H. J. Thim Trust's

THEEM COLLEGE OF ENGINEERING

Date : _____

Assignment - 01

Q.1 Explain with suitable example of the concept of agent and environment in AI.

→ In AI, an agent is an entity that ~~pr~~ perceives its environment through sensors and acts upon it using actuators to achieve a goal. The environment that the agent interacts with, which provides inputs (perceptions) and receives outputs (actions).

Example : Self - Driving Car.

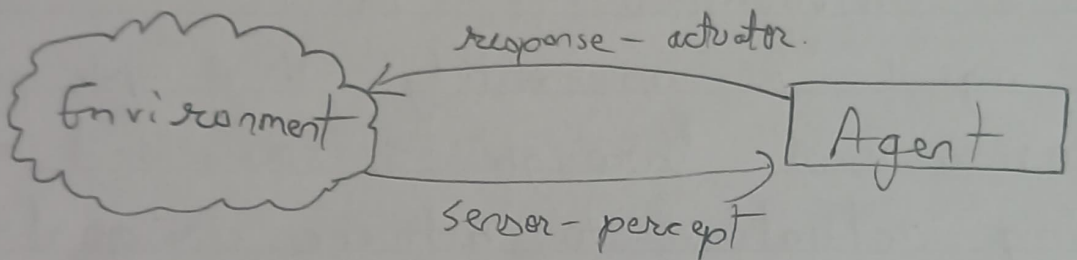
- Agent : The self - driving car
- Environment : The roads, traffic signals, pedestrians, weather conditions, and other vehicles.

How it Works : 1) The car (agent) perceives the environment using sensors (cameras, LiDAR, GPS, etc).

2) It processes this data and decides on an action (eg., stopping at a red light, slowing down for a pedestrian).

3) It executes the action using actuators (steering, acceleration, braking).

4) The environment responds (eg., other cars react, pedestrian crosses the road), and the process repeats.


response - actuator.
Environment
Agent
sensor - percept

Date :

This concept is fundamental in AI systems, from chatbots to robotics, where agents must interact with their environments to achieve specific goals.

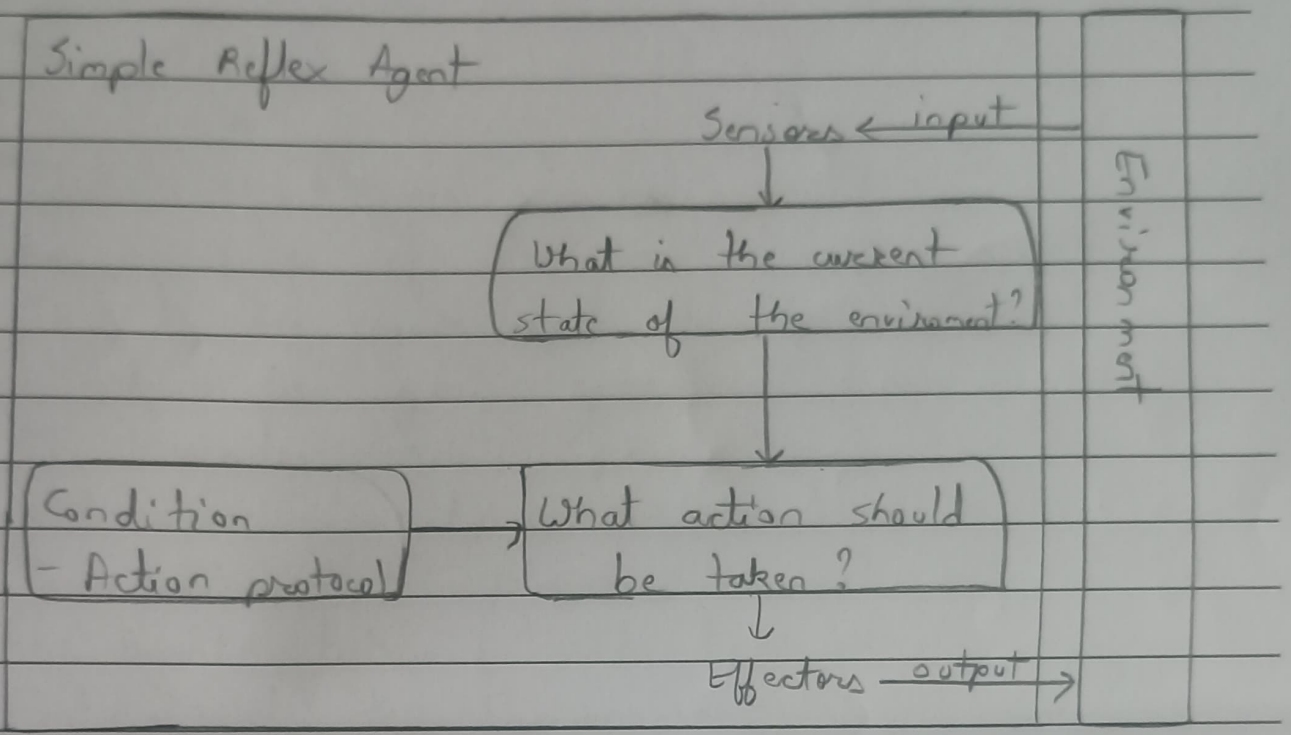
Q.2 List out various types of agents and explain simple reflex agent with suitable example.

