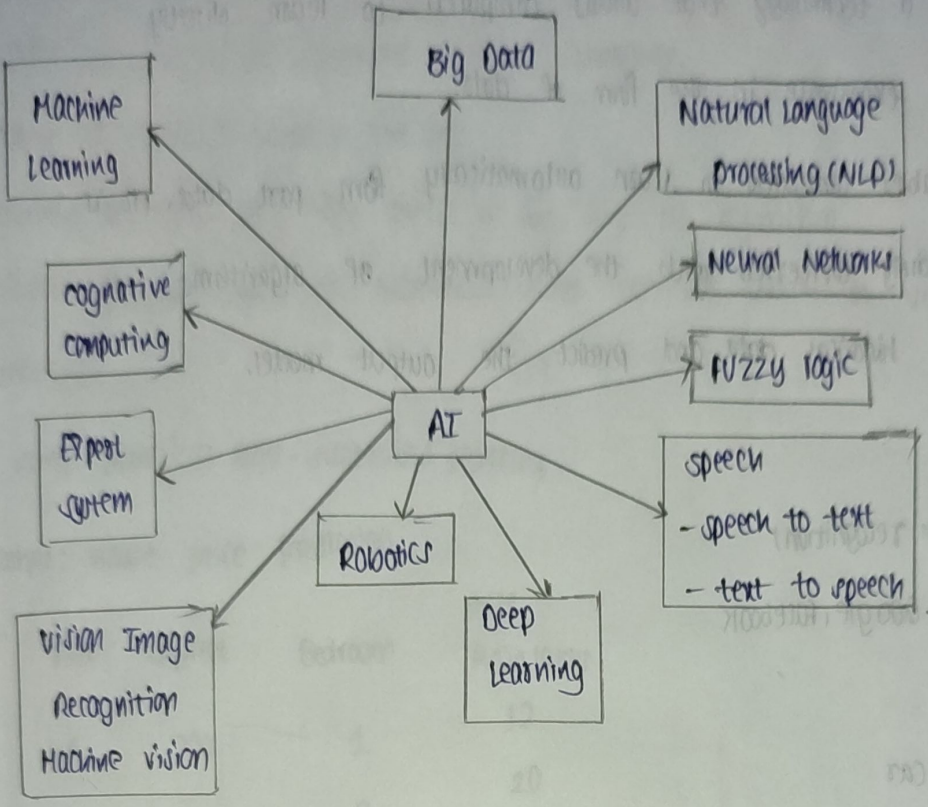
ARTIFICIAL INTELLIGENCE BRANCHES:



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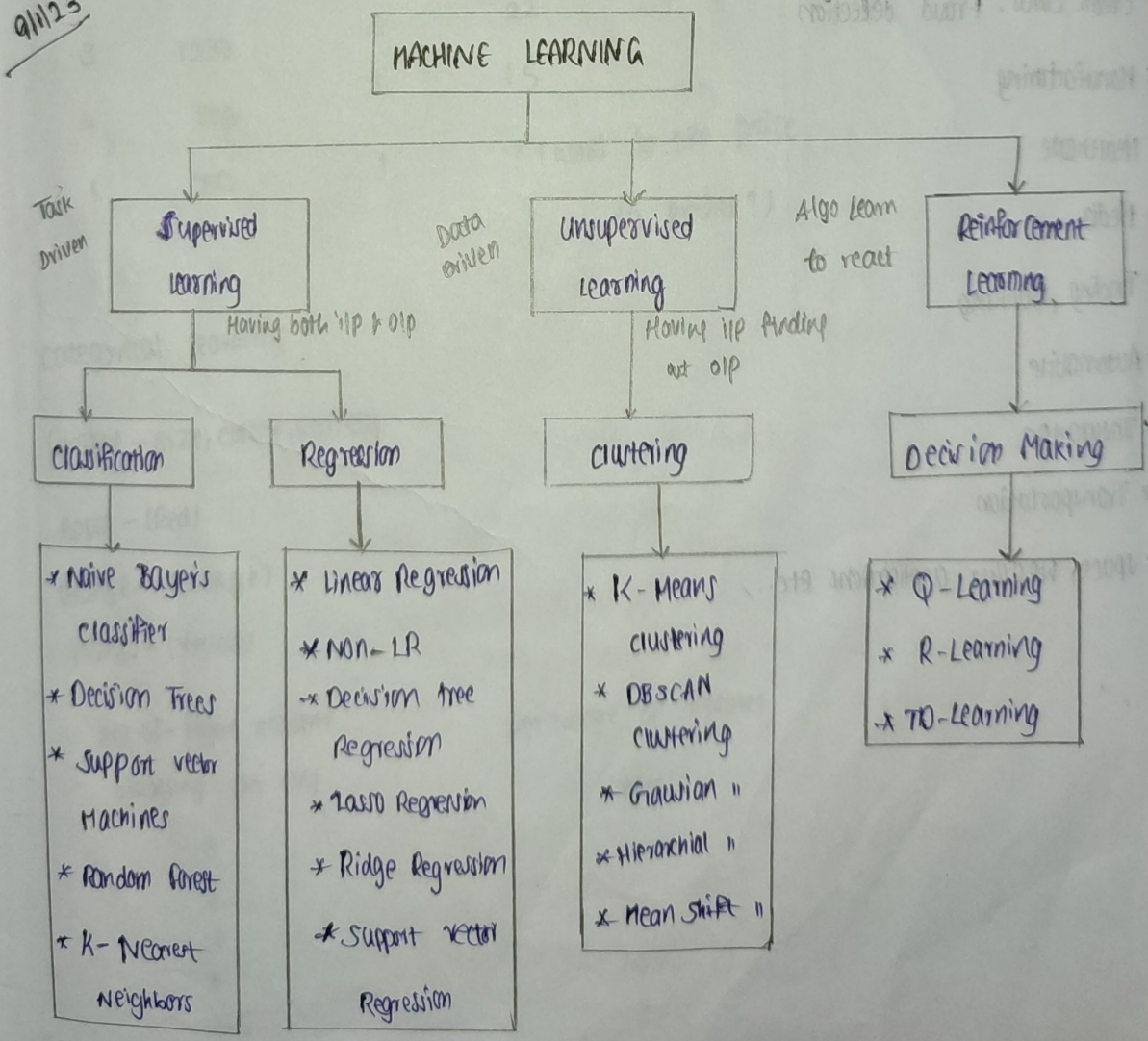


MACHINE LEARNING:

Machine Learning is a technology that allows computers to learn directly from examples and experience in the form of data.

Machine Learning enables computers to learn automatically from past data. ML is a subset of AI mainly concerned with the development of algorithms to learn computers from historical data and predict the output model.

APPLICATIONS OF ML:

* Amazon - Alex (speech recognition)
* Netflix, instagram, Google, facebook
* Email spam detection
* Tesla: self driving car
* Credit cards: Fraud detection
* Manufacturing
* Healthcare
* Media
* Trading, Banking
* Automobile
* Insurance
* Transportation
* space, weather applications etc../

10/1/23

SUPERVISED LEARNING:

- Supervised learning (or) supervised Machine learning.
- subset of Machine learning and AI
- Labeled data sets used for prediction by any ML algorithm.
- Either categorized data (or) Numerical data can be used in supervised learning.

By using Numerical data - supervised Learning.

Example: House price prediction

Area	Sqrfeet	Bedroom	price Rs in lakhs
1	700	1	12
2	1000	2	20
3	1200	3	22
4	800	1	15
1	750	1	? (what is the price to predict?)

categorical learning

Grapes - size, color, variety

Apple - (Red)

orange - (orange)

Mango - (Yellow)

No. of hours student studying per day	percentage of Results
5	80%.
4	70%.
3	65%.
1	60%.
4.5	?

