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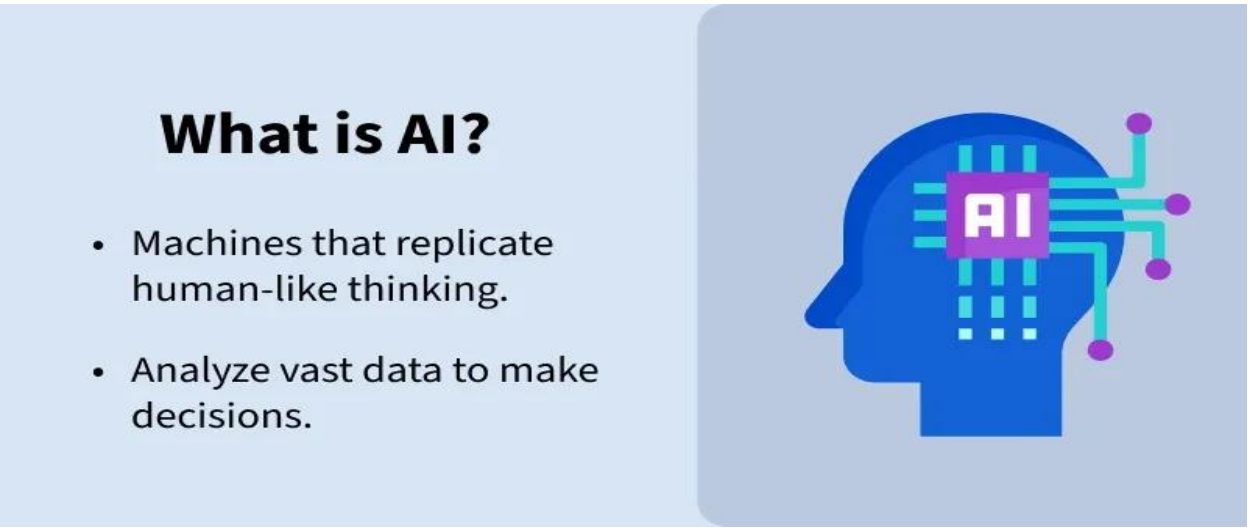
ARTIFICIAL INTELLIGENCE

Artificial Intelligence (AI) refers to the simulation of human intelligence in machines which helps in allowing them to think and act like humans. It involves creating algorithms and systems that can perform tasks which requiring human abilities such as visual perception, speech recognition, decision-making and language translation.



Short-Term Goals of AI

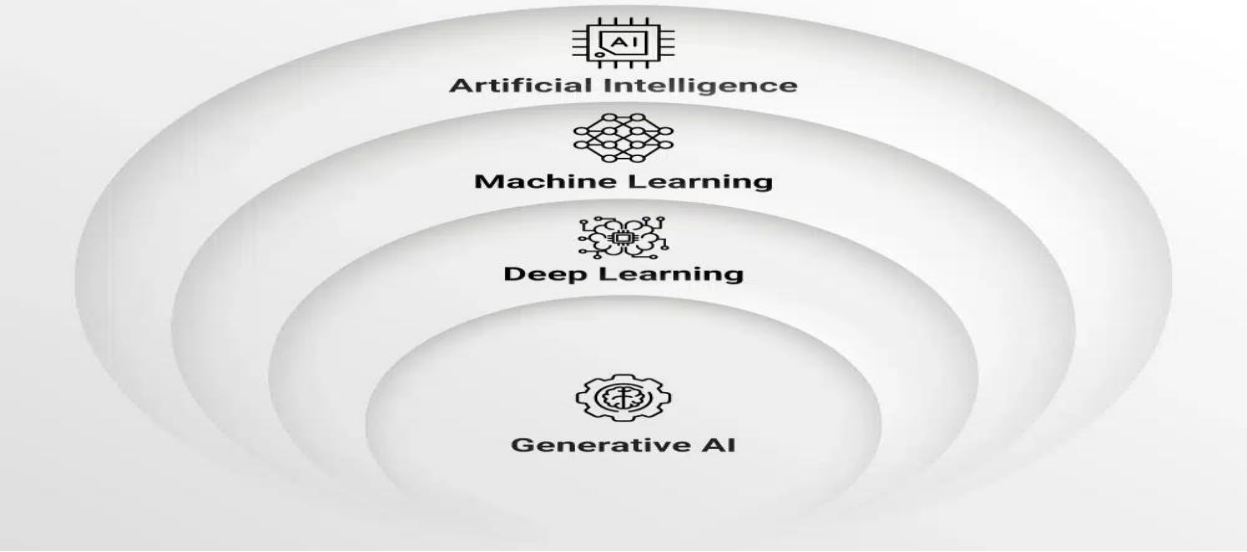
In the short term, the main goal of AI is to **create intelligent systems that can assist humans** by performing specific, well-defined tasks efficiently and accurately.
These systems do not think like humans but can mimic certain aspects of human intelligence such as learning, reasoning, and problem-solving in limited areas.