⇒ Types of Agents in AI

1) Simple Reflex Agents - Act based on current perception without considering history.
2) Model- Based Reflex Agents - Maintain an internal model of the enviroment to handle partially observable situations.
3) Goal - Based Agents - Act to achieve specific goals, evaluating different possibilities.
4) Utility - Based Agents - Aim to maximize a utility function to chose the best action.
5) Learning Agents - Improve their performance over time by learning from past experiences.

Simple Reflex Agent :- It makes decisions based only on the current perception and follows predefined rules (condition - action rules). It does not store past data or predict future consequences.

Date :



- It is a totally uncomplicated type of agent. The simple reflex agent's function is based on the situation and its corresponding action (condition - action protocol). If the condition is true, then matching action is taken without considering the percept history.

Example - Automatic Door System

- Perception : Detects motion near the door.
- Rule : "If motion detected, then open the door."
- Action : Opens the door.

This type of agent works well in fully observable environments but fails in complex scenarios

where past data is crucial (eg. tracking multiple moving objects).

Q.3 Write short note on environment in AI and the features of the environment.

→ In AI, the environment is the external system in which an agent operates ≠ and interacts. It provides inputs (perceptions) to the agent and receives outputs (actions) from the agent. The environment plays a crucial role in defining the agent's behavior and decision-making process.

Features of the Environment:

1) Fully Observable vs Partially Observable
- Fully Observable : The agent has complete information about the environment (eg. Chess game).
- Partially Observable : The agent has limited information (eg. self-Driving car in fog.

2) Deterministic Vs. Stochastic
- Deterministic : The next state is completely determined by the current state & action. (eg. Tic-Tac-Toe).
- Stochastic : The outcome is uncertain and influenced by random factors (eg. Poker game)

3) Static Vs Dynamic
- Static : The environment does not change while the agent is deciding (eg. Crossword, Puzzle).
- Dynamic - The environment changes in real-time (eg. Stock market trading).

4) Discrete vs Continous
- Discrete: Limited number of possible actions and states (eg. Chess)
- Continous: Infinite possibilities for actions and states (eg. Driving a car).

5) Episodic Vs sequential
- Episodic - Each decision is independent of previous actions (eg. Image classification).
- Sequential: Past actions affect future decisions (eg. Playing a video game).

6) Single - Agent vs Multi - Agent.
- Single - Agent: Only one agent interacts with the environment (eg. , vaccum cleaner robot).
- Multi - Agent: Multiple agents interact and complete or collaborates (eg. online multiplayer games).

Date :

Q4 Compare modal base agent & goal base agent.

