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Introduction to Artificial Intelligence.

* Artificial Intelligence is concerned with design of intelligence in an artificial device.

* Intelligence and artificial devices are two basic components of AI concept.

* Artificial devices should have the property of intelligence as human beings i.e It acts as human and think like human, those devices must understand how to immitate human thought process.

* Approaches to AI :-

1. Strong AI
2. Weak AI
3. Applied AI
4. Cognitive AI

1. Strong AI :-

AI which thinks freely is called strong AI. It aims to build machines that can truely listen and solve problem.

These machines should be self aware and their overall intellectual ability needs to be identical from that of a human being.

2. Weak AI :

It refers to the technology that is able to manipulate pre determined rules and apply the rules to reach a well defined goal.

3. Applied AI :-

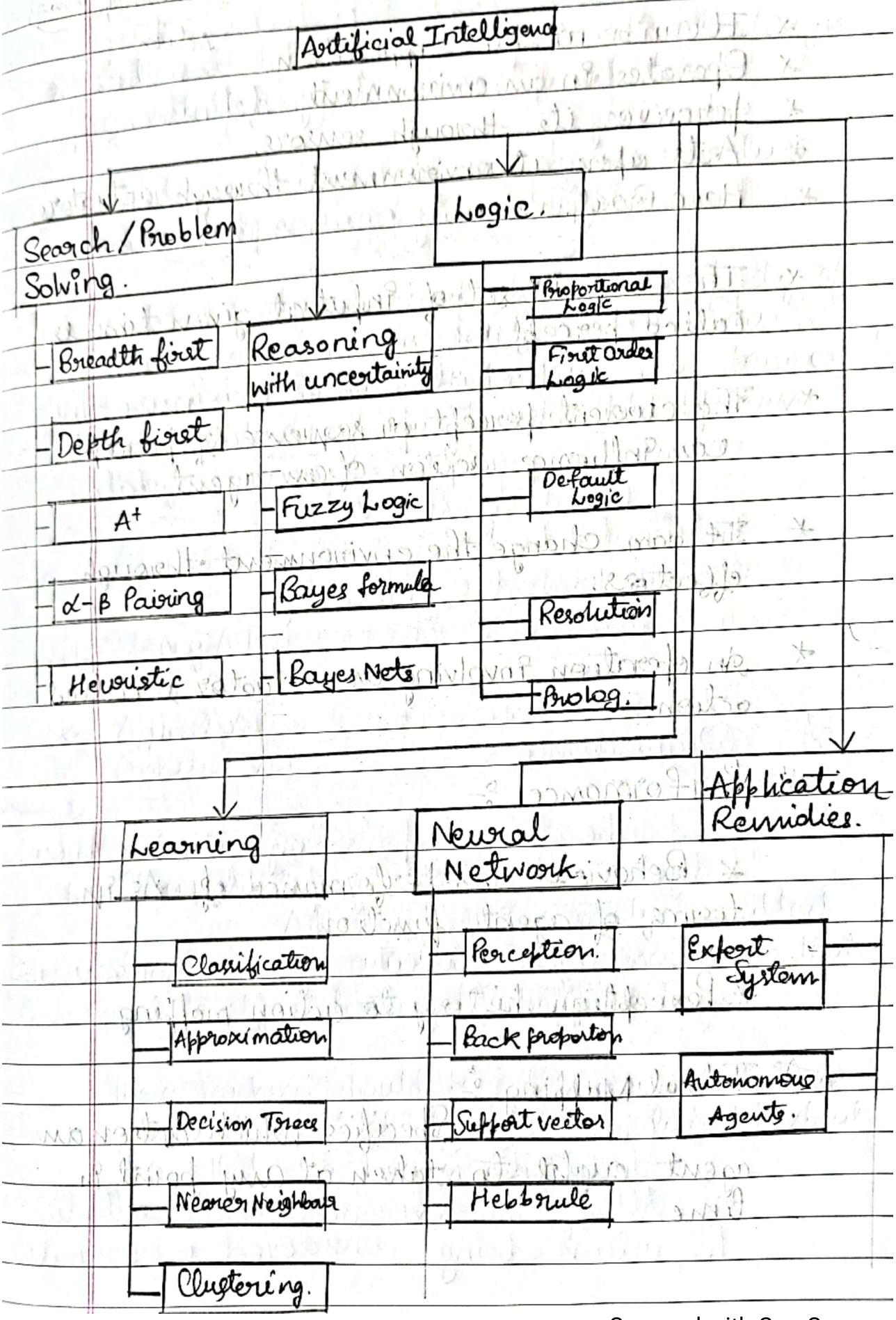
This type of approach produces commercially feasible i.e smart system such as a security system i.e able to identify faces of people who are permitted to enter a particular building.

