# K-Mean

Problem:

(2,3) (5,6) (8,7) (1,4) (2,2) (6,7)
(3,4) (8,6)

k=2

| x | y | $c_1 = \sqrt{(x-2)^2+(y-3)^2}$ | $c_2 = \sqrt{(x-5)^2+(y-6)^2}$ | Assignment |
|---|---|---|---|---|
| 2 | 3 | 0 | $\sqrt{18}$ | $c_1$ |
| 5 | 6 | $\sqrt{18}$ | 0 | $c_2$ |
| 8 | 7 | $\sqrt{52}$ | $\sqrt{10}$ | $c_2$ |
| 1 | 4 | $\sqrt{2}$ | $\sqrt{20}$ | $c_1$ |
| 2 | 2 | 1 | 5 | $c_1$ |
| 6 | 7 | $\sqrt{32}$ | $\sqrt{2}$ | $c_2$ |
| 3 | 4 | $\sqrt{2}$ | $\sqrt{8}$ | $c_2$ |
| 8 | 6 | $\sqrt{45}$ | $\sqrt{3}$ | $c_2$ |

$C_1 = \{(2,3), (1,4), (2,2), (3,4)\}$
$C_2 = \{(5,6), (8,7), (6,7), (8,6)\}$

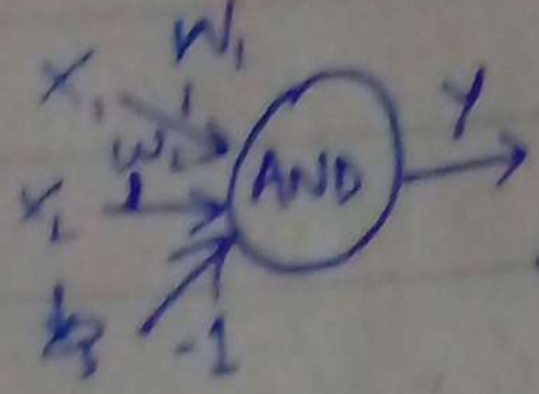
find out mean:

$C_1 = \left\{ \frac{2+1+2+3}{4}, \frac{3+4+2+4}{4} \right\} = (2, 3.25)$

$C_2 = \left\{ \frac{5+8+6+8}{4}, \frac{6+7+7+6}{4} \right\} = (6.27, 6.5)$

# NEURAL NETWORK

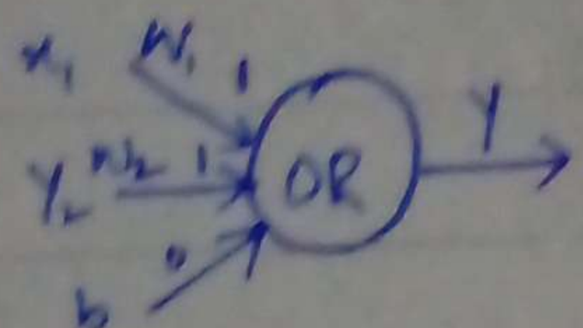
Implement And and OR Using Single Neuron:




$$y = \begin{cases} 0 & \text{if } w \cdot x + b \leq 0 \\ 1 & \text{if } w \cdot x + b > 0 \end{cases}$$

$$y = w_1 x_1 + w_2 x_2 + b$$

$$y = (1)(0) + (1)(1) - 1 = 0$$




F.P = Forward propogation
B.P = Backward propogation

$$Z = \Sigma x w + b$$

$$A = \sigma(Z) \doteq \hat{y}$$

$$Z_1^{[1]} = (W_1^{[1]})^T X + b_1^{[1]}$$

$n \times m$

↙ features ↘ Training Examples

Regression :-

Mapping your independent variable (x) to dependent variable (y)

Regression can be use for both classification and Prediction.

Two Types:

1:- Linear Regression

2:- Logical Regression.

| | Height | Age | Weight | Distance |
|---|---|---|---|---|
| $P_1$ | 6 | 46 | 60 | 3.066 |
| $P_2$ | 6.11 | 26 | 55 | 9.004 |
| $P_3$ | 5.9 | 36 | 56 | 7.00 |
| $P_4$ | 5.8 | 32 | 58 | 5 |
| $P_5$ | 5.3 | 33 | 75 | 4.097 |
| $P_6$ | 5.6 | 34 | 78 | 3.066 |
| $P_7$ | 5.5 | 35 | 80 | 2.02 |
| $P_8$ | 5.8 | 37 | ?? | |

$$\frac{P_1 + P_6 + P_7}{3} = \frac{3.066 + 3.066 + 2.02}{3} = 2.71$$

$$= \frac{60 + 78 + 80}{3} = 72.66$$

| X | Y |
|---|---|
| 1 | 3 |
| 2 | 4 |
| 3 | 2 |
| 4 | 4 |
| 5 | 5 |
| $\bar{x}=3$ | $\bar{y}=3.6$ |

$$m = \frac{\Sigma(x-\bar{x})(y-\bar{y})}{\Sigma(x-\bar{x})^2} \rightarrow (A) \qquad m = 0.4$$

