Machine Learning

MTE – 20
ETE – 40 } Practical / Implementation

PRS – 25

CWS – 15

→ Attendance : 5

>95 : 5
91–94 – 4
85–89 – 3
80–84 – 2
75–79 – 1
<75 → 0

→ Test : 2
Assignment : 1

Pre-requisite:

Probability

Differentiation

$\frac{\partial}{\partial x}(2) = 0$

$\frac{\partial (x^n)}{\partial x} = n x^{n-1}$

GG
GB
BB
BG

$\frac{1}{3}$

ML ?

Data → Patterns → External data

$\underbrace{\text{Data} \rightarrow \text{Patterns}}_{\text{Data Analytics}}$

Train Data

D
H
H
H
D

ht > 4ft → H
ht < 4ft → D

New Image

Testing Data

Why ?

- Data
- Computation
- Algorithm / Mathematical Model

ML

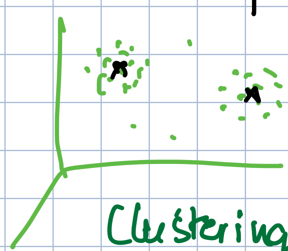
Supervised Learning

Unsupervised Learning

Reinforcement Learning

Input → label

→ Cat
→ Horse
→ Dog



Clustering

Semi-supervised

features x

ht color legs eye color

Cat → label y^1 → x^1

Dog → y^2 → x^2

Horse → y^3 → x^3

⋮

m data points

x^1_1 x^1_2 x^1_3 x^1_4 $\vdots$ x^m

Supervised Learning : $\{x^{(i)}, y^{(i)}\}_{i=1}^{m}$

$x^{(i)} = \{x^i_1, x^i_2 \ldots\ldots x^i_n\}$

x^i has n features

$x^i \in R^n$

$\boxed{x^i_j = \text{jth feature of ith example}}$

Features

Numerical (continuous)

Categorical

{Black, Brown, Green, Grey}

Label

Numerical (continuous)

house price prediction

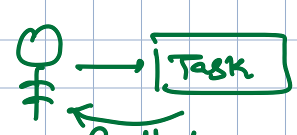
(Regression)

Categorical

{Cat, Dog, Horse}

(Classification)

Reinforcement



Reward
Punish

Environment Situation

LINEAR REGRESSION

Eg:

Training Data

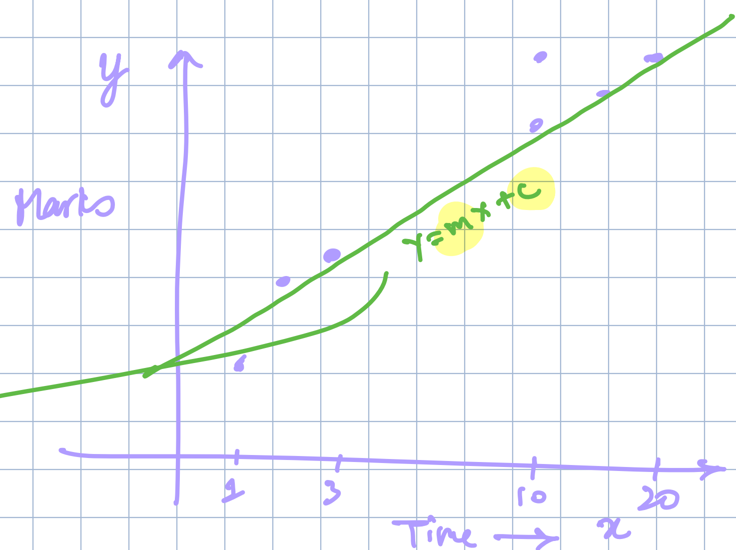
Time Spent (Feature)	Marks (Label)
1	4
3	7
10	8
20	10

$x^{(i)} \in R$

$y^{(i)} \in R$

$\rightarrow$ MODEL ?
(Pattern)

