Introduction to Artificial Intelligence and Machine Learning

Unlocking the Potential of AI and ML...

What is AI

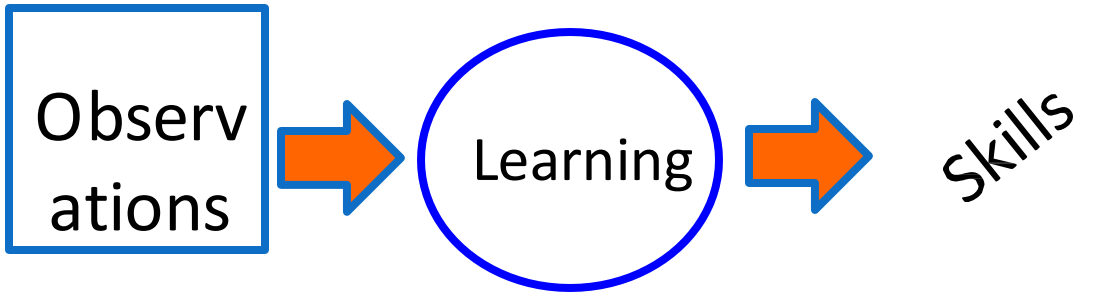
Artificial Intelligence (AI), is like giving computers the ability to think and learn on their own. It's making machines smart, enabling them to do tasks that typically require human intelligence. Imagine computers being able to understand, reason, and even learn from experiences, just like we do.

MACHINE LEARNING

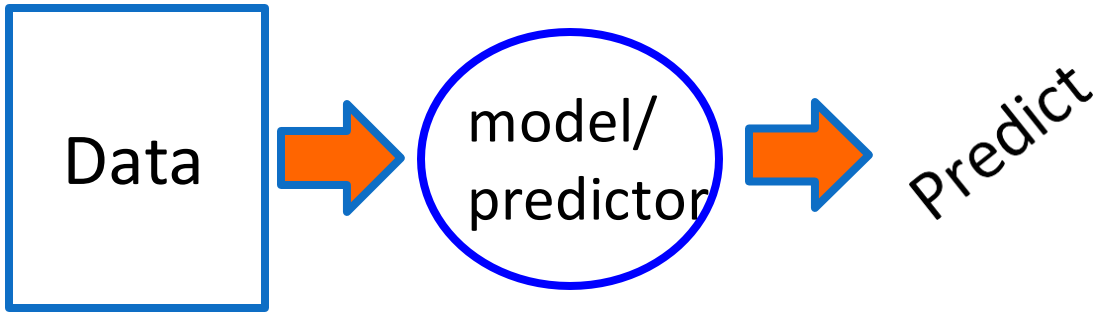
Machine learning is programming computers to optimize a performance criterion using example data or past experience. Machine learning can automatically detect patterns in data, and then to use the uncovered patterns to predict future data or other outcomes of interest.

What

Human Learning



Machine Learning



enables systems to learn and improve from experience without being explicitly programmed.

Why AI?

The simulation of human intelligence processes by machines, especially computer systems.

Why

AI makes our machines smart, allowing them to assist us in various ways. But why do we need it?

Efficiency Boost: AI helps machines do tasks faster and more accurately, saving time and effort.

Automation: It enables machines to handle repetitive jobs, freeing up humans for more creative and complex tasks.

Smart Decision-Making: AI processes vast amounts of data to aid in decision-making, ensuring informed and data-driven choices.

Predictions and Patterns: By recognizing patterns in data, AI can make predictions, assisting in areas like weather forecasting or stock market trends.

Why ML?

Machine learning based on statistics is basically attempting to find the relationship between input and output variables.

Why

Machine Learning (a subset of AI) is about machines learning from experience. Instead of explicit programming, they improve and adapt based on data.

Organizations /governments are collecting a lot of data Information from data is being used to take key business/ political decisions

Adaptable Systems: ML allows systems to learn and evolve, becoming better at their tasks over time.

Personalization: It powers personalized experiences, such as customized recommendations on streaming platforms or tailored search results.

Discussion 1

Examples of AI and ML

Has Any of us see or Experience AI or ML?

