Intro to **Machine Learning**

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Agenda

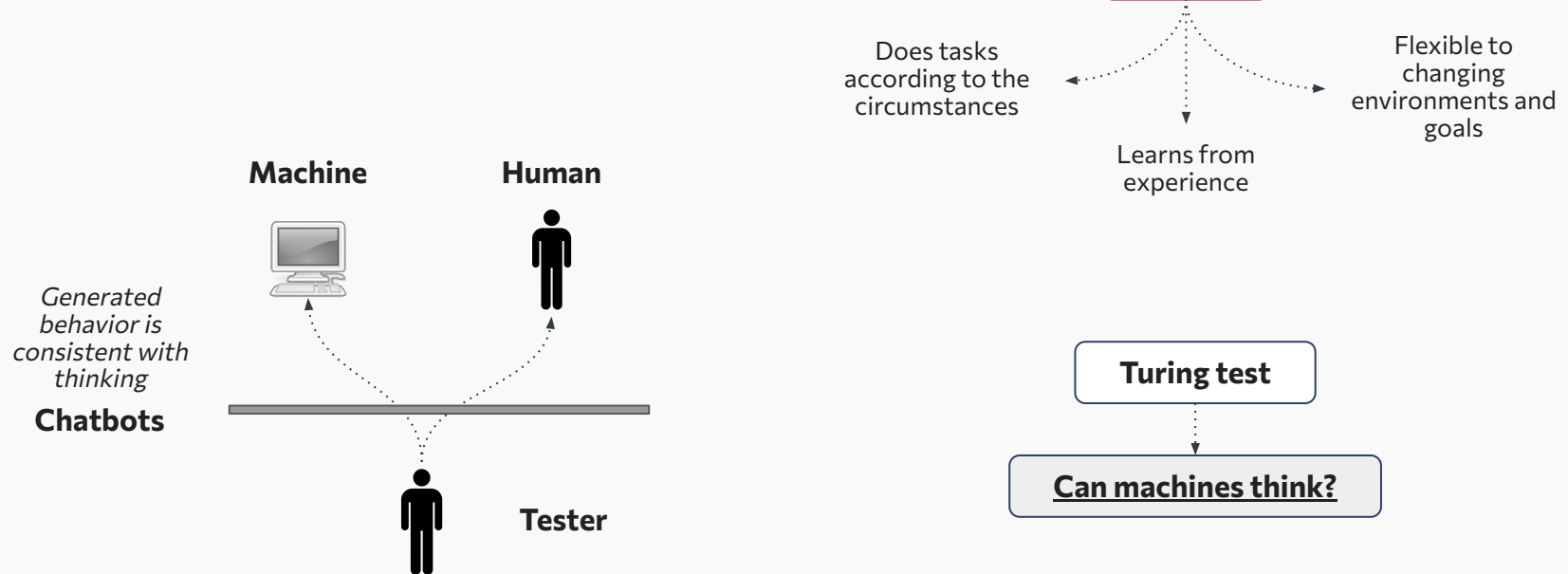**01** **Artificial Intelligence**

02 **Introduction to Machine Learning**

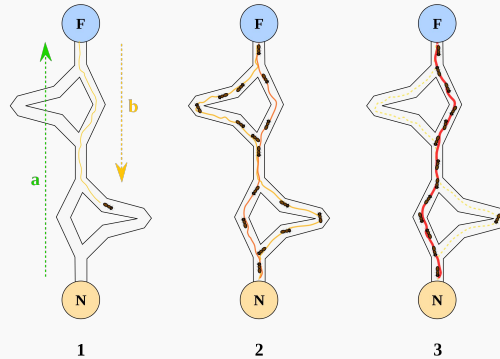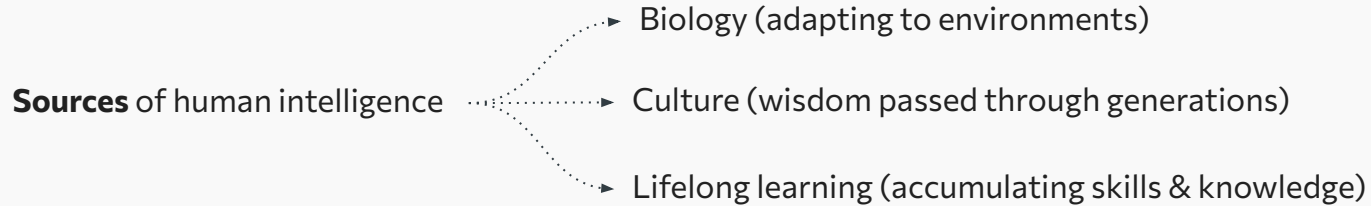**03** **ML Challenges**

Artificial Intelligence

The study of computer systems that attempt to model and apply the intelligence of the human mind.

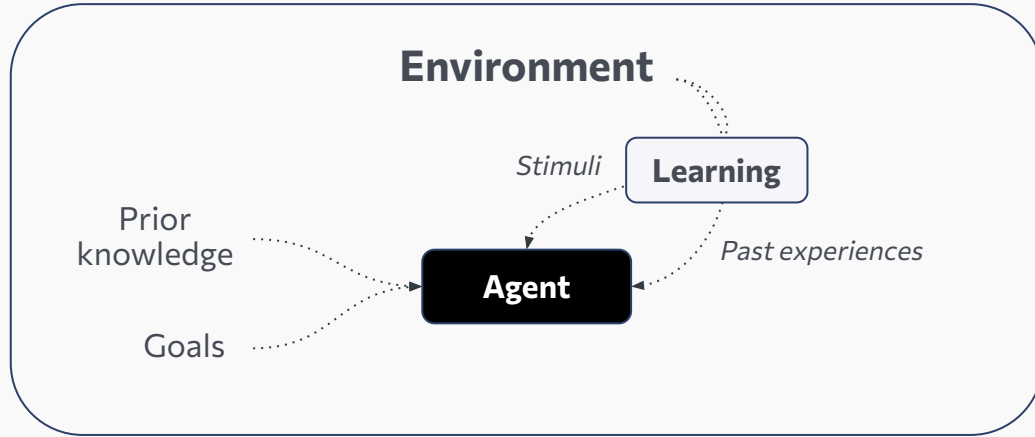Does tasks according to the circumstances

Learns from experience

Flexible to changing environments and goals

Machine

Human

Generated behavior is consistent with thinking

Chatbots

Tester

Turing test

Can machines think?

