Machine Learning Fundamentals

22 Maggio 2025

Danilo Parisi
danilo.parisi@aitho.it

Senior Data scientist

Agenda

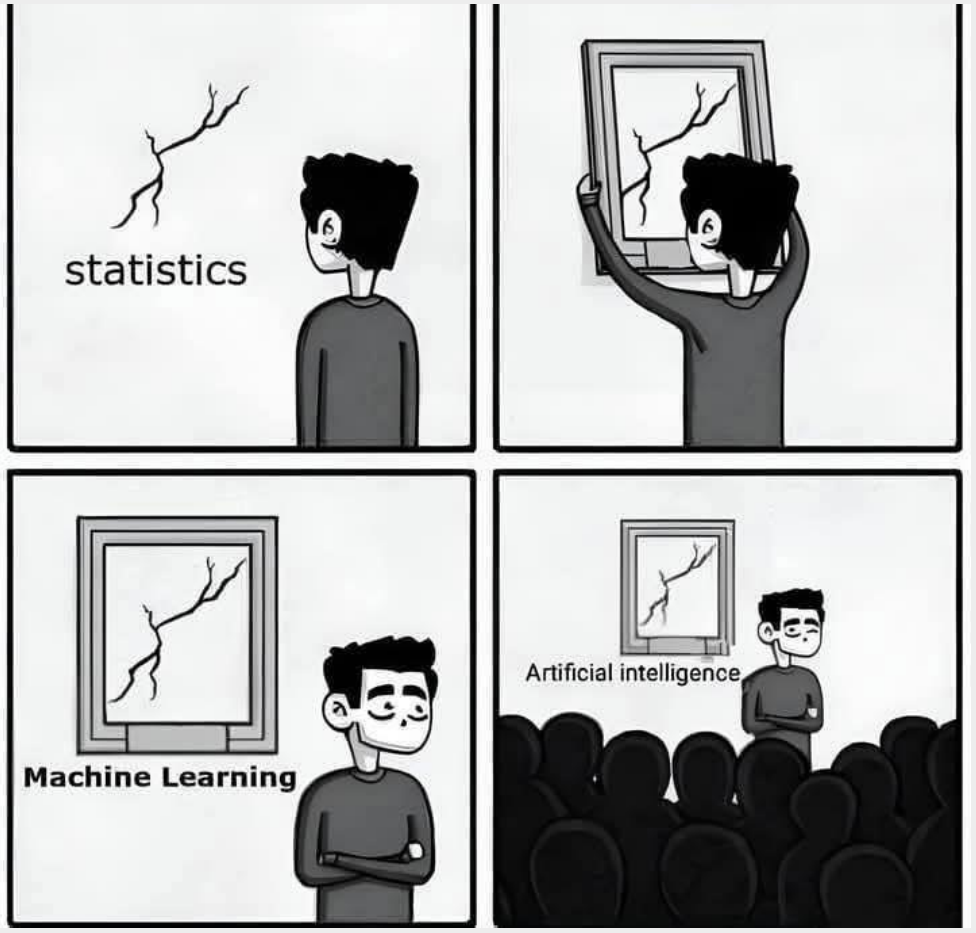
- What is Machine Learning
- ML family tree
- Project workflow
- Use case

aitho

What is Machine Learning

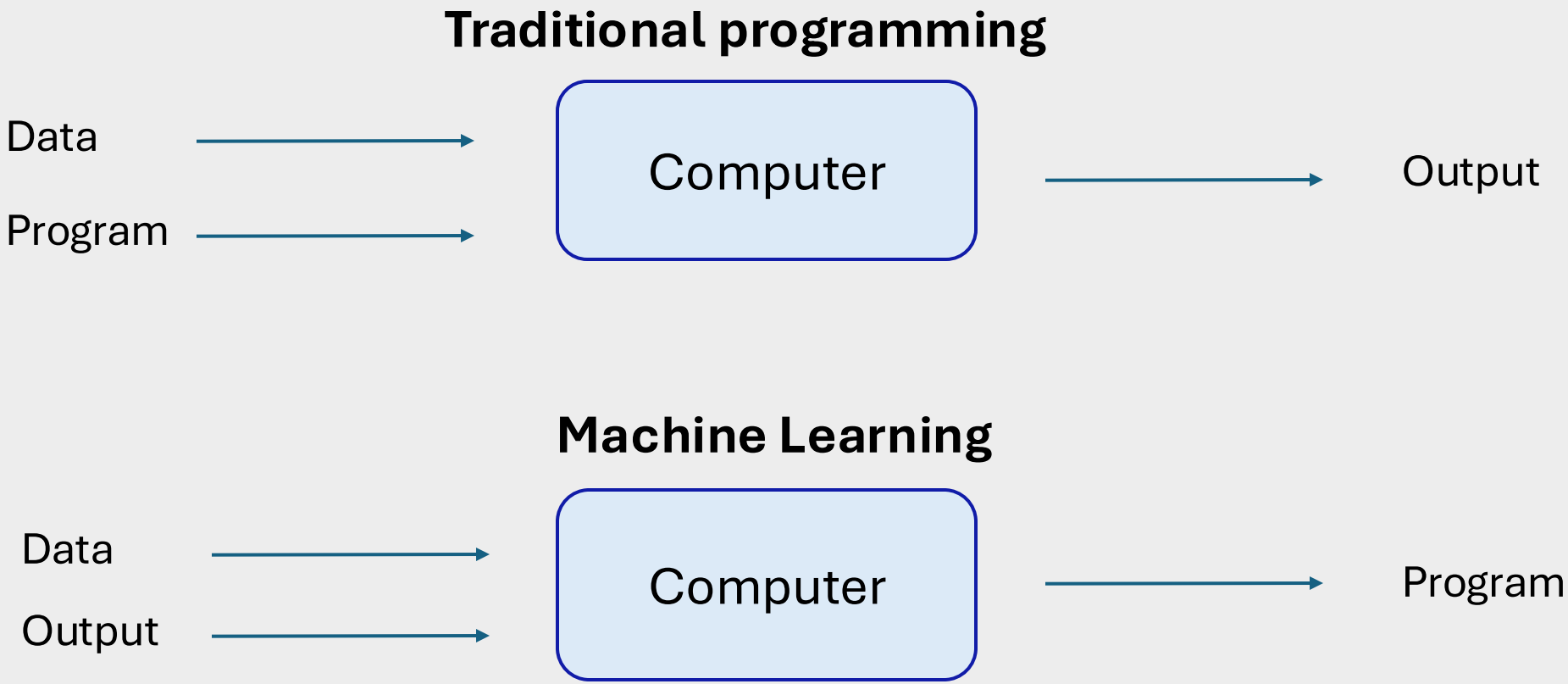
*"Machine learning (ML) is a type of artificial intelligence that **allows machines to learn from data** without being explicitly programmed."*