→

Features	Model-Base	Goal-Base
Definition	Maintains an internal model of the environment to handle partial observations.	Uses goals to make decisions & selects actions that lead to goal achievement.
Memory	Stores past information to ∄ infer unobservable states	Considers past & future possibilities to reach a goal.
Decision Making	Uses stored data to determine the best action in uncertain situations.	Evaluates different actions based on their contribution to achieving goal.
Adaptability	More flexible than simple reflex agents but doesn't necessarily plan ahead	More adaptive as it chooses actions dynamically to achieve goals.
Example	A self-driving car recognizing road conditions based on past sensor data.	A robotic delivery system planning the shortest path to deliver a package.

Date :

8.5 Explain with suitable example - Learning agent.

→ A learning agent is an AI system that improves its performace over time by interacting with its environment, gathering experiences, and adapting based on feedback. It consists of four key components:

1) Learning element - Improves the agent's knowledge based on past ~~exer~~ experiences.
2) Performace element - Makes ~~desion~~ decisions & takes actions.
3) Critic - Evaluates the agent's performace by comparing it to an ideal standard.
4) Problem generator - Suggests exploratory actions to enchance learning.

Example Self - Driving Car.

A self - driving car is a learning agent that continously improves its driving skills by processing data from sensors, cameras, & real-world experiences.

- Performance Element : It makes real - time decisions like stopping at a red light or slowing down in traffic.
- Learning element : Analyses past driving experiences to improve future decisions, such as recognizing pedestrians better.

- Critic : Evaluates actions by comparing them with traffic rules & expected outcomes.
- Problem ~~Creat~~ Generator : Encourages the car to explore new routes or optimize driving efficiency.

This learning process helps the car become more accurate and safer over time.

Q.6 Compare uninformed search with informed search technique.

→

Feature	Uninformed search	Informed search
Definition	Searches blindly without additional information about the goal.	Uses problem-specific knowledge to find solutions efficiently.
Use of heuristics	No heuristics, explores all possibilies equally.	Uses heuristics to guide the search.
Efficiency	Less efficient as it explores a large search space.	More efficient as it prioritizes promising paths.
Examples	Breadth - First Search (BFS), Depth - First Search (DFS).	A* Search, Greedy Best - First Search.
Time Complexity	Higher in complex problems due to	Lower as heuristics reduce unnecessary

Date :

	exhaustive search	exploration
Memory usage	Can be high depending on the strategy	Optimized based on heuristics, often requires less memory.
Optimality	Some (like UCS) guarantee optimal solutions.	Depends on the heuristic used.

8.7 Explain Problem Solving agent & formulation of problem.

→ -A problem - solving agent is a type of intelligent agent that finds a sequence of actions to achieve a specific ~~go~~ goal. It follows a well - defined process to explore possible solutions and select the best one.

-Example: A robot vaccum cleaner is a problem - solving agent that ~~determin~~ determines how to clean a room efficiently. It perceives obstacles, formulates the problem, ~~seach es~~ searches for an optimal path & executes the cleaning sequence.

- Formulation of a Problem is a process of defining a problem in a structured way, enabling an agent to search for a solution. It includes:

1) Initial state : The starting point of the agent.

Date :

2) Goal state: The desired outcome the agent want to achieve.
3) Actions: The set of possible moves the agent can take.
4) Transition model: Defines the outcome of taking an action from a given state.
5) Path cost: The cost associated with a sequence of actions.
6) Solution : A sequence of actions that lead ~~to~~ from the initial state to the ~~goa~~ goal state.

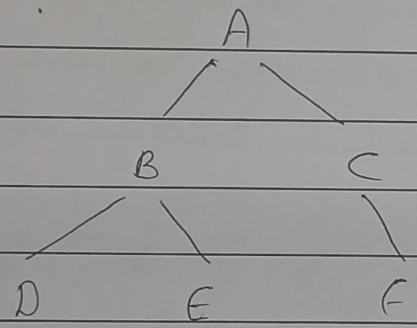
Example : Path finding in a Maze
- Initial state: The agent is at the ~~starting~~ position
- Goal state: The agent needs to reach the ~~exit~~ exit.
- Actions: Move left, right, up or down
- Transition Model - Moving in a direction results in the agent reaching a new position.
- Path cost : Each move might have a cost.
- Solution : The shortest ~~and~~ or most efficient path to the goal.