Human Intelligence & Beyond

Sources of human intelligence

- ➤ Biology (adapting to environments)
- ➤ Culture (wisdom passed through generations)
- ➤ Lifelong learning (accumulating skills & knowledge)

Ant colonies

Artificial Intelligence

Intelligence → **General** intelligence

Specialized intelligence

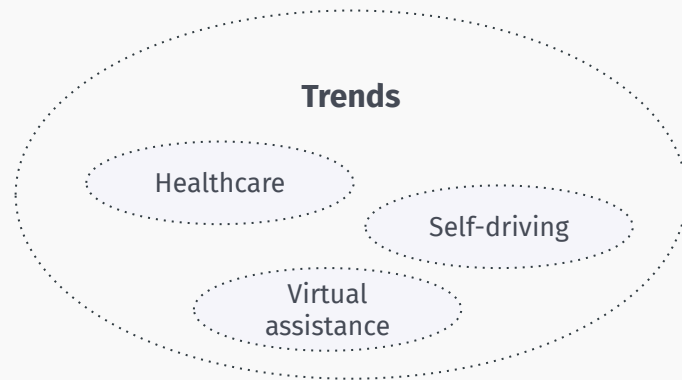Humans + computers→ **Collective** intelligence

Why do we need intelligence?
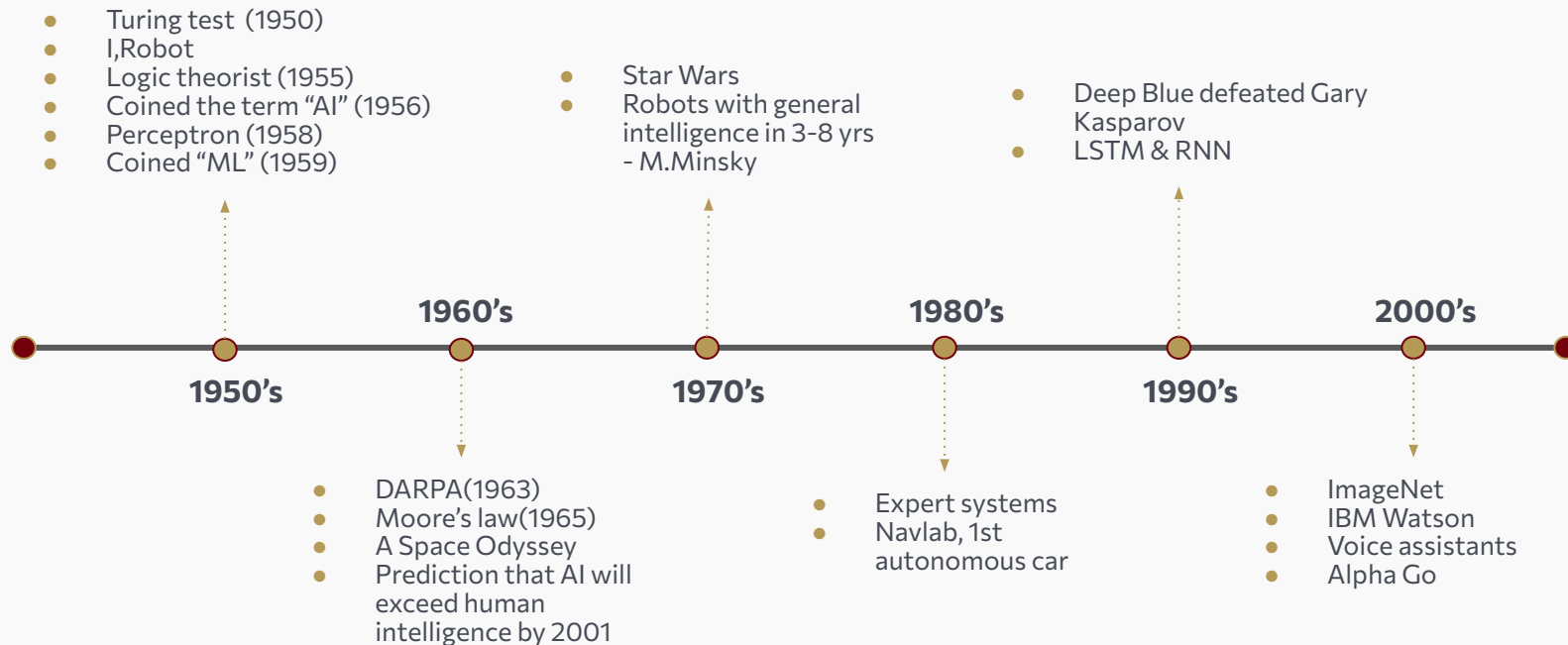
Data → Knowledge

