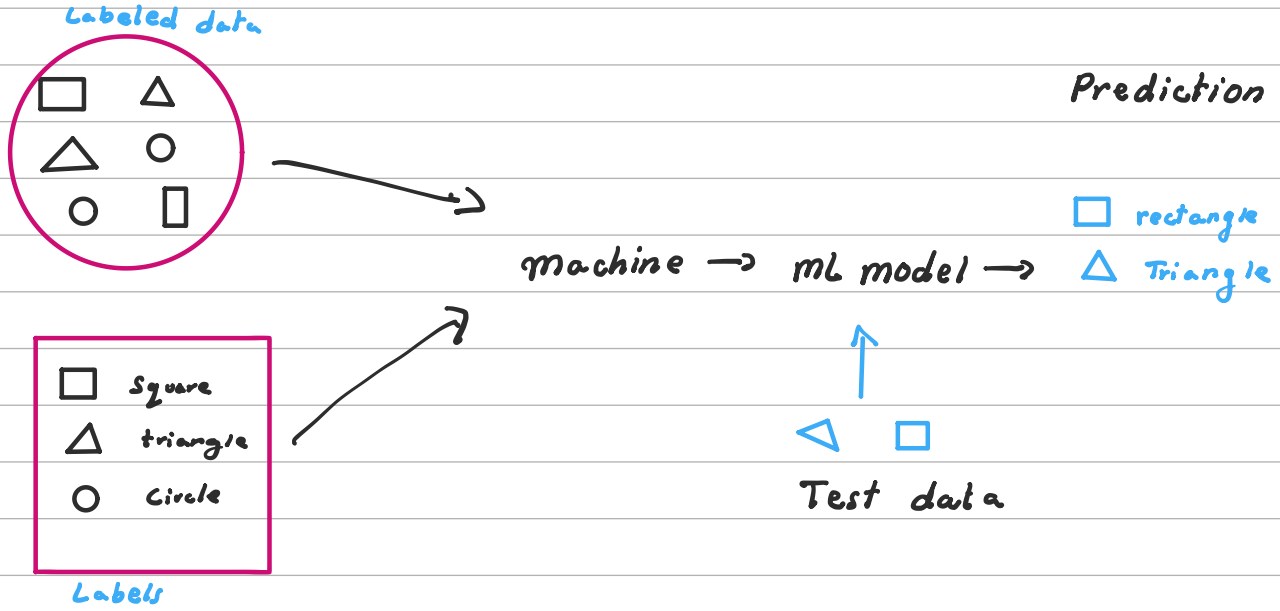
What is machine Learning ?

It is a process of training, a piece of software called model to make useful predictions or generate information using data

Types of ML systems :

Supervised Learning
UnSupervised Learning
Reinforcement Learning
Generative AI

Supervised Learning - a category of ML which uses labelled dataset to train algorithm to predict outcomes and recognize patterns.



Classification of supervised learning:

① Regression

② Classification → Binary Classification
→ Multi Class Classification
} Predicts categories

1) Regression : Predicts a number value

ex : amount of Rainfall - 3.6 mt

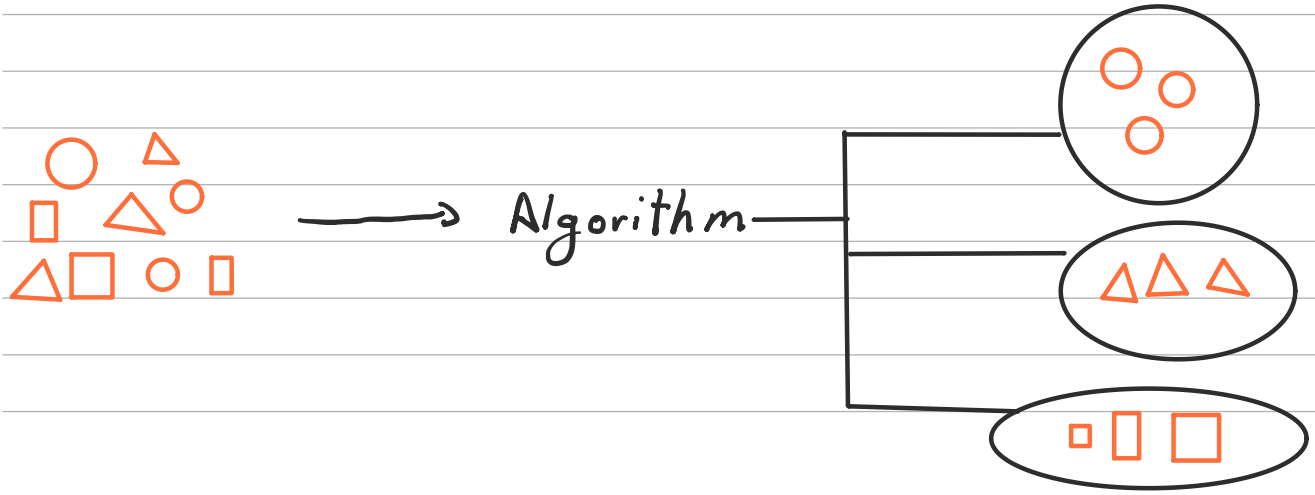
a) Binary Classification : Which classifies the output in two values.

