24/07/23

Machine learning

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Machine learning –

A model capable of learning by itself without being explicitely programmed.

* Machine learns from example and experiance.

Example } Dataset
Experiance }

Real life examples –

Addition –

Example – Count pair of bananas

Experiance – Mistakes and corrections

When we start learning about addition, we take some examples and then practice (get experiance) and then apply it in real life

Life –

Example – Past experiances

Experiance – Present and Future

We learn from our experiance in real life also.

Need for Machine learning –

* Mimic Human behaviour.

* Apply AI

Types of ML –

1. Supervised learning 2. Unsupervised learning
3. Reinforcement learning

1. Supervised learning –

INPUT	OUTPUT
Example X	Y
Independent	Dependent

* Contains both input and output

Two subtypes –

1. Classification –

* Classify into categories
* Categorization
* Labeled dataset train model
* Training - learning from previous example

Example –

Spam or Not Spam in mail

2. Regression –

- General formula
- Input values
- Real values like Rupees, height

2. Unsupervised learning –

- Only input data, no output data
- Model should learn on its own.

Example – Fraquently bought together in e-com websites

Two subtypes –

1. Clustering –

- Interest grouping in data

Suppose we have n number of customers. Now some categories can be –

1. Customers who want more discount
2. Discount and quality
3. Expensive products

- Now, recommendation and pricing is done

according to this categories.

Say, for people with high discount need we will give discount without focusing about product quality

Now, for people with both discount and quality requirement we will focus on both product reviews and discounts.

Now, people who want expensive products have no requirement of discounts so products can be sold to them at a higher price

- This is why websites show different product price to different users for the same products.

2. Association –

- Finding association in previous dataset
- Like customer pages, customer bills for products bought together

Example –

- Say someone bought a mobile phone, now seeing previous dataset we find association that phone cover and insurance is also bought with it
- Thus, all else will be shown after phone

3. Reinforcement learning –

- No input, No Output
- Set up a task, reward for correct step, punishment for mistake.

Example – Self driving cars

Applications –

- Face detection – Mobile phone lock unlock using facial recognition
- Email filtering – Spam or Inbox
- Weather prediction – Weather for next 5 days
- Stock prediction
- Attendance using face recognition

Difference between AI and ML –

- AI is entire domain while ML is just its subdomain

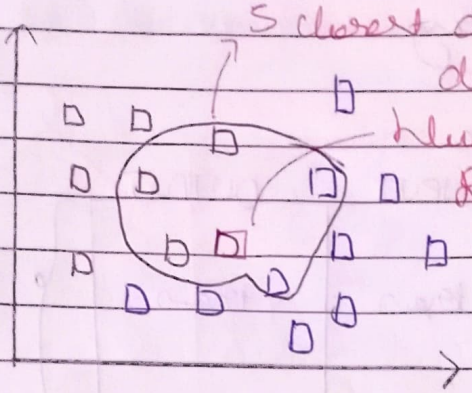
Alexa – Natural language processing (NLP) – text data, voice data

Online traffic fine – Detect and cut money online

Machine learning algorithm -

K-Nearest Neighbour -

- Type of Classification (Supervised learning)
- We have to categorise between ~~red~~ blue and black data
- Every data point is dataset



Value of k = 5 (No. of neighbours we are checking for.

Assuming 5 nearest neighbours
Count 5 nearest neighbours

How many box given black B = 4 = 80% } Calculation
for blue b = 1 = 20%
With this calculation, we decide the category of box

It is black box

k should be odd number

2 coordinates (x_1, y_1) and (x_2, y_2)