Avoid providing **manual rules** and going through **huge amount of data**
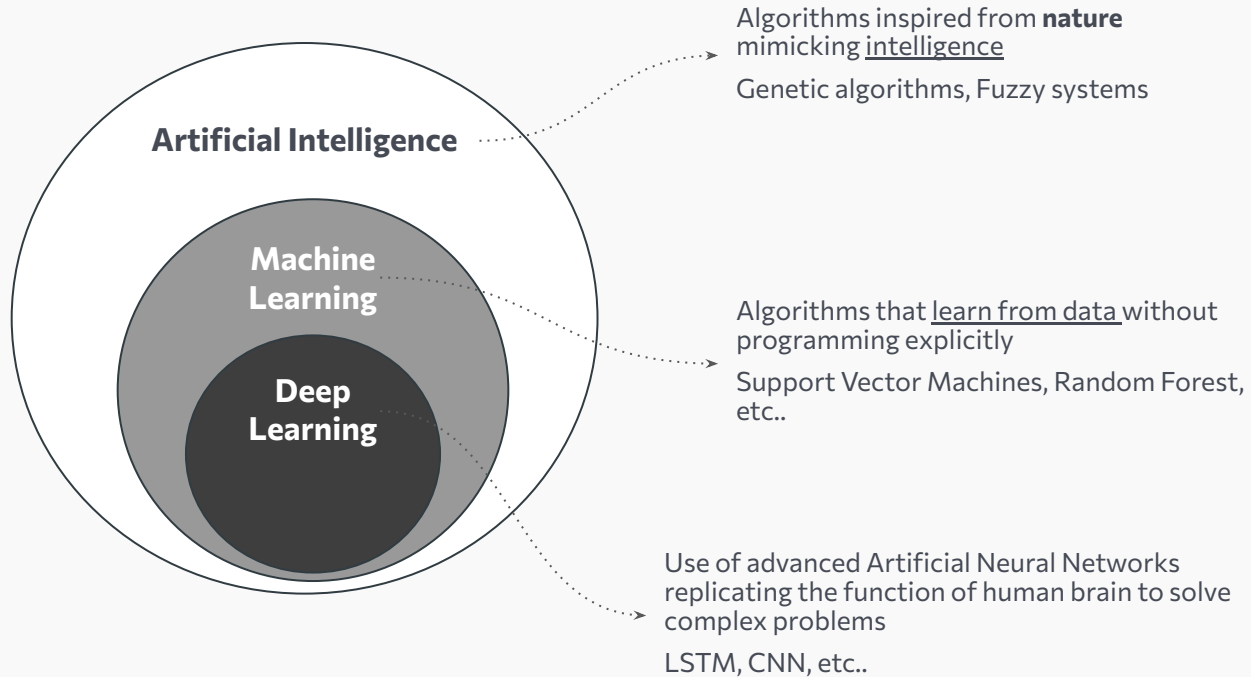
Recent developments:

- Detecting Skin cancer
- Investment Management
- AI powered logistics
- Speller100

Trends

Healthcare

Self-driving

Virtual assistance

Brief History of AI

- Turing test (1950)
- I, Robot
- Logic theorist (1955)
- Coined the term "AI" (1956)
- Perceptron (1958)
- Coined "ML" (1959)

- Star Wars
- Robots with general intelligence in 3-8 yrs – M.Minsky

- Deep Blue defeated Gary Kasparov
- LSTM & RNN

1960's

1950's

1980's

2000's

1970's

1990's

- DARPA(1963)
- Moore's law(1965)
- A Space Odyssey
- Prediction that AI will exceed human intelligence by 2001

- Expert systems
- Navlab, 1st autonomous car

- ImageNet
- IBM Watson
- Voice assistants
- Alpha Go

AI/ML/DL

Artificial Intelligence

Machine Learning

Deep Learning

Algorithms inspired from **nature** mimicking intelligence

Genetic algorithms, Fuzzy systems

Algorithms that learn from data without programming explicitly

Support Vector Machines, Random Forest, etc..

Use of advanced Artificial Neural Networks replicating the function of human brain to solve complex problems

LSTM, CNN, etc..

AI applications

INPUT	OUTPUT	APPLICATION
Voice Recording	Transcript	Speech Recognition
Image	Caption	Image Recognition
Videos/movies/posts	Relevant content	Recommendation Systems
Customer Data	Ads	Targeting Ads
Historical Market Data	Future Market Data	Trading Bots
Transaction details	Fraud labels	Fraud detection
Purchase history	Future purchase behavior	Customer retention
Faces	Names	Face Recognition
Car locations and speed	Traffic Flow	Traffic Lights Automation

Data is the new oil

Data → Better Decisions → Profits

Machine Learning

Science of programming computers so they can _learn from data_.

Machine Learning is the field of study that gives computers the **ability to learn** without being explicitly programmed - _Arthur Samuel, 1959_

A computer program is said to learn from **experience** (E) with respect to some **task** (T) and some **performance measure** (P), if its performance on (T), as measured by (P), improves with experience (E). - _Tom Mitchell, 1997_
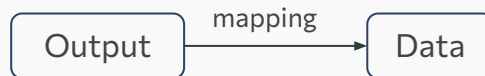
Why use Machine Learning?

Study the **problem** → Write rules → Evaluate → Launch

Evaluate → Analyze errors → Study the **problem**

Example: **Spam Filter**

ML approach

New Data ← update ← Launch

New Data → Train ML algorithm → Evaluate → Launch

Evaluate → Analyze errors → Study the **problem** → Train ML algorithm
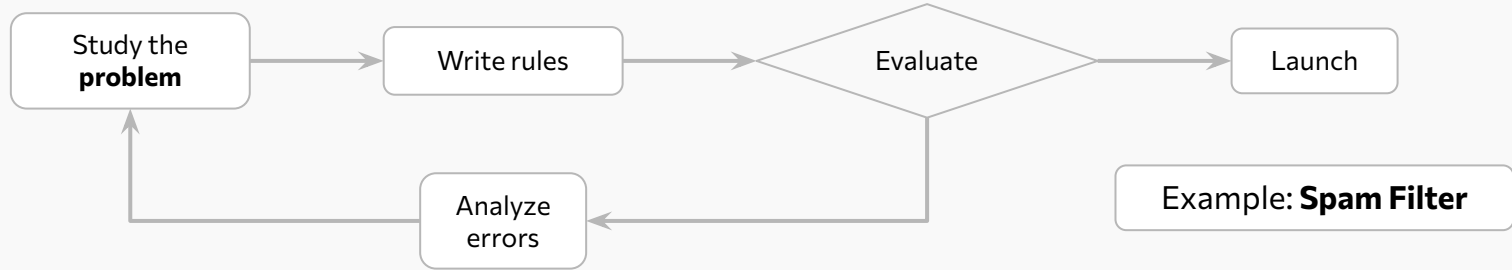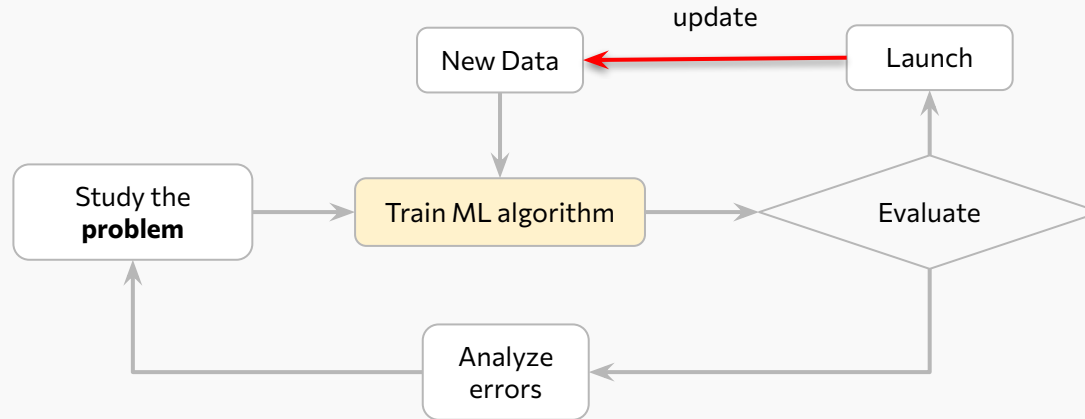
How does ML work?