MACHINE LEARNING

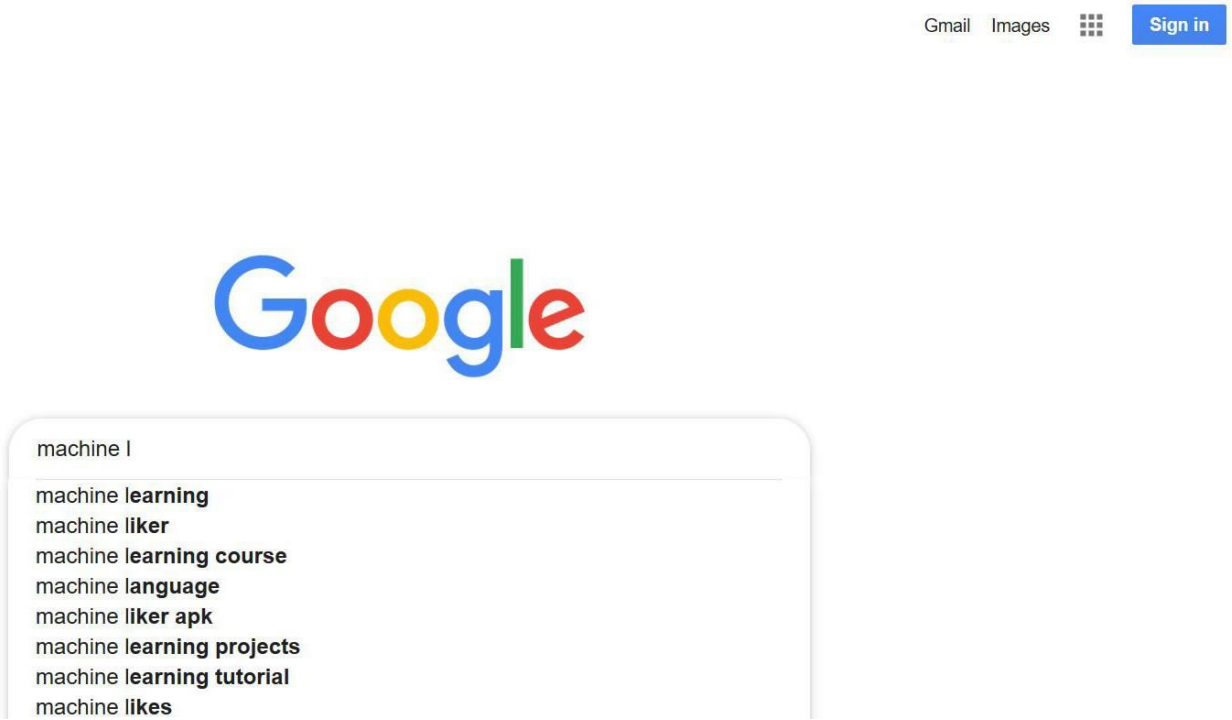
Machine learning is becoming more popular with industries and Companies These days

Example

MACHINE LEARNING

Machine learning based on statistics is basically attempting to find the relationship between input and output variables.

Example



MACHINE LEARNING

Machine learning based on statistics is basically attempting to find the relationship between input and output variables.

Use cases

Banking / Telecom / Retail

- Identify:
  - Prospective customers
  - Dissatisfied customers
  - Good customers
  - Bad payers
- Obtain:
  - More effective advertising
  - Less credit risk
  - Fewer fraud
  - Decreased churn rate

MACHINE LEARNING

Machine learning based on statistics is basically attempting to find the relationship between input and output variables.

Use cases

Computer / Internet

- Computer interfaces:
  - Troubleshooting wizards
  - Handwriting and speech
  - Chat bots
- Internet
  - Hit ranking
  - Spam filtering
  - Text categorization
  - Text translation
  - Recommendation

MACHINE LEARNING

Machine learning based on statistics is basically attempting to find the relationship between input and output variables.

Use cases

Biomedical / Biometrics

- Medicine:
  - Screening
  - Diagnosis and prognosis
  - Drug discovery
- Security:
  - Face recognition
  - Signature / fingerprint / iris verification
  - DNA fingerprinting

Discussion 2

Will AI Take Over 

Briefly touch upon recent advancements in AI, such as improved natural language processing, sophisticated algorithms, and the increasing integration of AI in various industries.