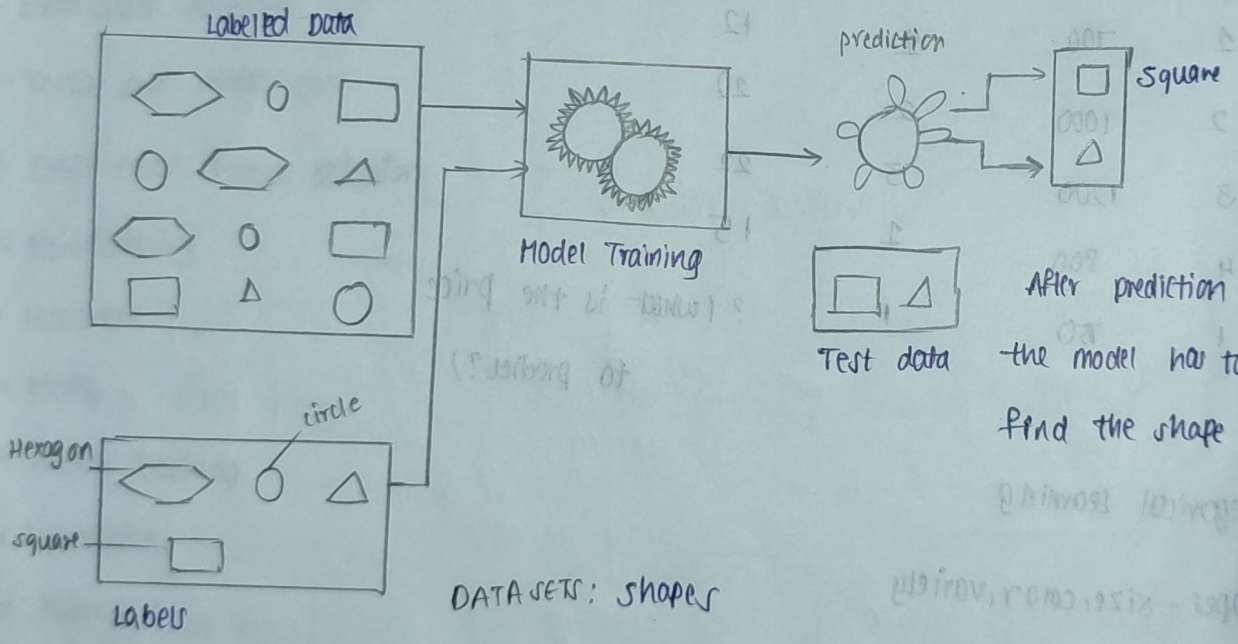
* It is defined by use of labelled datasets to train algorithm that to classify data or predict outcomes accurately. Datasets contains both input and output parameters.

* The aim of supervised learning is to find a mapping function to map input variables (x) with the output variables (y). The output (y) is a dependent variables of input (x) i.e $y = f(x)$

11/11/23

SUPERVISED LEARNING:

Example: CATEGORIZED DATA



DATASETS: shapes

Each shape have sides

3 sides equal triangle

4 sides equal square

6 sides Hexagon.

STEPS INVOLVED IN SUPERVISED LEARNING:

* Determine the type of training data set with prior knowledge about the data set
* Collect the labelled training data.
* Do data pre-processing technique (Data cleaning: remove null or empty value, remove incorrect value)
* Split the datasets into training dataset, testing dataset, validation dataset.
* Evaluate the algorithm with training data set.
* Evaluate the accuracy of the model by test data set.
* If the model predicts the correct output, which means our model is accurate.

ADVANTAGE OF SUPERVISED LEARNING:

* The model can predict the output based on the prior experiences.
* In supervised Learning we can have exact idea about the classes of objects.
* Help to solve various real-world problems.

DISADVANTAGES:

* Not suitable for complex tasks.
* Cannot predict properly if the test data is different from training data.
* Training required lot of computation time.
* We need enough knowledge about the datasets.

12/1/23

MACHINE LEARNING LIFE CYCLE:

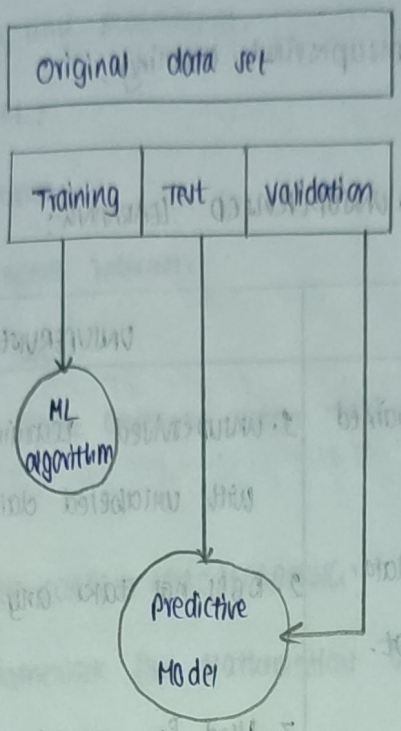
Machine Learning life cycle involves seven major steps which are given below.

1. Gathering data - Files (XLS, csv, etc.) internet, mobile integrate data from different sources.
2. Data preparation - pre-processing
3. Data wrangling - Raw data into usable format (duplicate, noise data)
4. Analyse data - Build model
5. Train the model
6. Test the model.
7. Deployment.

