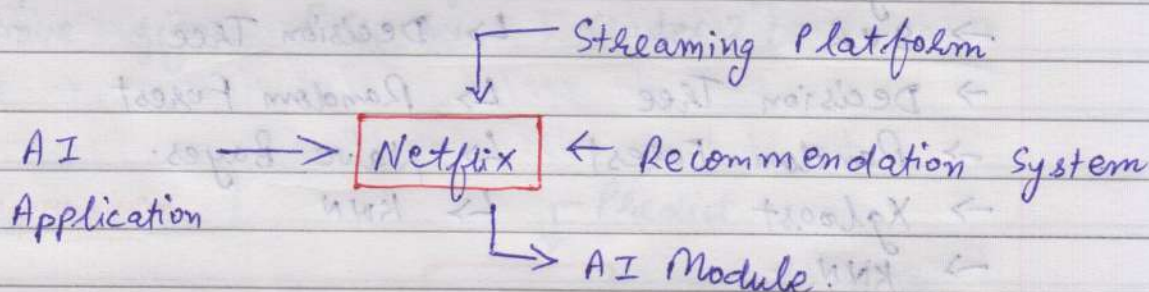


Introduction To Machine Learning:- 08/10/2022

Agenda:-

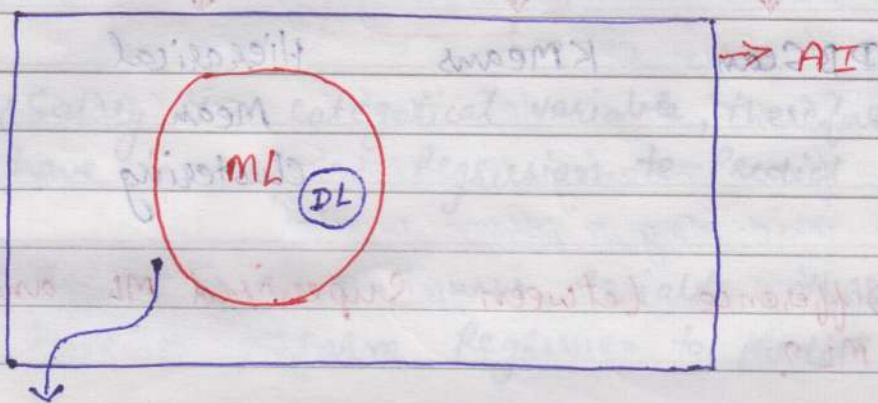
- ① Machine Learning Introduction
- ② AI VS ML VS DL VS DS
- ③ Simple Linear Regression \rightarrow Mathematical Intuition

\Rightarrow AI VS ML VS DL VS DS



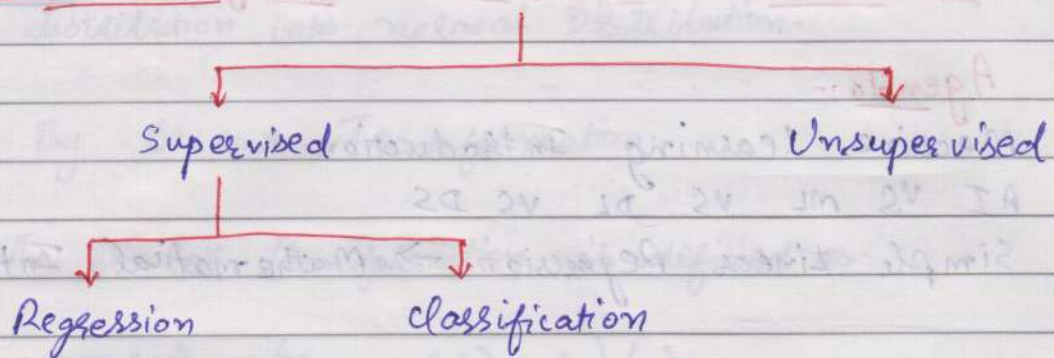
Artificial Intelligence:-

It is creating an application where it performs all its task without any human intervention.



Machine Learning provides stats tools to analyse, visualize, perform prediction and other task with the help of data.