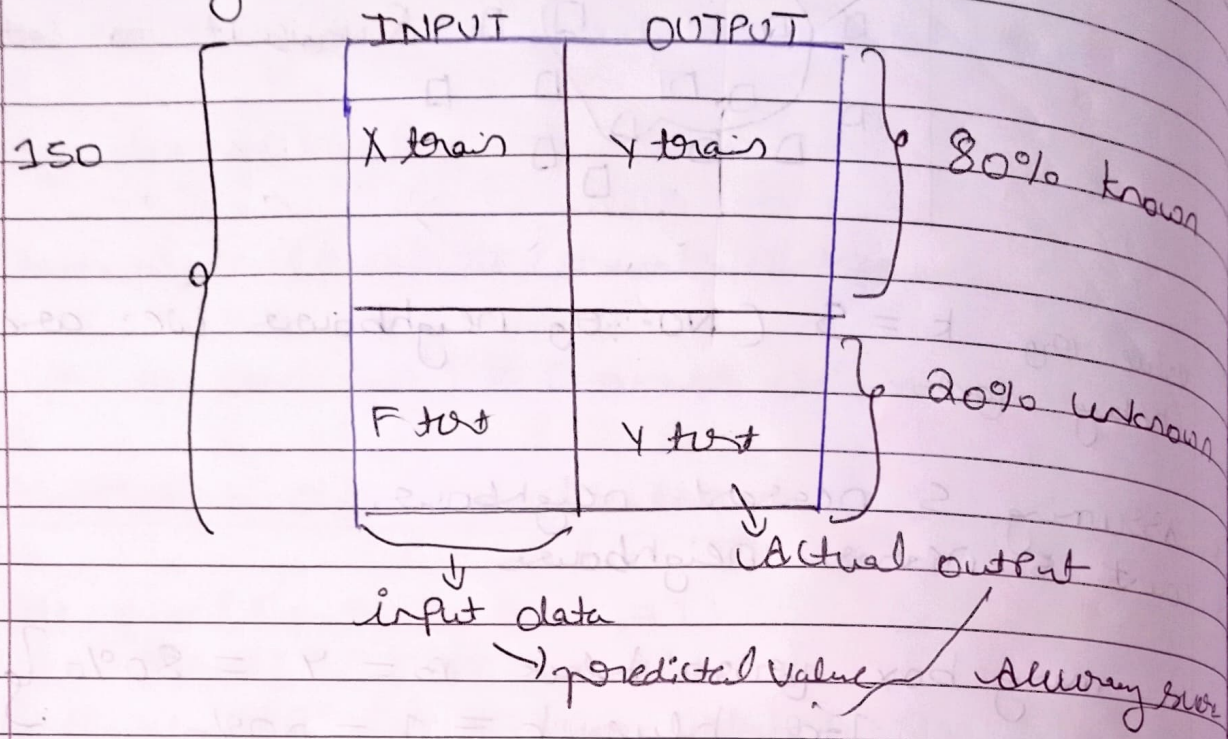
$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

Steps to Machine learning

1. Data Gathering
2. Data preprocessing
3. Choose an algorithm / Build a model
4. Train model

5 Evaluation / testing

02/08/23 Accuracy Score

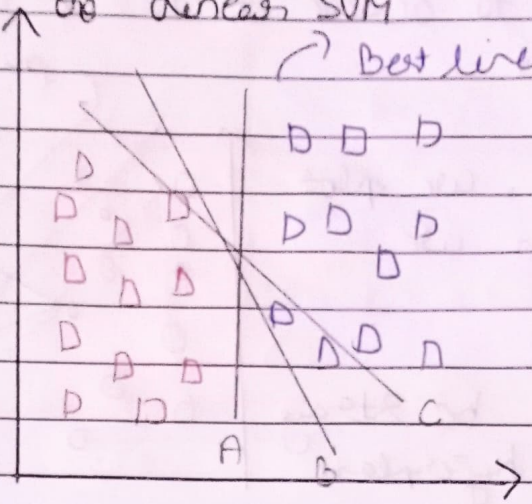


- Most of data for training, less for testing

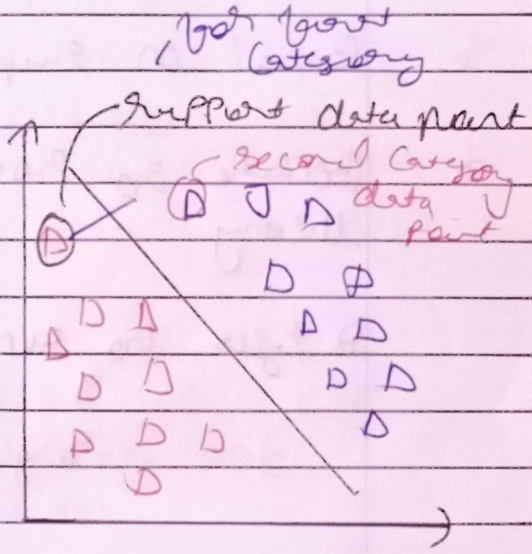
Support Vector Machine (SVM) –

- Most popular ML algorithm
- Can be used for both classification and regression but mostly used for classification
- best line or decision line
- hyperplane – 2d data, which can be plotted as a straight line
- line separating