Q: 8hrs ? Score ? } Test Data



$y = mx + c$

$= m \cdot 8 + c$

Hypothesis $Y = \theta_1 x + \theta_0$

$$\theta = \begin{bmatrix} \theta_0 \\ \theta_1 \end{bmatrix}$$

$$h_\theta(x) = \theta_1 x + \theta_0$$

x_1	x_2	x_3	x_4
Hours	CGPA	Classes	Assignments

$$Y = \theta_1 x_1 + \theta_2 x_2 + \theta_3 x_3 + \theta_4 x_4 + \theta_0$$

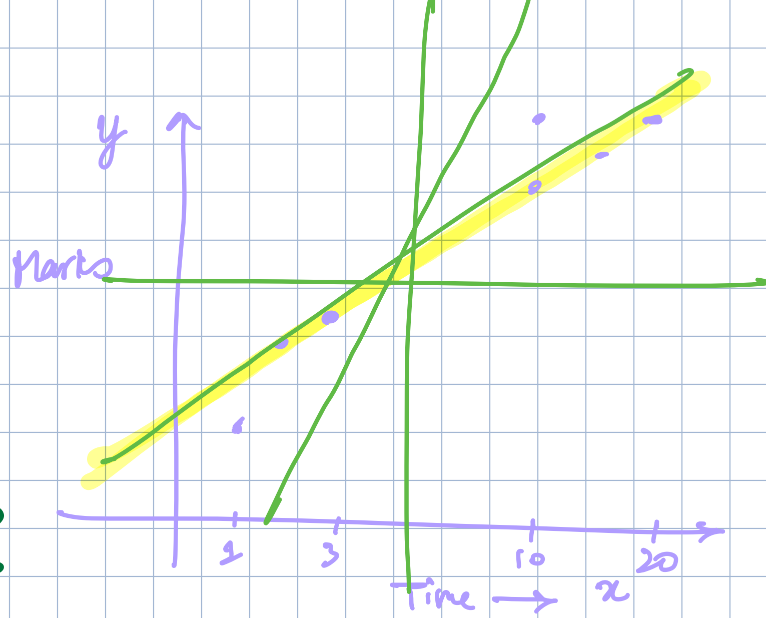
Aim:

To learn best line which fits through data points

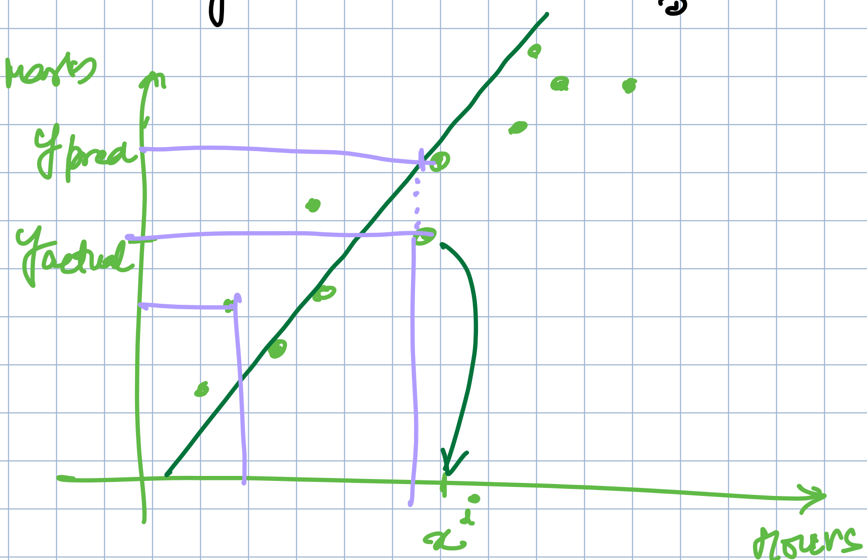
(a) Random value of θ start

(b) How good the line is ?

(c) θ change/update good performance



How good our θ is ?



$$\varepsilon^{(i)} = \left| y^{(i)}_{pred} - y^{(i)}_{actual} \right|$$

Error for ith example

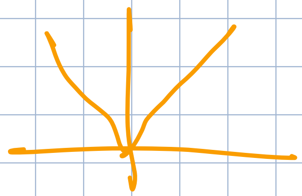
$$\text{Total Error for all points} = \sum_{i=1}^{m} \left| y^{(i)}_{pred} - y^{(i)}_{actual} \right|$$

$$\text{Total Error for all points} = \sum_{i=1}^{m} \left| \hat{y}^{(i)} - y^{(i)} \right|$$

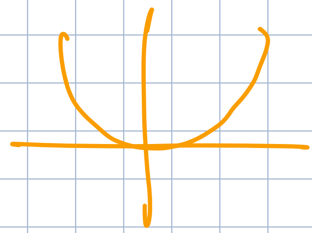
$$\text{Average Error} = \frac{1}{m} \sum_{i=1}^{m} \left| \hat{y}^{(i)} - y^{(i)} \right|$$

(Average Absolute Error)

$|x|$



x^2



Total Error for all points $= \sum_{i=1}^{m} \left[\hat{y}^{(i)} - y^{(i)}\right]^2$

Mean Squared Error (MSE) $= \frac{1}{m} \sum_{i=1}^{m} \left[\hat{y}^{(i)} - y^{(i)}\right]^2$

predicted

actual

Loss function

J

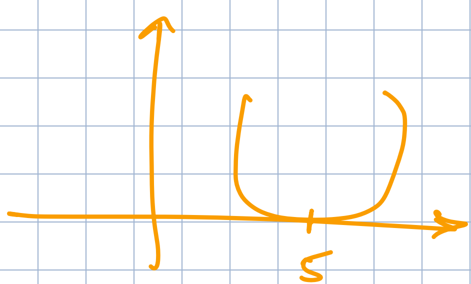
minimize

$$J(\theta) = \frac{1}{m} \sum_{i=1}^{m} \left[\theta_1 x^{(i)} + \theta_0 - y^{(i)}\right]^2$$

- make updation to your θ, so that it becomes a better θ

$y = (x-5)^2$

For what value of x y will be minimum?



$$\frac{dy}{dx} = \frac{\partial}{\partial x}(x-5)^2 = 2(x-5) = 0$$

$\underline{\underline{x = 5}}$

Gradient Descent