Date :

8.8 Give suitable example & explanation for Breadth First Search (~~BFG~~ ~~BFG~~ BFS) technique.

→ -Breadth First Search is an uninformed search algorithm that explores all the nodes at the current depth level before moving to the next level. It follows a FIFO (first-in-first out), queue structure to track nodes to be explored.

-Example:



If we start BFS from A & search for F, the search order will be:

1) Start at A, add neighbors B, C to the queue.
2) Visit B, add its neighbors D, E to the queue.
3) Visit C, add F to the queue.
4) Visit D, then E, but they don't have F.
5) Visit F, found the ~~goal~~ goal!

Path found: A → C → F (shortest path in terms of levels)

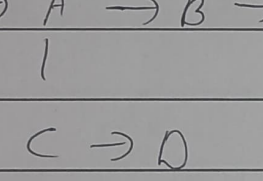
Date :

- Applications of BFS :- ① Shortest Path in Unweighted graphs.
② Web Crawlers (exploring links level by level)
③ AI & Game Development.
④ Network Broadcasting

Q.9 Give suitable example & explanation for Depth First Search (DFS) technique.

→ - Depth - First Search (DFS) is an uninformed search algorithm that explores as far as possible along on branch before backtracking. It uses a LIFO (Last - in, First - Out) stack structure to keep track of nodes to be explored.

- Example :- Maze solving



- ① Start at S, visit A (push A to the stack),
② From A, visit B (~~not~~ push B to the stack),
③ From B, visit E (goal found!).
If E wasn't directly reachable from B, B DFS would backtrack & explore C & D.

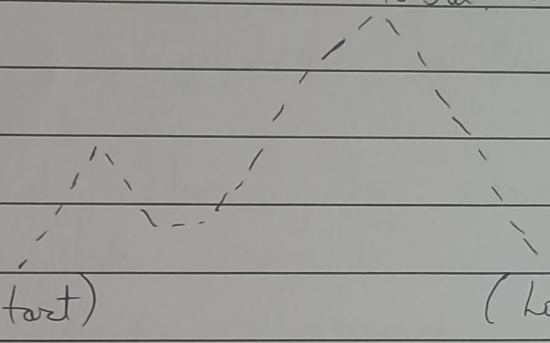
- Application of DFS: • Maze Solving
• Puzzle Solving
• Path finding in Graphs
• Web Crawling

Date :

Q.6 Illustrate Hill Climbing algorithm with suitable diagram & also discuss its limitation.

→ Hill Climbing is a heuristic search algorithm used for optimization problems. It continously moves in the direction of increasing value (higher elevation) to reach the peak (optimal solution).

- Example -



- The algorithm starts at a random point.
- It moves towards increasing elevation.
- It stops at a peak, assuming it's the best solution.
- Limitation of Hill Climbing:

(1) Local maxima: The algorithm may stop at a local maximum, missing the global best solution.

(2) Plateau Problem: If a region has constant elevation, the algorithm gets stuck because it sees no improvement.

(3) Ridges: The algorithm might struggle with ridges where the best move isn't straightforward.

Date :

i) No Backtracking: Once it moves up, it never goes down, even if a better peak exists.

