

MACHINE LEARNING

AN INTRODUCTION

Artificial Intelligence

AI involves techniques that equip computers to emulate human behavior, enabling them to learn, make decisions, recognize patterns, and solve complex problems in a manner akin to human intelligence.

Machine Learning

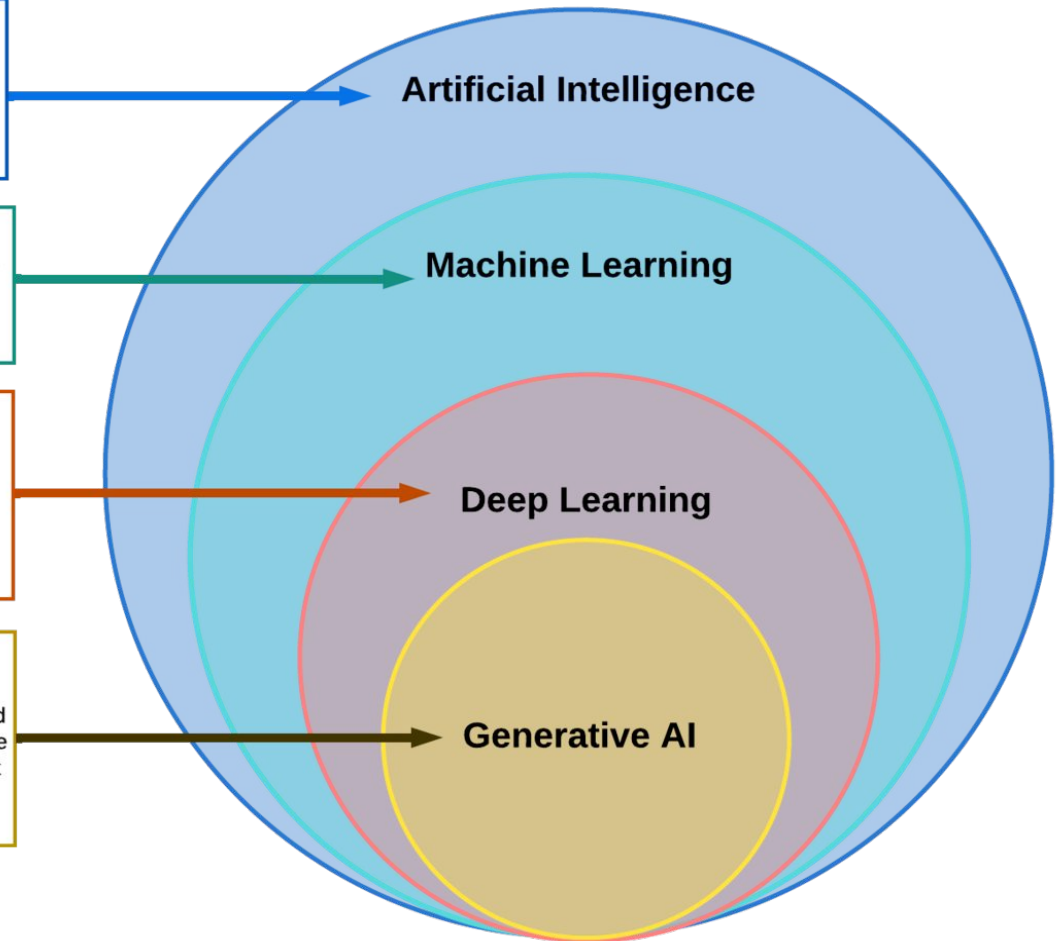
ML is a subset of AI, uses advanced algorithms to detect patterns in large data sets, allowing machines to learn and adapt. ML algorithms use supervised or unsupervised learning methods.

Deep Learning

DL is a subset of ML which uses neural networks for in-depth data processing and analytical tasks. DL leverages multiple layers of artificial neural networks to extract high-level features from raw input data, simulating the way human brains perceive and understand the world.

Generative AI

Generative AI is a subset of DL models that generates content like text, images, or code based on provided input. Trained on vast data sets, these models detect patterns and create outputs without explicit instruction, using a mix of supervised and unsupervised learning.



