

WEEK 2: MACHINE LEARNING CONCEPTS

DAY 7 (01/07/2025)

Types of Machine Learning:

Machine Learning (ML) is a way for computers to learn patterns from data without being explicitly programmed. Depending on how the learning happens and the type of data used, ML is divided into **three main types**:

1. Supervised Learning

Mechanism: The algorithm learns from **labeled data** — that is, each input comes with a correct output. The model finds patterns in the input (X) that map to the known output (Y).

Analogy: Think of a child learning to read flashcards. If the card has a picture of an apple with the word “apple” written on it, the child learns to recognize and connect the image to its correct name.

Example: We feed a model images of cats labeled ‘Cat’ and images of dogs labeled ‘Dog.’ The model identifies patterns in the images (like shapes, colors, fur patterns) to correctly classify new images as Cat or Dog.

2. Unsupervised Learning

Mechanism: The algorithm learns from **unlabeled data**. It must discover patterns, structures, or groupings on its own.

Analogy: Giving a child a pile of mixed toys (cars, blocks, dolls) without telling them what to do. The child groups them based on similarities, like color, shape, or size.

Example: Feeding a model image of apples and mangoes without labels. The model might group them into “Group 1” (apples) and “Group 2” (mangoes) based on similarities.

3. Reinforcement Learning

Mechanism: The model, called an **Agent**, interacts with an **Environment** and learns by taking **Actions** that maximize cumulative **Reward** over time.

Example: A computer program learning to play chess. The chessboard is the environment, the moves are actions, and winning or gaining positional advantage is the reward. The agent learns through trial and error which moves lead to higher rewards.

Types of Tasks in Supervised and Unsupervised Learning:

After understanding the learning types, it is important to know the kinds of tasks each can perform.

Types of Supervised Learning Tasks

1. Classification

- **Goal:** Predict a **class or category**.
- **Output:** A discrete label.
- **Examples:**
 - Image recognition: Cat or Dog
 - Email detection: Spam or Not Spam
 - Customer prediction: Will Buy or Not Buy

2. Regression

- **Goal:** Predict a **continuous value**.
- **Output:** A number within a range.
- **Examples:**
 - Predicting house prices
 - Estimating rainfall in centimeters
 - Predicting a patient's blood pressure

Key Difference: Classification predicts **categories**, regression predicts **numerical values**.

Types of Unsupervised Learning Tasks

1. Clustering

- **Goal:** Group similar data points without labels.
- **Mechanism:** Algorithms like K-Means iteratively find cluster centers and assign points to the nearest center.
- **Example:** A telecom company groups customers based on call time and internet usage to offer personalized plans.

2. Association

- **Goal:** Find relationships or rules between items in a dataset.
- **Example:** Market basket analysis in retail: “Customers who buy bread and butter are 70% likely to also buy milk.” This helps companies decide how to place products in stores.

Key Difference: Clustering groups similar data points, while association finds rules or relationships between items.

Learning Type	Task	Goal	Examples
Supervised	Classification	Predict a category/label	Cat vs Dog images, Spam email detection, Buy/Not Buy predictions
	Regression	Predict a continuous number/value	House prices, Rainfall, Blood pressure
Unsupervised	Clustering	Group similar data points	Customer segmentation by usage patterns
	Association	Find relationships/rules between items	Market basket analysis: Bread + Butter → Milk