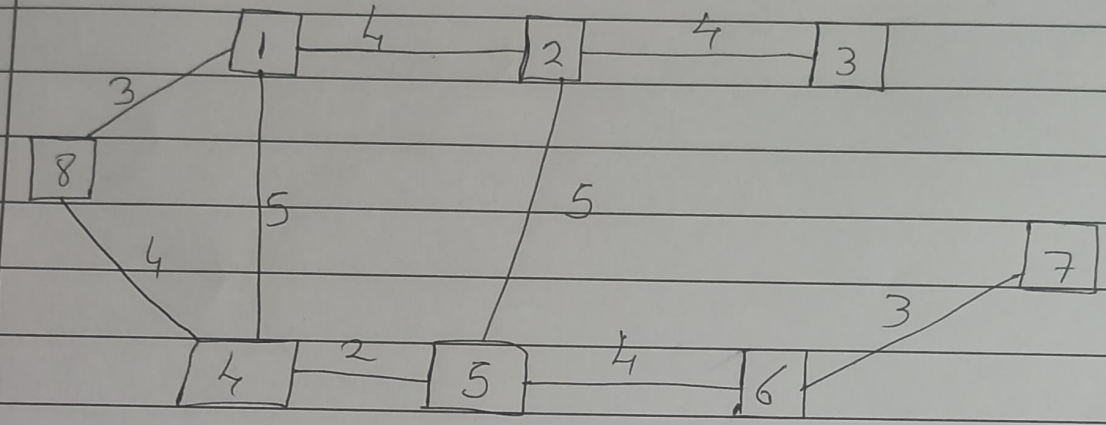
Q.11 Define state space search components.

⇒ State space search is a problem-solving approach where the agent explores a set of possible states to find a solution. The search process is guided by the following key components:

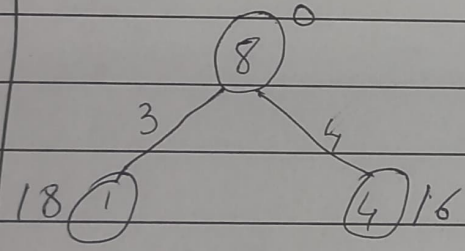
1) Initial state: The starting point of the problem.
2) Goal state: The desired end condition that the agent needs to reach.
3) State Space: The set of all possible states reachable from the initial state.
4) Actions: The set of legal moves or transitions available from a given state.
5) Transition Model: Defines how action lead from one state to another.
6) Path Cost Function: Assigns a cost to each path in the state space.
7) A Solution: A sequence of actions leading from the initial state to the goal state.

Date : _____

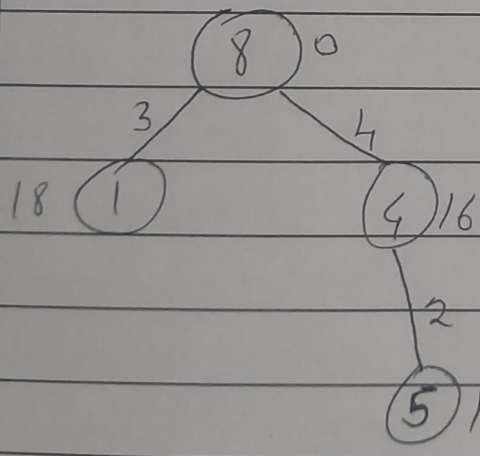
Q1. Perform A* algorithm with heuristic function value as follow : $h(1) = 18$, $h(2) = 14$, $h(3) = 12$, $h(4) = 16$, $h(5) = 14$, $h(6) = 14$, $h(7) = 19$.



⇒



Open :- 4(16+4), 1(18+3)
⇒ Closed : 8(0)

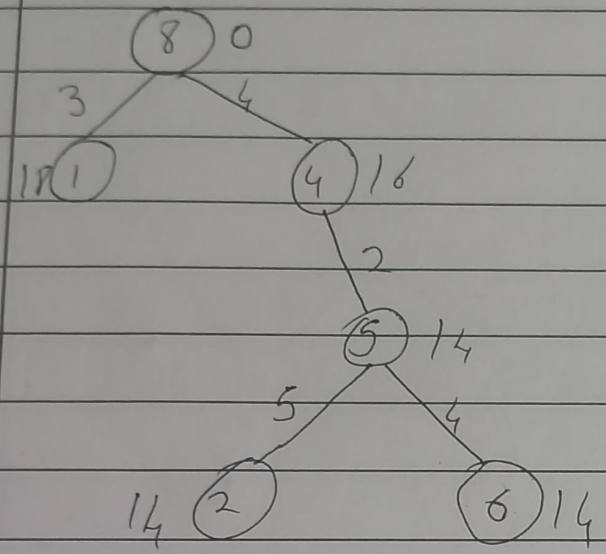


Open :- 1(18+3), 5(14+6)
⇒ Closed : 8(0), 4(16+4)