Output = **Function** (data)

Capable of dealing with complex problems such as **speech recognition**, **image/ video analysis** and **vast amount of numerical data.**
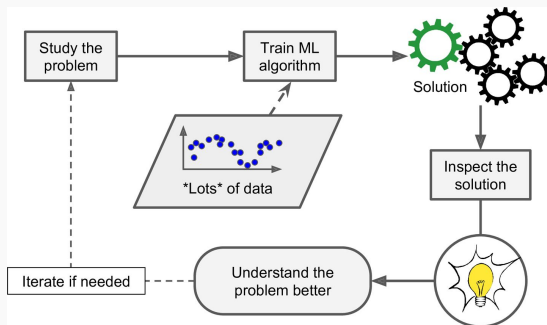
Helps us discover new patterns → **Data Mining**

Can **adapt** to new data

Types of
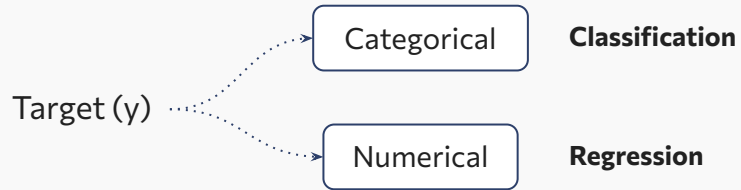**Learning**

Supervised Learning
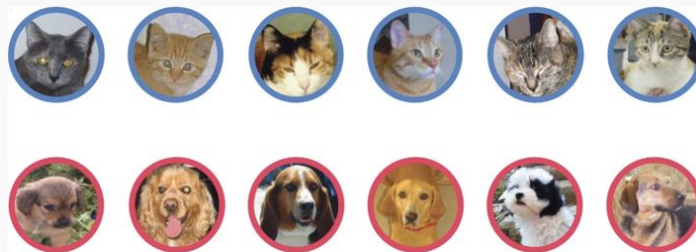
Examples:
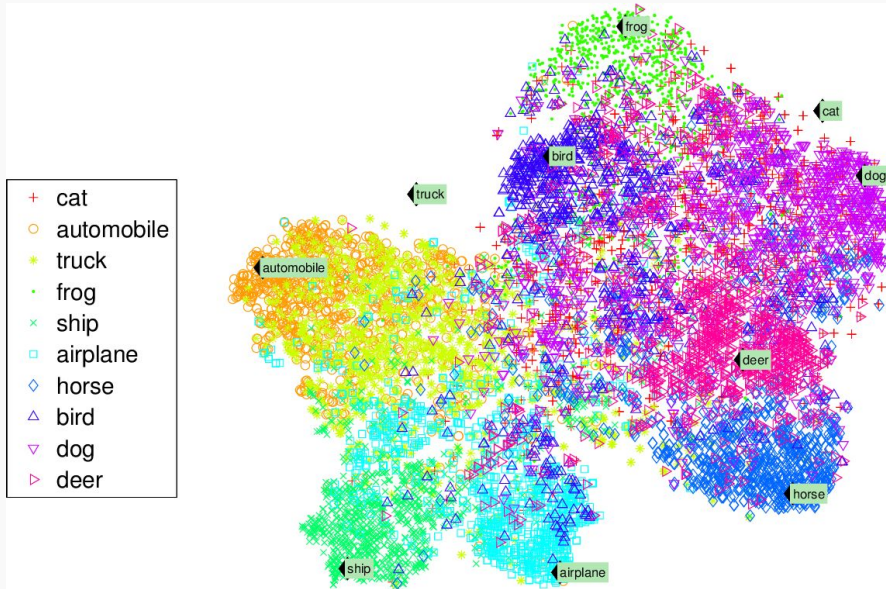**Classification & Regression**
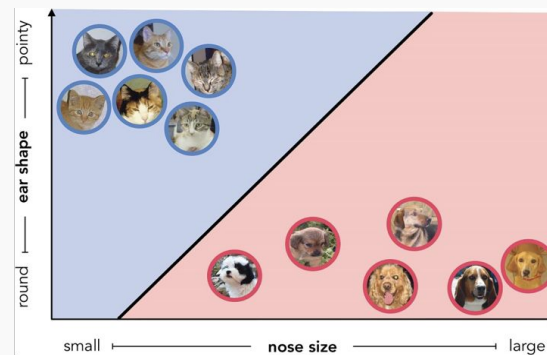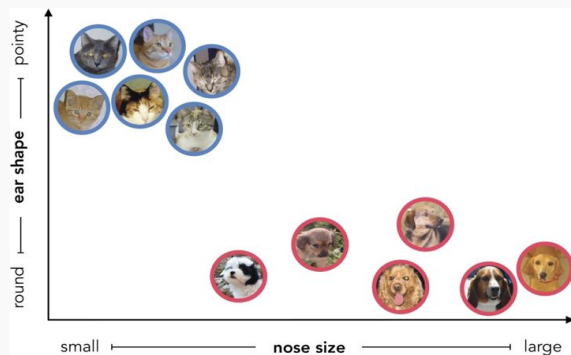
Training data includes labels