POPULAR DATASETS:

1. Kaggle website
2. UCI machine learning Repository
3. Data sets via AWS (Amazon)
4. Google dataset search engine.
5. Microsoft datasets.
6. Public dataset collections (ISRO, Pollution control Board ie, Government websites)
7. sci kit - learn datasets

DATA SPLIT-UP:



UNSUPERVISED LEARNING:

* The goal of unsupervised machine learning is to find the underlying structure of dataset, group that data according to similarities and represent that dataset in a compressed format.
* Unsupervised machine Learning algorithm to analyze and cluster unlabeled dataset.
* unsupervised machine learning discover patterns and information that was previously undetected.

NEED FOR UNSUPERVISED MACHINE LEARNING:

* Helpful for finding useful insights from the data.
* similar to human learn to think by their own experiences.
* works on unlabeled, uncategorized data which make unsupervised learning more important.

* In real world we dont have exact input data with the corresponding output, in such cases we use unsupervised learning.

23/1/23

DIFFERENCES BTW SUPERVISED LEARNING & UNSUPERVISED LEARNING:

SUPERVISED LEARNING	UNSUPERVISED LEARNING
1. supervised learning algorithms trained with labeled data.	1. unsupervised learning algorithms trained with unlabeled data.
2. Check the correct feedback of data whether the ouput is correct or not.	2. does not take any feedback.
3. Used to predict the output model.	3. Used for analysis and find the hidden
4. Input data is provided along with the output.	4. only the input will be provided.
5. Relatively complex because it is required labeled data.	5. Relatively less complex because no need to understand the labeled data.

REINFORCEMENT LEARNING:

* RL is the science of decision making.
* It is about learning the optimal behaviour in an environment to obtain maximum reward.
* It is a feedback based ML technique in which an agent learn to behave in an environment by performing the action and seeing the result of action.

Each goal action agent gets positive feedback, negative feed back penalty given, no rewards.

4 types of Reinforcement:

positive, negative, Extinction and punishment.

THE MAIN ELEMENTS OF RL:

1. The agent or the learner.
2. The environment to agent interact.
3. The policy that agent follows.
4. The reward signal the agent observer upon taking actions.

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PROBABILITY APPROXIMATELY CORRECT (PAC) LEARNING:

* ~~PAC~~ learning is a framework for mathematical analysis in machine learning.
* It was proposed in 1984 by a mathematician Leslie valiant.
* The ~~PAC~~ PAC framework is based on the idea that an algorithm can be considered "probably Approximately correct" if it produces result that are close enough to the true values with high probability.
* The framework has been used in many areas of machine learning including supervised learning, unsupervised learning, re-inforcement learning and deep learning.
* The learner must be able to learn the concept given approximate ratio, probability of success or distribution of the sampler.
* In this framework the learner receives the samples and must select a generalization concept (Hypothesis) from a certain class of possible functions.

HYPOTHESIS:

A simple hypothesis is a statement made to reflect the relation b/w exactly two variables.

one independent variable and one dependent variable to the independent.

STATISTICAL HYPOTHESIS:

50% of population lives beyond the age of 70 in India.

80% of USA population gets divorced.

45% of a poor in the USA are illeterate

SMOKING CAUSE LUNG CANCER:

Instance: A single row of data is called Instance in ML.

Instancespace: It is a subset of all possible examples or Instances.

6/2/23

UNIT-II

CLASSIFICATION:

* Classification is a process of categorizing a given set of data into classes.
* The classes are often referred to as target, label or categories.
* Classification is defined as the process of recognition, understanding and grouping of objects and ideas to proceed categories.

In classification algorithms are used to predict the output of the categorical data.

CLASSIFIER:

The algorithm which implement the classification on a dataset is known as "classifier."

NAIVE BAYESIAN CLASSIFICATION:

* Invented by Reverend Thomas Bayes in 1761.
* Naive Bayes assumes that all attributes are equally important, independent of one another in a given class.

BAYES THEOREM:

Bayes Theorem is one of the most popular machine learning concept that helps to calculate the probability of occuring one event with uncertain knowledge while other are already occured.

$$P(class|data) = \frac{(P(data|class) * P(class))}{P(data)}$$

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

P(A|B) - The probability of 'A' being true given that 'B' is True.

P(A) - The probability of 'A' being true.

7/2/23

Dataset: Weather condition.

