D/L/TY

Reg. No:

VIT
Vellore Institute of Technology

Final Assessment Test – November 2025

Course: BCSE306L - Artificial Intelligence
Class NBR(s): 2324/4820
Time: Three Hours
Slot: G2+TG2
Max. Marks: 100

- KEEPING MOBILE PHONE/ANY ELECTRONIC GADGETS, EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE
- DON'T WRITE ANYTHING ON THE QUESTION PAPER

COs	CO Statements
CO1	Evaluate Artificial Intelligence (AI) methods and describe their foundations.
CO2	Analyse and illustrate how search algorithms play a vital role in problem-solving.
CO3	Demonstrate knowledge of reasoning, uncertainty, and knowledge representation for solving real-world problems.
CO4	Apply basic principles of AI in solutions that require problem-solving, inference, perception, knowledge representation and learning.
CO5	Illustrate the construction of learning and expert system.
CO6	Discuss current scope and limitations of AI and social Implications.

BL – Blooms Taxonomy Level (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)

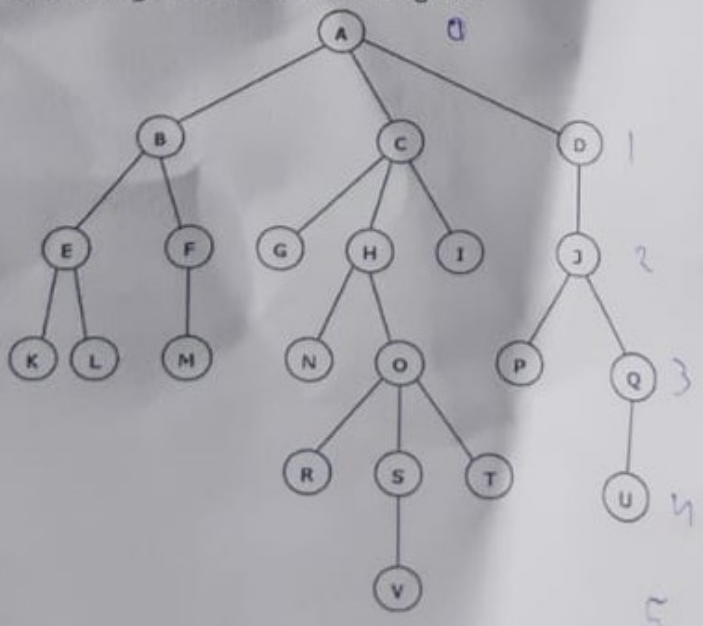
Answer ALL Questions
(10 X 10 = 100 Marks)

1. You are designing an AI agent for a robotic vacuum cleaner. CO1 BL2

   (a) Compare the suitability of the following agent types for this task: model-based reflex agent, goal-based agent, and utility-based agent. [6]

   (b) Based on the environment and task complexity, which agent type would you recommend and why? [4]