Supervised Learning

Target (y)
- Categorical → **Classification**
- Numerical → **Regression**
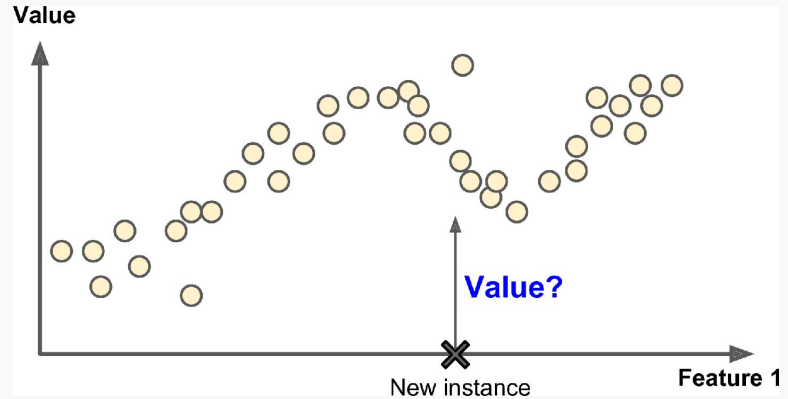
Linear Regression**,** Logistic Regression**,** Random Forest**,** Support Vector Machine **&** Neural Networks

Logistic Regression is used for **binary classification**
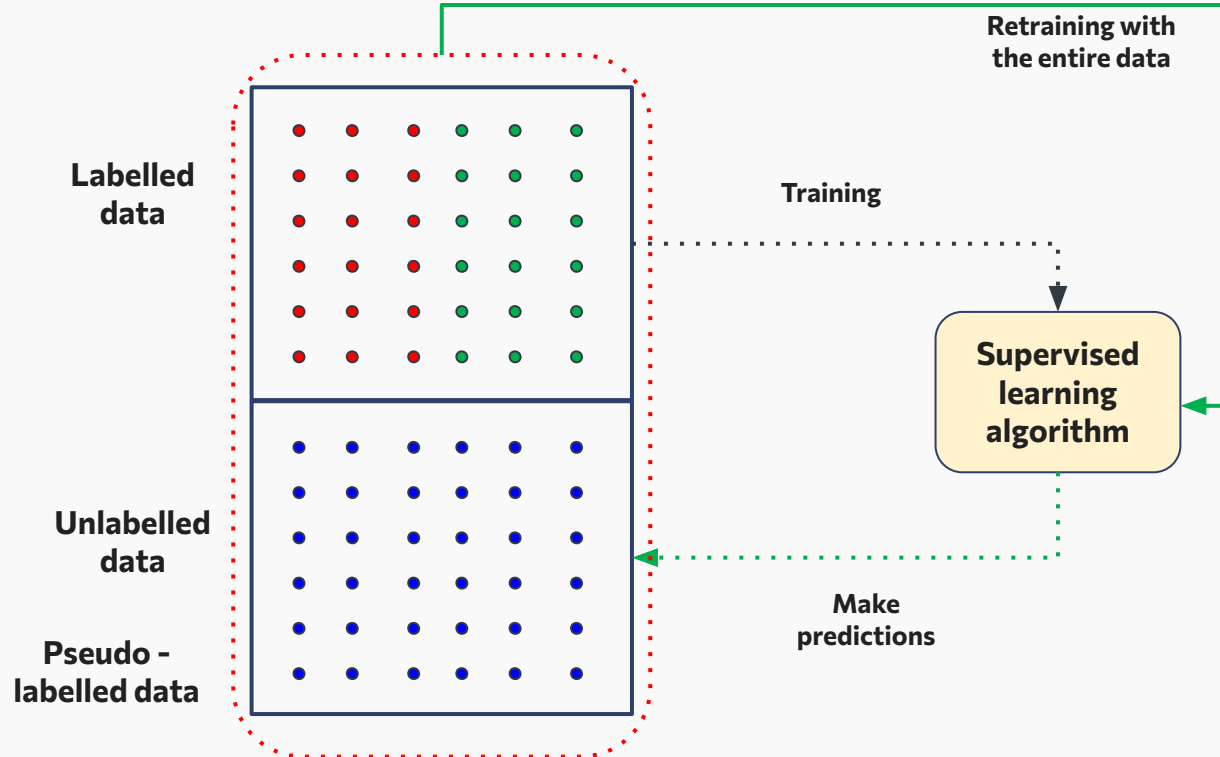
Unsupervised Learning

Dimensionality Reduction

Simplify data without losing too much information
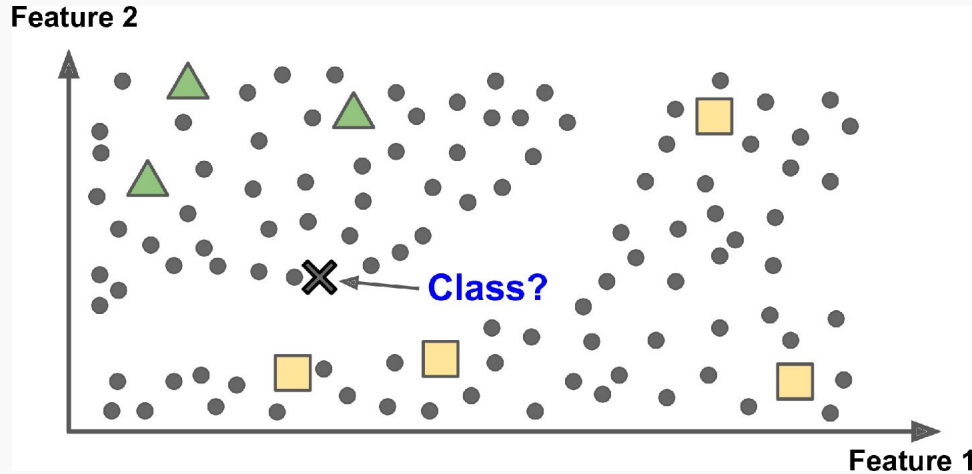
Principal Component Analysis (PCA)