4. Cognitive AI :

In this approach computers are used to test theories about how the human mind works

Eg: Theories about how we distinguish faces and other objects about how we solve problems

Components of AI :-



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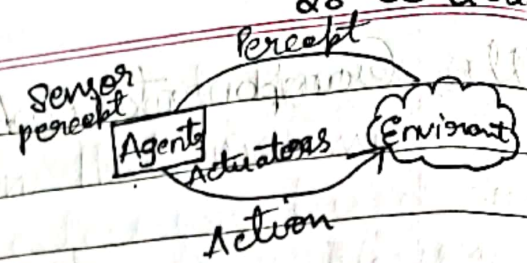

★ Agents :-

* It can be machine application.
* Operates in an environment.
* perceives its through sensors.
* Acts upon its environment through actuators
* Have Goal.

* The Complete set of input at given time is called percept.

* The current percept or sequence of percepts can influence action of an agent

* It can change the environment through effectors.

* An operation involving an actuator is called action.

★ Performance :-

* Behaviour and performance of As in terms of agent function.

* Perception history to action mapping.

★ Ideal Mapping :-

Specifies which action an agent ought to taken at any point in time.

* Performance measure speed, power, usage, accuracy.

☆ Fundamental Facilities of Intelligence.

* Sensing
* Acting
* Understanding, reasoning, learning.

☆ Intelligent Agent.

* Must Sense
* Must Act
* Must be Autonomous
* Rational Agent.

☆ Rational Agent :-

* AI is about building rational agent
* An agent is something that perceive and act
* A rational agent is agent which does right thing.

Rationality

- Perfect Rationality
- Bounded Rationality.

* Assume that the rational agent knows all and will take the action that maximize utility.
* Human beings dont satisfy definition of rationality
* Bounded rationality guess & take action

☆ Rational Action :

The action that maximize the expected value of performance measure given the percept sequence to date

Rational = Best. ?
Yes, to the best of knowledge.

☆ Omniscience :

* Is the state of possessing ultimate knowledge about all thing possible.
* The religious aspect suggested omniscience is attribute of god.

☆ Environment.

* Observability
* Fully Observable
* All of the environment relevant to the action being considered is observable

* Partially Observable
* Deterministic
* Stochastic
* Strategic

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Types of Agents :-

1. Simple Reflex Agent
2. Model Based Agent
3. Goal Based Agent
4. Utility Based Agent
5. Learning Based Agent.

1. Simple Reflex Agent.

* Acts only on base of current percept
* The agents acts on the base of condition i.e based on condition-action rule
* If the condition is true then take action
* This agent function only succeeds when the environment is fully observed

2. Model Based Reflex agent :-

* A model based agent can handle partially observable environment.
* The agent has to keep track of Internal state.

3. Goal - Based Agents

* These kinds of agents take decisions based on how far they are currently from their goal.
* Their every action is intended to reduce its distance from the goal
* This allows the agent a way to choose among multiple possibilities selecting the one which reaches a goal state

4. Utility Based Agents :(UBA)

* When there are multiple posible alternatives, then to decide which one is best, UBA are used
* They choose actions based on performance for each state
* Sometime achieving the desired goal is not enough we may look for a quick safer, cheaper, trip to reach destination
* Agent happiness should be taken into consideration

5) Learning Agent :-

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Unit-2.