$$y = mx + c$$

$$3.6 = (0.4)(3) + c$$

$$\boxed{c = 2.4}$$

$$y = 0.4x + 2.4$$

$$\hat{y} = \{2.8, 3.2, 3.6, ?, 4.4\}$$

$$\text{Loss} = \hat{y} - y$$

$$R^2 = \frac{\Sigma(y_p - \bar{y})^2}{\Sigma(y-\bar{y})^2}$$

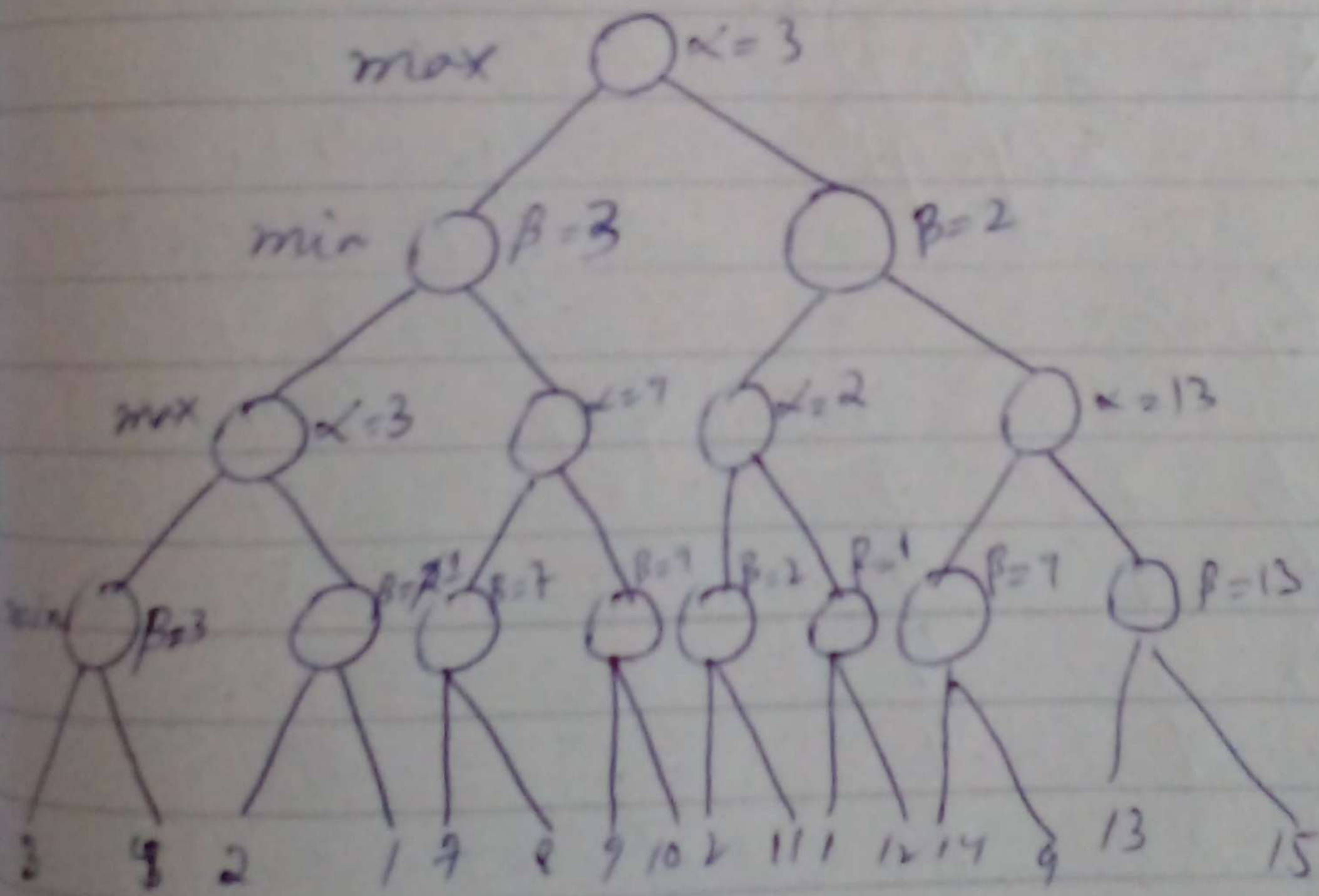
Given:

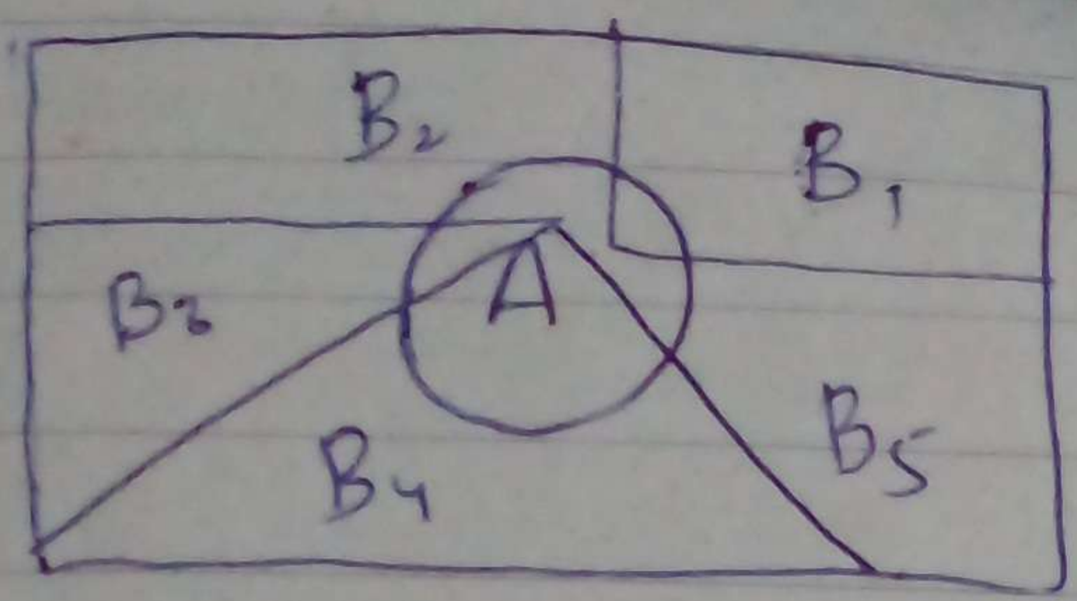
| | $x_1$ | $x_2$ | Group | Distance |
|---|---|---|---|---|
| $d_1$ | 7 | 7 | $a_1$ | 4 |
| $d_2$ | 7 | 4 | $c_2$ | 5 |
| $d_3$ | 3 | 4 | $c_1$ | 3 |
| $d_4$ | 1 | 4 | $c_1$ | $\sqrt{13}$ |
| $d_5$ | 3 | 7 | ?? | |

$$E.D = \sqrt{(x-x_i)^2 + (y-y_i)^2}$$

$P(D/P_1) = 0.01$
$P(D/P_2) = 0.03$
$P(D/P_3) = 0.02$
If a random product is observed and found to be defective, which plan was most likely used ~~for~~ this and thus responsible.