Association rules
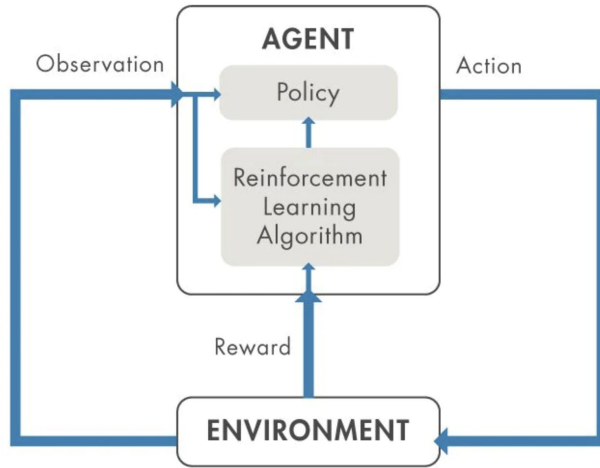
Apriori

Semi-Supervised Learning

Semi-Supervised Learning

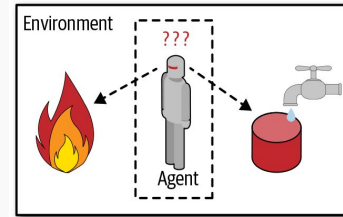Semi-supervised learning models are a **combination** of supervised and unsupervised models

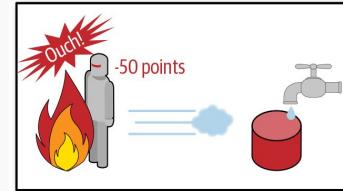Labeling data can be **costly** & **time consuming**

Reinforcement Learning

Algorithm → updates the policy based on the reward
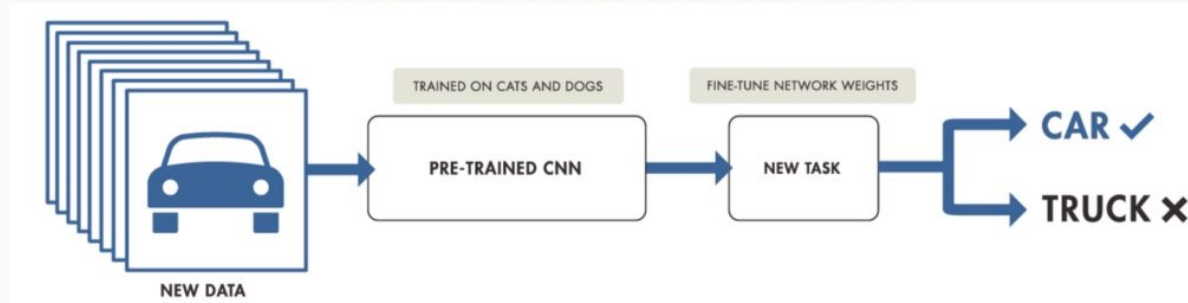
Autonomous driving

Environment

Agent

1 Observe

2 Select action using policy

Ouch! -50 points

3 Action!

4 Get reward or penalty

= bad! Next time avoid it.

5 Update policy (learning step)

6 Iterate until an optimal policy is found

Transfer Learning

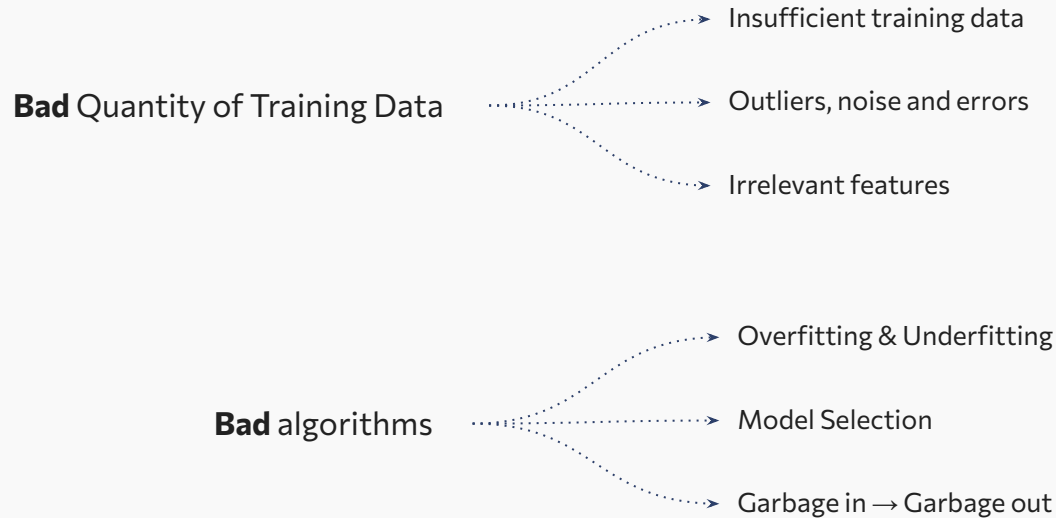**Saves times -** no need to build models from scratch.

Eliminates the need for **huge training dataset**

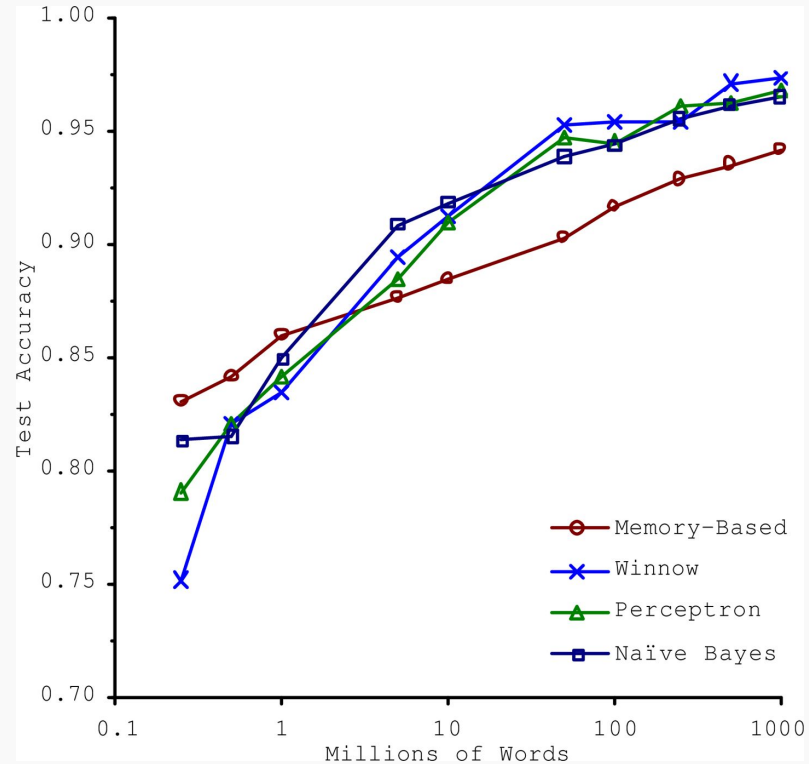Improves **generalizability**

Which ML approach would you use?