Problem: If the weather is sunny, then the player should play or not?

	outlook	play
0	Rainy	yes
1	Sunny	yes
2	overcast	yes
3	overcast	yes
4	sunny	yes
5	Rainy	yes
6	sunny	yes
7	overcast	yes
8	Rainy	NO
9	sunny	NO
10	sunny	NO
11	Rainy	NO
12	overcast	yes
13	overcast	yes

FREQUENCY TABLE:

Weather	yes	NO
overcast	5	0
Rainy	2	2
sunny	3	2

Likelyhood Table:

weather	yes	NO	
overcast	5	0	$5/14 = 0.35$
Rainy	2	2	$4/14 = 0.29$
sunny	3	2	$5/14 = 0.3$

All 10/14 4/14 = 0.29

= 0.71

Applying Bayes Theorem: —

$$P(yes|sunny) = \frac{P(sunny|yes) * P(yes)}{P(sunny)}$$

P(sunny|yes) = 3/10 = 0.3

P(sunny) = 0.35

P(yes) = 0.71

so, $P(yes|sunny) = \frac{0.3 \times 0.71}{0.35} = 0.60$

$$P(NO|sunny) = \frac{P(sunny|NO) * P(NO)}{P(sunny)}$$

P(sunny|NO) = 2/4 = 0.5

P(NO) = 0.29

P(sunny) = 0.35

so $P(NO|sunny) = \frac{0.5 \times 0.29}{0.35} = 0.41$

so P(yes|sunny) > P(NO|sunny)

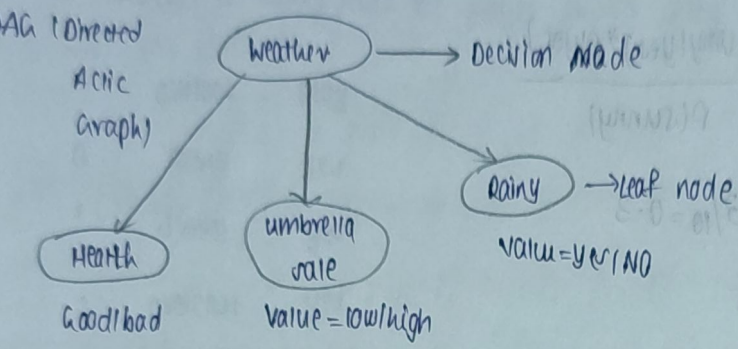
Hence on sunny days player can play the game.

13/2/23

BAYERIAN NETWORK:

* Bayerian networks are the type of probabilistic graphical model that can be used to build models from data.
* They are also commonly reffered as Bayes Network, Belief N/w.

Bayerian nrw are probabilistic because they are built from probability distribution.



- probability of Good Health based on weather.
- probability of umbrella sale based on weather.
- Random variables (weather, health) can give a hypothesis.

TYPES OF PROBABILITIES:

1. Join probability
2. conditional probability.

DECISION TREE:

* Decision Tree are some of the most used machine learning algorithm in supervised learning.
* Decision Trees are used in both classification & Regression.
* They can be used for both linear and non-linear data but they are mostly used in non-linear data.
* It is a tree structured classifier.

14/2/23

Predict the probability of a class variable using Bayes classification.

Training Dataset: All electronics customer database

Variable (X) = (age = youth, income = Medium, student = yes, credit = rating = fair)

RID	Age	Income	student	credit rating	buys-computer
1.	youth	high	NO	fair	NO
2	youth	high	no	Excellent	NO
3	Middle age	high	no	fair	yes
4.	senior	medium	no	fair	yes
5.	senior	low	yes	fair	yes
6.	senior	low	yes	Excellent	NO
7.	Middle age	low	yes	Excellent	yes
8.	youth	Medium	NO	fair	NO
9.	youth	Low	yes	fair	yes
10.	senior	Medium	yes	fair	yes
11.	youth	Medium	yes	Excellent	yes
12.	Medium age	Medium	NO	Excellent	yes
13.	MA	High	yes	fair	yes
14.	senior	Medium	NO	Excellent	NO

Class: c_1 : buys-computer = yes

C_2 : buys-computer = no

probability:

$$P(c_1) = p(C_1) = P(\text{buys\_computer} = yes) = \frac{9}{14} = 0.643$$

$$P(c_2) = P(\text{buys-computer} = NO) = \frac{5}{14} = 0.357$$

compute P(X|Ci) for each class:

P(age = youth | buys_computer = yes) = $\frac{2}{9}$ = 0.222

P(age = medium | buys_computer = yes) = $\frac{4}{9}$ = 0.444

P(student = yes | buys_computer = yes) = $\frac{6}{9}$ = 0.667

P(credit_rating = fair | buys_computer = yes) = $\frac{6}{9}$ = 0.667

my

P(age = youth | buys_computer = NO) = $\frac{3}{5}$ = 0.6

P(income = medium | buys_computer = NO) = $\frac{2}{5}$ = 0.4

P(student = yes | buys_computer = NO) = $\frac{1}{5}$ = 0.2

P(credit_rating = fair | buys_computer = NO) = $\frac{2}{5}$ = 0.4

SO P(X|Ci) : P(X | buys_computer = yes)

= 0.222 x 0.444 x 0.667 x 0.667 = 0.044

P(X | buys_computer = NO) = 0.6 x 0.4 x 0.2 x 0.4 = 0.019

P(X|Ci) x (P(Ci)

P(X | buys_computer) x P(buys_computer = yes)

= 0.044 x 0.643 = 0.028

P(X | buys_computer = NO) x P(buys_computer = NO)

= 0.029 x 0.357 = 0.007

RESULT:

P(X|buys_comp = yes) P(buys_comp = yes) > (greater than) P(X | buys_computer = yes)

P(buys_comp = no)

The variable X (age = youth, income = medium, student = yes, credit - ranking = fair), have the probability of buying a computer.

15/2/23

ASSOCIATION RULE:

* Association rule learning is a type of supervised learning in machine learning.
* It checks the dependency of one data item on another data item and maps accordingly.
* It is mostly used in questions, decision making and predict behaviours.
* It is a rule based machine learning method for discovering interesting relatives blw variables in large database.

ASSOCIATION RULE - APRIORI ALGORITHM:

* Apriori algorithm is used to find the frequent itemset in a dataset for boolean association rule.
* Apriori - means prior knowledge of frequent item set properties.
* Apriori is an algorithm used for association rule mining.
* Types of Association are multi-relational, quantative and generalized.

Apriori ALGORITHM MEASUREMENTS:

There are 2 measures mostly used in association rule.

1. support.

$$\text{support} = \frac{\text{frequency}(X,Y)}{N}$$

2. confidence

$$\text{confidence} = \frac{\text{frequency}(X,Y)}{\text{frequency}(X)}$$

Example: Apriori Algorithm.

The following are the set of items transacted in a market. Find the support and confidence?

Trans ID	
101	milk, bread, eggs
102	milk, juice
103	Juice, Butter.
104	milk, Bread, eggs
105	coffee, eggs
106	coffee
107	coffee, Juice
108	milk, bread, cookies, eggs
109	cookies, butter
110	milk, bread.

Index the Item sets

Item	Numbers
Milk	1
bread	2
Eggs	3
Juice	4
Butter	5
coffee	6
cookies	7

Find the overall support (Total item = 10 = 100%)

Itemset	support	%
Milk	5	50%,
Bread	4	40%,
Eggs	4	40%,
Juice	3	30%,
Butter	2	20%,
coffee	3	30%,
cookies	2	20%,

Find the support for 2 item set from Index.

Itemset	support	%
{1,2}	4	40%
{1,3}	3	30%
{1,4}	1	10%
{1,5}	0	-
{1,6}	0	-
{1,7}	1	10%
{2,3}	3	30%
{2,4}	0	-
{2,5}	0	-
{2,6}	0	-
{2,7}	1	10%
{3,4}	0	-
{3,5}	0	-
{3,6}	1	10%
{3,7}	1	10%
{4,5}	1	10%
{4,6}	1	10%
{4,7}	0	-
{5,6}	0	10%
{5,7}	1	10%
{6,7}	0	-

Itemset	support
{1,2}	4
{1,3}	3
{2,3}	3

Itemset	support
{1,2,3}	3

use 20% for the minimum support

CONFIDENCE: 70% or greater in the item set

$$\frac{\text{support}(1,2,3)}{\text{support}(1)} = \frac{3}{5} = 60\% < 70\% \quad \times$$

$$\frac{\text{support}(1,2,3)}{\text{support}(2)} = \frac{3}{4} = 75\% > 70\% \quad \checkmark$$

$$\frac{\text{support}(1,2,3)}{\text{support}(3)} = \frac{3}{4} = 75\% > 70\% \quad \checkmark$$

confidence R:

	Confidence
Bread → {milk, eggs}	75%
Eggs → {milk, bread}	75%

$$\frac{\text{support}(1,2,3)}{\text{support}(1,2)} = 75$$

$$\frac{\text{support}(1,2,3)}{S(1,3)} = 100\%$$

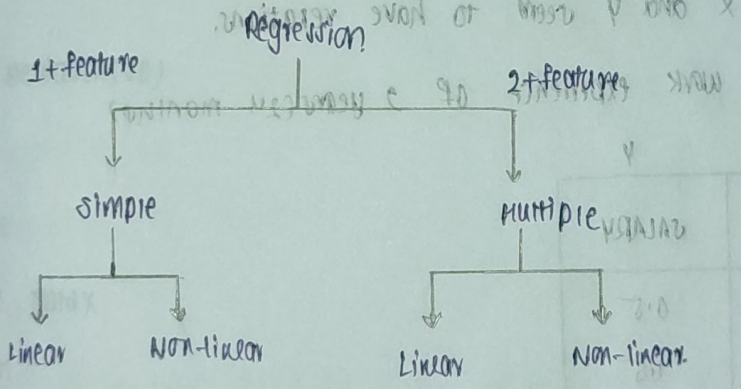
$$\frac{S(1,2,3)}{S(2,3)} = 100\%$$

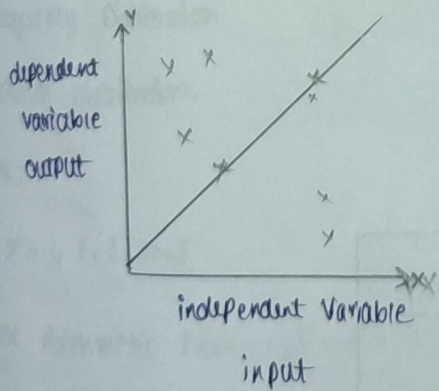
16/2/23

REGRESSION:

* Regression is a statistical method to determine the strength and character of the relationship b/w one dependent variable (usually denoted by Y) and a series of the other variables (known as dependent variable X).
* regression is a supervised Machine learning algorithm.
* Regression analysis is the process of estimating the relationship b/w a dependent variables and to independent variables.
* Regression will predict a continuous outcome (Y) based on the value of one or more predictor variables (X).

REGRESSION MODELS:





SIMPLE LINEAR REGRESSION:

simple linear Regression is a technique which plots a straight line within the data points. It is one of the most simple and basic type of machine learning Regression.

MULTIPLE LINE REGRESSION:

It is a technique used when more than one independent variable is used. polynomial is an example of a multilinear regression.

SIMPLE LINEAR REGRESSION:

* One variable (x) is called independent variable or predictor
* The other variable (y) is known as dependent variable or outcome, and the simple linear regression equation is

$$Y = b_0 + b_1 x$$

What is linear regression? The following table shows the work experience and salary obtained from employees

a) plot the data do x and y seem to have relations.

b) predict the salary for work experience of 2 years (24 months)

X WORK EXPERIENCE months	Y SALARY
3	0.5
6	1.5
9	1.5
12	4
15	6

X	Y	X^2	Y^2	XY
$\Sigma X = 45$	13.5	162	495	56.75

$$y = b_0 + b_1 x$$

$$b_0 = \frac{\Sigma y \Sigma x^2 - \Sigma x \Sigma xy}{n \cdot \Sigma x^2 - (\Sigma x)^2}$$

$$b_1 = \frac{n \cdot \Sigma xy - \Sigma x \Sigma y}{n \cdot \Sigma x^2 - (\Sigma x)^2}$$

$$y = -1.35 + 0.45 \times 24$$

$$= 9.45$$

20/9/23

STATISTICS:

1. Simple Arithmetic mean.
2. Median
3. Mode
4. Standard Deviation (SD)
5. variance
6. co-variance
7. co-variance Matrix
8. Distribution
9. Frequency Distribution
10. Normal Distribution.

MEAN:

$x = 1, 2, 3, 4, 5$

Simple Arithmetic Mean $= \frac{1+2+3+4+5}{5}$

$= \frac{15}{5} = 3$

MEDIAN :

50th percentile position

Position = N+1/2

V = 15, 10, 8, 12, 14

Arrange in highest to lowest 15, 14, 12, 10, 8

N=5 $\frac{N+1}{2} = \frac{6}{2} = 3^{rd}$ position

= 12

MODE: No. of occuring of data.