Rain , no Rain

b) MultiClass Classification : Which contains more than two value.

rain, hail, snow, sleet.

UnSupervised Learning models are trained using unlabeled dataset.



Unsupervised Learnings goal is to identify meaningful patterns among the data

Unsupervised Learnings → Clustering
Unsupervised Learnings → Association

Clustering : grouping object into clusters with similarties
→ used in google news, DNA microarray

Association : grouping by finding the relationship b/w the variables

Reinforcement Learning : It makes prediction by getting reward or penalties based on the action performed.

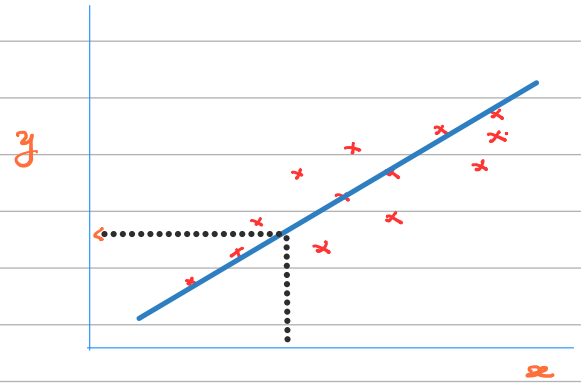
ex : Used for training robots to perform task.

Generative AI : model which creates content from user Input.

Simple Linear Regression

- Supervised Learning
- predict continuous numerical value
- finds best fitting straight line relation btw input and output

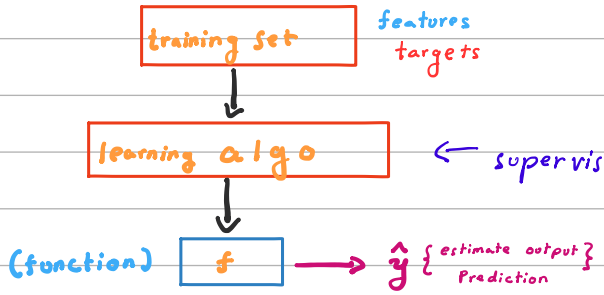
- used for a simple way to understand relationships and make prediction



x = "input" value
y = "output" value

$(x^{(i)}, y^{(i)})$ = i^{th} training example.

$(x^{(i)}, y^{(i)}) = (812, 120)$



← supervised Learning Algorithm

$f_{w,b}(x) = wx + b$

$f(x) = wx + b$

input feature

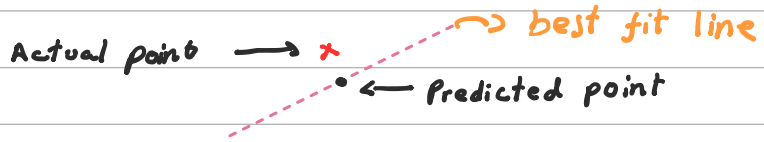
$f(x) = wx + b$ ← bias or intercept

weight or coefficient

Inputs represents the features
Output represents the target

The linear regression algo learns from the data to generate best fit line

Residual Error: Diffrence btw actual point and predicted point

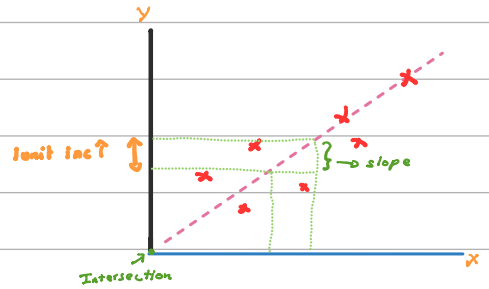


Aim: To find best fit line with minimal error

$$\hat{y} = mx + c$$

m = slope or coiffficient

c = Interception



Interception When the value of x is zero where is the best fit line intersecting y

$$h_\theta(x) = \theta_0 + \theta_1 x \longrightarrow \text{coefficient}$$

θ_0 ↓ intecept

Cost function formula

$$\sum_{i=1}^{m} \frac{1}{2m} \left(h_\theta(x)^{(i)} - y^{(i)} \right)^2$$

$$J(\theta_0, \theta_1) = \frac{1}{2m} \sum_{i=1}^{m} \left(h_\theta(x)^{(i)} - y^{(i)} \right)^2 \downarrow\downarrow\downarrow$$

