Machine Learning

MTE —20 ⎱ Practical /Implementation
ETE —40 ⎰

PRS — 25

CWS — 15
→ Attendance: 5

$>95 : 5$
$90-94 — 4$
$85-89 — 3$
$80-84 — 2$
$75-79 — 1$
$<75 → 0$

→ 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

$$\frac{1}{3}$$
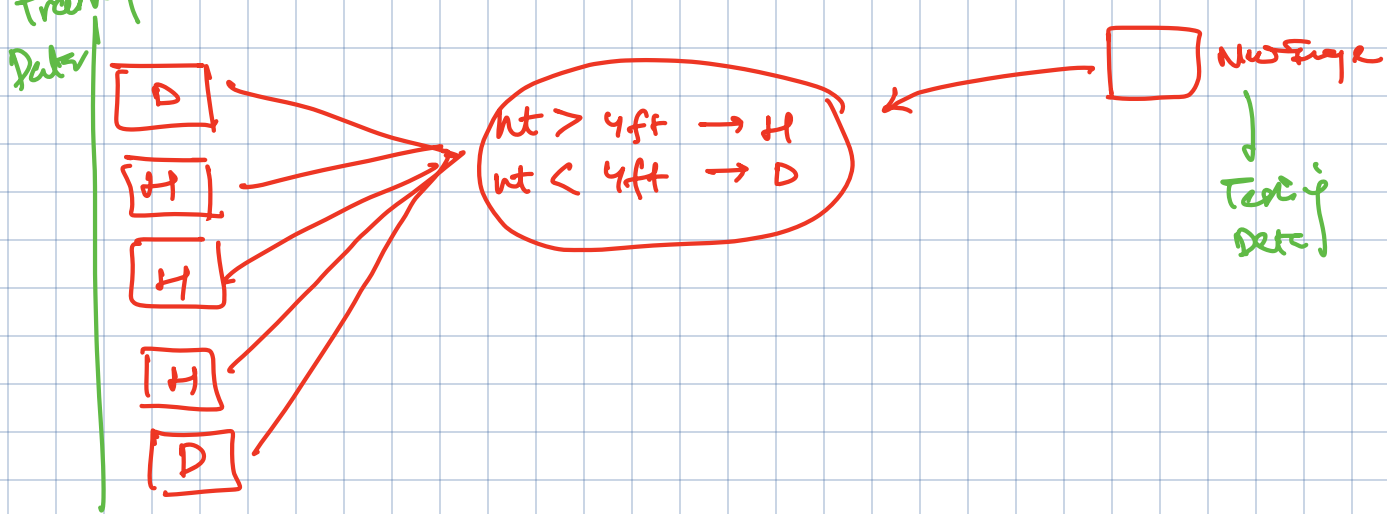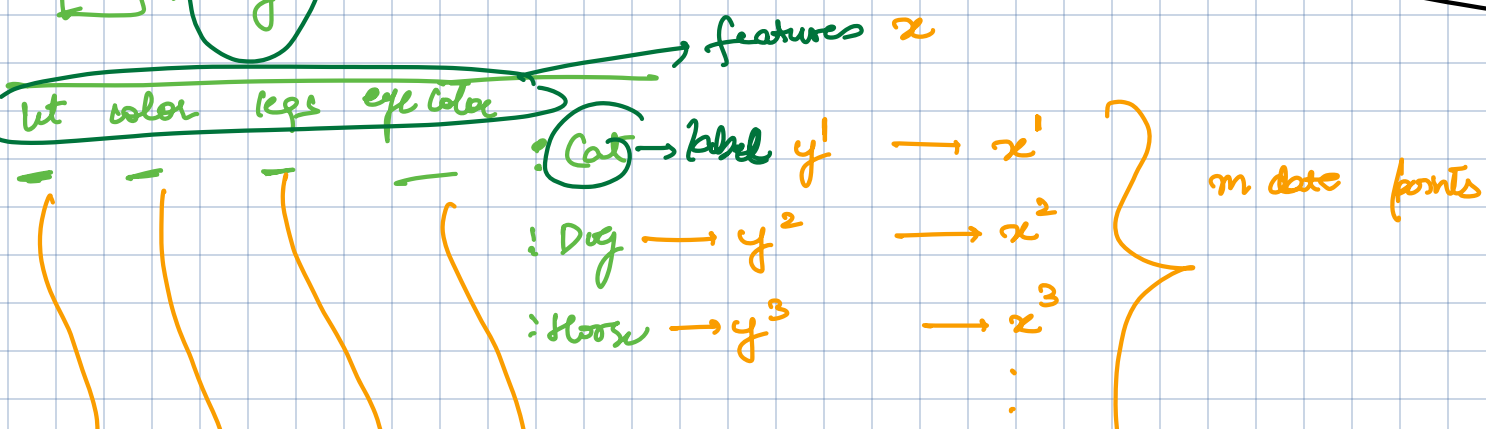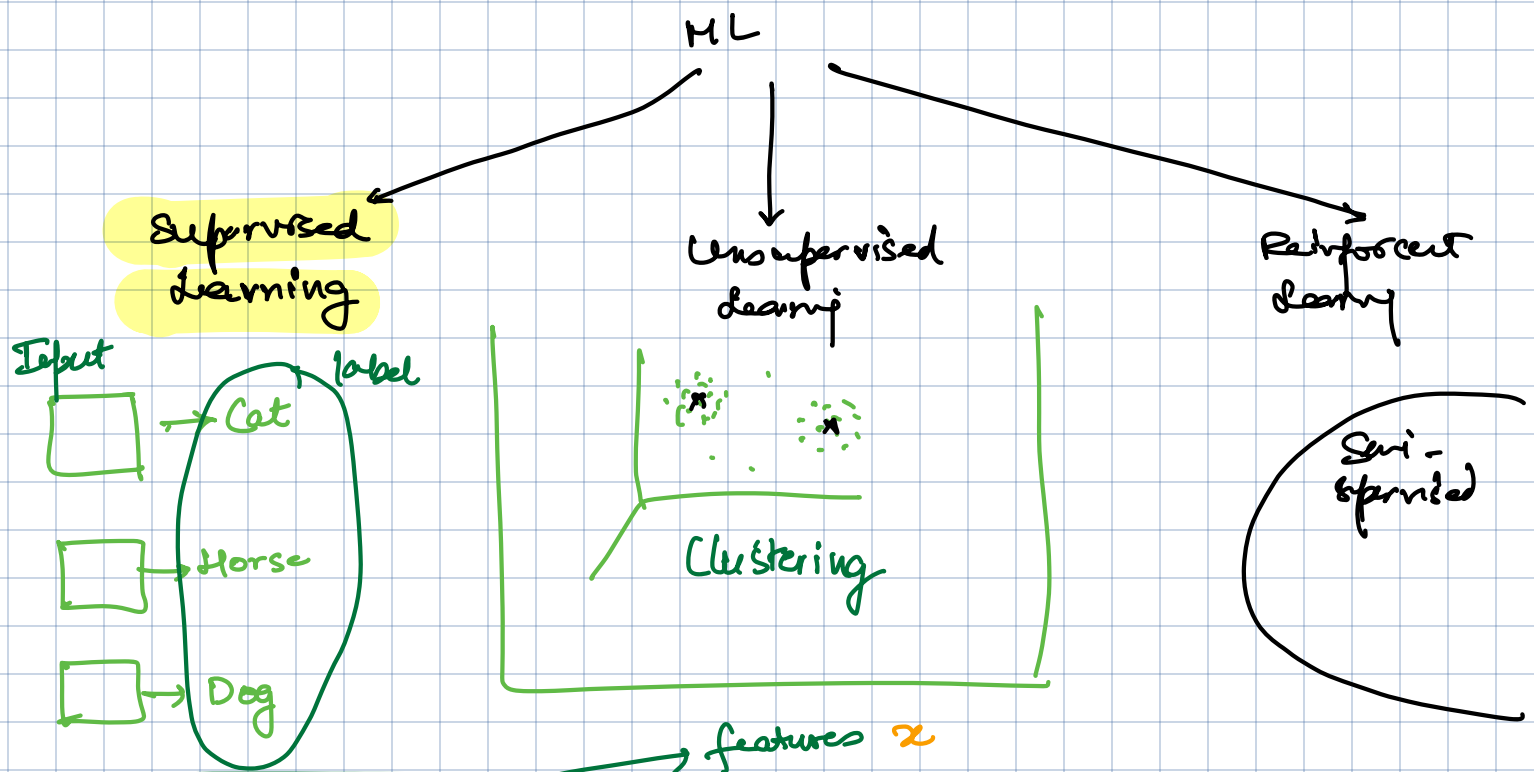
ML?