Problem Solving Agent

* PSA in AI is goal based agents that focus on goals

* Problem-solving agents decide what to do by finding sequence of actions.

* Algorithm for Simple Problem Solving Agent.

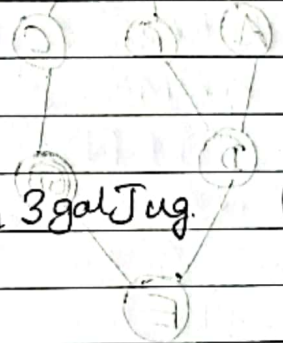
function Simple-Problems-Solving-Agent (percept) returns an action.
inputs: percept, a percept
Static: seq, an action sequence, initially empty
state, some description of the current world state
goal, a goal, initially null.
problem, a problem formulation.

State ← Update-State (state, percept)
if seq is empty then do
goal ← FORMULATE-GOAL (state)
problem ← FORMULATE-Problem (state, goal)
seq ← SEARCH (problem)
if seq = failure then return a null action.
action ← FIRST (seq)
seq ← REST (seq)
return action.

Eg: Water Jug Problem.

A water Jug Problem: You are given two jugs, a 4 l one & a 3 l one, a pump which has unlimited water which we can use to fill the jug and the ground on which water may be poured. Neither jug has any measuring marking on it. How can you get exactly 2 l of water in 4-l jug?

Steps:



Gals in 4 gal jug	Gals in 3 gal Jug	Rule Applied
0	0	
		1. Fill 4
4	0	
		6. Pour 4 into 3 to fill
1	3	
		4. Empty 3
1	0	
		8. Pour all of 4 into 3
0	1	
		1. Fill 4
4	1	
		6. Pour into 3.
2	3	

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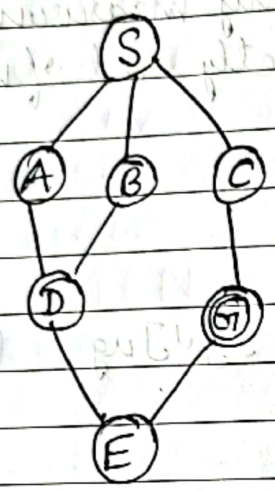
N-Queens Problem

* Uninformed Search.

1) BFS → Breadth First Search.



OPEN	Close
(S, nil)	
((A,S),(B,S),(C,S))	(S, nil)
((D,A),(B,S),(C,S))	((S,nil),(A,S))
((E,D),(B,S),(C,S))	(S,nil),(A,S),(D,A)
((G,E),(B,S),(C,S))	(S,nil),(A,S),(D,A) (E,D))

* Infrastructure for Search algorithms

1. N.state :- It is the state in the state place to which the node corresponds.

2. n.parent :- The node in the search tree that generated this node.

3. n.action :- The action that was applied to the parent to generate the node.

4. n.pathcost :- It is denoted by g(n) of the path from the initial state to the node as indicated by the parent pointers.

* Data structure use - Queue - First In First Out, Last in Firstout, Priority.

* Algorithm Performance :- ① Time complexity
② Space complexity
③ Completeness.
④ Optimality.

* BFS algorithm selects a single node in a graph and then visits all the nodes adjacent to the selected node.