Long-Term Goals of AI

Long-term goals look beyond narrow applications and aim to **build AI systems with human-like or even superior intelligence.**
These systems would be able to understand, reason, learn, and make independent decisions across multiple domains.

Hierarchical Structure of AI

The primary hierarchical relationship can be understood as:



- **Artificial Intelligence (AI):** The field focused on creating systems capable of performing tasks that typically require human intelligence, such as learning, reasoning, problem-solving, perception, and language understanding.

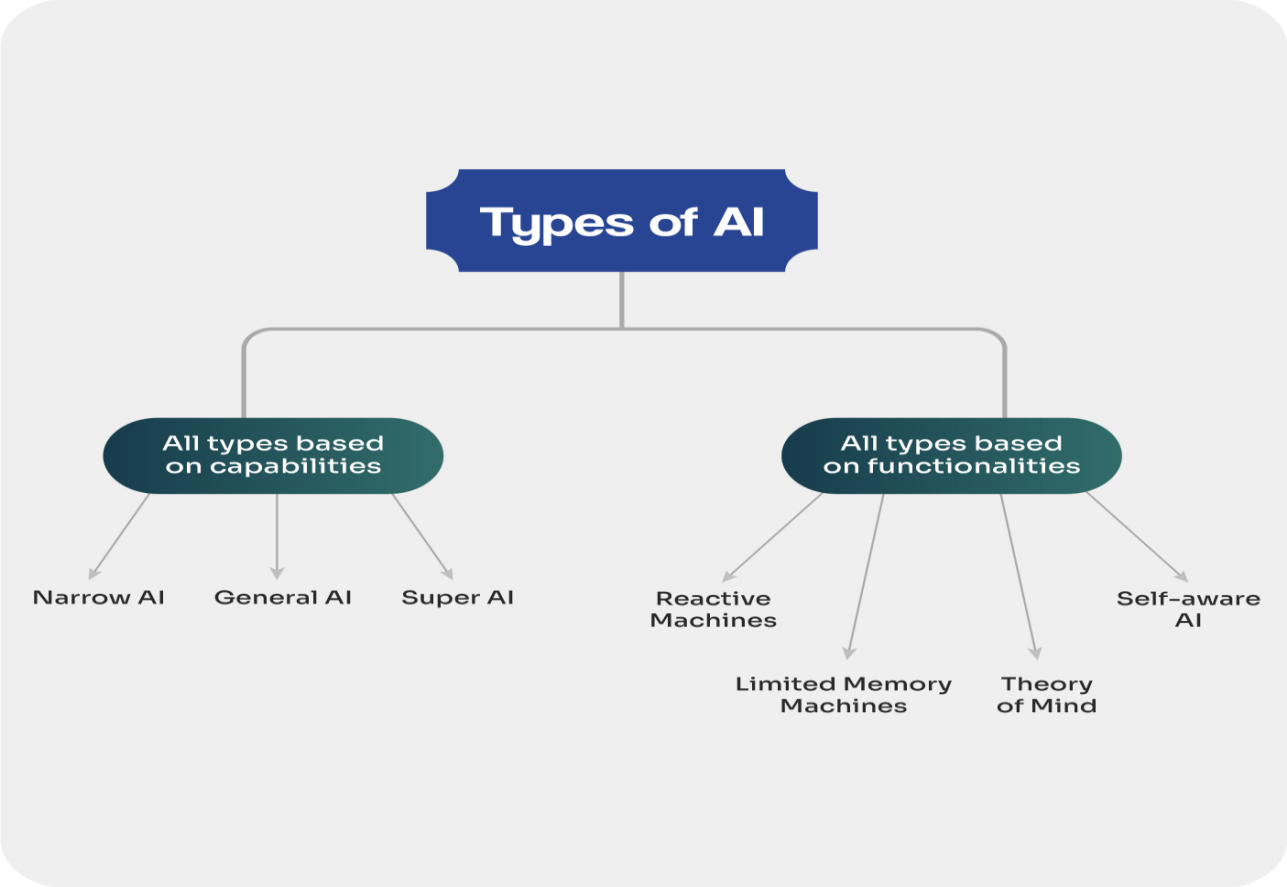
- **Machine Learning (ML):** A subset of AI that uses algorithms to enable computers to learn from data and improve their performance over time without being explicitly programmed for every task.

- **Deep Learning (DL):** A specialized subset of machine learning that employs multi-layered artificial neural networks to model complex patterns and decision-making processes, particularly effective with large amounts of data.

- **Generative AI:** A modern subset of machine learning (often relying on deep learning foundation models) that enables systems to generate new content, such as text, images, or audio, that appears realistic and authentic. Large Language Models (LLMs), like ChatGPT, are a key example.

Types of Artificial Intelligence

Artificial Intelligence (AI) is classified into:



Types based on Capabilities

1. Narrow AI (Artificial Narrow Intelligence / Weak AI)

- AI designed to perform specific tasks and operate within a limited domain.
- Cannot operate outside its domain or generalize to other tasks.