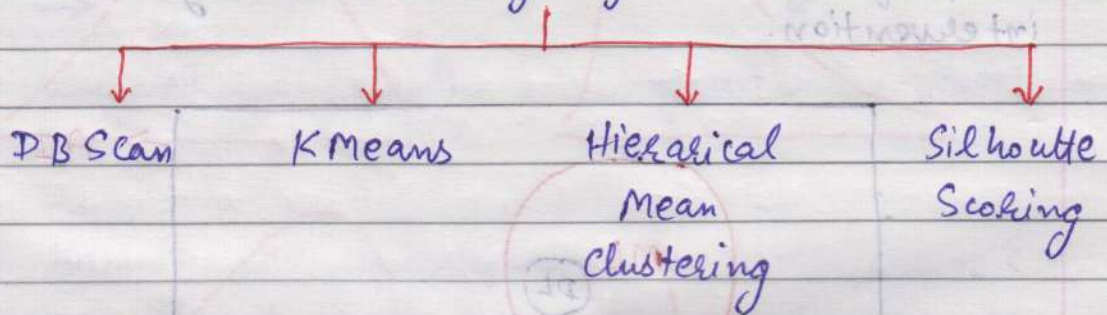
ML And DL



- | | |
|---------------------|-----------------------|
| → Linear Regression | → Logistic Regression |
| → Polynomial | → SVM |
| → SVR | → Decision Tree |
| → Decision Tree | → Random Forest |
| → Random Forest | → Naive Bayes |
| → Xgboost | → KNN |
| → KNN | |

Unsupervised ML

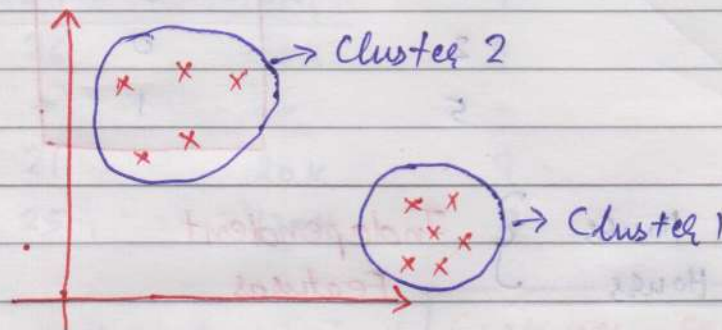
Clustering Algorithms



Difference between Supervised ML and Unsupervised ML?

- In Supervised ML, suppose we have the dataset, we know the output variable. [Target variable]
- In Unsupervised ML, we will never know the output variable, therefore we cluster similar kind of

data points



In Unsupervised Learning, we do not find the output variable, therefore we make clusters like above figure [Cluster 1, Cluster 2]

Supervised:-

↓ Predict

Degree	Exp.	Salary	} Regression.
B.E	7	50K	
PHD	2	70K	
-	-	-	
-	-	-	

Note:- Salary is a continuous variable, therefore we have to perform Regression to predict salary.

Playing Hours

9

7

3

Study Hours

1

2

5

Pass/Fail

0

0

1

classification

Here Playing Hours
Study Hours

} Independent
Features

Pass/Fail } Dependent Feature

Note:- Here Pass/Fail is a categorical variable, therefore we have to perform classification, to predict the student will Pass/Fail.

Example:-

① Flight Price Prediction → Regression

② Algerian Forest Fire → CLASSIFICATION

③ Predict the Air Quality Index → Regression

④ Predict Tomorrow is going to Rain or Not → CLASSIFICATION

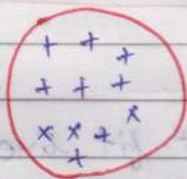
⑤ Predict a model that from Monday to Saturday which day a person would try

Unsupervised ML

Age	Salary	Spending Score (1-10)
24	70K	1
26	100K	9
-	-	-
21	20K	9
25	120K	2

Customer Segmentation

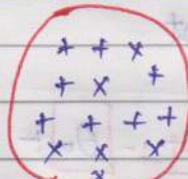
Earn More →
Spend More



People that are →
Earn Less
Spend More



Earn More
Spend Less



Simple Linear Regression

Whenever we say Simple Linear Regression, that means there will be 1 Independent feature and 1 Dependent Feature.

In Multi Linear Regression, there will be Multiple Independent feature and 1 Dependent Feature.

ONE Problem Statement

AIM:- To Create a model

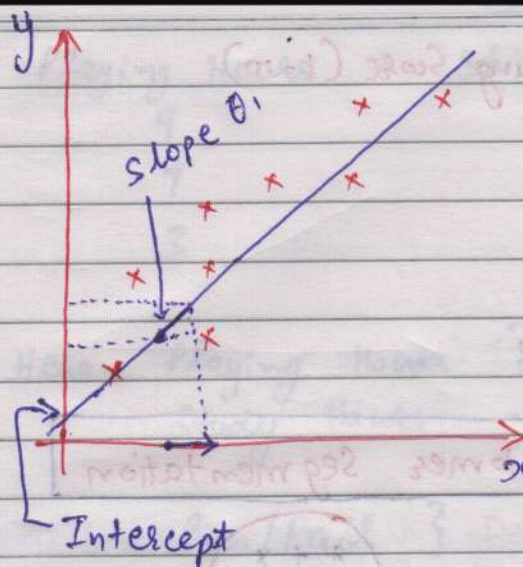
I/P - Height

Predict - Weight

DATASET

Height

Weight



Equation of a Straight Line

$$y = mx + c$$

$$y = \beta_0 + \beta_1 x$$

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

Intercept :- θ_0 :- In the best fit line, when the x value is 0, at that time where is the best fit line meeting the y axis, that particular point is intercept.