*"Machine learning (ML) is a type of artificial intelligence that **allows machines to learn from data** without being explicitly programmed."*



aitho

Different programming

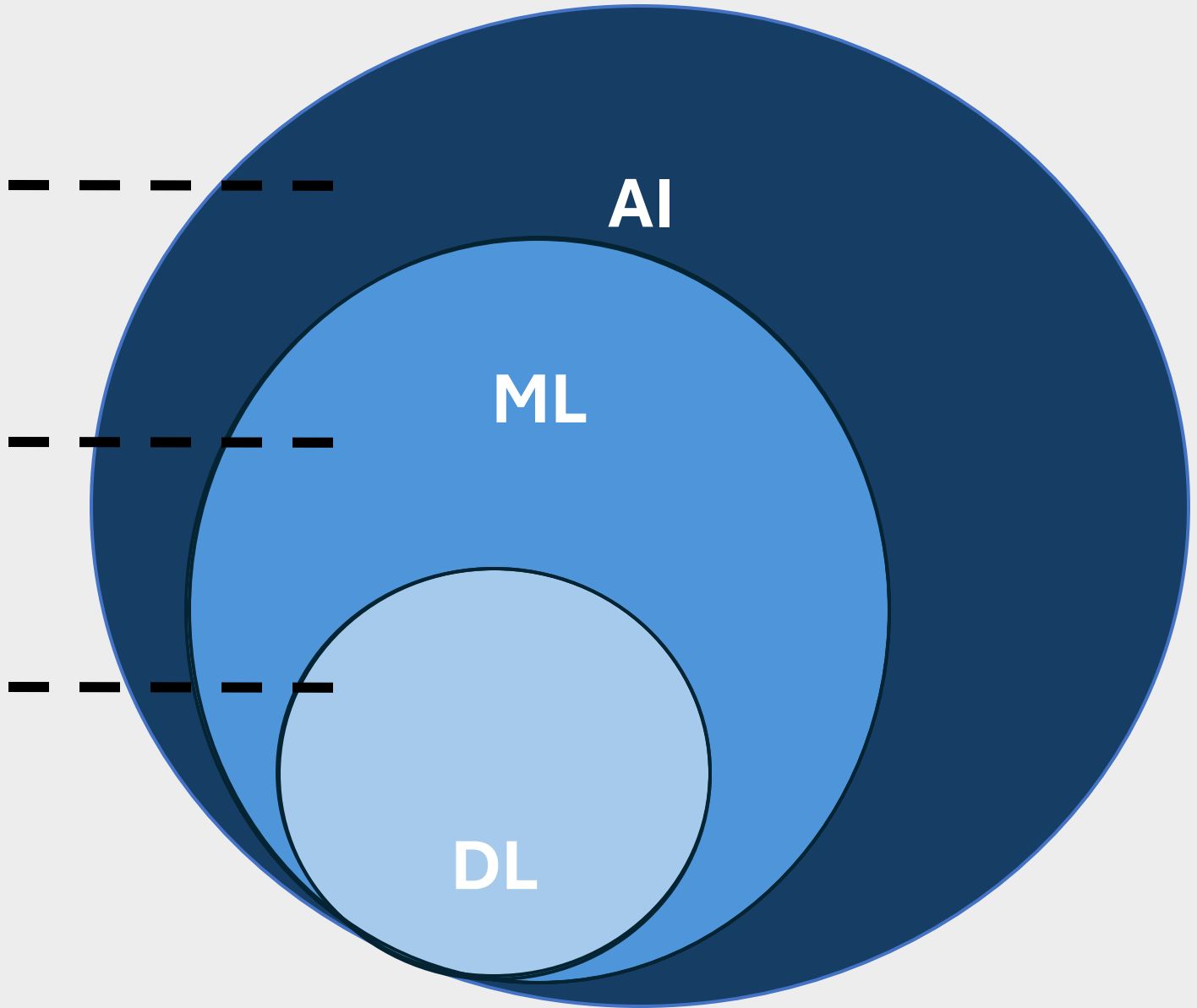


AI, ML, DL

Artificial Intelligence:
Engineering of making intelligent machines and programs.