Revision:-






$$P(A) = \sum_{i=1}^{5} P(B_i \cap A) = \sum P(A/B_i) P(B_i)$$

Baye's Theorem:-

If the event $B_1, B_2 \ldots B_k$ constitute a postition of the sample space S such that $P(B_i) \neq 0$ for $i = 1, 2 \ldots k$ then for any event A in S such that $P(A) \neq 0$

$$P(B_2/A) = \frac{P(B \cap A)}{\sum P(B_i \cap A)} = \frac{P(B_2) P(A/B_2)}{\sum P(B_i) P(A/B_i)}$$

Statement:-

A Manufacturing firm employees three analytical plan for the design and development of the product for cost reason, all are used plan 1, 2, 3 are used 30%, 20% & 50% of the products the defect rate is different for three product which are as follows

Problem:

| | Data Scientist | Software Engineer | Total |
|---|---|---|---|
| male | 460 | 40 | 500 |
| female | 140 | 260 | 400 |
| Total | 600 | 300 | 900 |

M - A man is chosen for interview
DS - the one chosen is data scientist

$$P(DS) = \frac{600}{900} = \frac{2}{3}$$

$$P(M \cap DS) = \frac{460}{900} = \frac{23}{45}$$

$$P(M|DS) = \frac{P(M \cap DS)}{P(DS)}$$

$$= \frac{23/45}{2/3} = \frac{23}{30}$$

Home tasks :-

What is mean by $\propto$ in Probability.

## Conditional Probability :-

$$P(A/B) = \frac{P(A \cap B)}{P(B)} \quad -(1)$$

$$P(B/A) = \frac{P(B \cap A)}{P(A)} \quad -(2)$$

$$P(A/B)P(B) = P(B/A)\,P(A)$$

---

Problem : 04

Finance = 26
Mechanical = 12
Electronic = 13
Total = 51

Randomly chosen belong electronic = ?

$26+12+13$
$51$

$\frac{13}{51}$

Problem: 1

Three Awards will be given one year for a class of 25 graduates.

$$\binom{n}{x} = \frac{n!}{(n-x)!} = \frac{25}{(25-3)!} = 25 \times 24 \times 23 = 13800$$

Problem: A

A dice is rolled in an experiment in which even number is twice likely to occur or odd number. If E is an event that shows number less than 4 occurs. Find P(E).

$$\frac{(E) = 6}{6} \qquad 0 = \frac{2}{6} \qquad \Theta = \{1, 2, 3, 4, 5, 6\} = 9$$

$$\Theta = \{1, 2, 3\} = \frac{1}{9} + \frac{2}{9} + \frac{1}{9} = \frac{4}{9}$$

Problem B:-

If A is the event that represents even number and B is the event that represents number divisible by 3. Find P(A∪B) and P(A∩B)

$$A = \{2, 4, 6, 8, 10, 12, 14, 16\} \qquad P(A \cup B) = 5/6$$

$$B = \{3, 6, 9, 12, 15, 18 \dots\}$$

$$P(A \cup B) = \{2, 3, 4, 6, 8, 9, 10, 12\} \qquad P(A \cup B = \frac{8}{9} = \frac{1}{3}$$

$$P(A \cap B) = \{6, 12, 18 \dots\} \qquad P(A \cap B) = \frac{1}{6} \qquad P(A \cap B) = \frac{2}{9}$$

# GAME THEORY

→ Science of Strategies
→ Players :- (for AI players is Agents)
→ Actions
→ Pay off (Preferences)
→ Oligopoly Behaviour

| | 7 | 5 |
|---|---|---|
| 7 | 15 15 | 15 30 |
| 5 | 30 5 | 10 10 |

## SAMPLE SPACE :-

$S_1 = \{H, T\} = 2^1 = 2$

$S_2 = \{HH, TT, HT, TH\} = 2^2 = 2$

$S_3 = \{HHH, TTT, HHT, \cdots\} = 2^3 = 8$

Dice :-

$S_1 = \{1, 2, 3, 4, 5, 6\} = 6^1 = 6$

$S_2 = \{(1,1), (2,2), (3,3) \cdots\} = 6^2 = 36$

$S_3 = \{(1,1,1), (2,2,2), (3,3,3), \cdots\} = 6^3 = 216$

1:- A'

2:- $A \cap B$

3:- $A \cap B = \phi$

4:- $A \cup B$

Permutation $= \binom{n}{r} = \frac{n!}{(n-r)!}$

Combination $= \binom{n}{r} = \frac{n!}{r!(n-r)!}$

# CRYPTARITHMATIC

0 - 9

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | S | E | N | D | | S | 9 |
| + | M | O | R | E | | E | 5 |
| | | | | | | N | 6 |
| M | O | N | E | Y | | D | 7 |

| | |
|---|---|
| M | 1 |
| O | 0 |

| | |
|---|---|
| K | 8 |
| Y | 2 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| S | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| E | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| N | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| D | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| M | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| O | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| R | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Y | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |

1:

$X = \{Ahmed\}$

$D = \{Industry, Time, Age, Experience\}$

Constraint :-

1:- No worker work more than 9 hours per day.

2:- There is should not be more than 3 leave on a month.

3:-

$X = \{Image1, Imag2, \ldots Image1000\}$

$D = \{Wheat\ field, Rice\ field\}$

Constraint:
1:- unary
2:- binary
3:- High Order

Robotic Arm Constraint:-

CSP Problem:

- Develop a CSP problem for a worker of automobile Industry
- Develop a CSP problem for a class Timetable of 6B-BCS
- Develop a CSP problem for a robot navigating an agriculture field.