2. Consider the following tree shown in the diagram: CO2 BL3

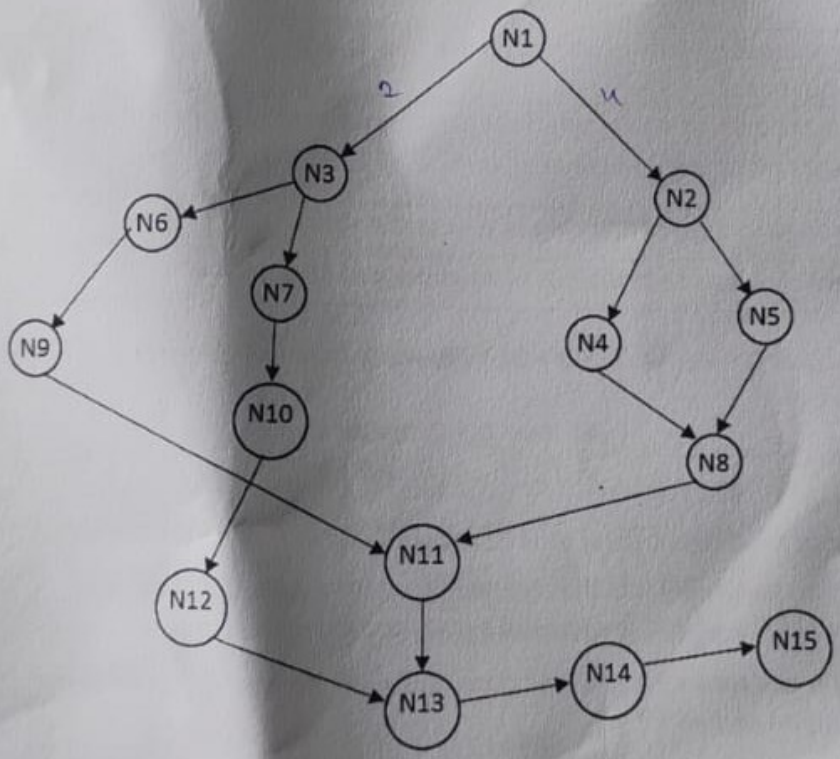


Consider node A as the initial node and node V as the goal node for the search.

(a) Compare Depth First Search (DFS) and Depth Limited Search (DLS) with a depth limit of 3 in the context of this tree traversal, time complexity, and space complexity. [7]

(b) Discuss how the choice of depth limit in DLS affects the search process. Illustrate your answer with examples from the given tree. [3]

3. Consider the following tree shown in the diagram: CO2 BL3

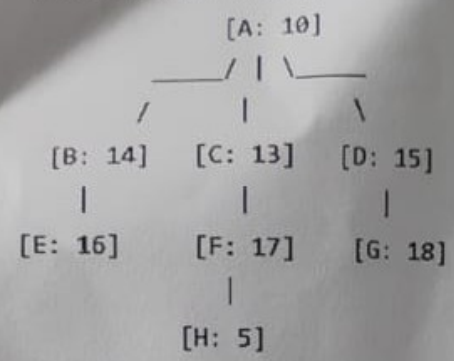


edges (start node, end node, weight) = [('N1', 'N2', 4), ('N1', 'N3', 2), ('N2', 'N4', 5), ('N2', 'N5', 10), ('N3', 'N6', 3), ('N3', 'N7', 8), ('N4', 'N8', 2), ('N5', 'N8', 1), ('N6', 'N9', 7), ('N7', 'N10', 4), ('N8', 'N11', 6), ('N9', 'N11', 2), ('N10', 'N12', 5), ('N11', 'N13', 3), ('N12', 'N13', 6), ('N13', 'N14', 2), ('N14', 'N15', 1)]

heuristic = {'N1': 14, 'N2': 13, 'N3': 12, 'N4': 10, 'N5': 10, 'N6': 9, 'N7': 9, 'N8': 8, 'N9': 7, 'N10': 7, 'N11': 6, 'N12': 6, 'N13': 3, 'N14': 1, 'N15': 0}

Using the A* search algorithm, find the optimal path from node N1 to node N15. Show the order in which nodes are expanded and the final path, along with total cost.

4. Consider the following tree shown in the diagram: CO4 BL3



Simulated Annealing Setup:

- Goal: Minimize cost. Goal node: H
- Start Node: A (cost = 10)
- Initial Temperature: T = 5
- Cooling Schedule: Tnew = $\alpha \cdot T$, where $\alpha = 0.9$

Using the Simulated Annealing algorithm, how can the goal state be achieved? Show all steps of the calculation.

5. CO4 BL3

A smart parking management system is being designed for a busy urban mall. There are 5 types of parking slots, each consuming different amounts of space and generating different revenue per hour.

The mall has a total space of 10 units, and the goal is to maximize hourly revenue by choosing an optimal combination of parking slot types within the space limit.

Each solution is encoded as a 5-bit binary string, where:

- 1 = Allocate that slot type
- 0 = Do not allocate

Slot Type	Space Required	Revenue/Hour ($)
1 (Compact)	2 units	8
2 (Standard)	3 units	12
3 (EV Slot)	4 units	15
4 (SUV Slot)	3 units	10
5 (Handicap)	2 units	9

Initial Population:

Individual	Chromosome
A	10101 (Selected slots: 1, 3, 5)
B	11100
C	01011
D	10010

Solve the above problem using the Genetic Algorithm approach, showing all steps including selection, crossover, mutation, and fitness evaluation.