Example of linear SVM

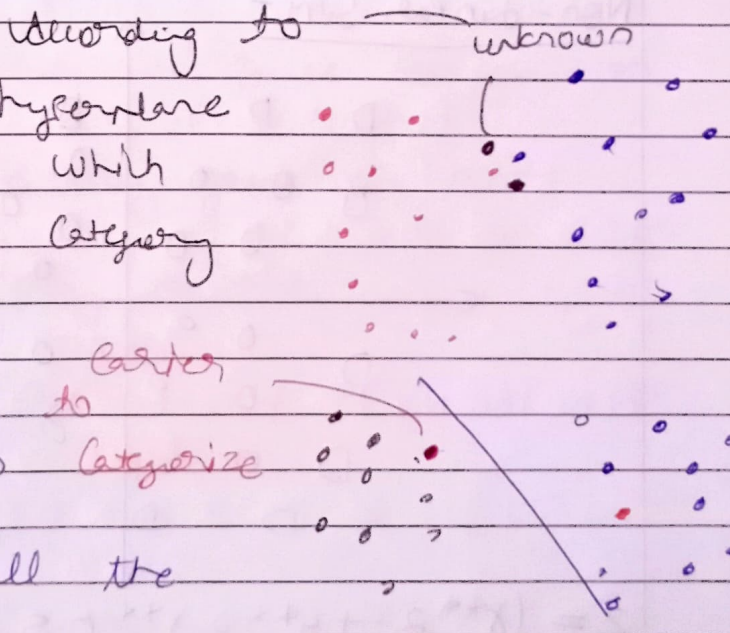


Maximum margin



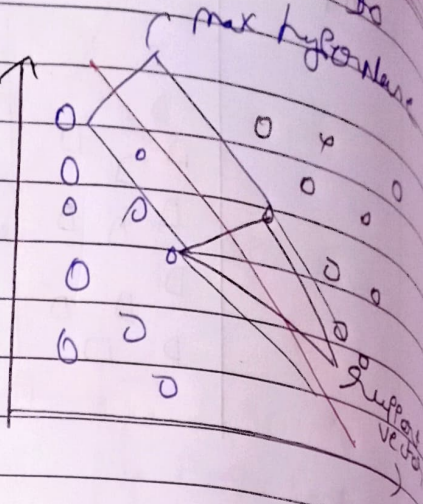
Support → Closer data point to line

- the more margin we have, less chance of error
- When data points are closer error chance is more, when we have more margin between Support Vectors



- We will try to get hyperplane with max margin
- Not possible all the time

- We will try to achieve it to be able to segregate it
- We have data, we plot it and then we separate it
- Hyperplane can be straight line or hyperplane
- Based on support vectors
- Because of some outlier we cannot change whole theory