2:-

X = {AI, TBW, CN, DSc, SE, CN lab, AI lab}

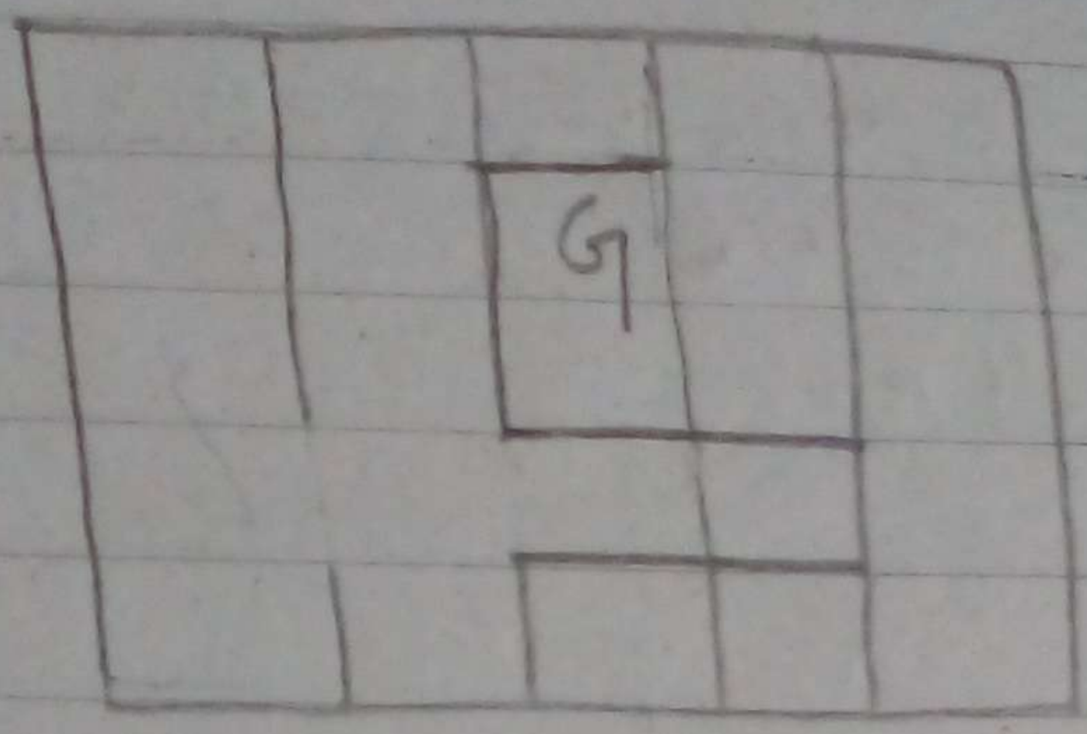
D = {Tawakh, Atifa, Eman, Sohail, M. Sohail, Rabia, Mufaza}

D = {8-9, 9-10, 10-11, 11-12, 12-1; 1-2, 2-3, 3-4}

Constraint:-

1:- lab should be 3 hours
2:- NO classes before 8 and after 4.
3:- There is no clashes of a class.
4:- Atleast 1 gap per day.

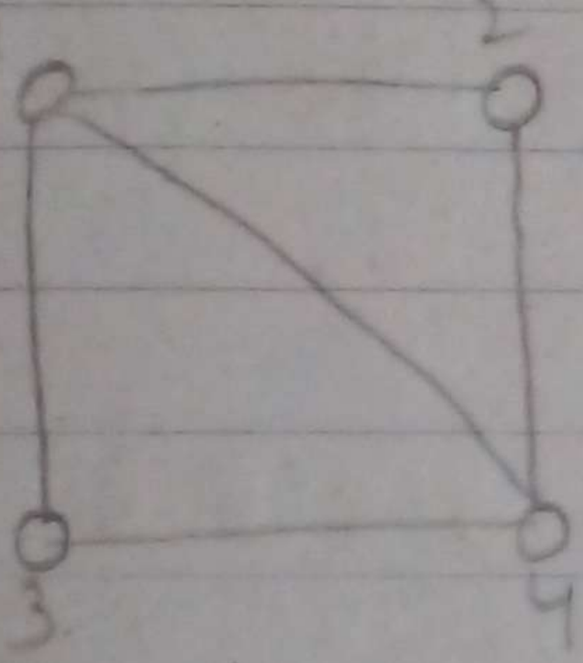
# BFS




15. March - 2022

## Constraint Satisfaction Problem (CSP)

Problem:




X = variables

D = Domain

C = constraint

$X = \{1, 2, 3, 4\}$

$D = \{R, G, B\}$

$C = \{1 \neq 2, 1 \neq 3, 1 \neq 4, 2 \neq 4, 3 \neq 4\}$

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Domain | RGB | RGB | RGB | RGB |
| 1 = R | R | GB | GB | GB |
| 2 = G | R | G | GB | B |
| 3 = G | R | G | G | B |

$C_4$ | 1 | 1 | 1 | 1 |

value of A + value of B + value of C + value of D

$= 12 + 5 + 10 + 7 = 34$

Weight of A + weight of B + weight of C + weight of D

$= 5 + 3 + 7 + 2 = 17$ kg

Since, 17kg > 12kg

$C_4$ is not selected.

Step 3:- Selection:-

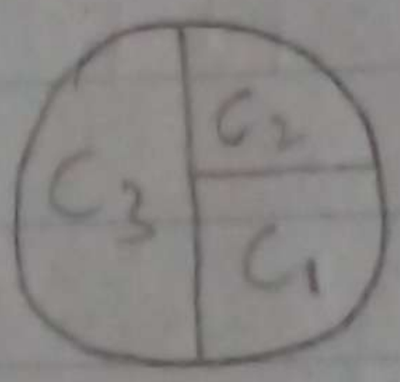
Total Fitness = value of $C_1$ + value of $C_2$ + value of $C_3$

$= 15 + 12 + 24 = 51$

$C_1 = 15/51$

$C_2 = 12/51$

$C_3 = 24/51$




Step 4:- Cross Over

$C_3$ | 1 | 1 | 0 | 1 | → | 1 | 1 | 0 | 0 | $OC_3$

$C_1$ | 0 | 1 | 1 | 0 | → | 0 | 1 | 1 | 1 | $OC_1$

$C_3$ | 1 | 1 | 0 | 1 | → | 1 | 1 | 0 | 1 | $OC_3$

$C_2$ | 0 | 1 | 0 | 1 | → | 0 | 1 | 0 | 1 | $OC_2$

Step 2:- Fitness function

| | A | B | C | D |
|---|---|---|---|---|
| $C_1$ | 0 | 1 | 1 | 0 |

value of B + value of C

= 5 + 10 = 15

weight of B + weight of C

= 3 + 7 = 10kg

Since, 10kg < 12kg

$C_1$ is accepted

| | | | | |
|---|---|---|---|---|
| $C_2$ | 0 | 1 | 0 | 1 |

value of B + value of D

= 5 + 7 = 12

weight of B + weight of D

= 3 + 2 = 5kg

Since, 5kg < 12kg

$C_2$ is accepted.