* Total number of nodes generated -

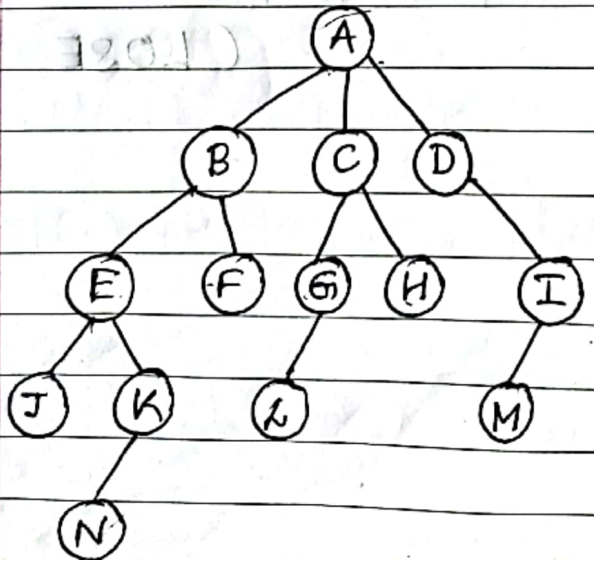
$$b + b^2 + b^3 + \cdots + b^d = O(b^d)$$

b - branching factor, d - depth.

* Problems with BFS

→ Memory Requirement.

Eg:-



OPEN

A

~~B~~ CD

~~C~~ DEF

~~D~~ EFGH

EFGHI

FGHIJK

GHIJK

HIJKL

IJKL

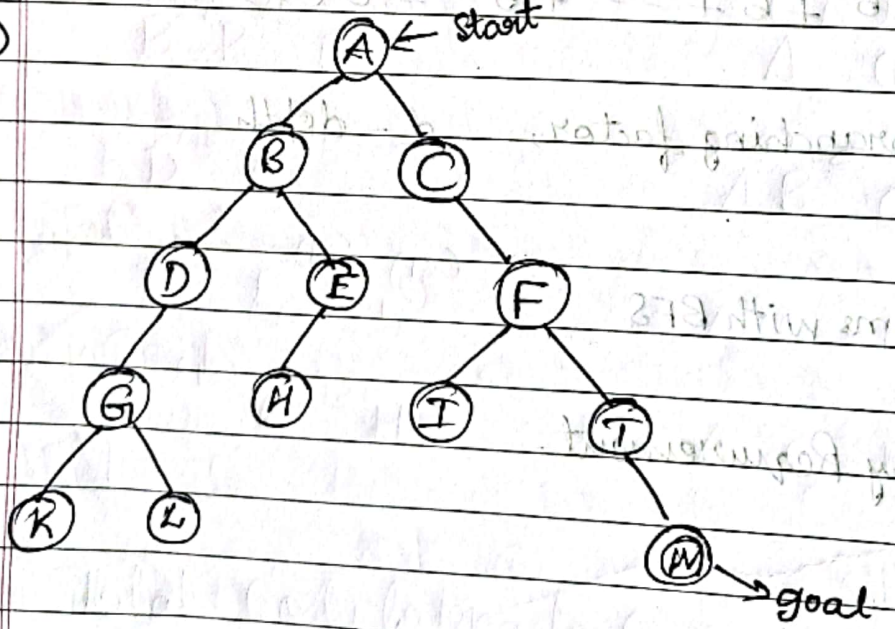
JKLM

KLM

MN

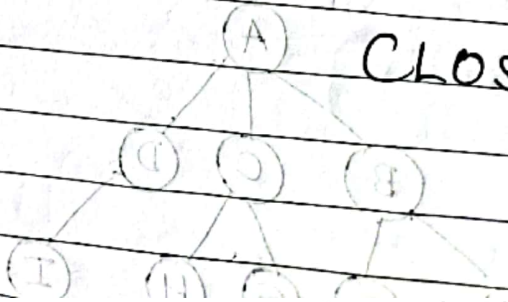
N

2)