Machine Learning
Ability to learn without being explicitly programmed.

Deep Learning
Learning based on deep neural networks.



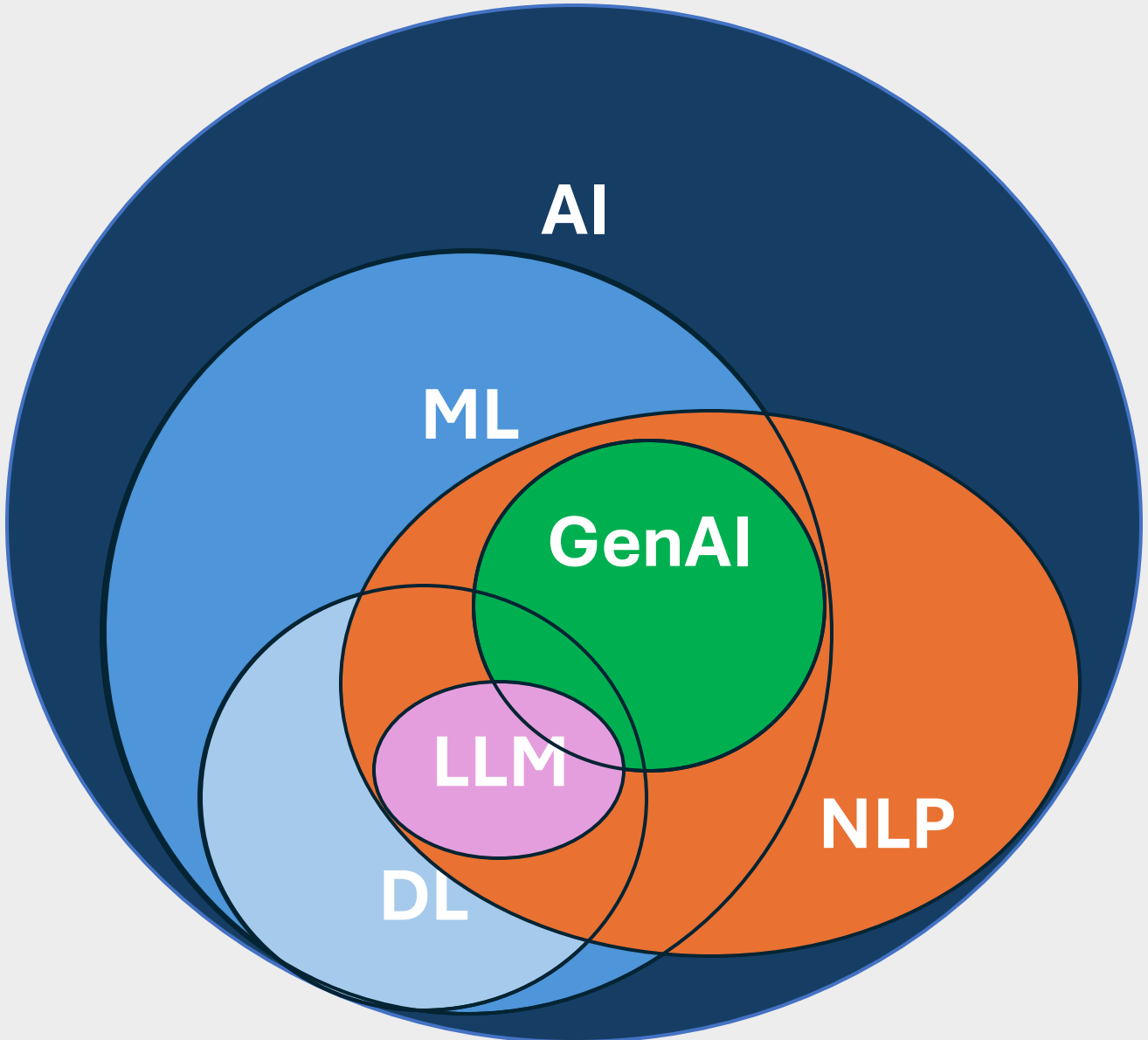
aitho

AI in language field

NLP
Field of AI that deals with the automatic processing of natural language (text or human voice).

GenAI
Field of AI that focuses on generating content, such as text, images, code, audio, or video.

LLM
DL model trained on massive amounts of text to predict the next word in a sentence.