No.	Application	Example	Scenario	Explanation
1	**Chatbots / Virtual Assistants**	ChatGPT, Siri, Alexa	Customer support assistant that answers queries, provides information, or schedules appointments.	Excellent at specific tasks (chat, reminders) but cannot perform unrelated tasks like coding or making financial decisions.
2	**Recommendation Systems**	Netflix, Amazon, TikTok	Suggests movies, products, or music based on user behavior.	Learns preferences and recommends relevant content but cannot create original content or make unrelated decisions.
3	**Fraud Detection in Banking**	AI systems in banks	Detect suspicious transactions and alert customers.	Can detect patterns of fraud but cannot provide general financial advice.
4	**Autonomous Vehicles (Specific Tasks)**	Tesla Autopilot, Waymo	Driving and navigation in controlled environments.	Excellent in driving but cannot perform tasks like household chores or manage finances.

2. General AI (Artificial General Intelligence / Strong AI)

- AI capable of **human-level intelligence**, able to perform **any intellectual task** a human can do.
- Can learn, reason, and solve problems across **multiple domains**.

SN	Scenario	Hypothetical AI	Explanation / Use
1	**Personal Assistant**	Advanced AI that can manage your entire life	Schedules tasks, negotiates contracts, provides health advice, writes reports, and learns from experience.
2	**Research and Development**	AI scientist or engineer	Can conduct experiments, discover new materials or drugs, and solve new problems autonomously.
3	**Education**	AI tutor across subjects	Personalizes learning for each student in multiple disciplines, adapts teaching strategies, and answers complex questions.

3. Super AI (Artificial Superintelligence / ASI)

- AI that surpasses human intelligence in every cognitive field.
- Capable of self-improvement, creativity, reasoning, and emotional understanding beyond human levels.

SN	Scenario	Potential AI	Explanation / Use
1	**Global Problem Solving**	AI that manages climate change, poverty, or global resources	Can process massive data, predict outcomes, and implement solutions better than humans.
2	**Scientific Innovation**	AI discovering cures for all diseases	Can solve problems humans cannot comprehend and innovate autonomously.
3	**Autonomous Societies**	AI managing governments or economies	Makes optimal decisions for society, outperforming human leadership.

Types based on Functionalities

1. **Reactive Machines:** The most basic type of AI, these systems react to current inputs and do not have memory. They are task-specific and cannot learn from past experiences.

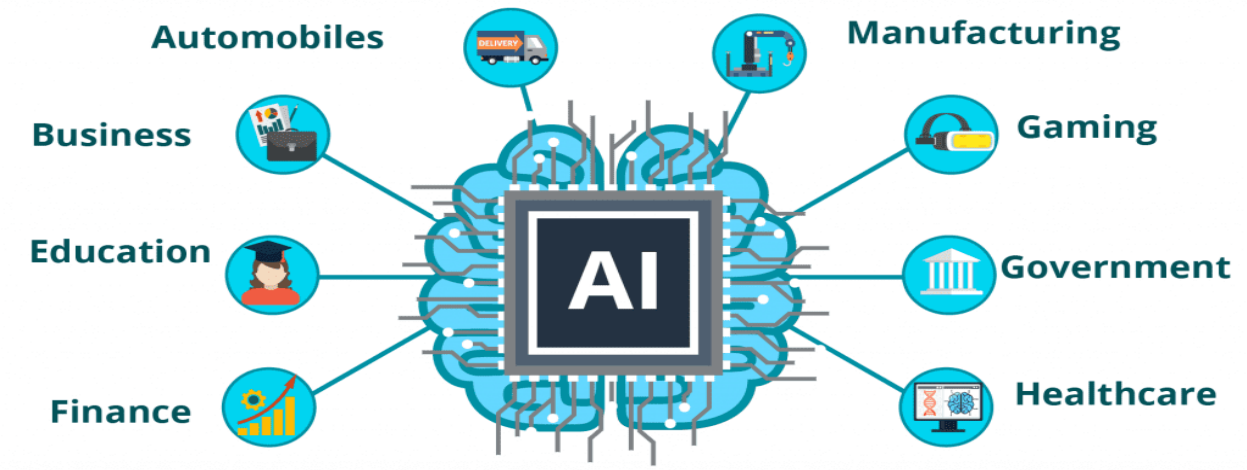
   Example:

   a. Deep Blue, the IBM chess-playing computer that beat Garry Kasparov, was a reactive machine.
   b. **Email Spam Filter:** Identifies spam emails based on predefined rules and keywords, but cannot adapt to new spam types without updates.