H. J. Thim Trust's

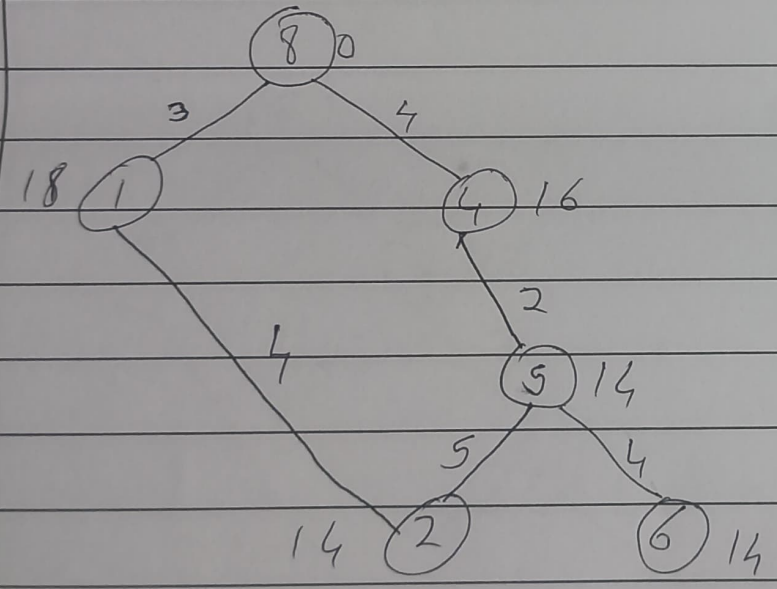
THEEM COLLEGE OF ENGINEERING

Date : _____



⇒ Open : 1(18+3), 2(14+11), 6(14+10)

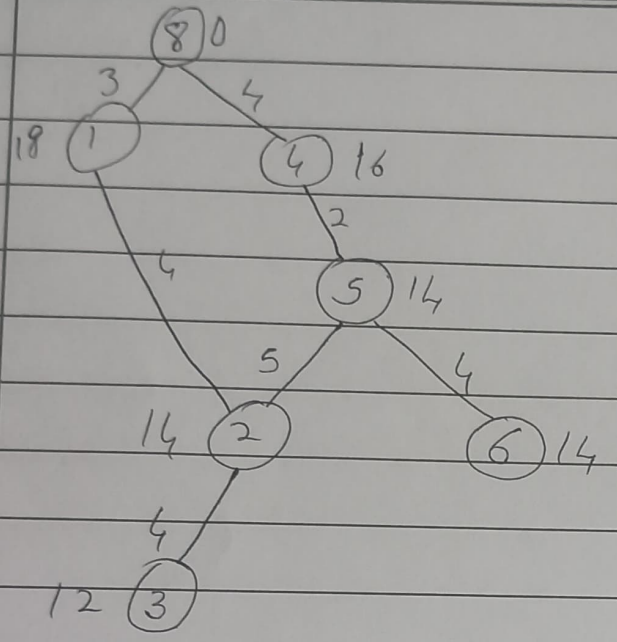
Closed : 8(0), 4(16+4), 5(14+6)