OPEN

CLOSE



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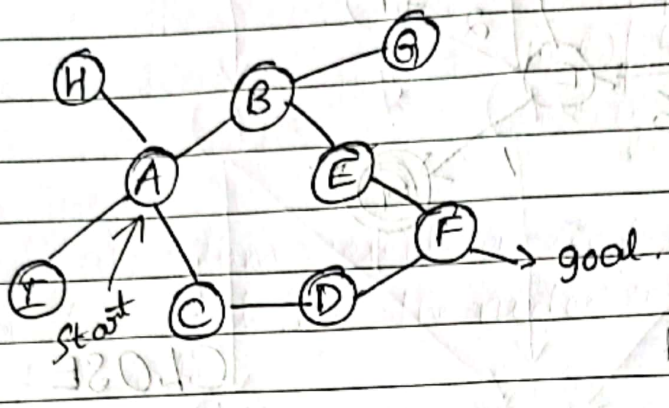

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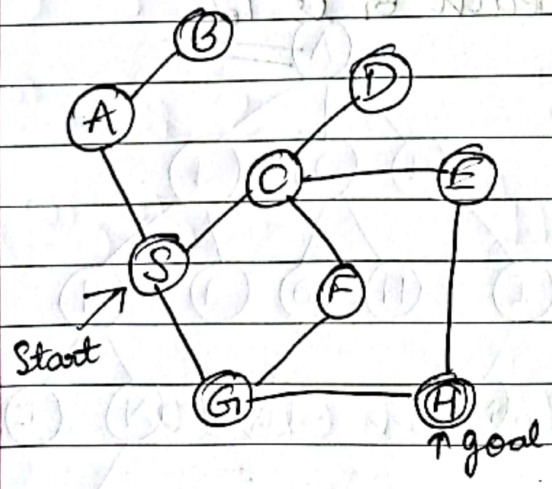

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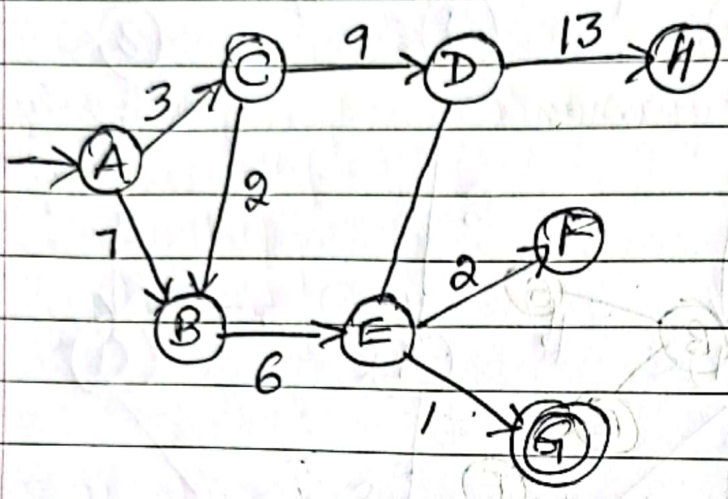
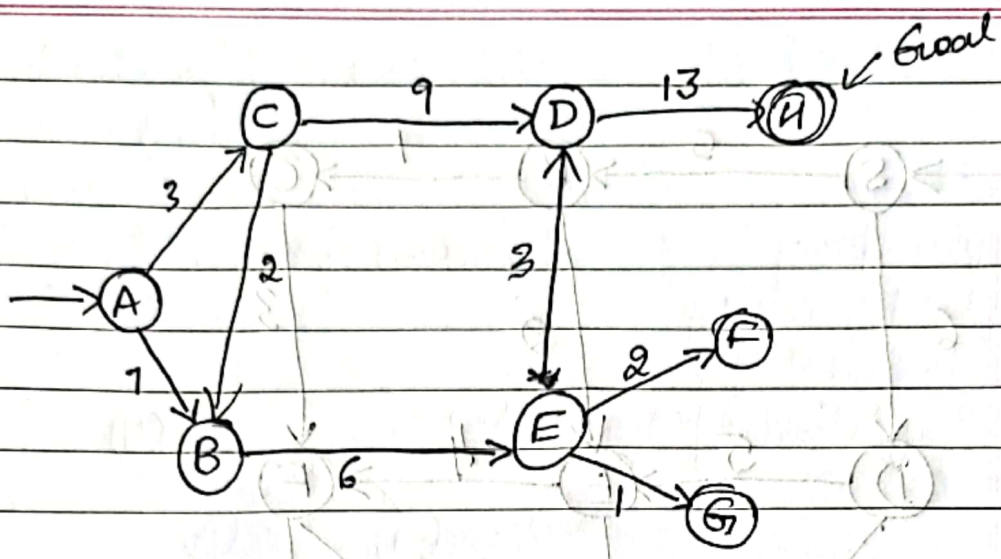
Uniform Cost Search :-