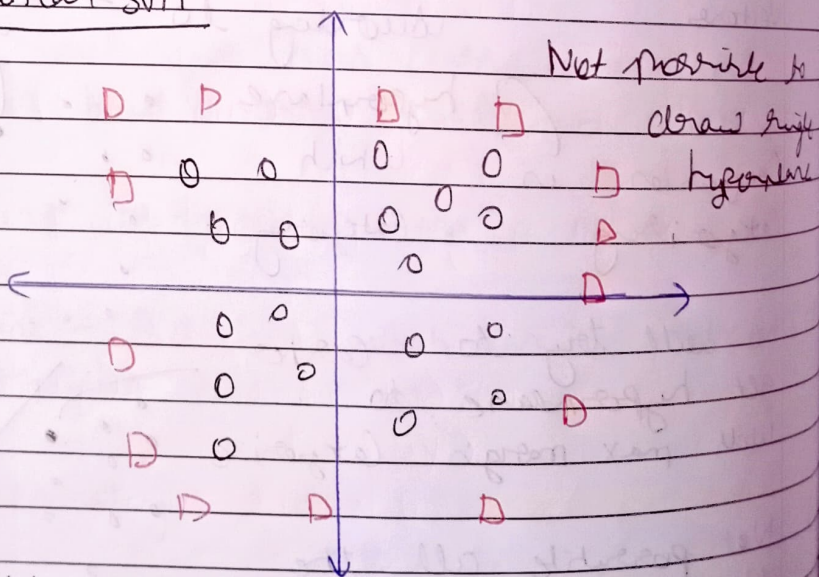


2 types of SVM - linear and Non-linear

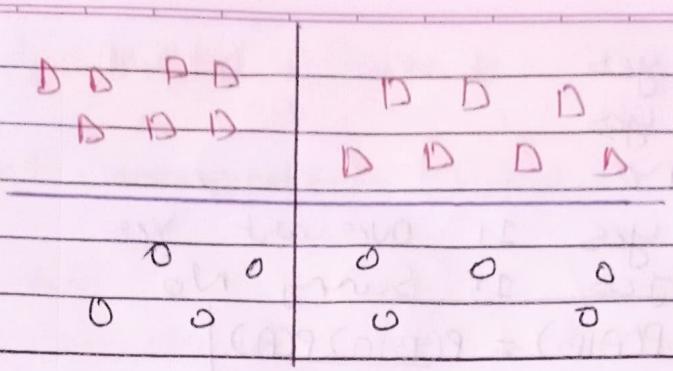
↓ Single hyperplane

↓ cannot be separated with one hyperplane

Non-linear SVM -



$z = (x^{**}2 + y^{**}2)^{**}0.5$



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10/8/23 Naive-Bayes Classifier –

- Based on Bayes theorem
- Mainly used for text classification.
- High dimensional dataset
- Probabilistic classifier
- Naive → assumes - certain features are independent of other features
- Bayes theorem is used for conditional probability
- Sentimental analysis and face recognition
- Weather condition → play game or not

	Weather condition	Play or Not
1.	Rainy	Yes
2.	Sunny	Yes
3.	Overcast	yes
4.	Sunny	No
5.	Rainy	Yes
6.	Overcast	yes

7	Sunny	yes
8	Overcast	yes
9	rainy	no
10	Overcast	yes
11	Overcast	Yes
12	Sunny	Yes
13	Sunny	No

$$P(A|B) = \frac{P(B|A)\,P(A)}{P(B)}$$

WEATHER	YES	NO	Total probability
RAINY	2	1	3/13 = 0.230
SUNNY	3	2	5/13 = 0.384
Overcast	5	0	5/13 = 0.384
Total	10	3	
Overall	10/13	3/13	
	0.769230	0.2307692	