3, 5, 7, 10 - No mode

3, 5, 3, 7, 3, 10, 3 Mode = 3

POPULATION VARIANCE:

$$\sigma = \frac{(X-\bar{X})^2}{n}$$

(X − X̄)² → variable, X̄ → Mean, n → No. of score

SAMPLE VARIANCE:

$$\sigma = \frac{X-\bar{X}}{n-1}$$

mean x = 3

$$PV = (1-3) + (2-3) + (3-3) + (4-3) + (5-3)/5$$

$$= (-2)^2 + (-1)^2 + (0)^2 + (1)^2 + (2)^2/5$$

$$= \frac{4+1+0+1+4}{5}$$

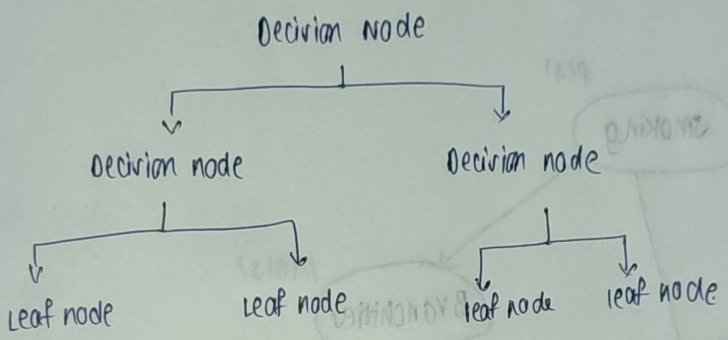
$$P.C.V = \frac{|X-\bar{X}|^2 + |Y-\bar{Y}|^2}{n}$$

Standard deviation: Square root of variance.

2/12/23

DECISION TREE:

* Decision Trees are some of the most used machine learning algorithm.
* Decision Tree is a supervised learning algorithm.
* Decision Tree can be used in both classification and regression techniques.
* Decision Tree can be used for both linear (continuous) and non-linear (discrete) data but mostly used in non-linear data.



INTERNAL NODE: Represent features of dataset.

BRANCHES: Represents the decision rule.

LEAF NODE: Represents the outcome.

BAYESIAN NETWORK:

Bayesian Nlw are a type of probabilistic graphical model that can be used to build models from data.

They are also commonly reffered to as Bayes Network, Belief Nlw, caried as Nlw model.

* Bayesian Nlw are probabilistic because they are built from probability distribution.

2 types of probability

1. Join probability
2. conditional

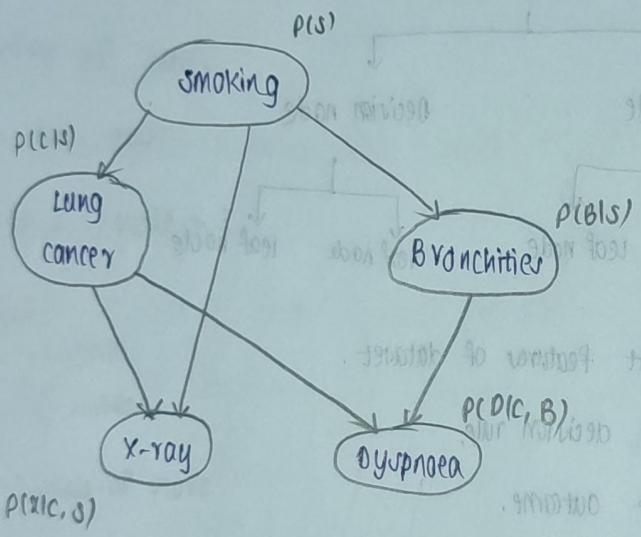
28/2/23

BAYESIAN NETWORK:

Structured Graphical representation of probabilistic relationship btw several random variables.

PROBABILITIES:

1. Joint probability
2. Conditional probability distribution (cpd)



BAYESIAN NETWORK (BN = G, θ)

G - Directed Acyclic Graph (DAG) nodes - random variables edges - direct dependencies

θ - set of parameters in all conditional probability Distribution (cpd)

cpd:-

C	B	D=0	D=1
0	0	0.1	0.9
0	1	0.7	0.3
1	0	0.8	0.2
1	1	0.9	0.1

0 - False, 1 - True

cpd of node X = P(X / parents(X))

X - random variable (smoking, lung cancer, Bronchities, X-ray, Dyspnoea)

compact representation of Joint Distribution in a product form

$P(S, C, B, X, D) = P(S)\, P(C/S)\, P(B/S)\, P(X/C,S)\, P(D/C,B)$

$= 1 + 2 + 2 + 4 + 4 = 13$ parameters instead of $2^5 = 32$