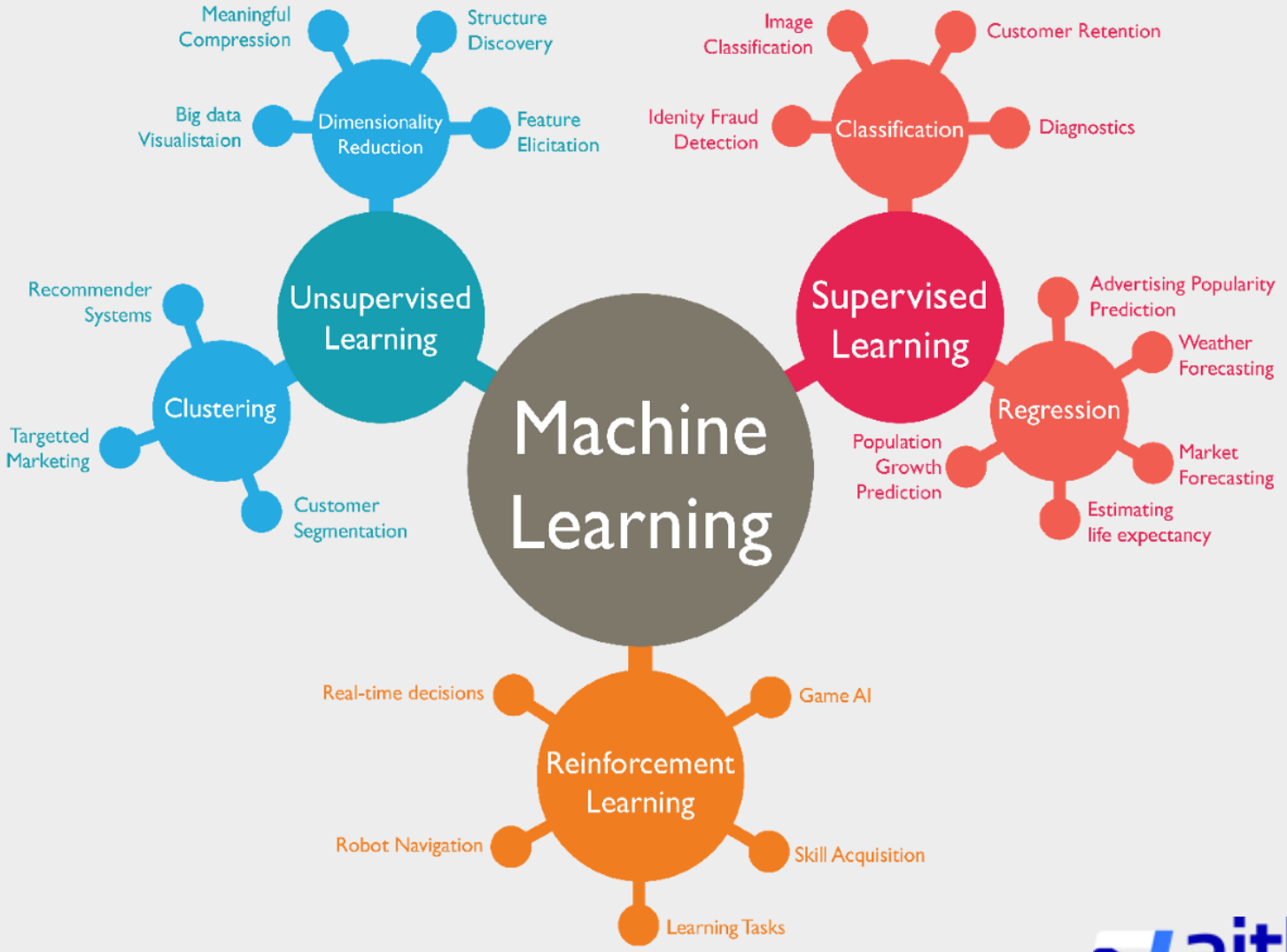
aitho

ML family tree

ML family tree

Machine Learning **algorithms** can be categorized into three types:

- **Supervised learning:**
  Learn the model
- **Unsupervised learning:**
  Learn the representation
- **Reinforcement learning:**
  Learn to control



