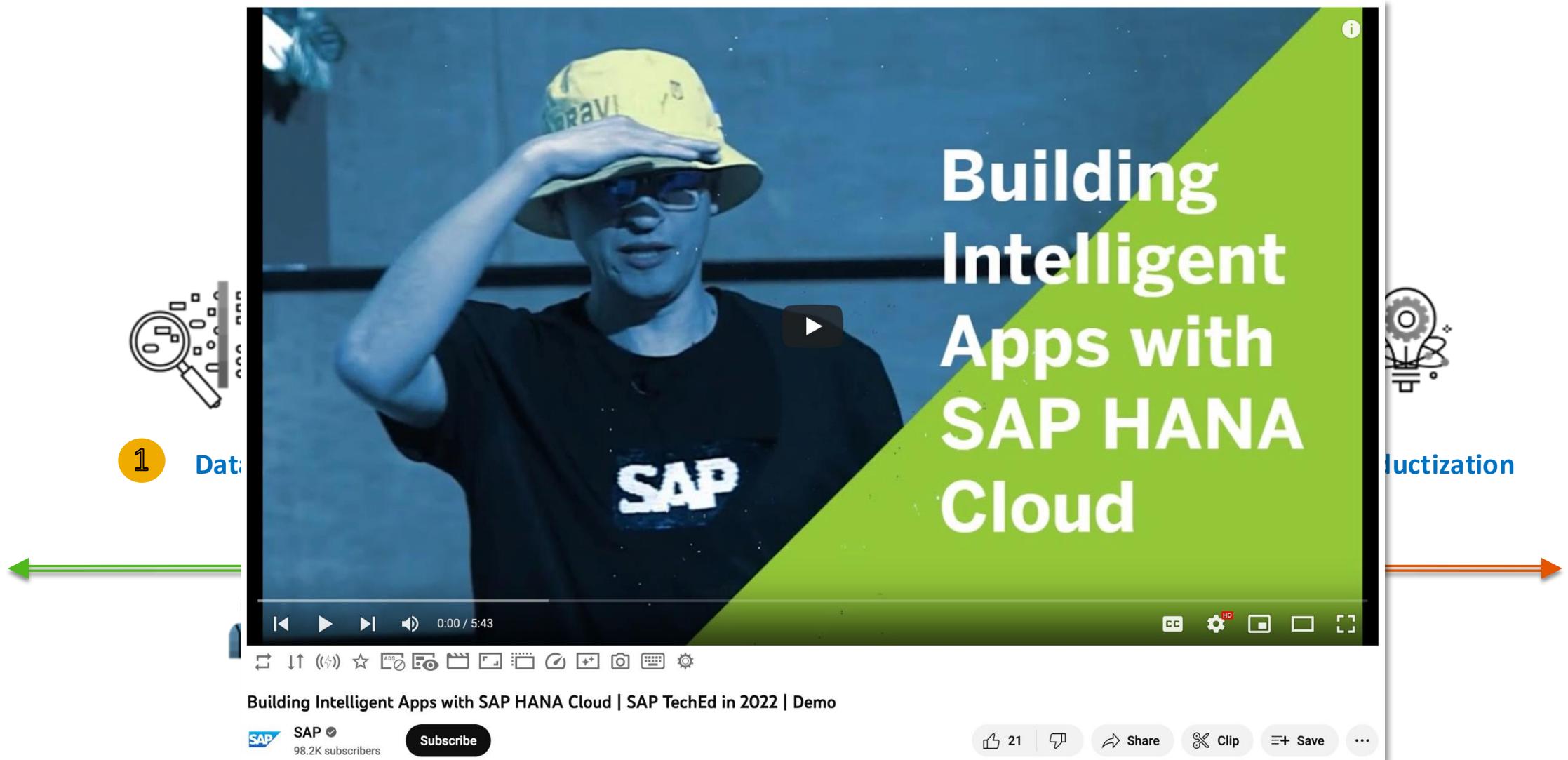
# Predictive Analysis Library | Automated Machine Learning – Supported Operators



# **Additional content**



## Development Approach | Building an Intelligent Data Application (demo)



## Embed the latest from SAP HANA's AI functions into your SAP BTP Application

### Devtoberfest

MAD (Machine Learning, AI, and Data)

**Embed the latest  
from SAP HANA AI functions  
into your SAP BTP App**

Christoph Morgen, SAP



**SAP TechEd**

# Learning journey: Developing Regression Models with the Python Machine Learning Client for SAP HANA

The screenshot shows the SAP Learning platform interface. At the top, there's a navigation bar with the SAP logo, 'Learning', 'Browse', 'Get Certified', 'My Learning', 'Subscribe', 'Explore SAP', a search icon, and a user profile icon.