MACHINE LEARNING

Traditional Programming



Machine Learning



Features or Attributes

Categorical


Numerical

Binary

Categorical

Dish Name	Spice Level (1-10)	Cooking Time (minutes)	Contains Coconut?	Main Protein
Chettinad Chicken Curry	8	45	No	Chicken
Sambar	5	30	Yes	Lentils
Rasam	4	20	No	Tomato
Avial	2	25	Yes	Mixed Vegetables
Meen Kuzhambu	7	35	Yes	Fish
Pongal	4	40	No	Rice

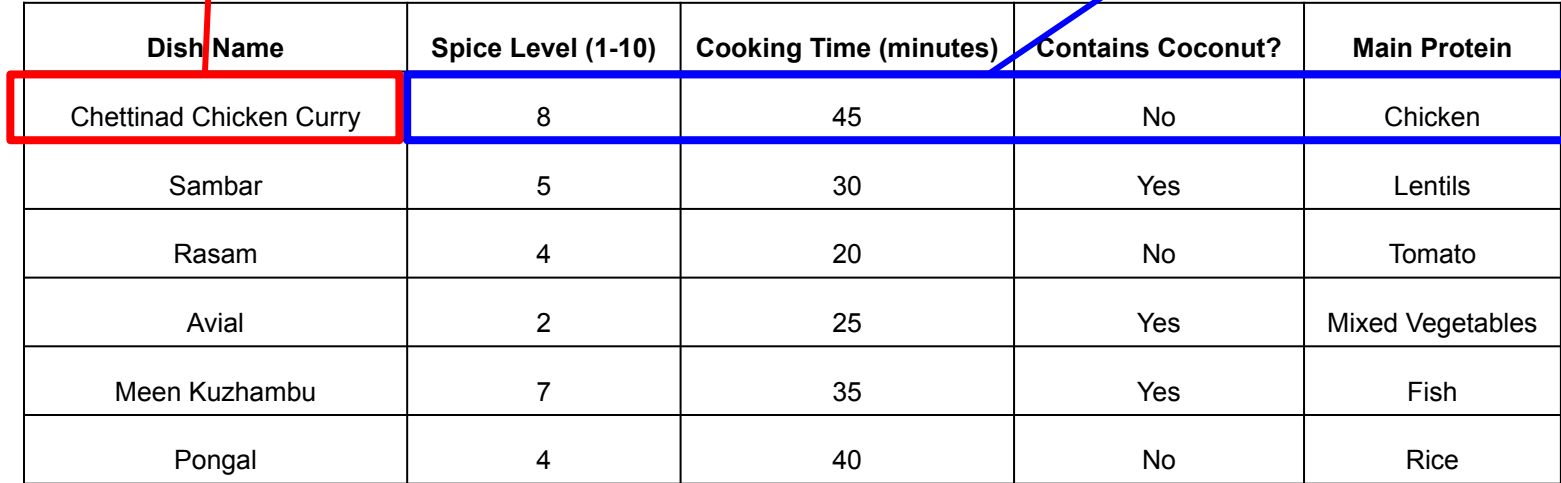
Instance



Dish Name	Spice Level (1-10)	Cooking Time (minutes)	Contains Coconut?	Main Protein
Chettinad Chicken Curry	8	45	No	Chicken
Sambar	5	30	Yes	Lentils
Rasam	4	20	No	Tomato
Avial	2	25	Yes	Mixed Vegetables
Meen Kuzhambu	7	35	Yes	Fish
Pongal	4	40	No	Rice

Label or Target Variable

Feature Vector

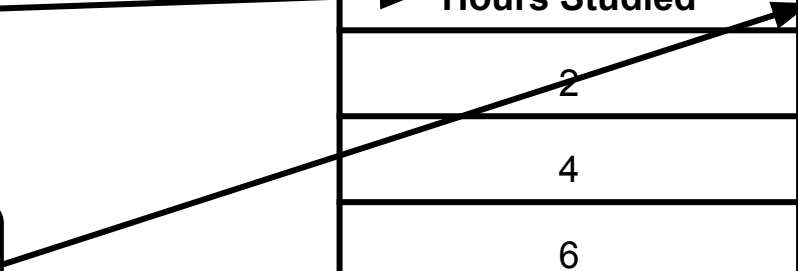


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Features (Input)

Target (Output)

Hours Studied	Final Exam Score
2	65
4	75
6	85
8	95



Features (Input)

Target (Output)

Hours Studied	Final Exam Score
2	65
4	75
6	85
8	95

Model

$$Y = mx + b$$

Features (Input)

Target (Output)