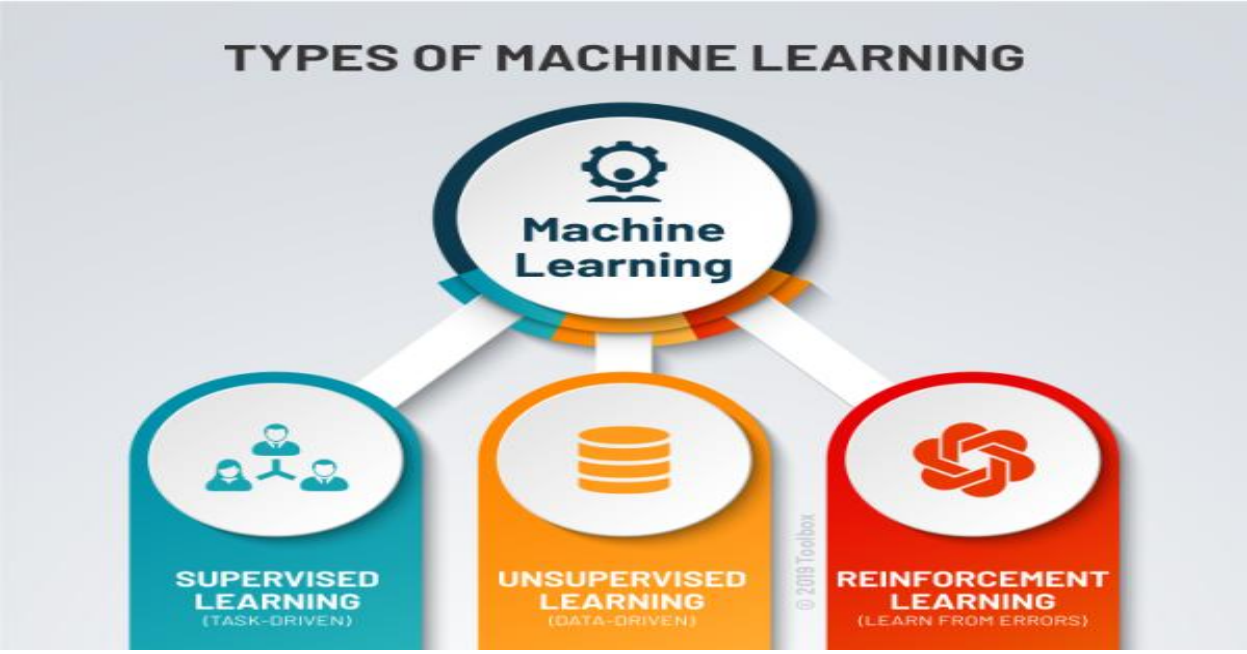
2. **Limited Memory AI:** These systems can look into the past to inform present decisions. They use past data to make better predictions and decisions in the future, though their memory is not permanent.
   a. • **Self-Driving Cars (Tesla, Waymo):** Continuously observe traffic, speed, and the behavior of nearby vehicles to make safe driving decisions.
   b. • **ChatGPT & Virtual Assistants (Siri, Alexa):** Use recent conversation context to generate relevant responses but forget previous chats after a session.

3. **Theory of Mind AI:** A theoretical type of AI that would be able to understand human emotions and thought processes. This level of AI would be able to understand that other people and entities have their own beliefs and intentions.
   a. **Sophia the Robot (by Hanson Robotics):** Attempts to simulate emotional responses and facial expressions, representing early steps toward Theory of Mind AI.
4. **Self-Aware AI:** A purely theoretical form of AI that would possess consciousness and sentience, similar to humans. It would have a sense of self and be aware of its own existence.