| | | | | |
|---|---|---|---|---|
| $C_3$ | 1 | 1 | 0 | 1 |

value of A + value of B + value of D

= 12 + 5 + 7 = 24

weight of A + weight of B + weight of D

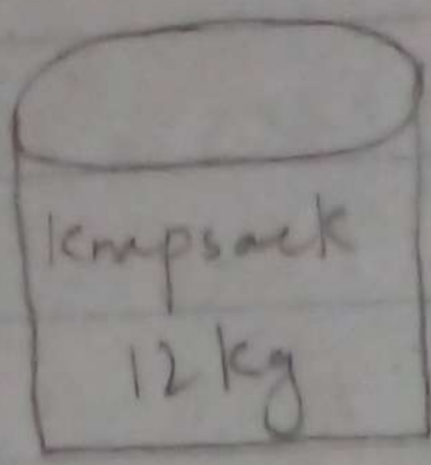
= 5 + 3 + 2 = 10kg

Since, 10kg < 12kg

$C_3$ is accepted

# Genetic Algorithm

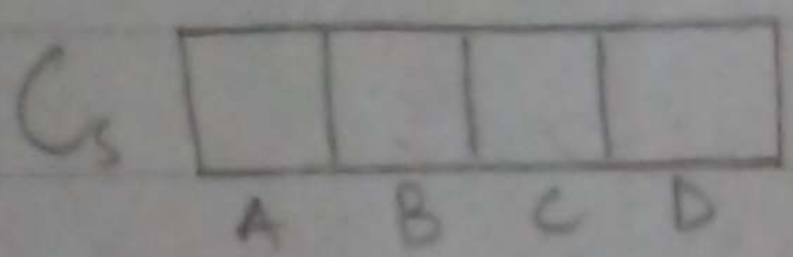
| Item | W | Price |
|---|---|---|
| A | 5 | 12 |
| B | 3 | 5 |
| C | 7 | 10 |
| D | 2 | 7 |




Problem :- Max the capacity without breaking using GA

- Solution :-

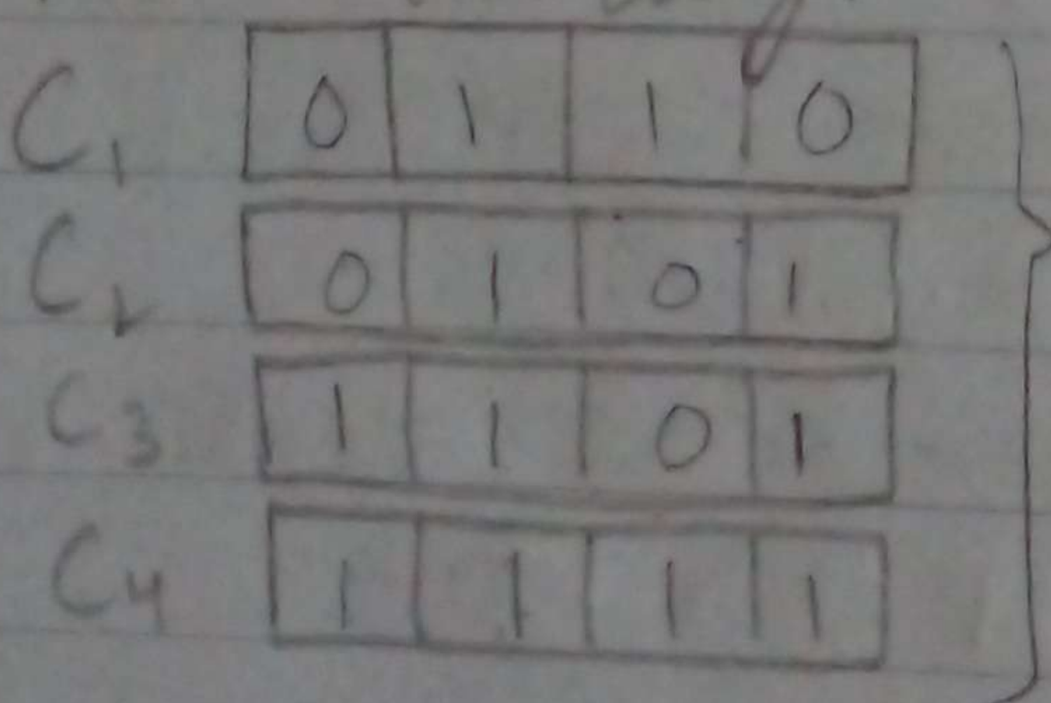
Step 1 :- Chromosone Encoding




Gene → 0 → Absence of an item
1 → Presence of an item

4 bits set space $2^4 = 16$

Now Encoding :