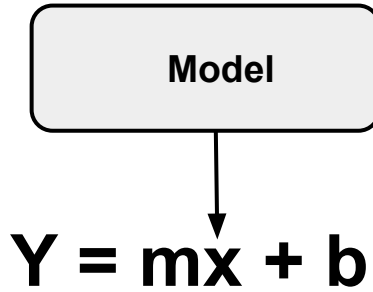
Hours Studied	Final Exam Score
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Model

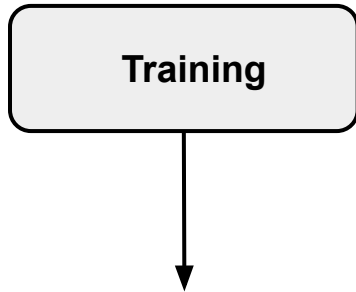
$$Y = mx + b$$

Parameters

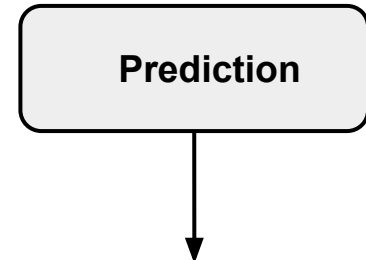
m (slope) and b (y-intercept)



Hours Studied	Final Exam Score
2	65
4	75
6	85
8	95



The process of finding the best m and b



Final Exam Score = $7.5 * (\text{Hours Studied}) + 50$

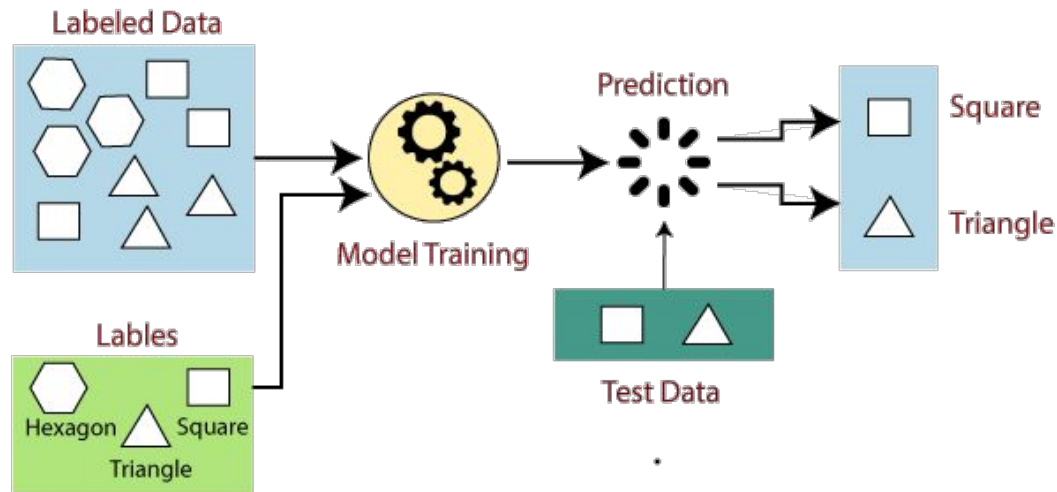
Final Exam Score = $7.5 * 5 + 50 = 87.5$

Types:

- Supervised Learning
- Unsupervised Learning
- Reinforcement Learning

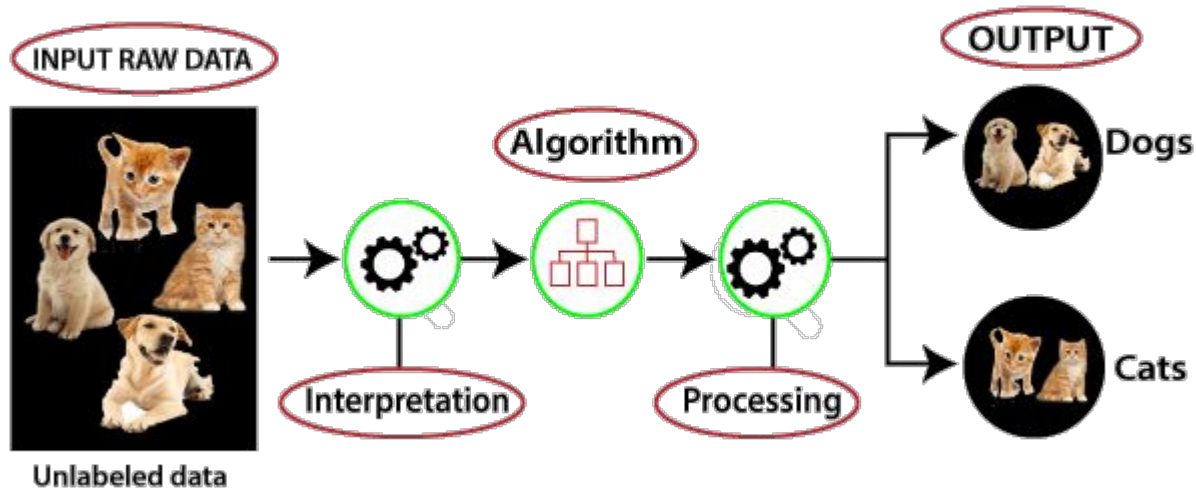
Supervised Learning

Given: training data + desired outputs (labels)



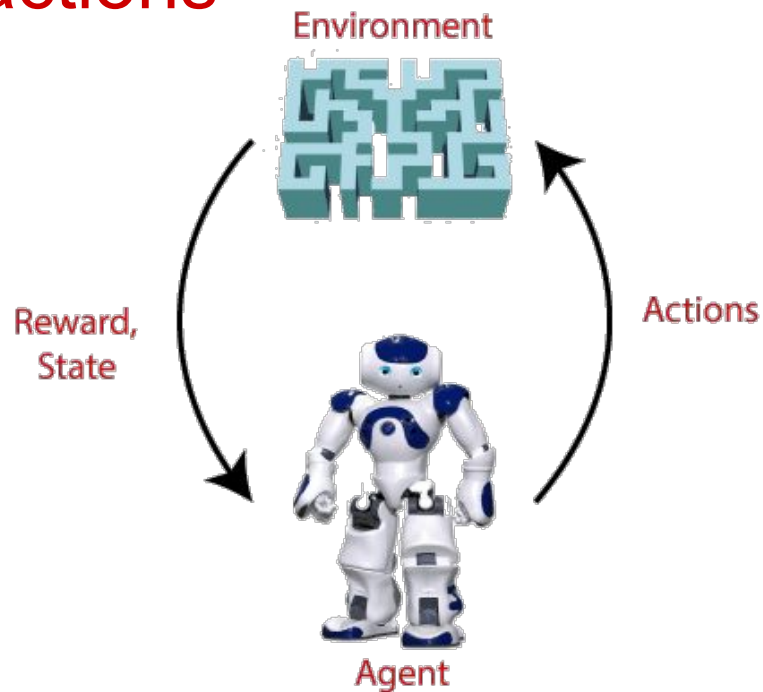
Unsupervised Learning

Given: training data (without desired outputs)