Slope θ_1 :- With the unit movement in the x axis, what is the unit movement in y axis.

COST FUNCTION

$$J(\theta_0, \theta_1) = \frac{1}{m} \sum_{i=1}^m \left(\underset{\substack{\uparrow \\ \text{predicted} \\ \text{datapoint}}}{h_{\theta}(x)^{(i)}} - \underset{\substack{\uparrow \\ \text{Actual} \\ \text{datapoint}}}{y^{(i)}} \right)^2 \quad \left. \vphantom{\sum_{i=1}^m} \right\} \text{Mean Squared Error.}$$

where m = No. of datapoints.

$h_{\theta}(x)^{(i)}$ = Predicted values

$y^{(i)}$ = Actual values.

Final Aim :-

Minimize.

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

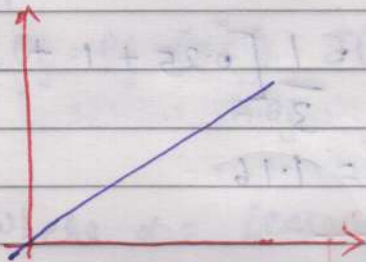
Where θ_0 = Intercept

θ_1 = Slope

$$(h_{\theta}(x)^{(i)} - y^{(i)})^2 = \text{MSE}$$

Mean Squared Error.

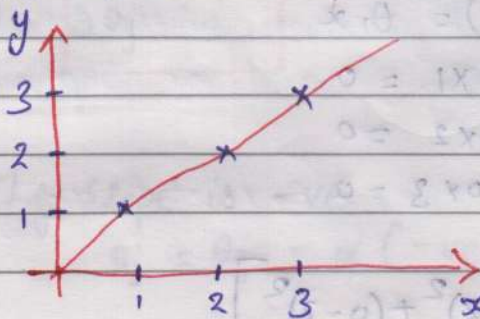
Let us consider $\theta_0 = 0$



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

$$\therefore h_{\theta}(x) = \theta_1 x$$

Example :-



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

$$= \frac{1}{3} [0 + 0 + 0]$$

$$= 0$$

$$\theta_1 = 1, \theta_0 = 0$$

$$h_{\theta}(x) = \theta_1 x$$

$$h_{\theta}(x) = 1 \quad x = 1$$

$$h_{\theta}(x) = 2 \quad x = 2$$

$$h_{\theta}(x) = 3 \quad x = 3$$

Training dataset.

x	y
1	1
2	2
3	3

Here When $\theta_1 = 1$ $J(\theta_1) = 0$

Example 2 :- If $\theta_1 = 0.5$

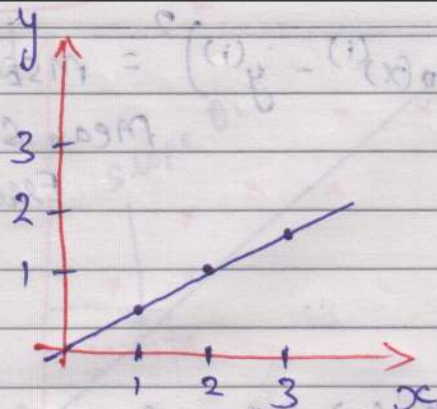
$$h_{\theta}(x) = \theta_1 x$$

$$h_{\theta}(x) = 0.5 \quad x = 1$$

$$h_{\theta}(x) = 2 \times 0.5 \quad x = 2$$

$$h_{\theta}(3) = 3 \times 0.5 \quad x = 3$$

$$= 1.5$$



$$\therefore J(\theta_1) = \frac{1}{m} \sum_{i=1}^m (h_{\theta}(x)^{(i)} - y^{(i)})^2$$