$$P(YES|SUNNY) = \frac{P(SUNNY|YES)\,P(YES)}{P(SUNNY)}$$

$P(SUNNY|YES) = 3/10 = 0.3$
$P(YES) = 10/13 = 0.769$
$P(SUNNY) = 5/13 = 0.769$ ~~0.769~~ 0.384

$$P(YES|SUNNY) = \frac{0.3 \times 0.769}{0.384} = 0.59 = 0.6$$

60% is probability of playing match on sunny day

$$P(NO|RAINY) = \frac{P(NOT\ RAINY|NO)\,P(NO)}{P(RAINY)}$$

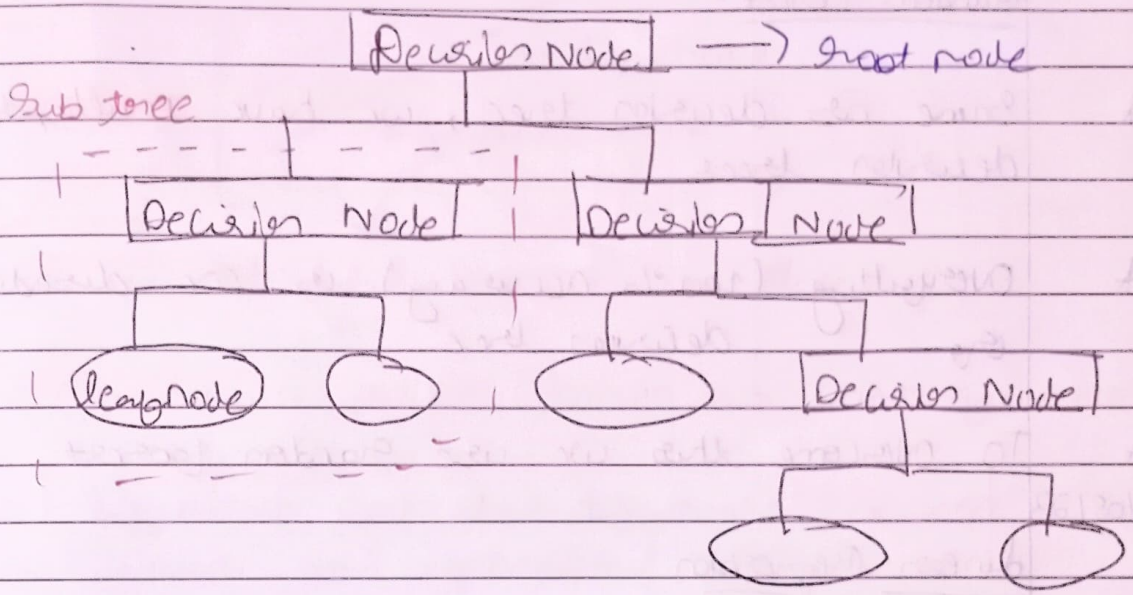
$$= \frac{1/3 \times 0.23}{0.23}$$

$$= 0.333 = 33.3\%$$

- Input and output data seperate
- Supervised, ~~Unsupervised~~ → input and output
- Labelled data
- We have to decide input and output

05/08/23 Decision Tree Algorithm

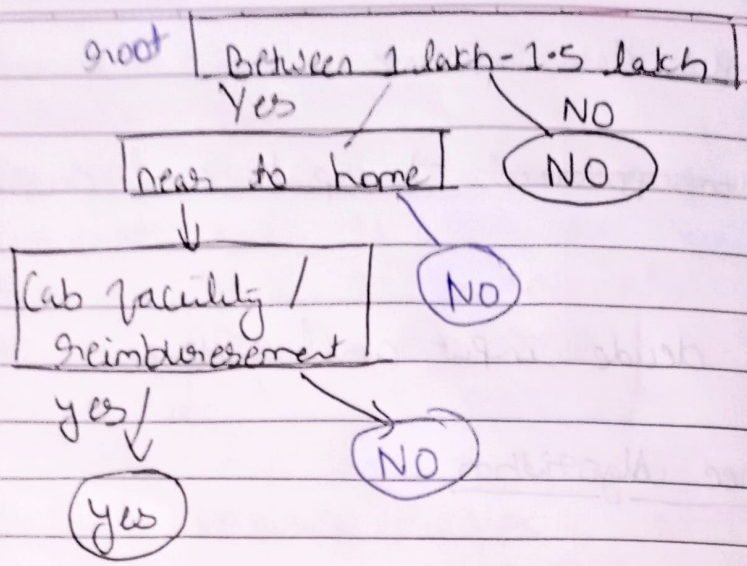
- Branches in algorithm



- Start from root node

Employee selected in a company and deciding based on future parameters to join or not in a new company

- Nodes generating from root node → child node
- last or Nodes without any child are leaf nodes



Random Forest –

* Same as decision tree, we have multiple decision trees

* Overfitting (100% accuracy) is one disadvantage of decision tree

* To overcome this we use random forest

07/08/23

Linear Regression

→ We will get real values as output.

→ Independent and dependent variable.