External Data
↓

Data ⟶ Patterns ⟶ ↓

Data Analysis

Train
Data

D
H
H
H
D

$ht > 4ft \rightarrow H$
$wt < 4ft \rightarrow D$

New Image

Testing
Data

Why ?

— Data

— Computations

— Algorithms / Mathematical Model

ML

Supervised Learning

Unsupervised Learning

Reinforcement Learning

Input → label

Cat

Horse

Dog

Clustering

Semi-supervised

wt	color	legs	eye color

→ features x

: Cat → label y^1 → x^1

: Dog → y^2 → x^2

: Horse → y^3 → x^3

m data points

$$x^i_1 \qquad x^i_2 \qquad x^i_3 \qquad x^i_4 \qquad \qquad x^m$$

$$\text{Supervised} \quad \{x^{(i)}, y^{(i)}\}^m_{i=1}$$
$$\text{Learning}:$$

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

$$\longrightarrow \quad x^i \text{ has } n \text{ features}$$

$$\checkmark \quad x^i \in R^n$$

$$\boxed{x^i_j = j\text{th feature of } i\text{th example}}$$

features
→ Numerical (continuous)
→ Categorical
$\{$Black, Brown, Green, Grey$\}$

Label
→ numerical (continuous)
house price prediction
==(Regression)==

→ Categorical
$\{$Cat, Dog, Horse$\}$
(Classification)

Reinforcement

Reward Push

Task

Feedback

Current Situation
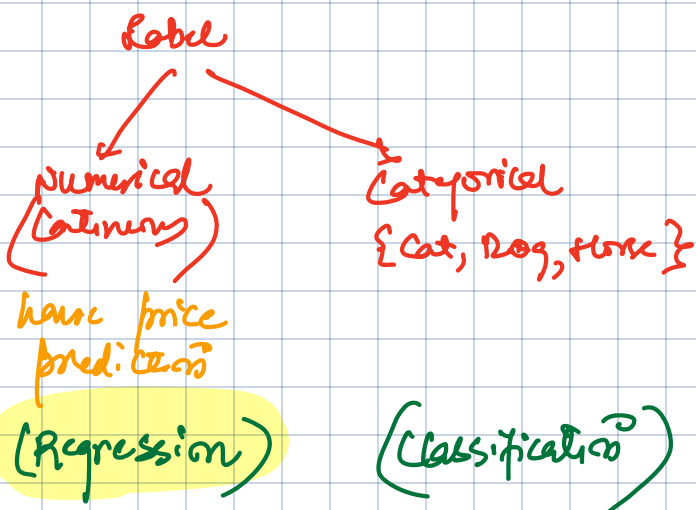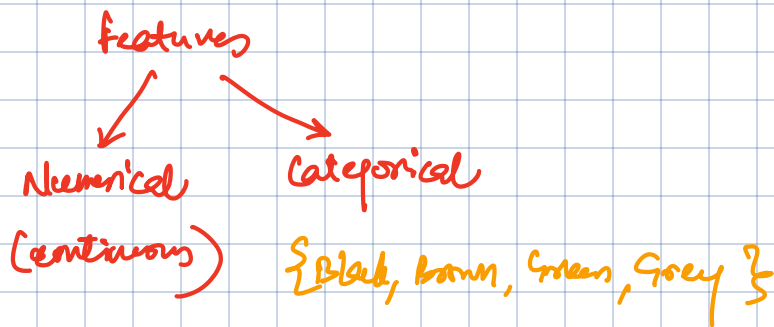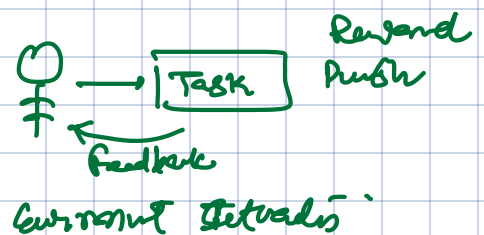
LINEAR REGRESSION