aitho

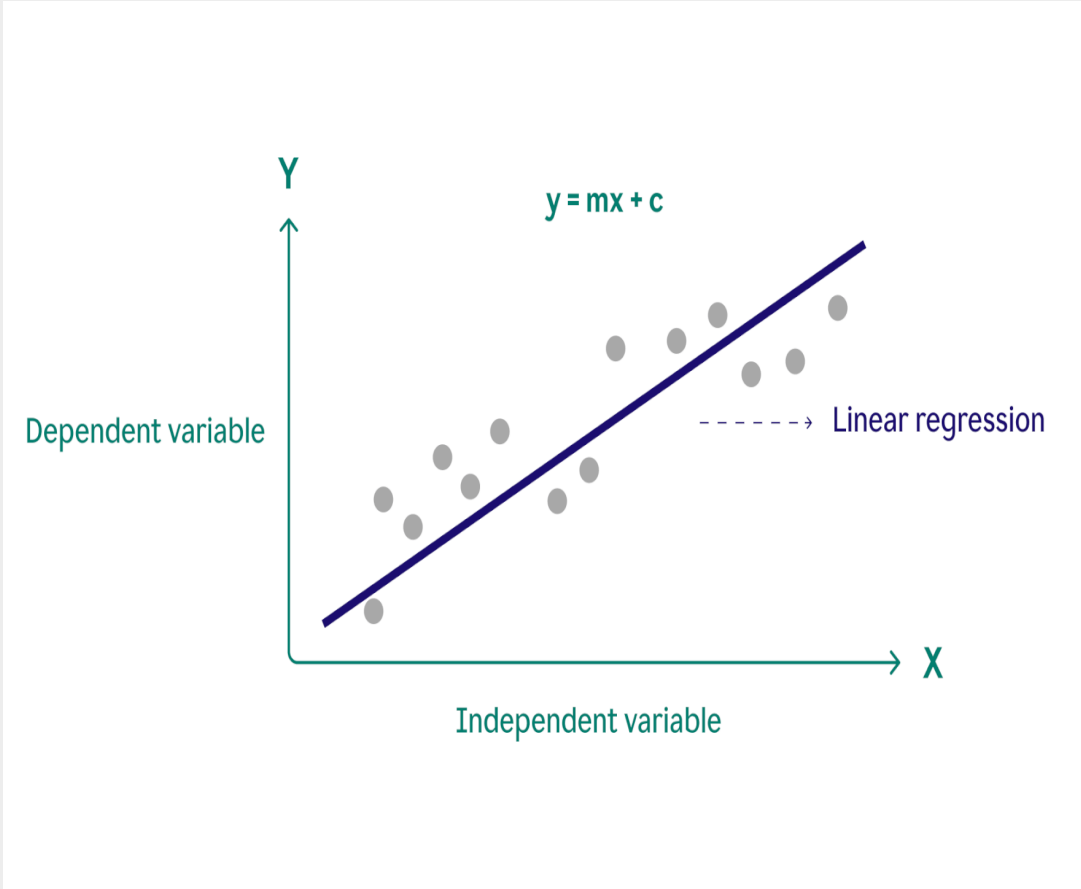
Supervised Learning

The algorithm is trained on **labeled** data, where the input and output are explicitly provided.

The **goal** is to learn a **mapping function** from inputs to outputs, allowing the algorithm to make predictions on new, unseen data.

<u>Common algorithms</u>

- Linear Regression
- Logistic Regression
- Decision Tree
- Support Vector Machines



Learn the model

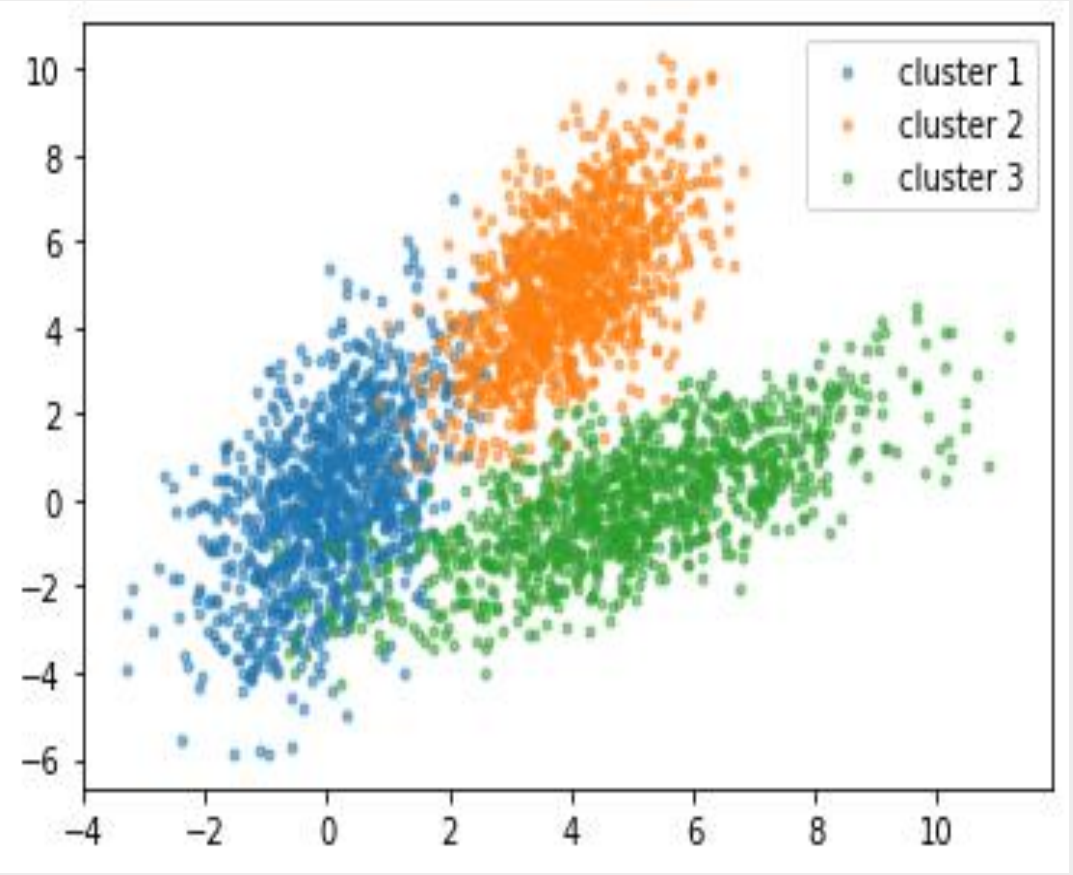
Unsupervised Learning

The algorithm is trained on **unlabeled** data.