Training data — output

→ Regression gives a general formula

Regression formula ← $y_i = f(x_i, B) + e_i$

e_i ← Extra error term

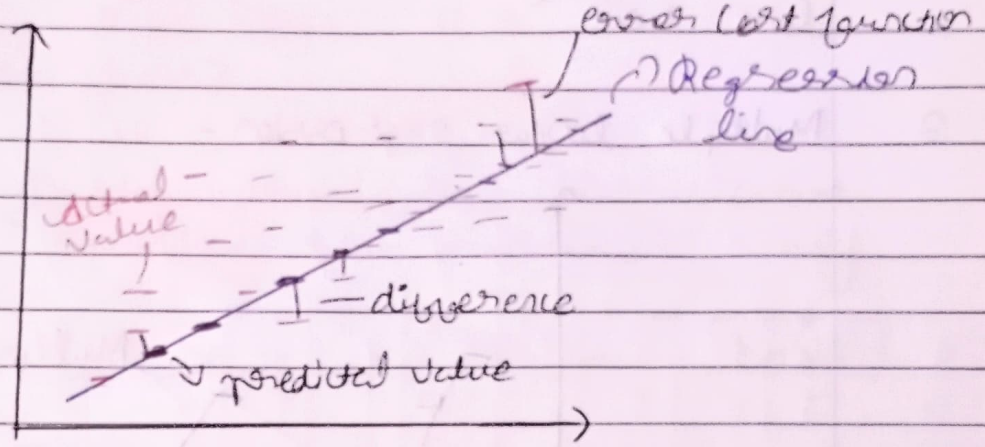
x_i ← Independent

B ← dependent multiple parameters

Linear Regression — $Y_i = B_0 + B_1 X_i$ / formula

$Y = mx + c$

B_1 => Slope X => independent variable
B_0 => Constant



- Error is calculated for entire data
- cost for each point (known as cost function)
- This difference is the difference between actual value and predicted value

actual value ——— predicted value

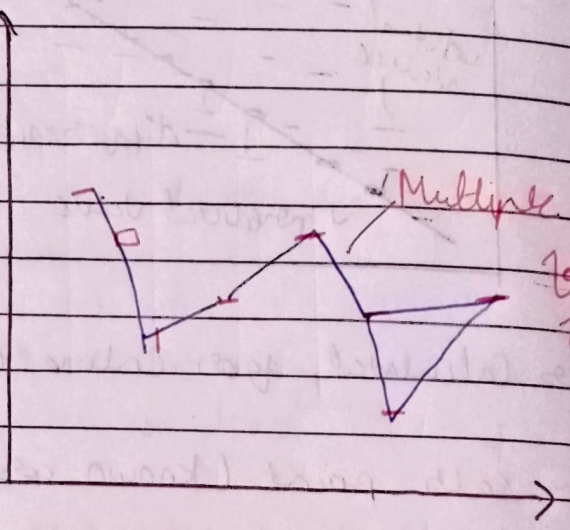
↓

cost function

- The less the difference, model is more accurate.
- We cannot calculate accuracy score
- We cannot get exact data S= 4.98

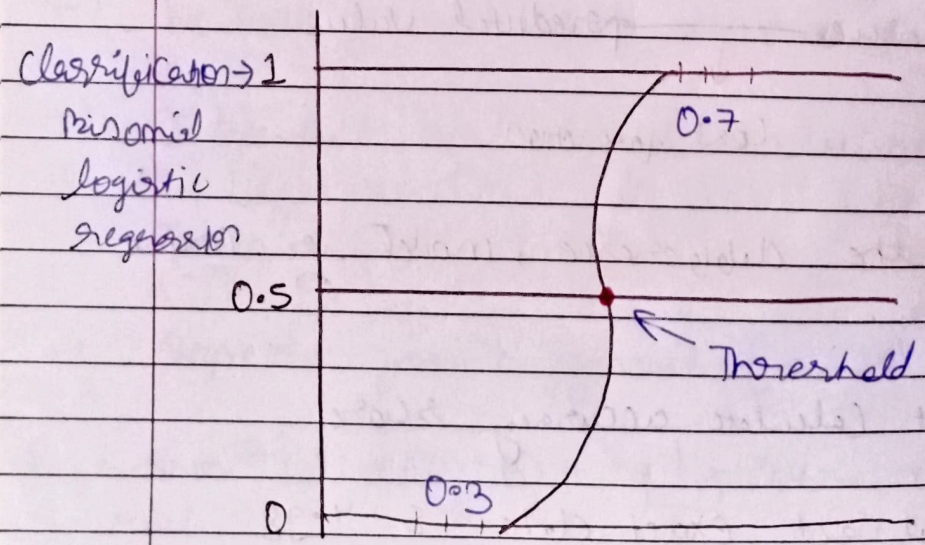
- We will find out the overall errors
- We calculate this difference for overall model
- We are going to draw only single best fit line here.