Application of Artificial Intelligence

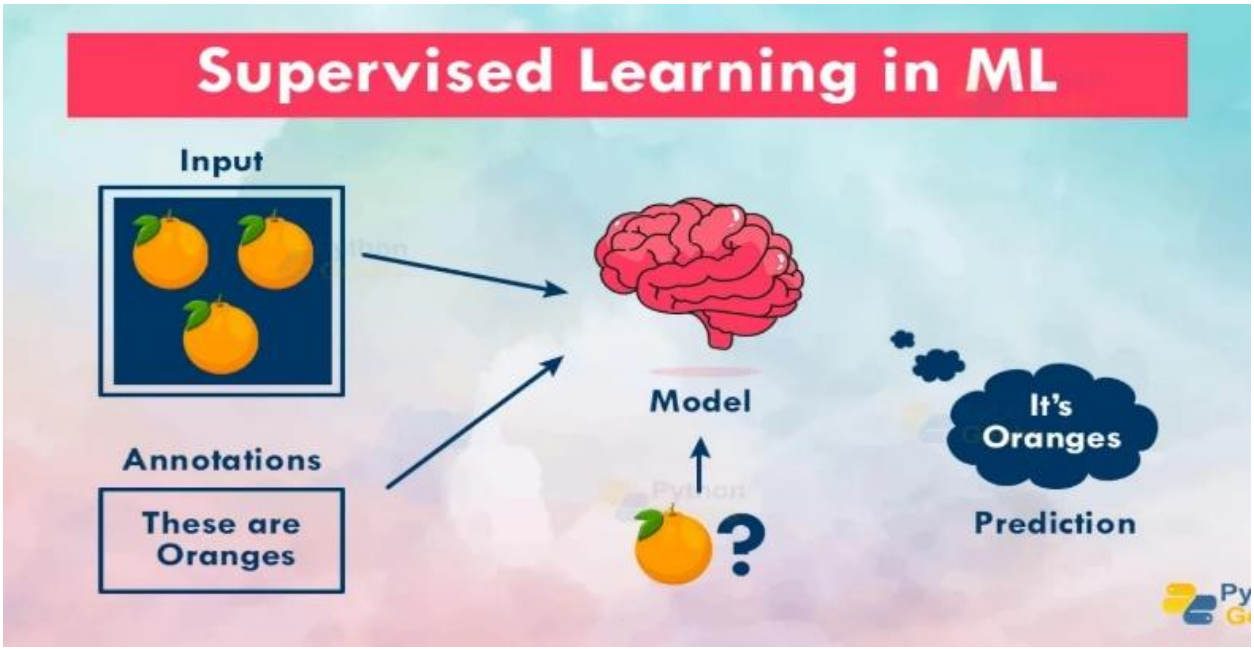


Machine Learning Foundations **Machine learning (ML)** allows computers to learn and make decisions without being explicitly programmed. It involves feeding data into algorithms to identify patterns and make predictions on new data. It is used in various applications like image recognition, language translation, recommender systems, etc.



1. Supervised Learning

Supervised Learning is a type of machine learning where the model is trained on **labeled data** meaning each input has a correct output (label). The goal is for the model to learn the relationship between inputs and outputs so it can predict the correct output for new, unseen data.



The image explains how **Supervised Learning** works using oranges as an example.

1. Input (Training Data)

On the left, you see **pictures of oranges**.
These images are the **inputs** given to the machine learning model during training.

2. Annotations (Labels)

Below the images, you see a label:
"These are Oranges"
This is called **annotation** or **label**.
It tells the model the correct answer for each input.

- Input: Image of oranges
- Label: "Oranges"

This is why it's called **supervised learning** — the model is *supervised* with correct answers.

3. Model Training

The inputs (images) and their labels are sent to the **model** (shown as a brain).

The model learns patterns such as:

- Shape of oranges
- Color
- Texture

It studies many examples so it can recognize oranges later.

4. Prediction

After learning, when you give the model **a new image of an orange**, it analyzes it and predicts: "It's Oranges"

This is the **output** or **prediction**.

Branches of Supervised Learning

Supervised Learning is divided into **two main branches**:

1. Classification

Definition:

Classification is used when the output is a **category**, **class**, or **group**.
The model learns to assign each input to the correct class.

Examples:

- **Spam Detection:**
  Email → *Spam* or *Not Spam*
- **Medical Diagnosis:**
  Symptoms → *Malaria*, *Typhoid*, etc.
- **Fruit Recognition:**
  Image → *Orange*, *Mango*, *Apple*
- **Gender Prediction:**
  Voice → *Male* or *Female*
- **Loan Approval:**
  Applicant → *Approved* or *Rejected*

Keywords:

Categorical output, labels, classes, yes/no, multi-class.

2. Regression

Definition:

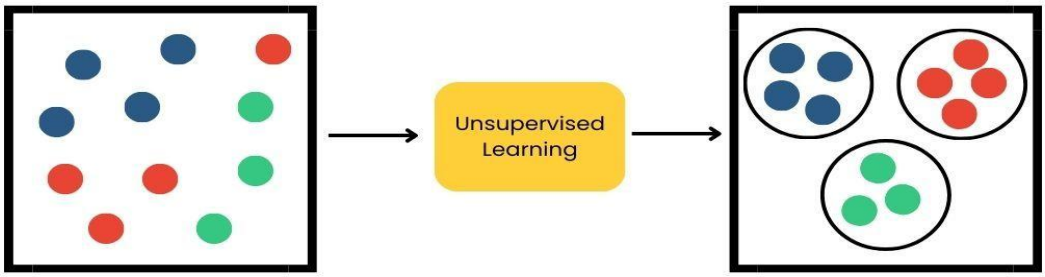
Regression is used when the output is a **number** or **continuous value**.
The model predicts *how much* or *how many*.

Examples:

- **House Price Prediction:**
  Features → Price in dollars
- **Temperature Forecasting:**
  Past weather → Tomorrow's temperature
- **Salary Prediction:**
  Education + Experience → Salary amount
- **Sales Forecast:**
  Past sales → Next month's sales
- **Age Prediction:**
  Facial features → Estimated age (number)

2. Unsupervised Learning

Unsupervised Learning is a machine learning method where the model learns from **data without labels**.
No answers are given — the model **finds patterns on its own**.



It has two major branches:

A. Clustering

Definition:

Clustering is the process of **grouping similar items** together based on patterns in the data.

Key Idea:

Items in the **same group (cluster)** are similar.
Items in **different groups** are different.

Examples:

- **Customer Grouping:**
  Grouping customers into segments (e.g., big spenders, occasional buyers)
- **Grouping Students:**
  By performance levels without using labels
- **Image Grouping:**
  Automatically grouping similar images (e.g., animals, objects)
- **Document Clustering:**
  Grouping news articles by topic (sports, politics, tech) without predefined labels

B. Association

Definition:

Association finds **relationships, patterns, or rules** between items in a dataset.