Model as a Function $f(x)$

In the world of machine learning, we often represent our models as mathematical functions, denoted as f(x), where 'x' is the input data.

Model

$$f(x)$$

A machine learning model is a program that can find patterns or make decisions from a previously unseen dataset. For example, in natural language processing, machine learning models can parse and correctly recognize the intent behind previously unheard sentences or combinations of words. In image recognition, a machine learning model can be taught to recognize objects - such as cars or dogs.

A machine learning model can perform such tasks by having it 'trained' with a large dataset. During training, the machine learning algorithm is optimized to find certain patterns or outputs from the dataset, depending on the task. The output of this process - often a computer program with specific rules and data structures - is called a machine learning model.

Think of f(x) as a magical box that takes in information (x) and produces an output. This output could be a prediction, estimation, or classification, depending on the nature of the problem.

Choice of Model $f(x)$

In the world of machine learning, we often represent our models as mathematical functions, denoted as f(x), where 'x' is the input data.

Model

$f(x)$

Choosing the right model is crucial for the success of your machine learning project. It's like selecting the right tool for a specific job.

Estimate or Predict?

- **Inference**: When the relationship between input and output variable is important. We want to establish how output variable varies with change in each predictor variable.
- **Prediction**: If you're forecasting future outcomes, such as predicting whether a student will pass or fail based on their study habits.

- For Prediction, accuracy of predicted function is the most important
- For Inference, interpretability of predicted function is most important

TYPES OF LEARNING

Supervised vs Unsupervised learning

Supervised Vs Unsupervised

Supervised Learning:

- Supervised learning is where you have input variables (x) and an output variable (Y) and you use an algorithm to learn the mapping function from the input to the output.
- The goal is to approximate the mapping function so well that when you have new input data (x) that you can predict the output variables (Y) for that data.

Unsupervised Learning:

- Unsupervised learning is where you only have input data (X) and no corresponding output variables.
- The goal for unsupervised learning is to model the underlying structure or distribution in the data in order to learn more about the data.

Supervised Learning: Example

Supervised Learning Example

examples

label

$label_1$

$label_3$

$label_4$

$label_5$

labeled examples

Supervised Learning: Example

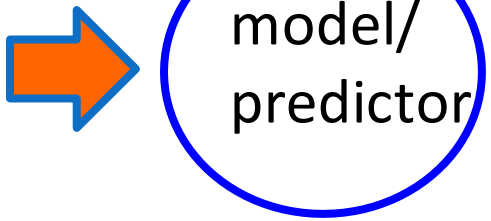
Supervised Learning Example

Category	Weight
Apple	100 gm

Category	Weight
Apple	80 gm

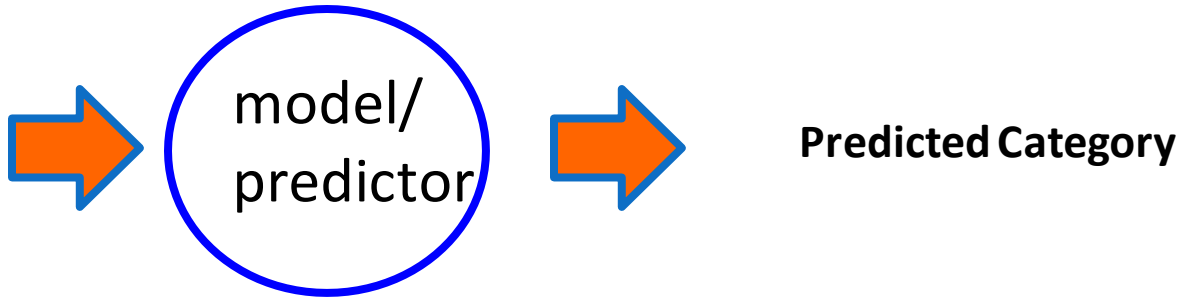
Category	Weight
Banana	40 gm

Category	Weight
Banana	60 gm



Supervised Learning: classification

Supervised Learning Example (classification)



Supervised Learning (classification)

Supervised Learning (classification)