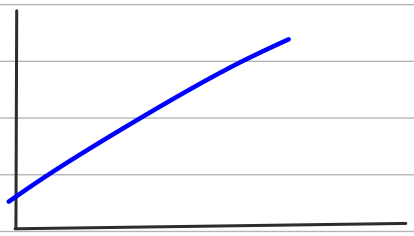
↳ squared Error Function

model :

$$f_{w,b}(x) = wx + b$$

parameters :

w, b



cost function :

$$J(w,b) = \frac{1}{2m} \sum_{i=1}^{m} (f_{w,b}(x^{(i)}) - y^{(i)})^2$$

$f_{w,b}(x^{(i)})$: Predicted Value

$y^{(i)}$: actual value

goal :

minimize $J(w,b)$
w,b

Types of Linear Regression

LR

- Simple LR
- Multiple LR
- Polynomial LR

x_1	x_2	x_3	y_1
CGPA	gen	grade	lpa

$y = mx + b$

$y = m x_1 + n x_2 + b$

$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2$

$y = \beta_0 + \beta_1 x_1 \dots + \beta_n x_n$

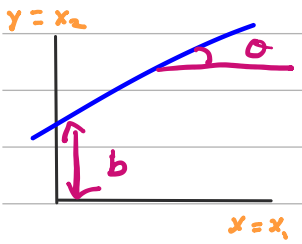
$$\boxed{y = \beta_0 + \sum_{i=1}^{n} \beta_i x_i}$$