Key Idea:

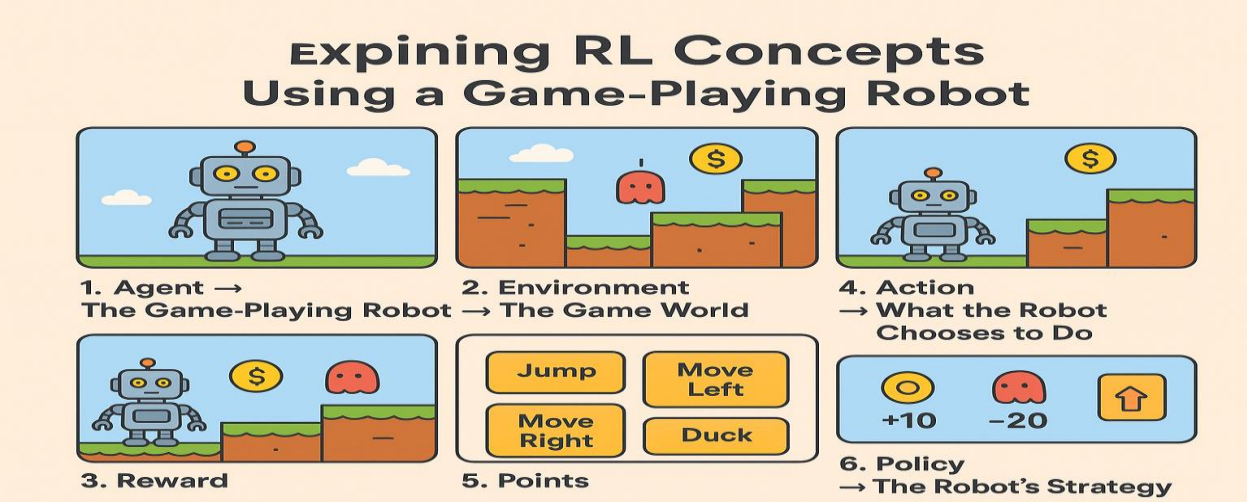
"If a user buys item A, they are likely to buy item B."

Examples:

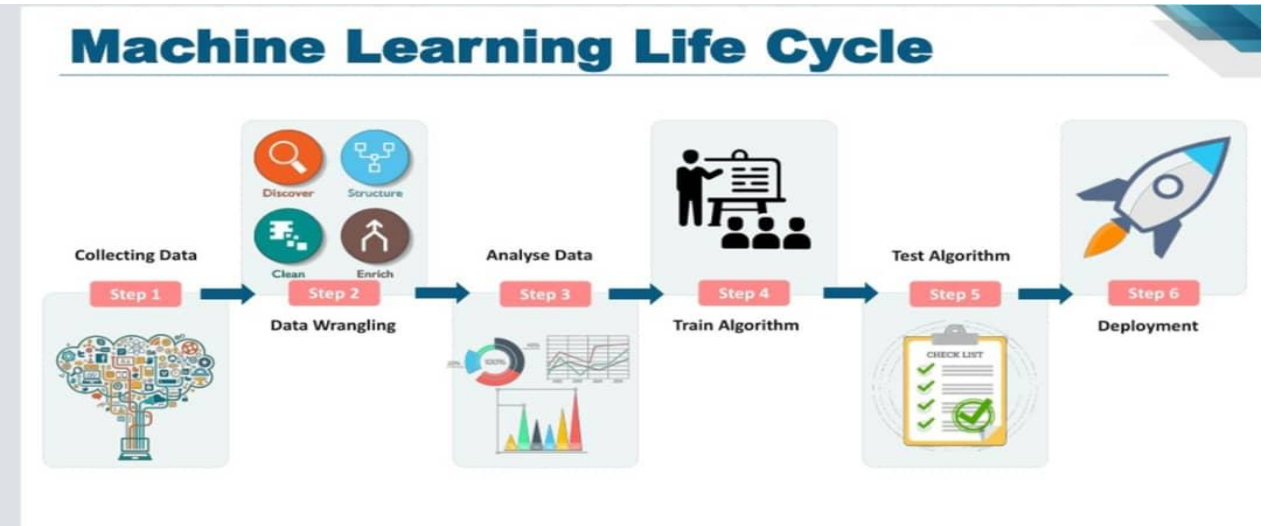
- **Market Basket Analysis:**
  People who buy bread often buy butter.
  (E-commerce recommendation)
- **Store Arrangement:**
  Grouping products frequently bought together
- **Online Recommendations:**
  "Customers who viewed this also viewed…"
- **Fraud Detection:**
  Detecting unusual combinations of activities

3. Reinforcement Learning

Reinforcement Learning (RL) is the branch of machine learning where an **agent learns by interacting with an environment** instead of being told the correct answers (supervised) or left to find structure on its own (unsupervised).



Machine Learning Life Cycle



Step 1

Gather relevant data that will be used to train and evaluate the machine learning model.