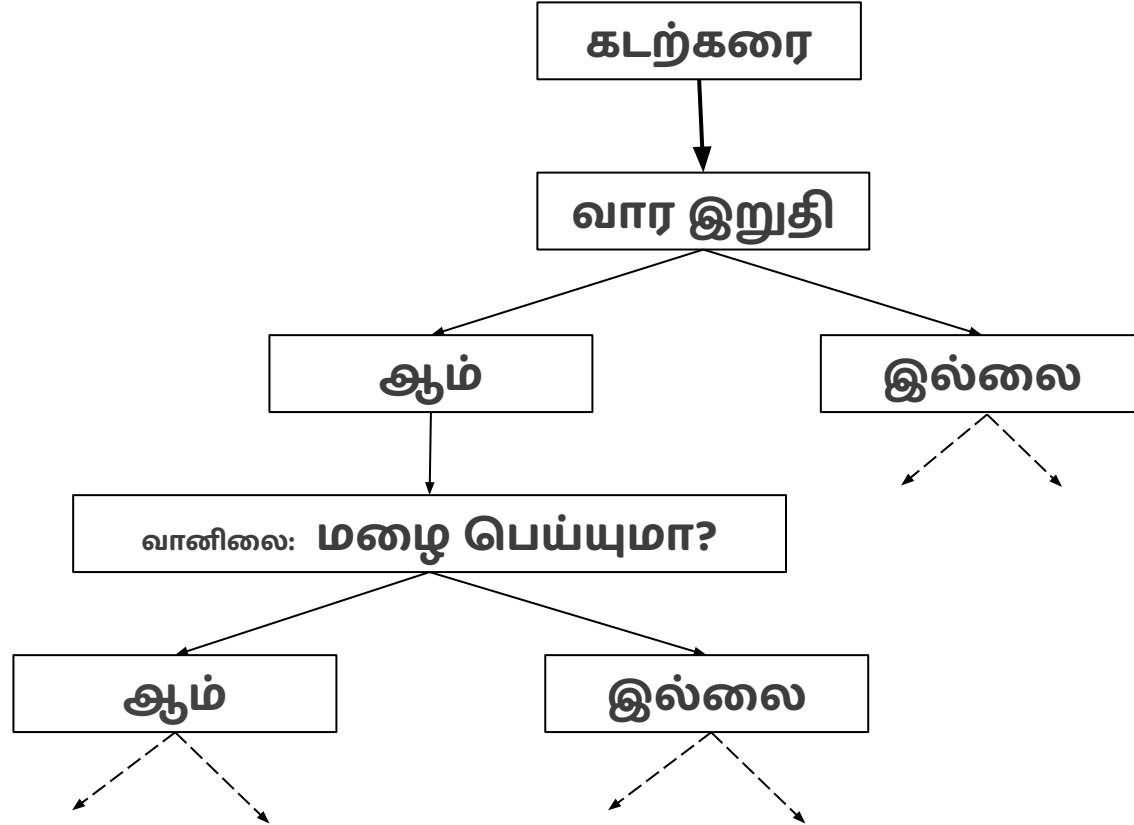


Reinforcement learning

Rewards from sequence of actions



Decision Tree



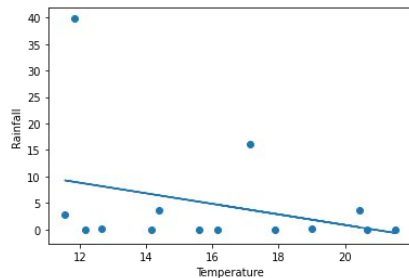
Supervised Learning - Linear Regression

Supervised Learning

Regression

Classification

Predicts Numeric Values



Binary



Multiclass



Linear Regression

Independent Variable

$$Y = mx + b$$

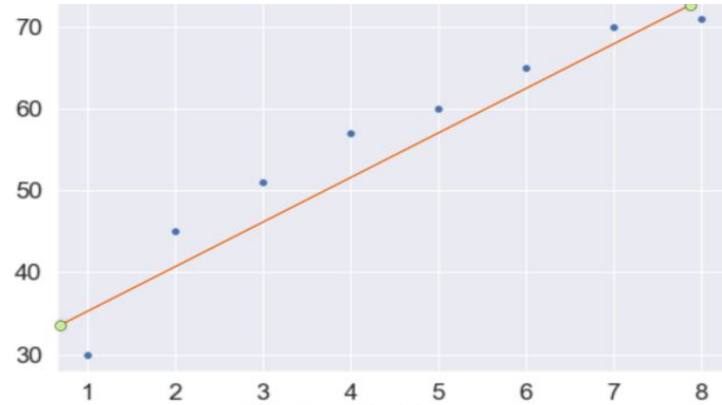
Dependent Variable

Short History - Linear Regression

Carl Friedrich Gauss - Form of Linear Algebra

Gauss used the least squares method to guess when and where the asteroid Ceres would appear in the night sky.

No. of Butterflies (x)	Percent of Hunts (y)
1	30
2	45
3	51
4	57
5	60
6	65
7	70
8	71
36	449



$$Y = mx + b$$

$$m = \frac{n(\sum xy) - (\sum x)(\sum y)}{n(\sum x^2) - (\sum x)^2}$$

$$b = \frac{\sum y - m(\sum x)}{n}$$

No. of Butterflies (x)	Percent of Hunts (y)	xy	x ²	y ²
1	30	30	1	900
2	45	90	4	2025
3	51	153	9	2601
4	57	228	16	3249
5	60	300	25	3600
6	65	390	36	4225
7	70	490	49	4900
8	71	568	64	5041
36	449	2249	204	26541

$$m = \frac{n(\sum xy) - (\sum x)(\sum y)}{n(\sum x^2) - (\sum x)^2} \quad b = \frac{\sum y - m(\sum x)}{n}$$

$$m = \frac{8(2249) - (36)(449)}{8(204) - (36)^2} \quad b = \frac{449 - 5.4405(36)}{8}$$

$$m = 5.4405 \quad b = 31.6429$$

$$y = mx + b$$

$$y = 5.4405x + 31.6429$$