OPEN List is Priority Queue



OPEN	CLOSE
A^{0}	$A^{(0)}$
$B^{(7)}\ C^{(3)}$	$A^{(0)}\ C^{(3)}$
$B^{(2+3)}$ $D^{(3+9)}$ $B^{(7)}\ B^{(5)}\ D^{(12)}$	$A^{(0)}\ C^{(3)}\ B^{(5)}$
$D^{(12)}\ E^{(11)}$	$A^{(0)}\ C^{(3)}\ B^{(5)}\ E^{(11)}$
$D^{(12)}\ F^{(13)}\ G^{(12)}$	$A^{(0)}\ C^{(3)}\ B^{(5)}\ E^{(11)}\ D^{(12)}$
$F^{(13)}\ G^{(12)}\ H^{(25)}$	

Total Cost to reach G is 12

② 

OPEN

$A^{(0)}$

$B^{(7)}\ C^{(3)}$

$B^{(7)}\ B^{(5)}\ D^{(12)}$

$D^{(12)}\ E^{(11)}$

$D^{(12)}\ F^{(13)}\ G^{(18)}\ D^{(14)}$

$H^{(25)}\ F^{(13)}\ G^{(12)}$

CLOSE.

$A^{(0)}$

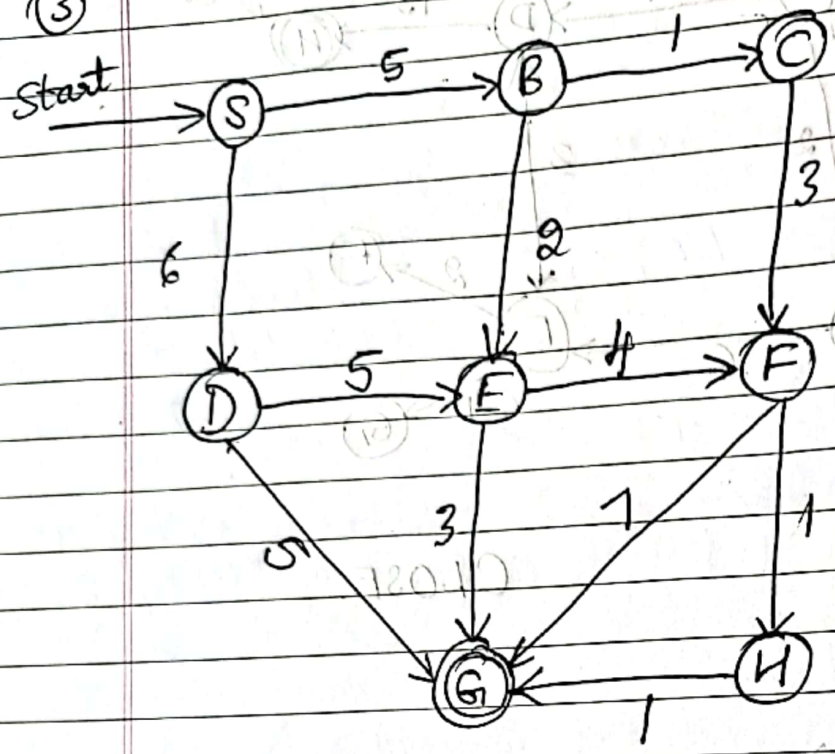
$A^{(0)}\ C^{(3)}$