The **goal** is to uncover **hidden patterns** or structures within the data. Clustering and dimensionality reduction are common tasks in unsupervised learning.

<u>Common algorimths</u>

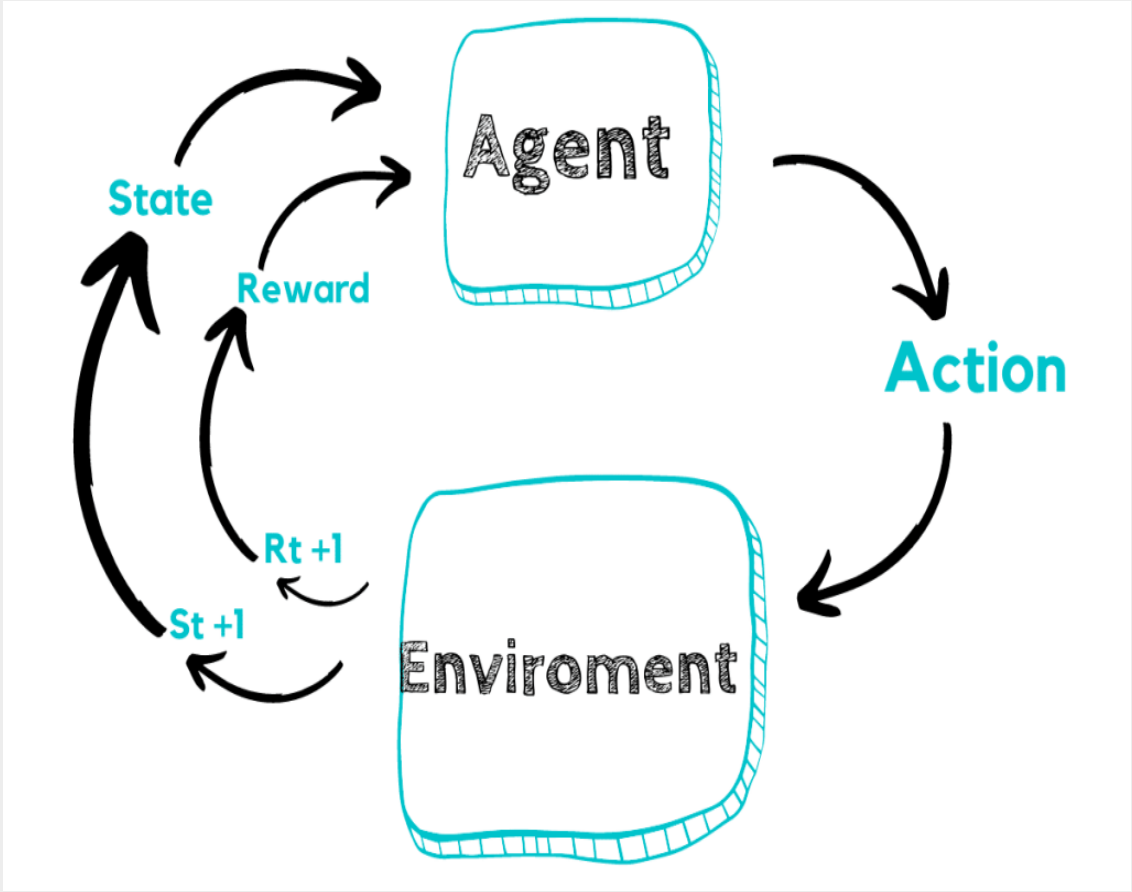
- K-Means
- DBSCAN
- Principal Component Analysis



Learn the representation

Reinforcement Learning

An agent learns to make decisions by interacting with an environment. The agent receives feedback in the form of rewards or penalties based on its actions, allowing it to learn optimal strategies over time.