$$= \frac{1}{3} [(0.5 - 1)^2 + (1 - 2)^2 + (1.5 - 3)^2]$$

$$= \frac{1}{3} [0.25 + 1 + 2.25]$$

$$J(\theta_1) = 1.16$$

When $\theta_1 = 0.5$ $J(\theta_1) = 1.16$

If $\theta_1 = 0$ $h(\theta)(x) = \theta \cdot x$

$x=1$ $\theta h_{\theta}(1) = 0 \times 1 = 0$

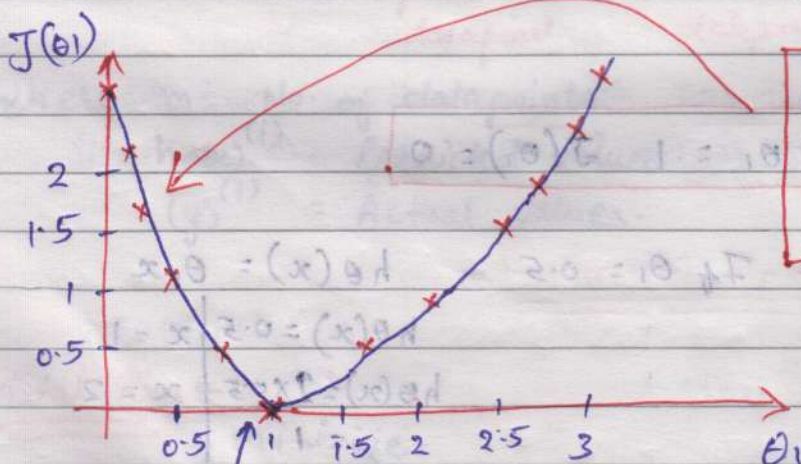
$x=2$ $\theta h_{\theta}(2) = 0 \times 2 = 0$

$x=3$ $\theta h_{\theta}(3) = 0 \times 3 = 0$

$$J(\theta_1) = \frac{1}{3} [(0 - 1)^2 + (0 - 2)^2 + (0 - 3)^2]$$

$$= 4.66$$

When $\theta_1 = 0$ $J(\theta_1) = 4.66$



GRADIENT
DESCENT
CURVE.

GLOBAL MINIMA

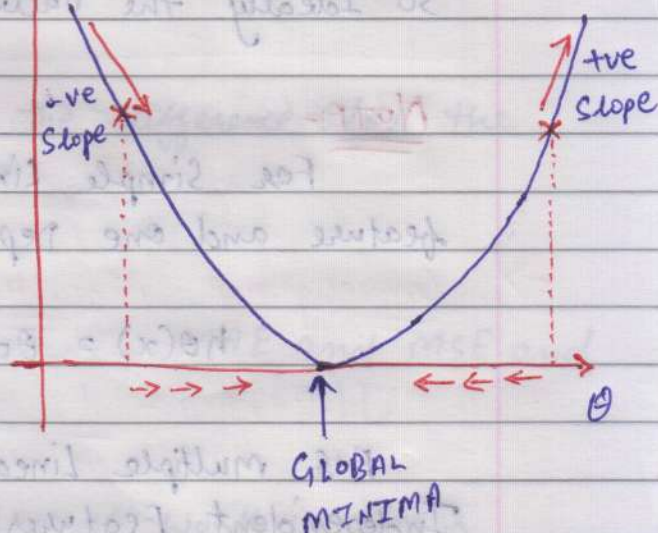
Convergence Algorithm { optimize the changes of θ_i value }

Repeat until convergence $J(\theta)$

$$\theta_j = \theta_j - (\alpha) \frac{\partial}{\partial \theta_j} J(\theta_j)$$

where α = Learning Rate.

$$\frac{\partial}{\partial \theta_j} J(\theta_j) = \text{Slope.}$$



If Slope is -ve
 $\theta_j = \theta_j - \alpha (-ve) = \theta_j + \alpha$

$\therefore \theta_j$ will go towards Global Minima. (+ve Direction)

If Slope is +ve
 $\theta_j = \theta_j - \alpha (+ve) = \theta_j - \alpha$

$\therefore \theta_j$ will go towards Global Minima (-ve Direction)

Question:- What is the Learning Rate?

Answer:- Learning Rate decides the speed of convergence. { How Fast you want to converge }

If Learning Rate (α) = 0.0000001 means if α is very small then it will take more time to come towards Global Minima.

If α value is very large, then it will jump here and there very fast, and would not come near Global minima.

So Ideally the value of $\alpha = 0.001$

NOTE:-

For Simple Linear Regression, where 1 Independent feature and one Dependent Feature.

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

For Multiple Linear Regression, where multiple Independent Features {Say 3} and one Dependent Feature

$$h_{\theta}(x) = \theta_0 + \theta_1 x_1 + \theta_2 x_2 + \theta_3 x_3$$

Questions:-

① What is Linear Regression?

Ans: It is a statistical method that is used for predictive analysis. Linear regression algorithm shows a linear relationship between a dependent and one or more independent variables, hence called as linear regression.

② How we can calculate Error in linear Regression?

Ans: - Error is the difference between predicted value and real value.

- Linear regression most often uses mean-squared error (MSE) to calculate the error of the model