Eg:

	(feature) Time Spent	(label) Marks
Training Data	1	4
	3	7
	10	8
	20	10

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

$\longrightarrow \dfrac{MODEL}{(Pattern)}$?

Q: 8hrs ? $\dfrac{}{?}$ Score ? $\Big\}$ Test Data

$Y = mx + c$

$= m \cdot 8 + c$
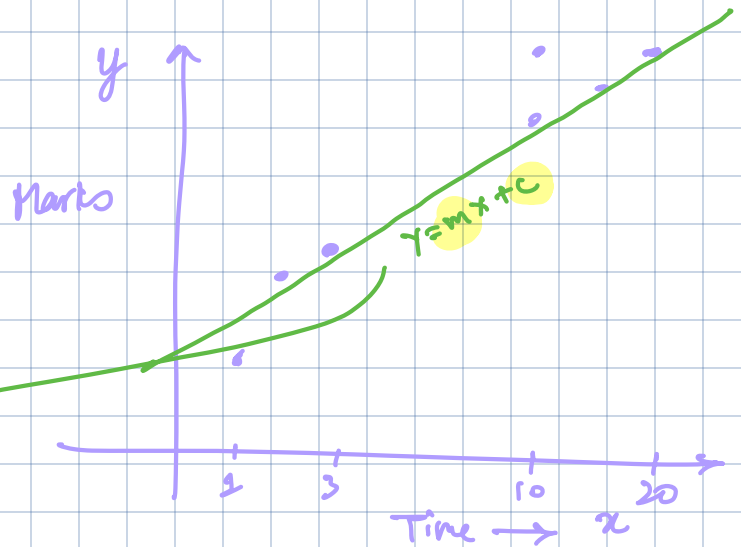
Hypotheses $Y = \theta_1 x + \theta_0$

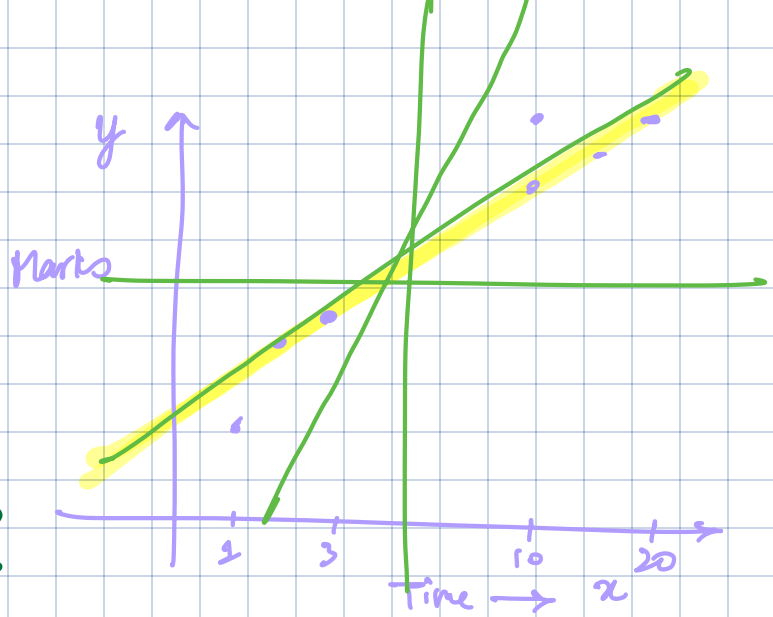$\theta = \begin{bmatrix} \theta_0 \\ \theta_1 \end{bmatrix}$