Below the navigation bar, it says 'On this page:' followed by 'Course Content' (which is highlighted in blue) and 'SAP Learning Group'.

## Developing Regression Models with the Python Machine Learning Client for SAP HANA

**UNIT 1**  
**Introducing SAP HANA Machine Learning**  
2 Lessons | 1 hr

After completing this unit, you will be able to:

- Identify the two main components of the Python ML client
- Define the core features of SAP HANA Cloud
- Configure the SAP HANA Cloud environment
- Utilize SAP HANA DataFrames for data handling
- Visualize the attributes of the California housing dataset

**Content**

- Setting Up the Environment
- Exploring Data with SAP HANA DataFrames
- Quiz

**Go to learning**

**UNIT 2**  
**Building and Evaluating Regression Models**  
2 Lessons | 45 mins

After completing this unit, you will be able to:

- Explore the capabilities of the Hybrid Gradient Boosting Tree (HGBT) algorithm for regression
- Evaluate the linear regression model's performance using the R-squared metric
- Evaluate changes in feature importance in the re-trained model

**Content**

- Training a Regression Model with SAP HANA PAL
- Understanding Model Evaluation and Optimization
- Quiz

## Code samples: <https://github.com/SAP-samples/hana-ml-samples>

Screenshot of the GitHub repository page for `hana-ml-samples`.

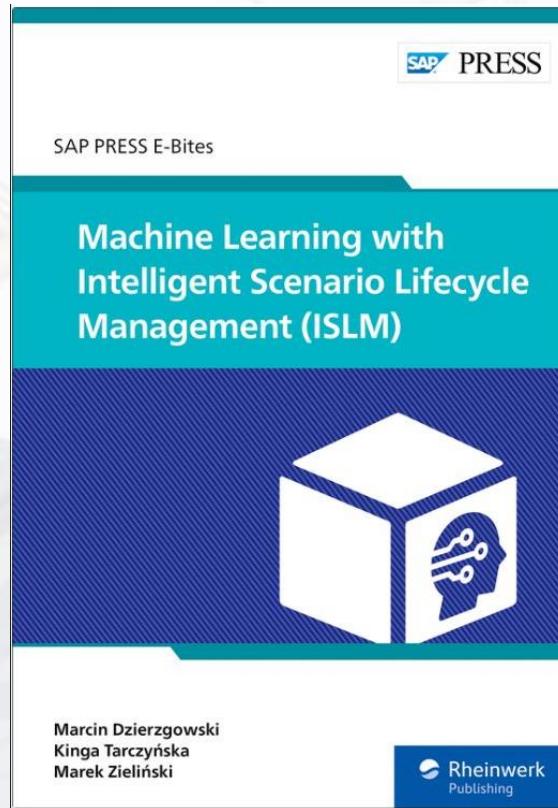
The repository path is `hana-ml-samples / Python-API / usecase-examples /`. The current branch is `main`.

Search bar: Go to file  t

Add file  ...

Commit by **cmog**: FairML - Fair Recruiting Model, f009115 · 3 weeks ago, History

Name	Last commit message	Last commit date
..		
diabetes-classification	Create OpenSAP-SAPHANA-HANA Machine Learning Demo (2...	2 years ago
estimate-car-price	update estimate car price	3 years ago
fairml-examples	FairML - Fair Recruiting Model	3 weeks ago
fraud-detection	fraud-detection use case	2 years ago
melbourne-housing-price	Add files via upload	4 years ago
ml-anonymized-data	Tutorial example - ML with HANA-ML Python ML client on HAN...	4 years ago
multimodel-analysis-airroutes	Update README.md	4 years ago
sapcommunity-automl-examples	update community call examples	2 years ago
sapcommunity-hanaml-challenge	Create SAP HANA Cloud Machine Learning Demo - Employee C...	7 months ago