①

$S \rightarrow B$

$g(B) = 4$

$h(B) = 12$

$f(S \rightarrow B) = 16$

$S \rightarrow C$

$g(C) = 3$

$h(C) = 11$

$f(S \rightarrow C) = 14$ ✓

②

$SC \rightarrow D$

$g(D) = 3+7 = 10$

$h(D) = 6$

$f(SC \rightarrow D) = 10+6 = 16$ ✓

$SC \rightarrow E$

$g(E) = 3+10 = 13$

$h(E) = 4$

$f(SC \rightarrow E) = 13+4 = 17$

③

$SCD \rightarrow E$

$g(E) = 3+7+2 = 12$

$h(E) = 4$

$f(SCD \rightarrow E) = 4+12 = 16$ ✓

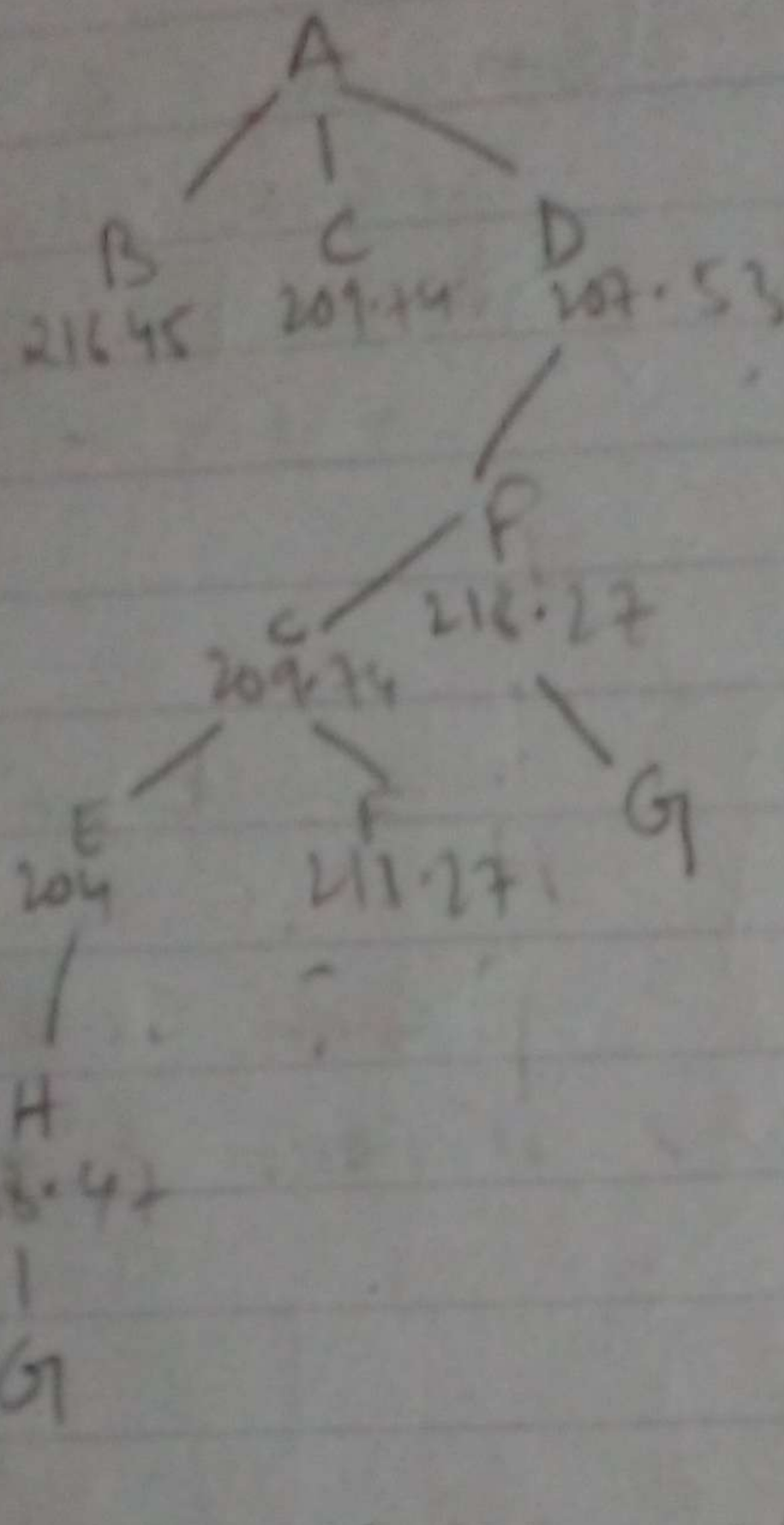
④

$SCDE \rightarrow G$

$g(G) = 3+7+2+5 = 17$

$h(G) = 0$

$f(SCDE \rightarrow G) = 17+0 = 17$



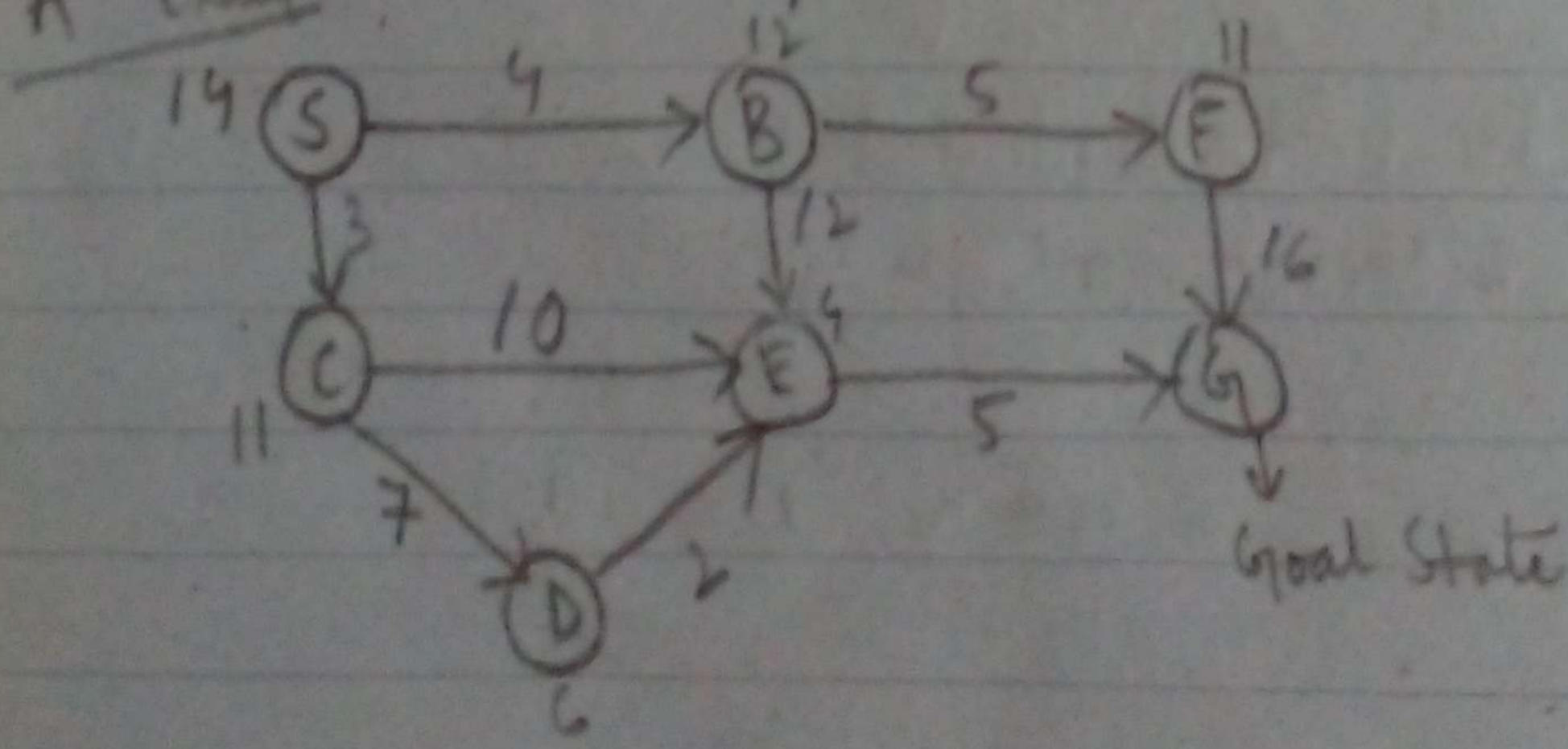