Hyperplane

The line formed in 3D, 4D or ND is known as hyperplane

Equation of Hyperplane

2D



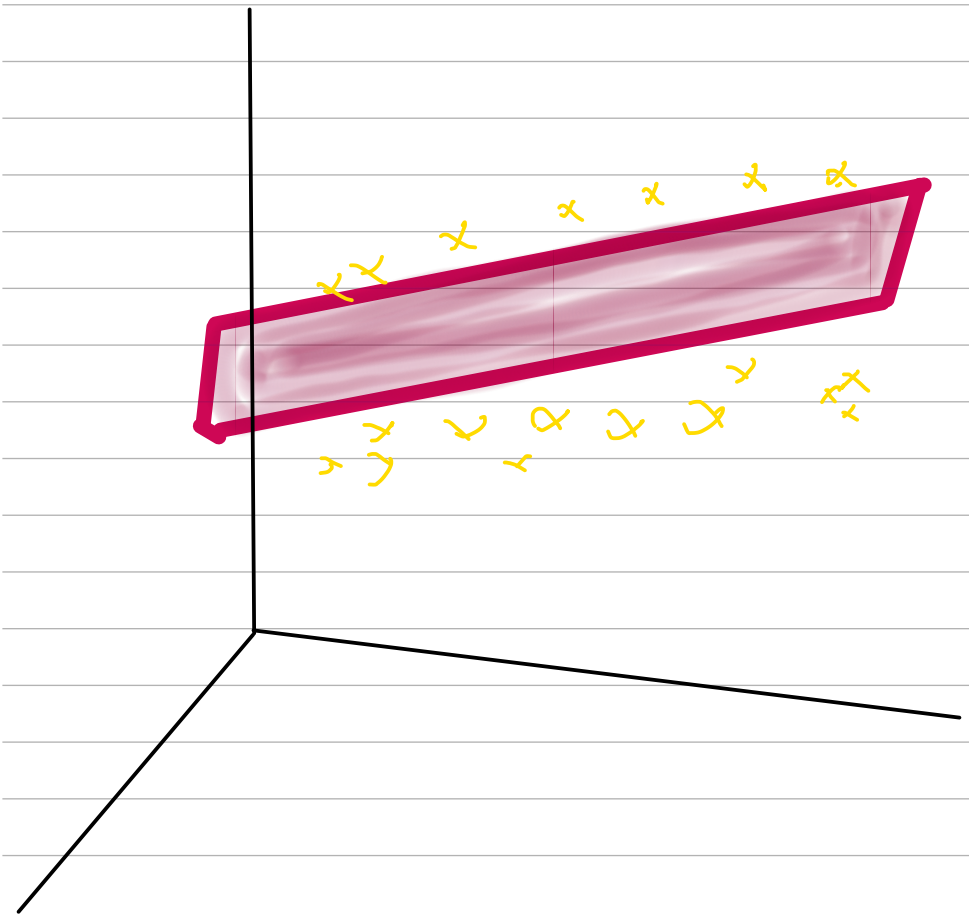
$$Y = mx + b$$

$$ax + by + c = 0$$

$$a x_1 + b x_2 + c = 0$$

$$w_1 x_1 + w_2 x_2 + w_0 = 0$$

$$w_1 x_1 + w_2 x_2 + \ldots + w_n x_n + w_0 = 0$$



Labels: A label is things which we predict
- y variable in simple linear Regression

ex: future price of wheat
animal in the picture.

Features: It is the input variable - X

- It may have single features or could use millions of features.

$x_1, x_2, \ldots x_n$

A Labeled example can have both features and the lable

A unlabled example contains only features but not labels

Models:

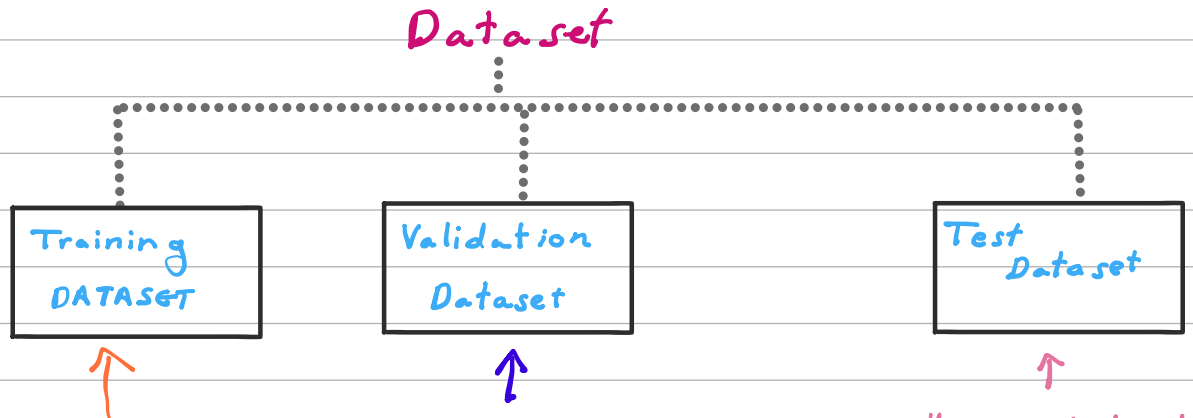
A model defines relation b/w Lable & features

Two phases of model's life.

Training: means creating a learning to the model show the labeled dataset for the model to learn

Inference: Applying the trained model to unlabeled example

Train, Validation, Test



We will train Our models

Hyper Tuning of the model
(By changing parameters of the model can we get more accuracy or not)
Tweaking the parameters

Model will be tested using test dataset

Books
Q & A
Train

Different Books
Hyper Parameter Tuning

Exam
Test
85 %

Accuracy score

① Model Performance – Accuracy ↑↑ → High

② overfitting , Underfitting

③ Bias Vs Variance

overfitting , Underfitting

Low Bias
High Varience

Train → Model is Trained → Accuracy ↑↑ → 95%

Test → Model is Tested → Accuracy ↓↓ → 65%

} overfitting

When the train data has high accuracy but when the new data is checked the accuracy is low. Overfitting is a worst condition.

Train → Model is Trained → Accuracy ↓↓ → 59%

Test → Model is Tested → Accuracy ↓↓ → 50%

} underfitting
↓
High Bias
High Varience

When the data is not trained properly and when the new test data is given its accuray is low

Generalized model :

Train → Accuracy ↑↑ Low Bias

Test → Accuracy ↑↑ Low Varience

Bias vs Variance

Bias {
- Training Accuracy high ↑↑ = Low Bias
- Training Accuracy Low ↓↓ = high Bias

Training Accuracy ∝ Bias

Variance {
- Test Accuracy high ↑↑ = Low Varience
- Test Accuracy Low ↓↓ = high Varience

Test Accuracy ∝ Varience

Defination

Bias : The inability for machine learning method to capture the true relationship is known as bias

Variance : The diffrence in fits between data sets is called varience