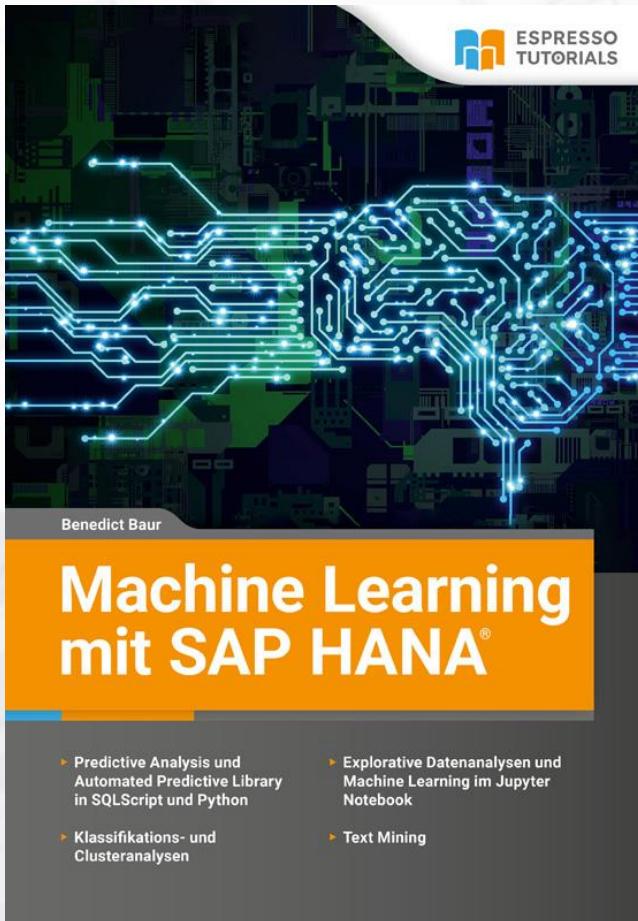


**Machine Learning with Intelligent Scenario Lifecycle Management (ISLM)**  
115 pages, 2023, E-Book  
ISBN 978-1-4932-2395-4  
[www.sap-press.de/5668](http://www.sap-press.de/5668)

## Update your machine learning skills with Intelligent Scenario Lifecycle Management (ISLM)!

In this E-Bite, you'll develop a complete machine learning application for SAP S/4HANA using SAP HANA PAL, from data preparation and model building to training and prediction generation. You'll learn to use the ISLM framework to simplify machine learning implementation with standard apps for managing intelligent scenarios. Learn the ins and outs of machine learning with ISLM in this how-to guide!

- Learn to use the ISLM framework in SAP S/4HANA
- Develop an end-to-end machine learning scenario with SAP HANA PAL
- Prepare data, train models, and implement predictions with ISLM