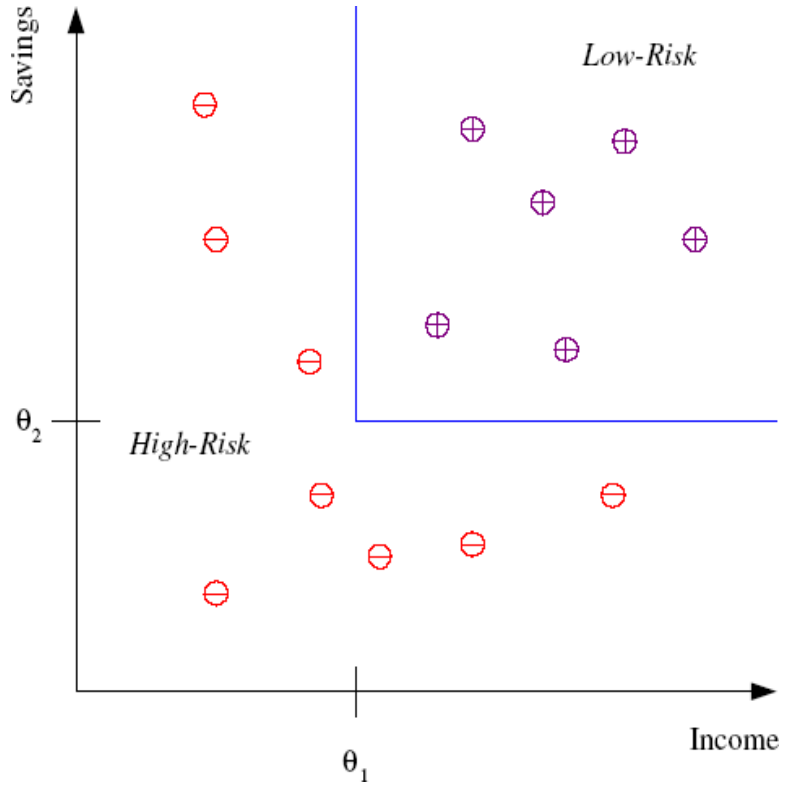
Classification:

- Example: Credit scoring
- Differentiating between low-risk and high-risk customers from their income and savings
- Model - Discriminant

IF *income* > θ_1 AND *savings* > θ_2
THEN low-risk ELSE high-risk

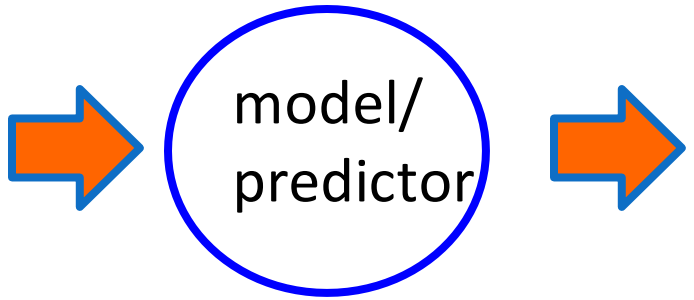
Applications :

- Pattern recognition
- Face recognition
- Character recognition
- Medical diagnosis
- Web Advertising



Supervised Learning: Regression

Supervised Learning Example (Regression)



Predicted Weight

Supervised Learning (Regression)

Supervised Learning (Regression)