For example, collect historical data on house prices, including the features mentioned.

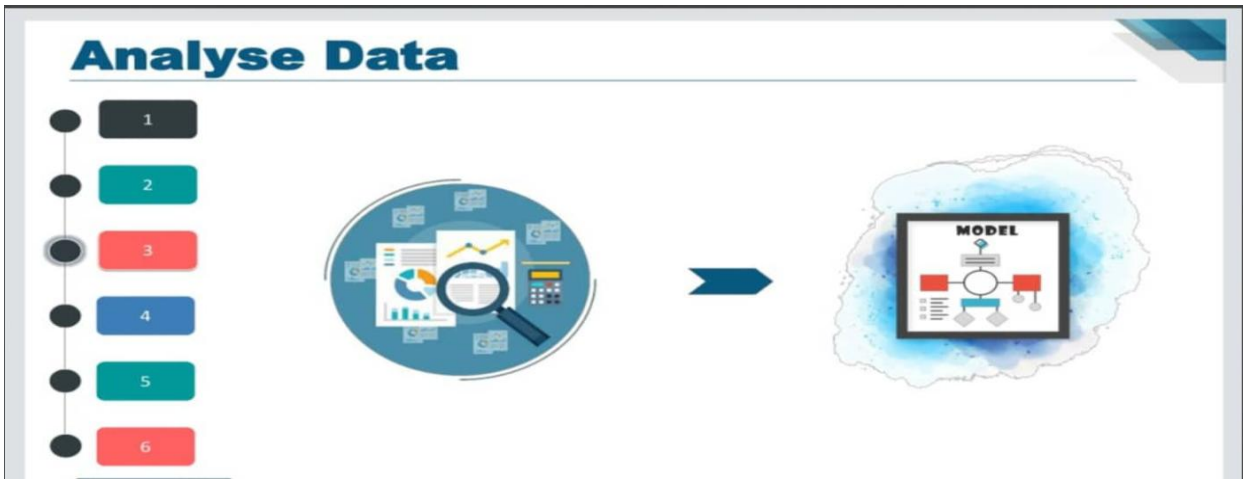
Step 2

Clean and preprocess the collected data to make it suitable for training the machine learning model

This involves handing missing values removing duplicates, transforming data types, and addressing outliers.

Step 3

Explore and analyze the preprocessed data to gain insights and understand its characteristics. This involves statistical analysis, visualization, and other techniques to identify patterns, corrections and important features.

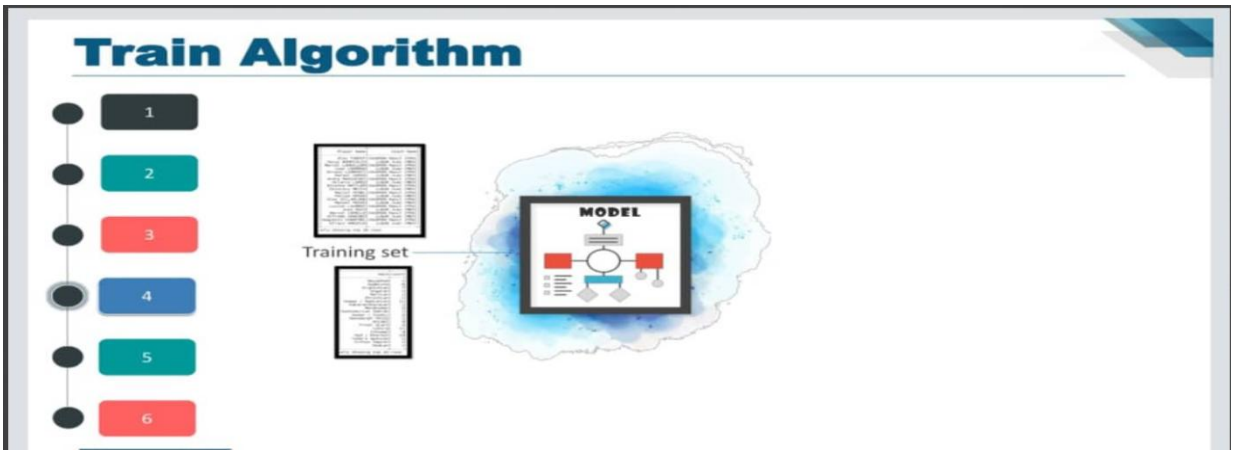


Step 4

Split the preprocessed data into two subsets:

Training data and Test data.