- Develop a model that integrates with wearable devices to help patients manage chronic diseases like diabetes or hypertension. The agent should provide personalized recommendations for medication, diet, and exercise based on continuous monitoring of the patient's physiological data.

- A hospital wants to predict how long a patient is likely to stay based on their diagnosis, medical history, and current condition.

- An insurance company wants to identify potentially fraudulent claims to reduce losses and prevent abuse.

- A public health organization wants to design targeted campaigns to promote healthy lifestyles. They need to segment the population into groups with shared characteristics.
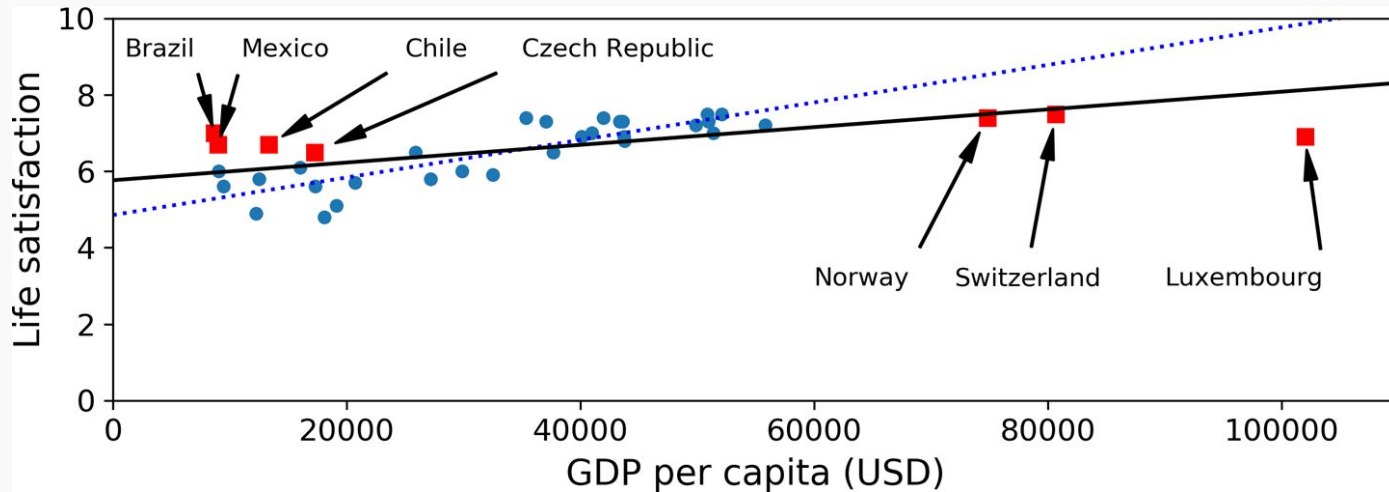
ML - Challenges

Bad Quantity of Training Data

- Insufficient training data
- Outliers, noise and errors
- Irrelevant features

Bad algorithms

- Overfitting & Underfitting
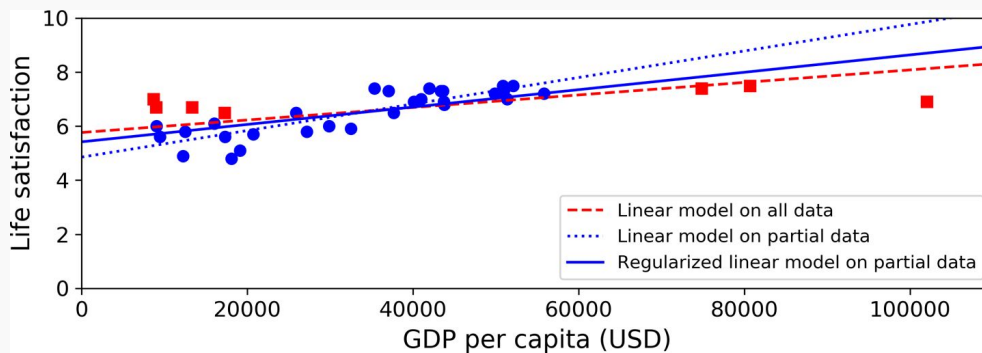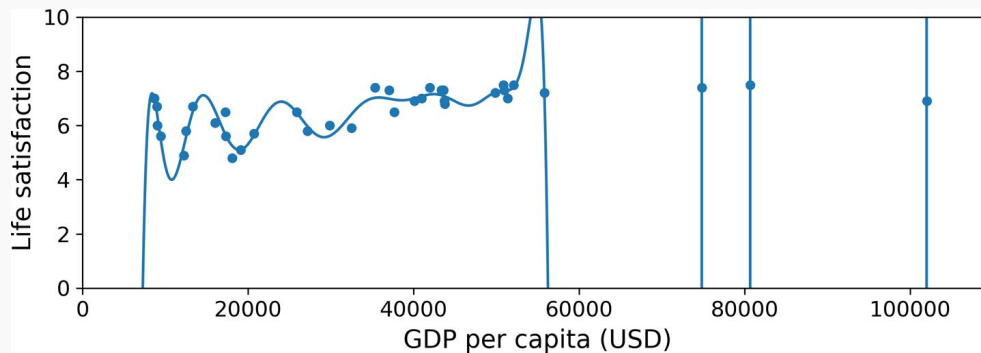- Model Selection
- Garbage in → Garbage out