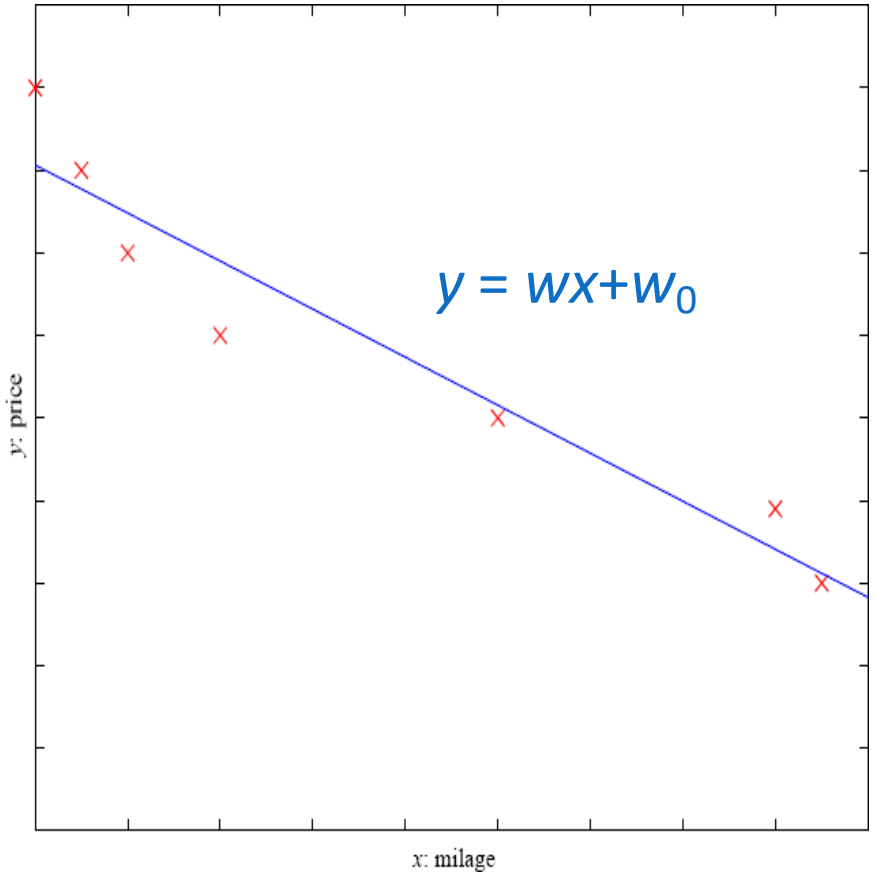
Regression:

- Example: Price of a used car
- x : car attributes
  (e.g. mileage)
  y : price
- Model – Linear Regression

$$y = wx+w0$$

Applications :

- Weather forecast
- Sales forecasting
- Advertising budget allocation
- Product pricing



Unsupervised Learning: Example

Unsupervised Learning Example





Unupervised learning: given data, i.e. examples, but no labels

Unsupervised Learning Algorithms

Unsupervised Learning Algorithms

Unsupervised Learning - Algorithms:

- Clustering
  - K means
  - Hierarchical clustering
- Hidden Markov Models (HMM)
- Dimension Reduction (Factor Analysis, PCA)
- Feature Extraction methods
- Self-organizing Maps (Neutral Nets)

MACHINE LEARNING

Machine learning based on statistics is basically attempting to find the relationship between input and output variables.

Example Problem

For example, The Dean of Faculty of Education wants an AI Model for Predicting student performance based on historical data.

Output variable: Student Performance (Y)
Input variables:
Study Hours (x1): Number of hours a student dedicates to studying.
Previous Exam Scores (x2): Scores achieved in previous exams.
Extracurricular Activities (x3): Participation in activities outside of regular classes.

The Dean wants to find out

$$Y = f(X1, X2, X3, \ldots)$$

So that whenever s/he gives a value of the input variables to this function, s/he can get the student's overall performance.

Discussion 3

How will we solve this Problem?

What Choice of model?
(are we trying to predict or infer)

What type of ML are we using

(Supervised or Unsupervised)

Machine Learning Algorithm

At the core of machine learning are algorithms, step-by-step procedures that guide our models in learning from data.

An algorithm is like a recipe for our machine learning model. It's a set of instructions that the model follows to learn patterns and make predictions.

A machine learning algorithm is a mathematical method to find patterns in a set of data. Machine Learning algorithms are often drawn from statistics, calculus, and linear algebra. Some popular examples of machine learning algorithms include linear regression, decision trees, random forest, and XGBoost.

Machine Learning Model

Steps

Steps in Building ML Model

1. Problem formulation
2. Data Tidying
3. Pre-Processing
4. Train-Test Split
5. Model Building
6. Validation and Model Accuracy
7. Prediction

Machine Learning Tools

Tools

1. Programming Language: Python

- Python is the go-to language for machine learning due to its simplicity and a rich ecosystem of libraries like NumPy, Pandas, and Scikit-Learn.

2. Integrated Development Environment (IDE): Jupyter Notebooks

- Jupyter Notebooks provide an interactive environment for writing, running, and visualizing code. It's widely used for data exploration and model development.

Importance of Data Analysis in Machine Learning

- Understanding the Problem
- Feature Identification
- Quality Input, Quality Output(*Garbage In, Garbage Out*)
- Iterative Improvement:
- Enhancing Predictive Accuracy
- Real-World Applications

Any Question?

Thank You