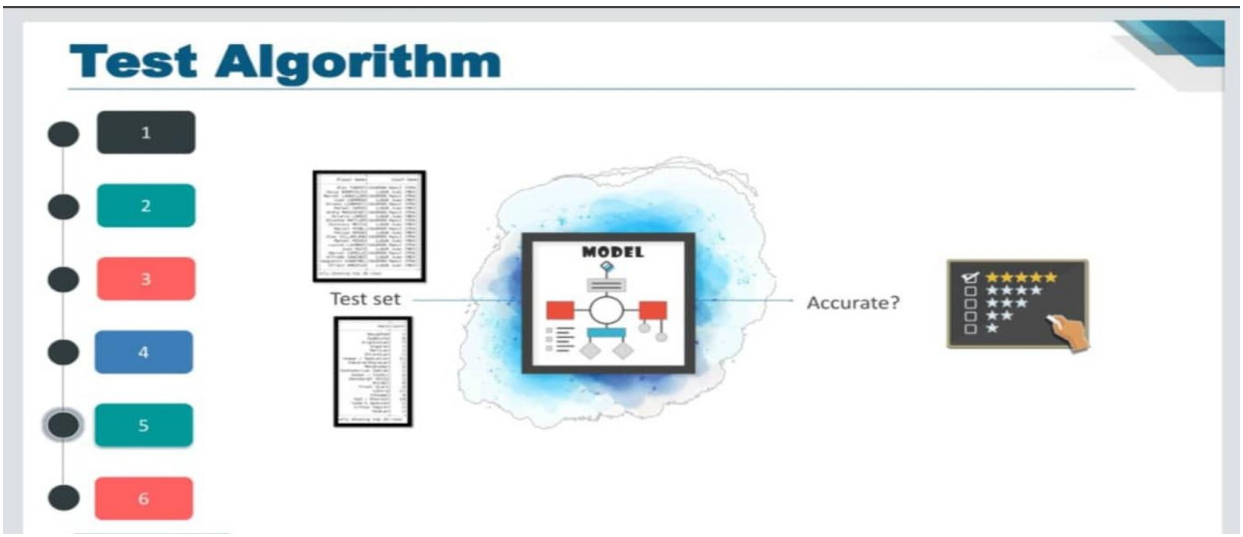
The training data is used to train the machine learning model

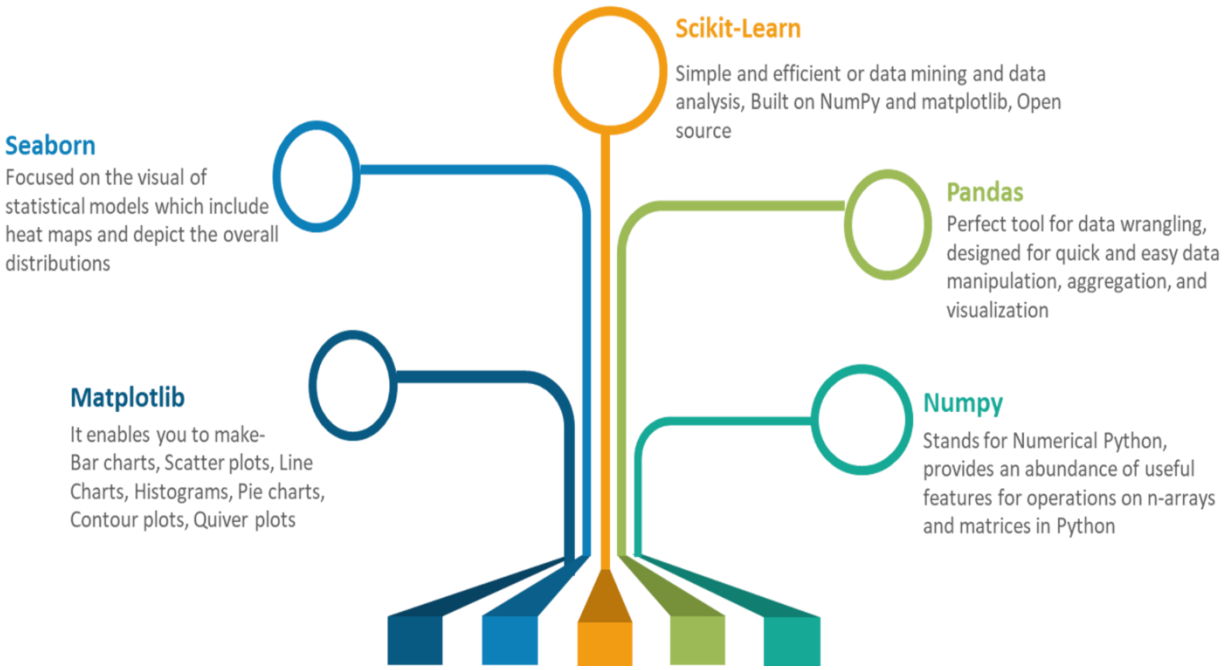


Step 5

The test data is used to evaluate its performance.

Typically, around 70-80% of the data is used for training and the remaining 20-30% is used for testing.




Scikit-Learn
Simple and efficient or data mining and data analysis, Built on NumPy and matplotlib, Open source
Seaborn
Focused on the visual of statistical models which include heat maps and depict the overall distributions
Pandas
Perfect tool for data wrangling, designed for quick and easy data manipulation, aggregation, and visualization
Matplotlib
It enables you to make- Bar charts, Scatter plots, Line Charts, Histograms, Pie charts, Contour plots, Quiver plots
Numpy
Stands for Numerical Python, provides an abundance of useful features for operations on n-arrays and matrices in Python