Overview of ML systems

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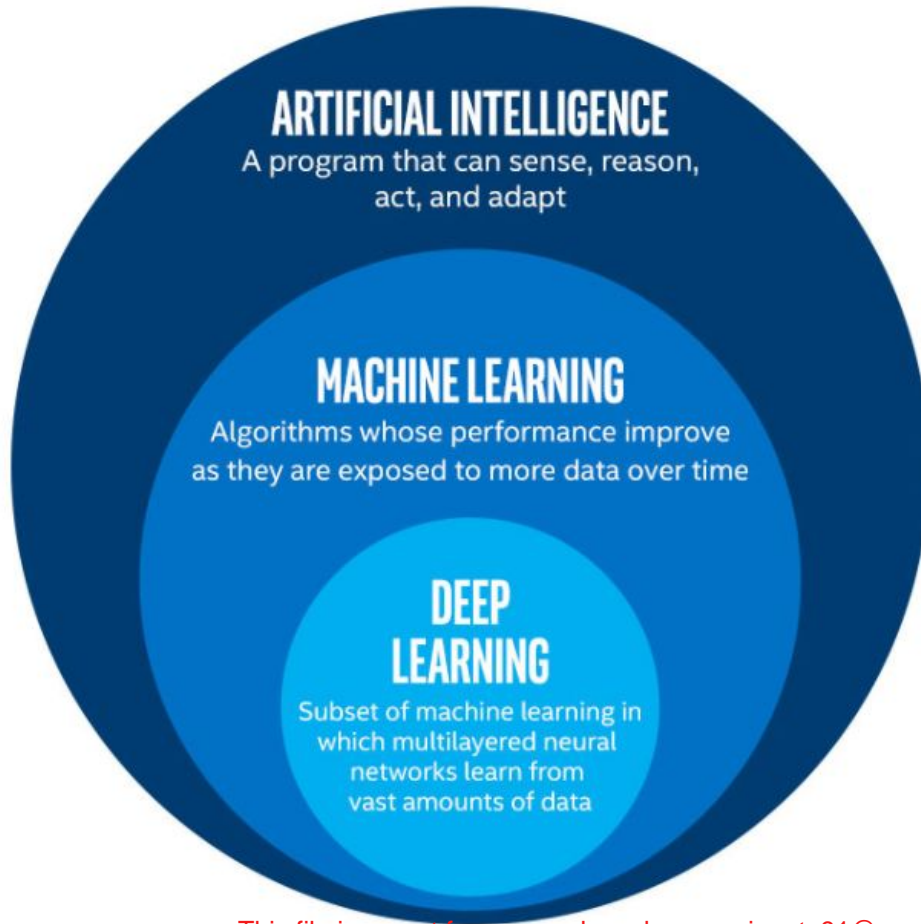
ARTIFICIAL INTELLIGENCE
A program that can sense, reason, act, and adapt

MACHINE LEARNING
Algorithms whose performance improve as they are exposed to more data over time

DEEP LEARNING
Subset of machine learning in which multilayered neural networks learn from vast amounts of data

AI, ML and deep learning

- *The effort to automate intellectual tasks normally performed by humans*
- *Symbolic AI (Playing chess, image classification etc.)*
- *Expert systems*

What is ML ?

Machine Learning is an approach to learn complex patterns from existing data and use their patterns to make predictions on unseen data.

When to use ML ?

Learn: The system has capacity to learn

- ML system learns from data (Historical, stream).
- Eg; Learn and predict the rental prices for Airbnb listings !! for that we will need relevant data (sq footage, number of rooms, neighbourhood, amenities, rating etc.)

Complex patterns: there are patterns to learn and they are compleX !!

- Eg, To predict the outcome of a fair die !!
- To predict the stock prices for next month.
- To sort the Airbnb house listings into the states they are located in.
- To predict how Elon Musk's tweets effect the cryptocurrency prices.

Provide the ML systems with input and

outcomes of a sample and the ML system

will figure out the patterns.

Data ⟶ [Classical Programming] ⟶ Answers
Rules ⟶

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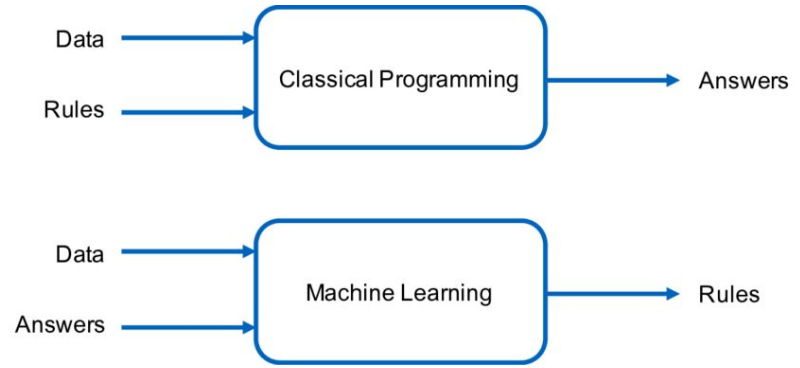
Existing data: data is available or its possible to collect data

- To build a model to predict how much tax a person should pay a year; but it's not possible unless you have access to tax and income data of a significantly large population.

Predictions: it's a predictive problem

- "Predict" means "estimate a value in future"
    - What will the weather be like tomorrow?
    - Which team will win IPL this year?
    - Which movie will a user want to watch next?
- What would the answer to this question be? Regardless of whether this question is about something in past, present or future.
- Compute intensive problems can be reframed as predictive. Not to predict the exact outcome, but an approximation. Eg, LIdar data, Lane assistance

Unseen data: unseen data shares patterns with the training data

- The patterns your ML models learns from the existing data is only useful if the unseen data also shares the same patterns.
  - To predict whether an app will get downloaded on Christmas 2024 won't perform very well if its trained on data from 2008, where the most popular app in appstore was Koi Pond.

- The unseen data and the training data should come from same distribution.

Some additional characteristics

- The model learning is repetitive
- The cost of wrong prediction is cheap
- Its at scale
- The patterns are constantly changing.

ML Use cases

- ❏ Youtube, Netflix recommendations
- ❏ Smartphone (Predictive typing, facial unlocking, language translator)
- ❏ Personal assistant
- ❏ Fraud detection, anomaly detection
- ❏ Price optimization, customer segmentation, churn predictions, customer demand forecasting
- ❏ Brand monitoring

ML research vs. Production

- Different stakeholders and their requirements
  - ML engineer, sales team, product team, ML platform team, Manager
  - "Recommending the restaurants that users are most likely to click on" and "recommending the restaurants that will bring in the most money for the app" are 2 different objectives.
- Computational priorities
  - High throughput vs low latency
- Data
  - Clean vs messy
- Fairness
- Interpretability
  - Suppose you have cancer and you have to choose between a black box AI surgeon that cant explain how it works but has a 90% cure rate and human surgeon with an 80% cure rate. Do you want AI surgeon to be illegal?

Business and ML objectives

- Model accuracy metrics vs. business metrics
- Return on investment

Requirements of ML systems

- Reliability
- Scalability
- Maintainability
- Adaptability
- Iterative process

Framing ML problems

Regression

Classification

    Binary

    Multiclass

    Multilabel

Use cases

1. What will be the price of the house ?
2. Will there be rain tomorrow?
3. Out of Rainy, sunny and outcast, what will be tomorrow's weather?
4. Classifying an article to one of the following

   Tech, entertainment, finance, politics