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

x_1	x_2	x_3	x_4
Hours	CGPA	Classes	Assign

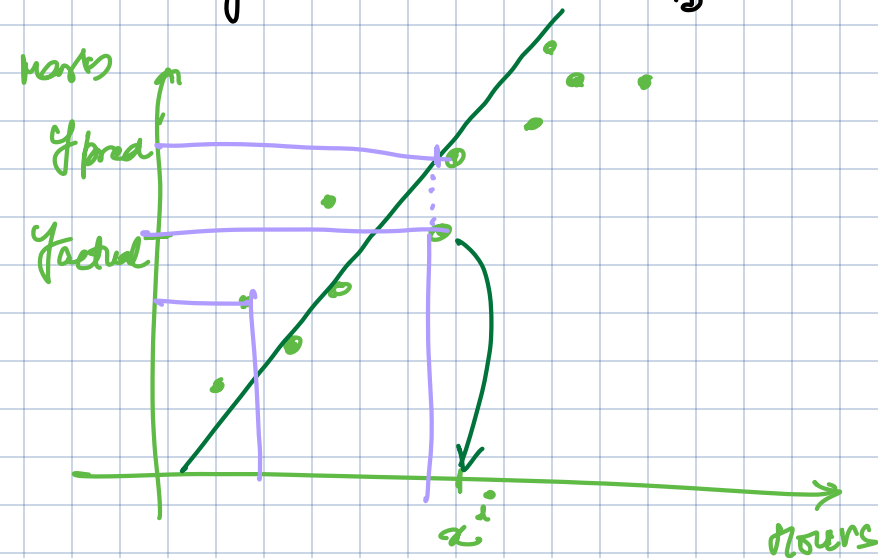$Y = \theta_1 x_1 + \theta_2 x_2 + \theta_3 x_3 + \theta_4 x_4 + \theta_0$

<u>Aim :-</u>

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

y

Marks

1   3   10   20

Time → x

How good our Θ is ?

marks

y pred

y actual

x^i

hours

$$\mathcal{E}^{(i)} = \left| y_{pred}^{(i)} - y_{actual}^{(i)} \right|$$

Error for
i th example

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

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

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

(Average Absolute Error)

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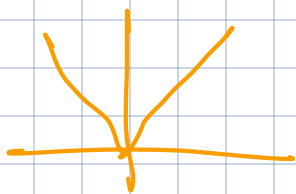
x^2
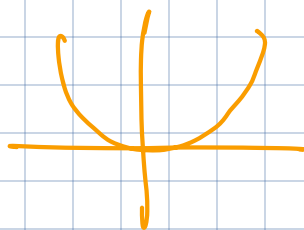
Total Error for all points $= \sum_{i=1}^{m} \left[\hat{y}^{(i)} - y^{(i)}\right]^2$

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

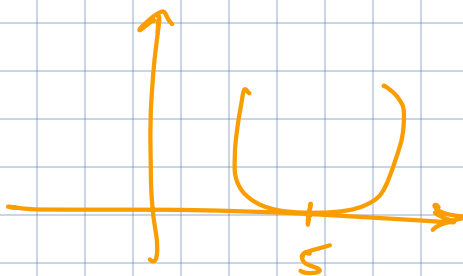predicted ↓   actual →

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?

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

$\underline{x=5}$

5

Gradient Descent