A Star Algorithm :-

$f(n) = g(n) + h(n)$

↳ heuristic value

link to respective cost

A* Example :-

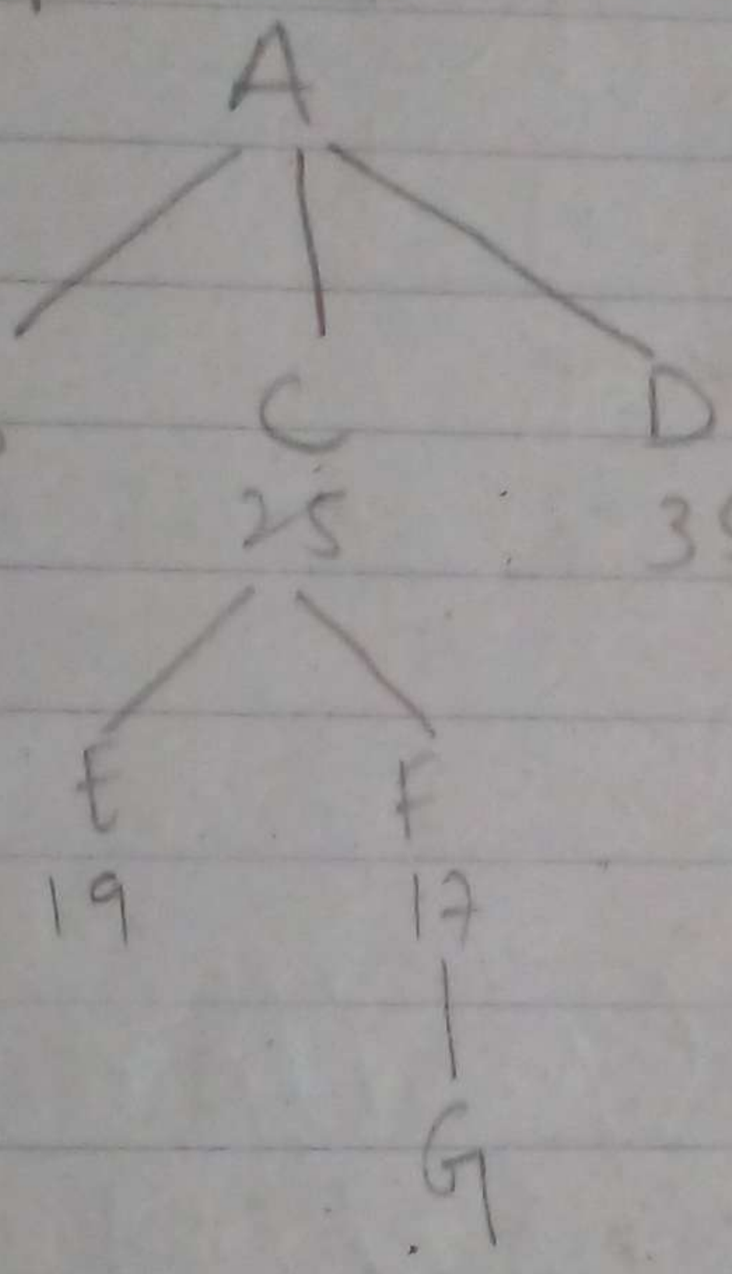


3:- BI Directional search-

LSTM =

Use in Signal Music production

BFS examples-




heuristic (h) value Given

when point is Given the H-Value is

A-G = 220.02

B-G = 216.45

C-G = 209.74

D-G = 207.53

E-G = 204

F-G = 218.22

H-G = 268.47

Heuristic Approach:

. check Distance formula from Google.

→ Distance

- Cosine
- Correlation
- City Block
- Manhattan Distance

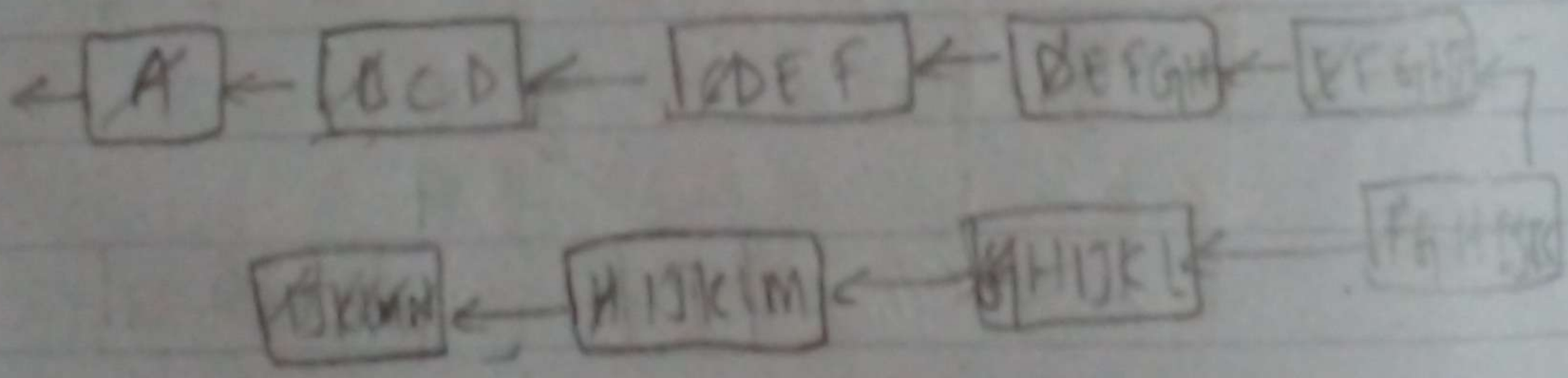
Measuring Problem solving performance:

1:- Completeness
2:- Cost optimality
3:- Time complexity
4:- Space complexity

Types of Search

1:- Uninformed Search
2:- Informed Search (heuristic Information)

1:- BFS (Breadth First Search)




2:- DFS (Depth first search)

6 State for solving Problem:

1:- State

2: Initial State

3: Actions

4: Transition Model

5:- Goal States

6:- Action Cost

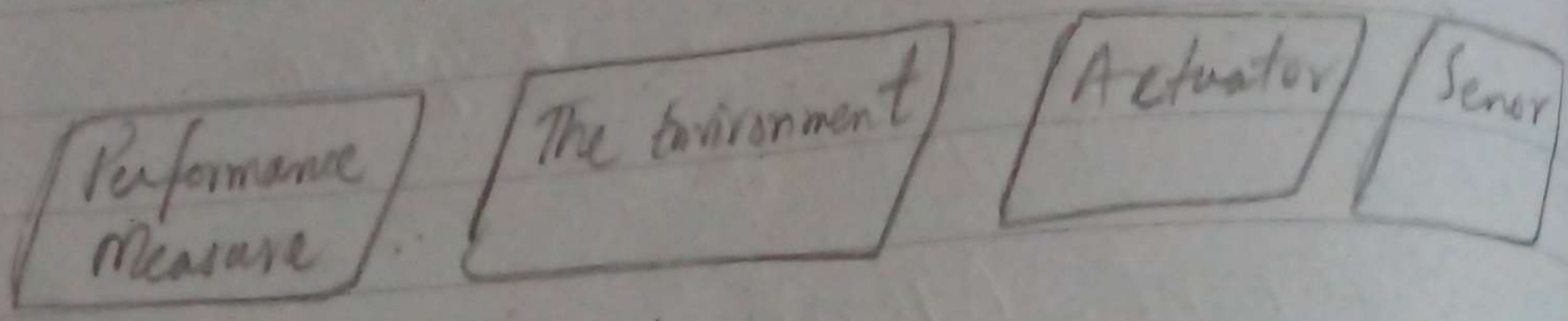
Develop Model for Robot Navigation

| | |
|---|---|
| S | Home |
| I.S | Room to Room |
| A | Left, Right, forward |
| T.M | Navigate through Room to Room |
| G.S | Reach the anothe room |
| A.C | Time |

Search Algorithm:-

1:- frontier :- Path which we select for to reach the destination

## Task Environment :-




## Properties of Task Environment :

1. Fully observable vs Partially observable
2. Deterministic vs stochastic (Random)
3. Episodic vs Sequential
4. Discrete vs continuous
5. Single vs Multi Agent

## Agent = Architecture + Program

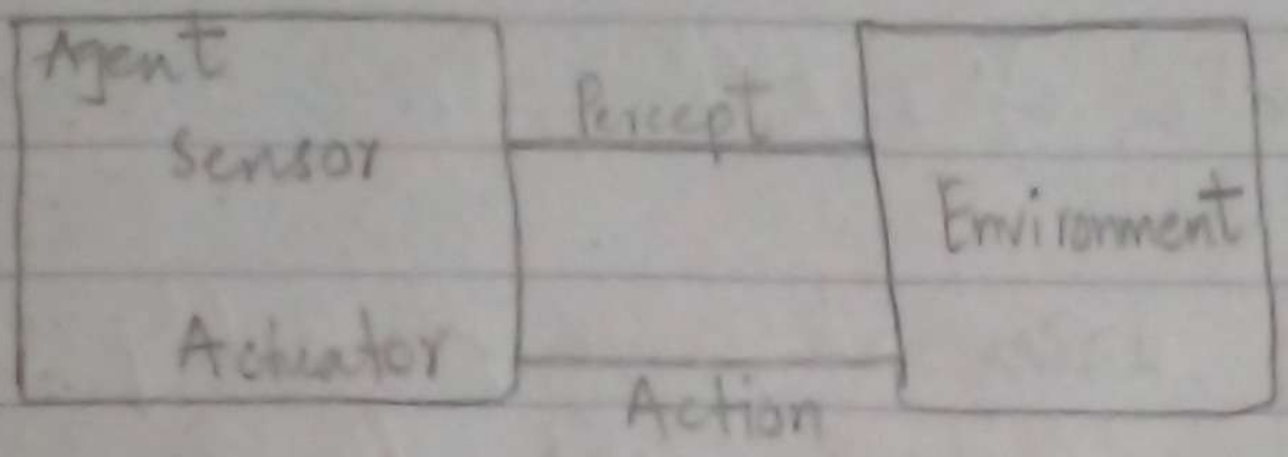
### Agent Programs :

- simplex Reflex Agent (if x happen, do y)
- Model Based Reflex Agent (maintain history)
- Goal Based Agents (set a single goal)
- utility Based Agents (best way to perform task)
- learning Agents (Take decision & for that le

The Turing Approach:

interrogator — [ AI System
                Human ]

Intelligent Agent :-




e.g:
Human Agent
Robotic Agent
Software Agent

Agent Function:-
We have a input & a output.

Rationality factor:-

1:- Performance measures that define the criterion of success.
2:- The agent prior knowledge of the environment
3:- The action that agent can perform.
4:- The agent's percept sequence to date.

# AI

Intelligence :
- Self awareness
- reasons
- Knowledge

Types of Solution :
1:- Algorithmic (Step by step)
2:- Heuristic (Training or experience)
Steps to make a Tea :-
1:- Go to the Kitchen take a pan
2:- Add some water on it
3:- Then add sugar, milk
4:- Put the pan into the stove

→ Mathematical Formula of Intelligence

$$F = T \nabla S_t \rightarrow \frac{\partial}{\partial t}$$

F → force
T → strength
$S_t$ → Action

Concept of Rationality :

- A system is rational if it does the "Right Things".