$A^{(0)}\ C^{(3)}\ B^{(5)}$

$A^{(0)}\ C\ B\ E^{(11)}$

$A^{(0)}\ C\ B\ E\ D^{(12)}$

③



OPEN

$S^{(0)}$

$B^{(5)}$ $D^{(6)}$

$C^{(6)}$ $E^{(7)}$ $D^{(6)}$

$F^{(9)}$ $E^{(7)}$ $D^{(6)}$

$F^{(9)}$ $E^{(7)}$ $G^{(11)}$ $E^{(11)}$

$F^{(9)}$ $F^{(11)}$ $G^{(10)}$ $G^{(11)}$

$G^{(16)}$ $G^{(10)}$ $G^{(11)}$ $H^{(10)}$

CLOSE

$S^{(0)}$

$S^{(0)}$ $B^{(5)}$

$S^{(0)}$ $B^{(5)}$ $C^{(6)}$

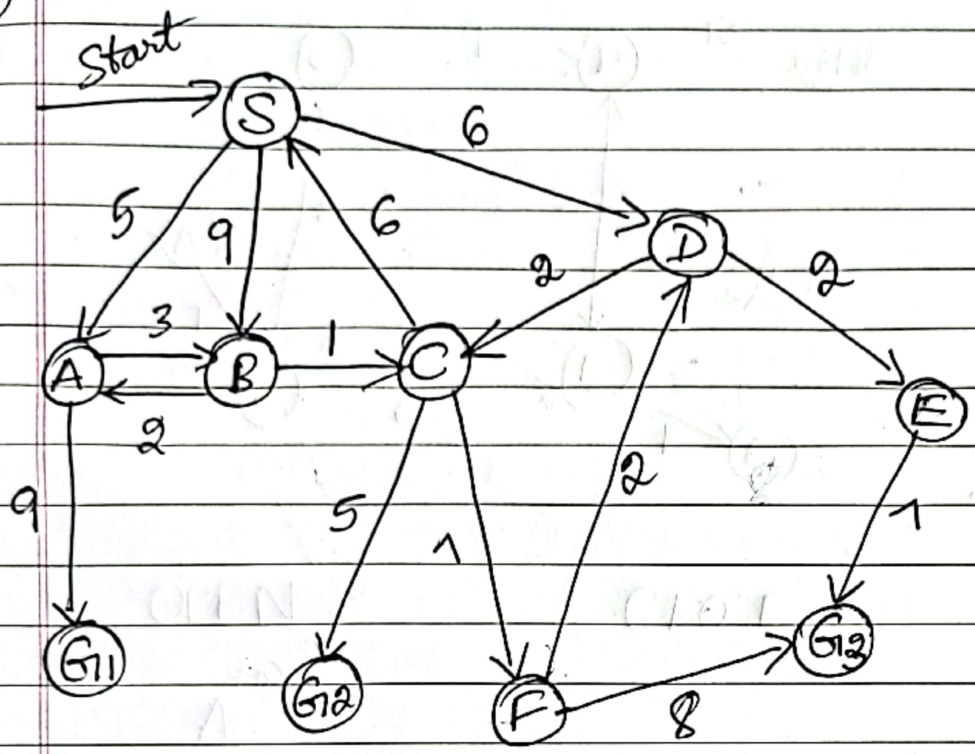
$S^{(0)}$ $B^{(5)}$ $C^{(6)}$ $D^{(6)}$

$S^{(0)}$ $B^{(5)}$ $C^{(6)}$ $D^{(6)}$ $E^{(7)}$

$S^{(0)}$ $B^{(5)}$ $C^{(6)}$ $D^{(6)}$ $E^{(7)}$ $F^{(9)}$

Total Cost to reach G = 10

(4)



G_1 - 14
G_2 - 13
G_3 - 15.