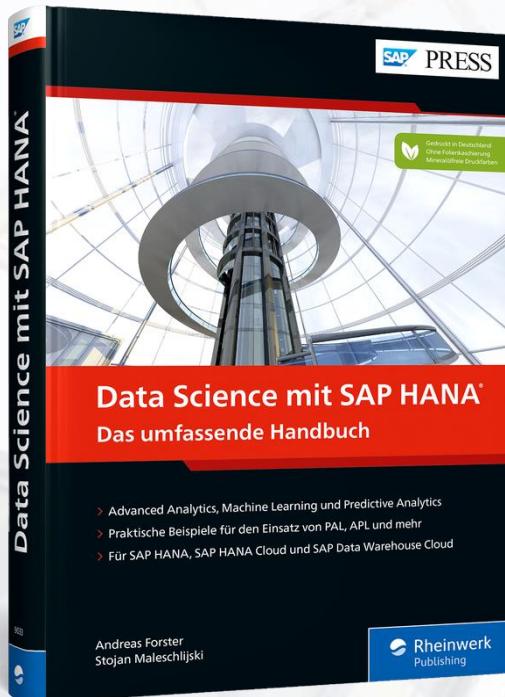


**Machine Learning mit SAP HANA**  
von Benedict Baur  
320 Seiten, 1. Auflage, ISBN: 9783960121237

**Seit einigen Jahren preist die SAP das intelligente Unternehmen als Wettbewerbsvorteil an.** Mit diesem Buch springen Sie mitten hinein in die Welt der künstlichen Intelligenz (KI). Erfahren Sie, welche Algorithmen die leistungsstarke In-Memory-Datenbank SAP HANA für das Machine Learning (ML) bereithält. Auf deren Basis lassen sich Muster und Gesetzmäßigkeiten in Datenbeständen erkennen und Vorhersagen treffen, die helfen, Geschäftsprozesse zu verbessern.

- Predictive Analysis und Automated Predictive Library in SQLScript und Python
- Klassifikations- und Cluster-Analysen
- Explorative Datenanalysen und Machine Learning im Jupyter Notebook
- Text Mining

<https://www.espresso-tutorials.de/produkt/machine-learning-mit-sap-hana/>



## Mit SAP HANA, SAP HANA Cloud und SAP Data Warehouse Cloud ist viel mehr möglich als das Speichern großer Datenmengen.

In diesem Buch erfahren Sie, wie Sie die Automated Predictive Library (APL) und die Predictive Analysis Library (PAL) einsetzen können, um komplexe Auswertungen vorzunehmen und Vorhersagen zu treffen. Praktische Beispiele zu Klassifizierung, Textanalyse, Clustering, Regression u.v.m. zeigen Ihnen die vielfältigen Möglichkeiten auf und lassen sich direkt auf Ihre Anwendungsfälle übertragen.

- Advanced Analytics, Machine Learning und Predictive Analytics
- Praktische Beispiele für den Einsatz von PAL, APL und mehr
- Für SAP HANA, SAP HANA Cloud und SAP Data Warehouse Cloud

### Data Science mit SAP HANA

Das umfassende Handbuch

von [Andreas Forster, Stojan Maleschlijski](#)

<https://www.rheinwerk-verlag.de/data-science-mit-sap-hana/>

# SAP HANA Cloud – Free offering

## SAP HANA Cloud Basic Trial

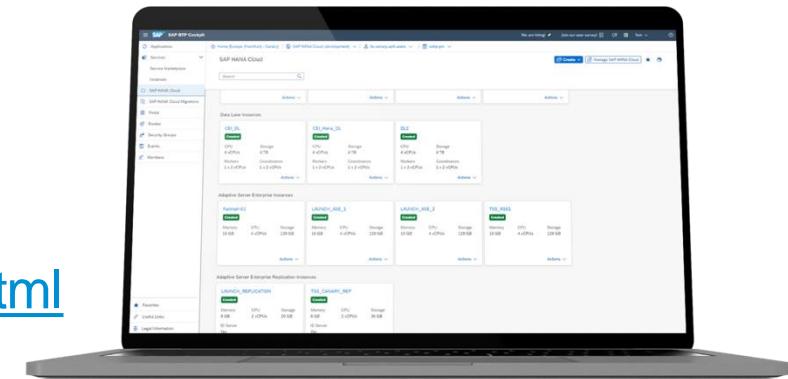
- 30-days own-schema shared-instance
- <https://www.sap.com/products/technology-platform/hana/trial.html>

## SAP HANA Cloud (Advanced) Trial

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

## SAP HANA Cloud Free Tier

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



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

<https://ugearsmodels.com/>

Free shipping on all orders of €60 or more!

UGEARs  
Mechanical Models

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👤 🛒

## NEW RELEASE

SERENITY'S DREAM YACHT

NASA SPACE SHUTTLE DISCOVERY

RESUCE HOVERCRAFT

STEGOSAURUS

LEARN MORE

SELF ASSEMBLY

Details are already cut and ready to assemble

MECHANICAL

The models produce motion

EDUCATIONAL

Perfect for family projects through hands-on STEM learning

<https://ugearsmodels.com/catalogue/preorder5/>



Thank you // Дякую! // ধন্যবাদ

Contact information:

Witalij Rudnicki, SAP Developer Advocacy