Learn to control

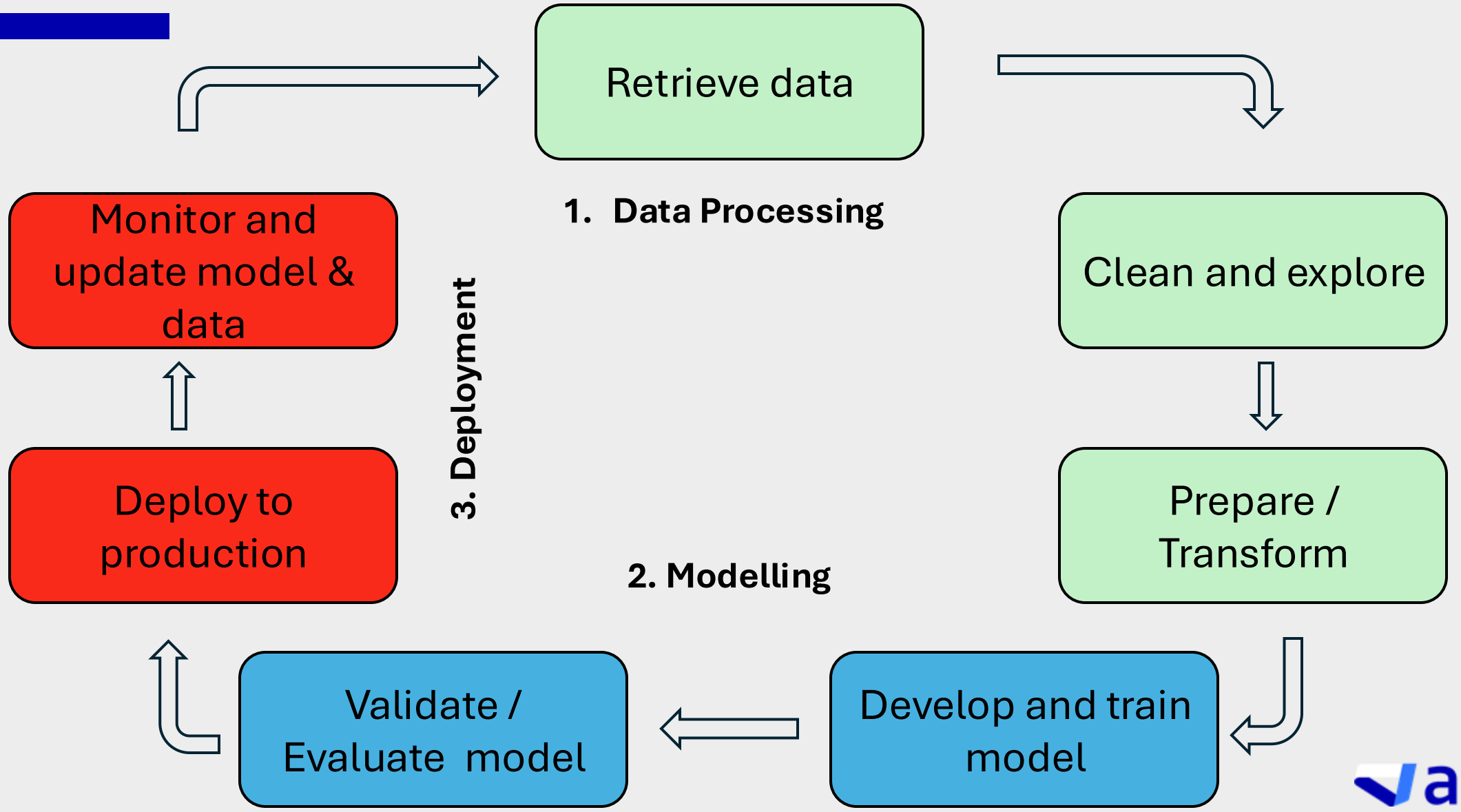
Common algorimths

- Q-learning
- SARSA

Project workflow

aitho

Workflow



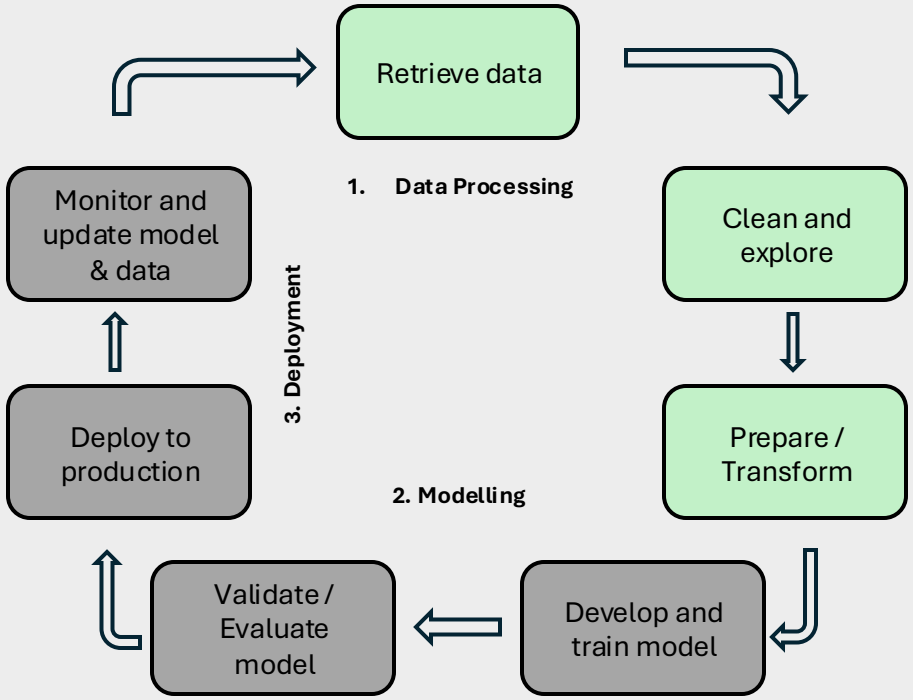
aitho

Data Processing

80% of the battle is won if you have the right data.
Preparing data is tedious, but it's what separates an experiment from a working model.

Objective: Clean and transform data into a form useful for the model.

- **Exploration (EDA)**: statistical analysis, variable visualization.
- **Cleaning**: removal of null values, outliers, duplicate data.
- **Feature engineering**: encoding, normalization, scaling, variable selection.
- **Data splitting**: train/test split, possibly validation set or cross-validation.