2. Multiple linear regression -



$$y_i = f(X_1, B_1) + f(X_2, B_2) \cdots + e_i$$

Logistic Regression -



- Classification problem solving model
- Used for solving categorization problem
- probabilistic Value from 0 to 1
- S shaped curve

0 — 1
0.3 | 0.5 | 0.7

- Used in yes/No, true/false classification problems Spam/not spam problems

Formula — $y = b_0 + b_1x_1 + b_2x_2 + \cdots b_nx_n$

→ $\frac{y}{1-y}$ If $y=0 = \frac{0}{1-0} = 0$

$y=\infty = \frac{\infty}{1-\infty} = 1$

Range is 0 to ∞ but we want a different range so we use log conversion

$\log\left[\frac{y}{1-y}\right]$ $(-\infty, \infty)$

- This is logistic regression equation

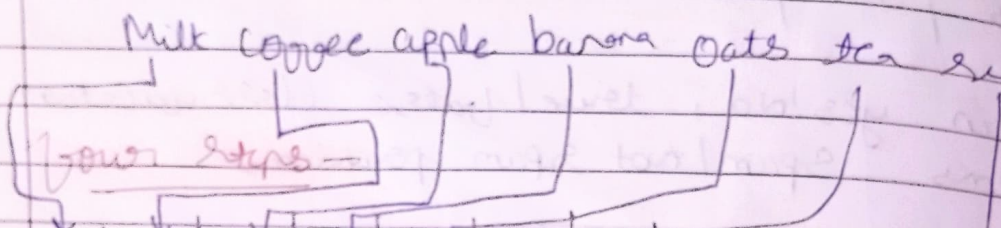
1. Binomial logistic regression
2. Multinominal logistic regression — multiple animals multiple categories
3. Ordinal logistic regression — dependent and independent temperature and temperature Values — High, low or medium

08/08/23

Unsupervised learning —

APRIORI

———	Milk apple Oats banana
———	milk Sugar tea Oats
———	milk Sugar coffee banana
———	Milk coffee apple
———	



1.	T	F	T	T	T	F	F
2.	T	F	F	F	T	T	T
3	T	T	F	T	F	F	T
4	T	T	T	F	F	F	F
	4/4	2/4	2/4	2/4	2/4	1/4	2/4

⇒ Support value based on product dataset

Milk and coffee together

1. F
2. F
3. T
4. T

Support value = 2/4 = 0.5 ⇒ for combination of this

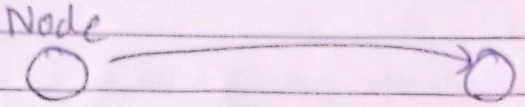
& For each combination we found support value

& Used for finding association among various items

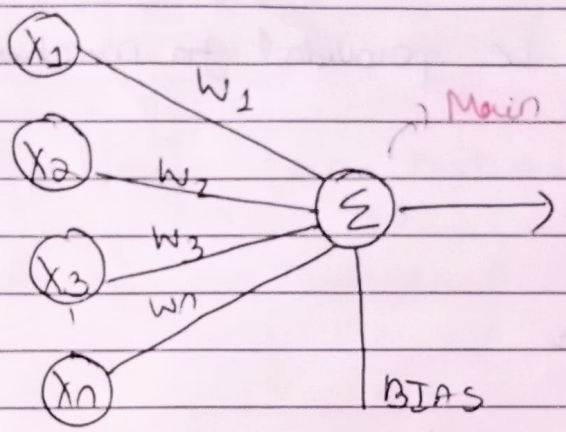
& Based on this support values, final decision is made

Deep learning

Neural Network –



* Its node to node communication -
* Mimicking the human behaviour



+ Find Output dependent on input value as well as weighted value

Activation function – $\boxed{\Sigma(W_i * x_i) + Bias}$

Even if we do not set it, we will have Weight values random values

* In this we also train the dataset but we also have other background functions