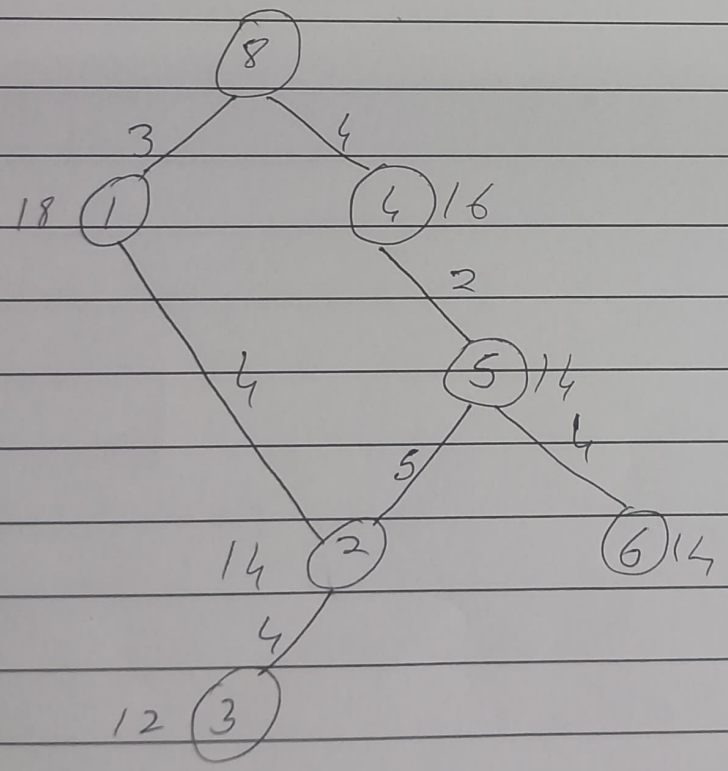
⇒ Open : 2(14+7), 6(14+10)

Closed : 8(0), 4(16+4), 5(14+6), ~~2(14+7)~~ 1(18+3)

Date :



⇒ Open: 6(14+7), 3(12+11)
Closed: 8(0), 4(16+4), 5(14+6), 2(14+7), 1(18+3).

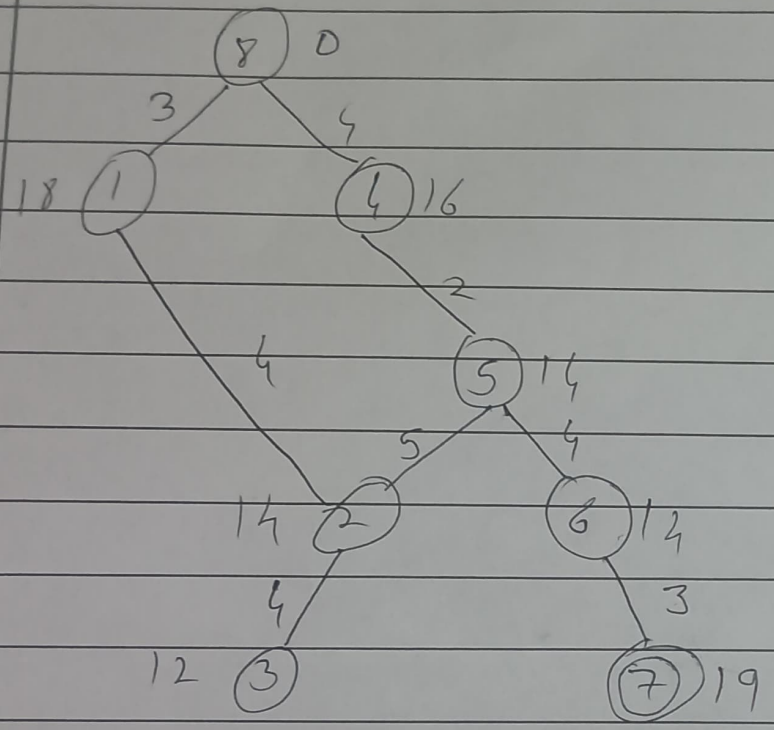


⇒ Open: ~~6~~ 3(12+11)
Closed: 8(0), 4(16+4), 5(14+6), 2(14+7), 1(18+3), 6(14+7)

H. J. Thim Trust's

THEEM COLLEGE OF ENGINEERING

Date : _____



Open :- 7(19+13)

→ Closed :- 8(0), 4(16+4), 5(14+6), 2(14+7), 1(18+3), 6(14+7), 3(12+11).