6. A security system activates an alarm based on the following rules: CO4 B

1. If the window is open, then the alarm is triggered.
2. If motion is detected, then the alarm is triggered.
3. If the alarm is triggered, then the guard is alerted.
4. The window is not open.
5. The guard is not alerted.

Using the resolution method and proof by contradiction, prove that *motion was not detected*.

7. A simple medical expert system is designed to diagnose patients based on their symptoms. The following rules and facts are known: CO4 BL3

1. If a person has a fever, then they have the symptom of high temperature.
2. If a person has a cold, then they have the symptom of runny nose.
3. If a person has COVID, then they have the symptom of cough.
4. If a person has COVID, then they also have a fever.
5. If a person has both cough and high temperature, they are suspected to have COVID.
6. If a person has a runny nose and does not have a high temperature, they are suspected to have a cold.

Facts:

- John has a cough.
- John has a high temperature.

Goal: "John is suspected to have COVID"

(a) Convert all the above rules and facts into FOL. [4]
(b) Apply Forward Chaining to determine whether the goal can be inferred. [3]
(c) Apply Backward Chaining to determine whether the goal can be proven. [3]

Show each inference step clearly for both methods.

8. A smart coffee vending machine uses internal sensors to predict whether it has a machine fault (F) based on observable evidence. A fault in the machine can affect the temperature sensor (T) and pressure sensor (P). If either the temperature or pressure reading is abnormal, the system might raise an alert (A). The company uses a Bayesian network to model and reason about these dependencies. CO3 BL4

Given Probabilities:

- P(F=true)=0.05
- P(T=abnormal|F=true)=0.9, P(T=abnormal|F=false)=0.1
- P(P=abnormal|F=true)=0.8, P(P=abnormal|F=false)=0.2

- P(A=true|T,P) is given as:

T (abn?)	P (abn?)	P(A=true|T,P)
True	True	0.98
True	False	0.85
False	True	0.75
False	False	0.05

Suppose the system raises an alert. Compute the probability that the machine has a fault.

9.a) Imagine an AI agent tasked with navigating a robot through a warehouse to pick up multiple items in sequence. The robot can move between locations, pick up items, and avoid obstacles. To efficiently plan the sequence of actions, the AI uses a planning graph to represent possible actions and states over time. CO5 BL2

1. Draw the planning graph for this scenario for the first 3 levels (alternating state and action levels). [7]
2. How does the structure of a planning graph help the AI agent systematically explore possible action sequences to achieve the goal of collecting all items? [3]

OR

9.b) In a smart factory, an AI agent manages a robotic arm tasked with assembling a product. This task involves several subtasks, such as: CO5 BL2

- Fetch Components
- Assemble Parts
- Test Product
- Package Product

Some of these tasks must be done in a specific order (e.g., testing must come after assembly), but others (like fetching multiple components) can be done in parallel. Additionally, a second robot may help with subtasks like fetching or packaging.

The AI uses hierarchical planning to coordinate these tasks and assign responsibilities between the two robots.

Visualize the planning and answer the following questions:

1. How does hierarchical planning handle partial ordering of subtasks (e.g., some tasks must be sequential, others can be parallel)? [5]
2. How does hierarchical decomposition help distribute work between multiple agents (e.g., Robot A and Robot B)? [5]

10.a) In a smart hospital, an AI-powered scheduling assistant receives voice instructions from a doctor: **CO6** **BL2**

"Schedule an MRI scan for Patient X tomorrow morning and notify the radiologist."

The assistant processes the speech, accesses the hospital's scheduling system, and reserves the MRI slot. It then sends a structured digital message to the hospital's radiology AI system, which updates its calendar and sends an automatic confirmation to the radiologist.

Based on the scenario above, identify and distinguish which parts of the interaction involve human-AI communication and which involve AI-AI communication. Justify your answer by explaining: the nature of the interaction (language, medium, intent) and the roles of the human and AI systems.

OR

10.b) A legal research assistant AI is deployed in a law firm. A lawyer types the query: **CO6** **BL2**

"Recent Supreme Court rulings on data privacy involving multinational tech companies."

The AI system must retrieve the most relevant legal documents, case summaries, and rulings from a large, unstructured legal database. The system uses natural language processing to understand the query and ranks results based on their relevance.

In this scenario, explain how the AI system performs information retrieval to return relevant results.

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