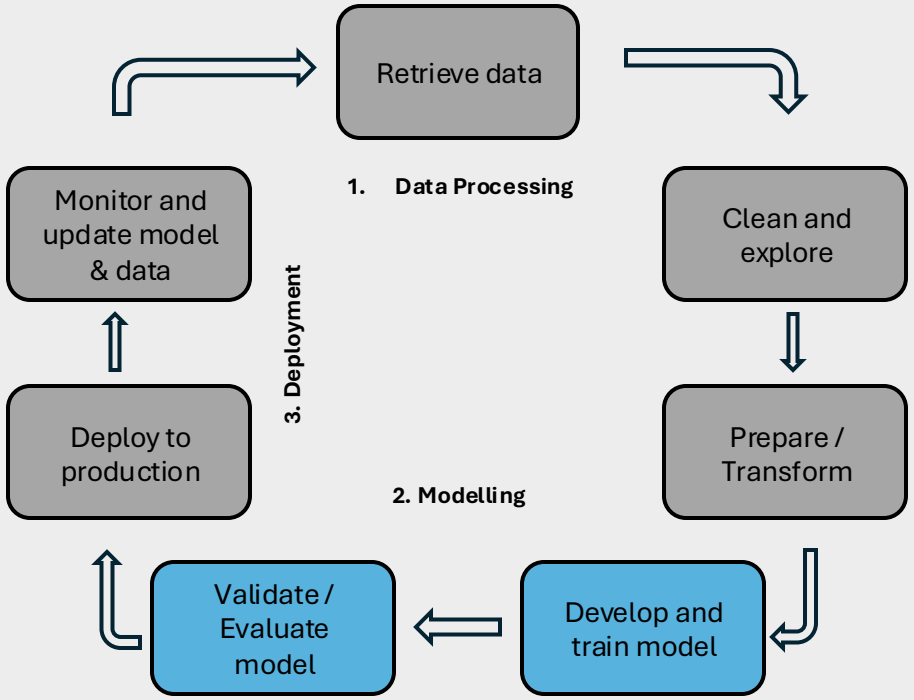
aitho

Modelling

The cool part of the job.
This is where math meets magic. But remember: garbage in, garbage out.

Objective: Train, select and evaluate a ML model.

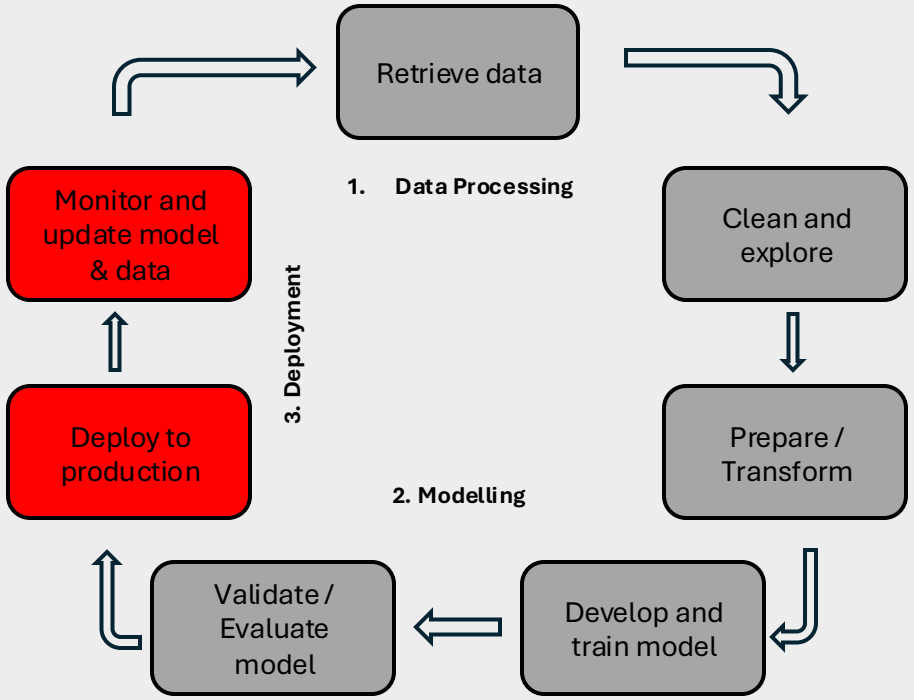
- **Model selection**: decision tree, SVM, neural network, etc.
- **Training**: train the model on the training data.
- **Evaluation**: metrics (accuracy, F1, precision, recall, MSE...).
- **Tuning**: optimize hyperparameters (GridSearch, RandomSearch, etc.)



aitho

Deploying

Real impact starts after the model leaves your notebook.
A model is useless if it is not used. The real value comes when code meets the real world.



Objective: Put the model into production and monitor its performance.

- **Deploy**: export the model, integrate into API or app.
- **Monitoring**: performance over time, data drift, logging.
- **Update**: periodic re-training with new data.

aitho

Tools and libraries

seaborn

XGBoost

Dopamine

aitho

Let's look at the code

Thank you!

aitho
welcome home developers

www.aitho.it

partners@aitho.it

Q&A

aitho
welcome home developers

www.aitho.it

partners@aitho.it