No Free Lunch
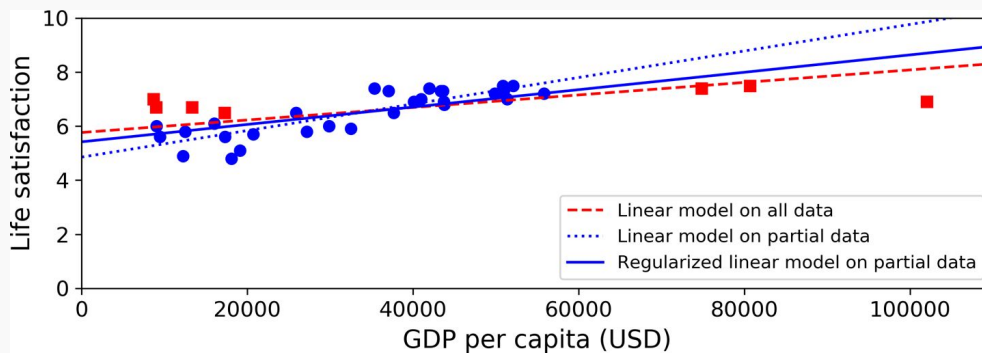
Effectiveness of Data

Non-representative training data

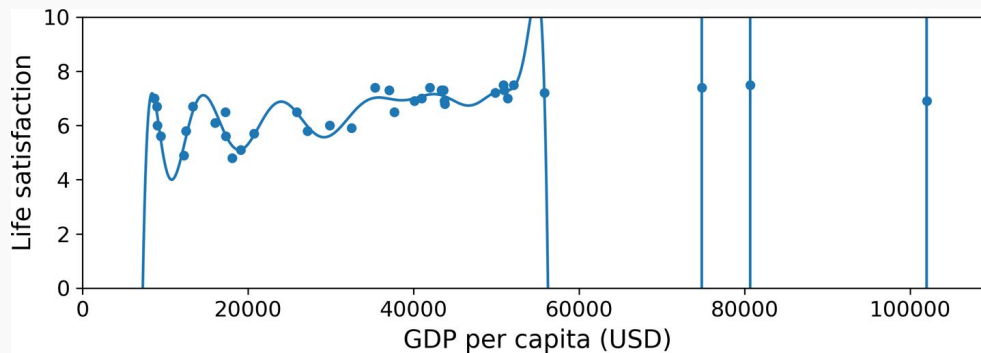# Overfitting

ML Process
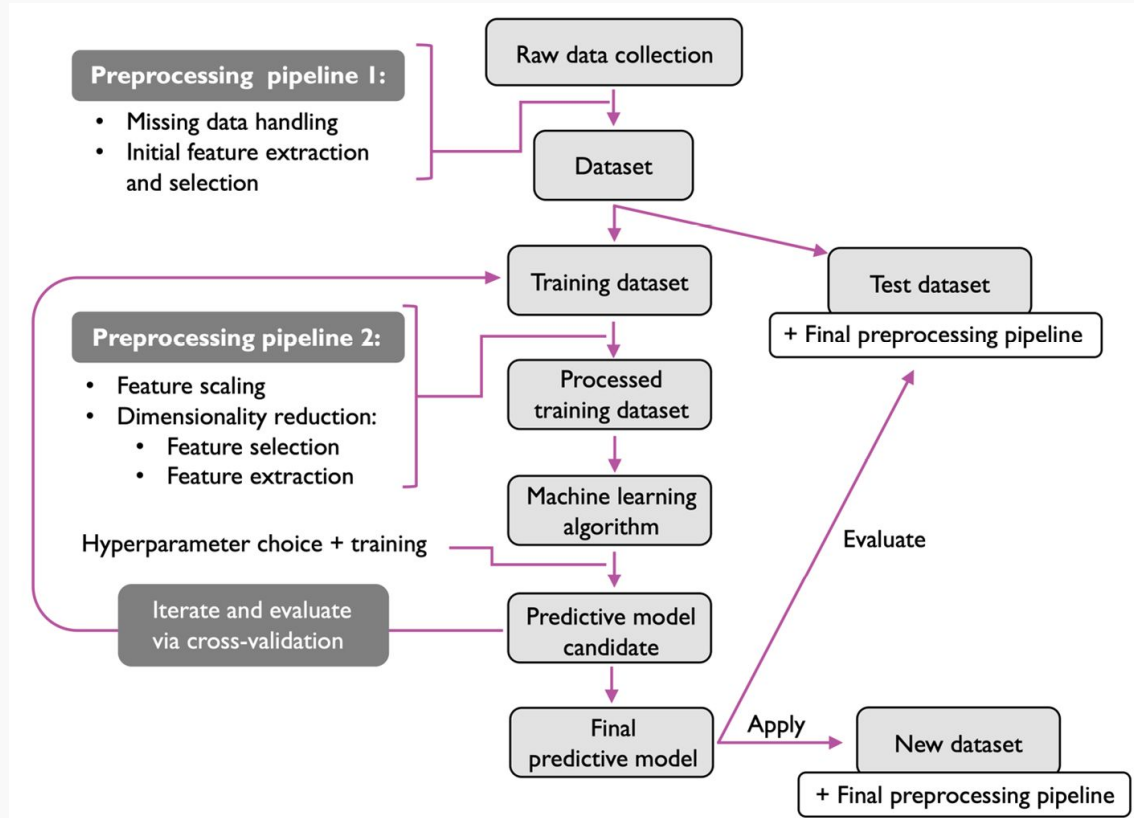
Overfitting

Keeping up with AI research

INPUT	OUTPUT
New code (Research)	https://paperswithcode.com/
New models (Open source)	https://huggingface.co/models?sort=trending
News (HBR, MIT)	https://www.technologyreview.com/
Conference Proceedings	https://aaai.org/aaai-publications/aaai-conference-proceedings/
Podcast	https://emerj.com/artificial-intelligence-podcast/
LinkedIn	https://www.linkedin.com/in/yann-lecun/

Podcast Task

Pick an episode of your choice from the **year 2024** from "**AI in Business**" podcast. Submit a summary of all three episodes after going through them. The summary should contain the problem, challenges, and AI solution.

https://podcasts.apple.com/us/podcast/the-ai-in-business-podcast/id670771965

Thank you!

Any questions?

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