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Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)
CHENNAI

Reg. No

Final Assessment Test(FAT) – Apr/May 2025

Programme	M.C.A.	Semester	Winter Semester 2024-25
Course Code	PMCA611L	Faculty Name	Prof. Saleena B
Course Title	Artificial Intelligence	Slot	F1+TF1
		Class Nbr	CH2024250501750
Time	3 hours	Max. Marks	100

Instructions To Candidates
- Write only your registration number in the designated box on the question paper. Writing anything elsewhere on the question paper will be considered a violation.

Course Outcomes
CO1: Understand the foundational concepts of artificial intelligence and intelligent agents
CO2: Apply the uninformed and heuristic approaches to discover the optimal solution for search problems
CO3: Implement adversarial search and CSP techniques for decision-making on complex problems
CO4: Use the knowledge representation and reasoning approaches to solve intelligent decision-making problems
CO5: Solve sequential decision-making problems using autonomous planning techniques

Section - I
Answer all Questions (4 × 10 Marks)

01. A delivery robot must navigate a college campus to deliver food orders. It must avoid students, animals, and weather hazards, and adjust its path in real time.

    a) Using the PEAS framework to describe how the delivery robot operates within its campus environment. (8 Marks)

    b) Which type of intelligent agent is best suited for this task and why? (2 Marks)

    [10] (CO1/K3)

02. a) Consider the following game tree where the **Max** player is trying to maximize the score, and the **Min** player is trying to minimize the score. The values in the leaf nodes represent the evaluation of the terminal states. Apply Alpha-Beta pruning technique to this game tree and illustrate the value of Alpha and Beta at every node. (8 Marks)
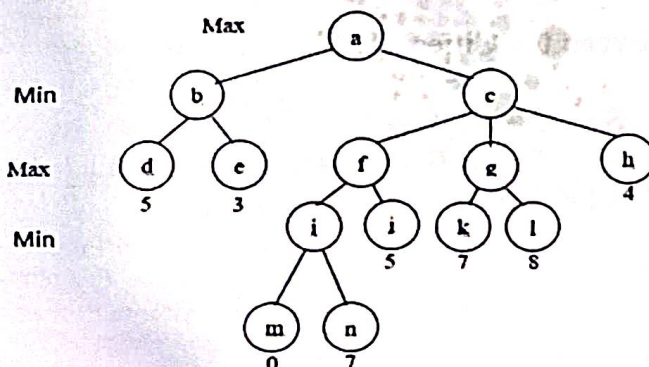
    b) What is the purpose of adversarial search in AI? How does it differ from traditional search strategies? (2 Marks)

    [10] (CO3/K5)

03. Consider the following class hierarchy
   - Machine (root)
   - Electrical Machine and Mechanical Machine subclass of Machine
   - Motor and Generator sub class of Electrical Machine
   - Conveyor Belt sub class of Mechanical Machine.
   Properties
   - Machine → has parts, requires maintenance
   - Electrical Machine → uses electricity, risk: shock
   - Mechanical Machine → risk: overheating
   - Motor → rotates, energy consumption: high
   - Generator → produces electricity
   - Conveyor Belt → moves materials, energy consumption: medium

   a) What properties will the Motor automatically inherit from Machine and Electrical Machine? (3 Marks)

   b) Suppose ConveyorBelt is upgraded to use electric motors, and someone defines it as both Electrical Machine and Mechanical Machine. What conflicts could arise? How should the AI system resolve conflicting inherited properties? (3 Marks)

   c) The factory introduces EcoMotors (a subtype of Motor) that have low energy consumption. How should the system represent this change without affecting the inherited "energy consumption: high" of other motors? (4 Marks)

   [10] (CO4/K3)

04. Imagine three color blocks stacked one over the other on the ground in the order: green, red, blue (with green on the ground). The task is to rearrange the stacking of blocks in the order: red, green, blue (with red on the ground) using the actions 'move', 'from_ground', and 'to_ground'. The condition is that only one block can be moved at a time, and a block with another block stacked on top of it cannot be moved.

   a) Create a problem formulation to outline the initial state, goal state, and action schema using Planning Domain Definition Language(PDDL). (7 Marks)

   b) Utilize a goal stack planning approach to formulate a plan for the given task. (3 Marks)

   [10] (CO5/K3)

Section - II
Answer all Questions (4 × 15 Marks)

05. a) A digital marketing manager is trying to optimize how to allocate a fixed budget across different channels: Google Ads, Facebook Ads, Instagram, and LinkedIn. She starts with an initial budget split and tries small changes like: shifting $500 from Google Ads to Instagram, shifting $1000 from LinkedIn to Facebook, or reallocating between any two channels. At each step, she measures the total ROI (return on investment) and keeps the new split only if ROI increases. She keeps repeating this process until no reallocation improves the ROI further. Identify the optimisation strategy and the search algorithms required. Justify it with respect to the above scenario with a neat diagram ? (6 Marks)

   b) Use A* Algorithm to find the shortest route from one city(S) to a destination (G) in the below given graph. Illustrate the step by step procedure (9 Marks)
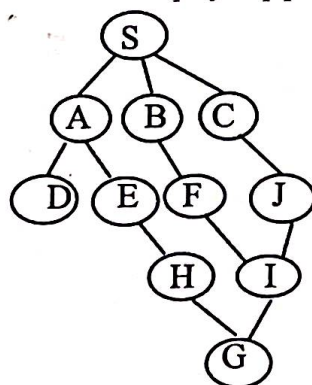
Distance between the Cities
- S → A = 2 , S → B = 3, S → C = 5, C → J = 9
- A → D = 4, A → E = 2, B → F = 5, E → H = 3
- H→G=1, F→ I = 2, J → I = 2, I → G = 1

Heuristic Values

City	S	A	B	C	D	E	F	H	I	J	G
h(n)	10	8	6	5	7	4	3	2	1	3	0

[15] (CO2/K2)

06. Consider the following statements.
   • Everyone who is in the same city as a crime scene is a suspect.
   • Anyone who was seen with a known criminal is a suspect.
   • Mike was seen with Alex.
   • Alex is a known criminal.
   • The crime happened in Boston.
   • John was in Boston.
   • Mike was in Chicago.
   • Anyone who is a suspect must be investigated

   a) Convert the above statements in to a knowledge base of first order logic. State what is a horn clause and identify the horn clauses from the above knowledge base. (7 Marks)
   b) Is Mike a suspect? Prove it using Unification and Resolution. (8 Marks)

   [15] (CO4/K4)

07. A smart home system uses various sensors to detect fire-related emergencies. The knowledge base of the system includes the following facts and rules:
   Facts:
   • detects_smoke(kitchen_sensor)
   • temperature_high(kitchen_sensor)
   • no_person_detected(kitchen_sensor)
   Rules:
   • possible_fire(S) :- detects_smoke(S), temperature_high(S)
   • raise_alert(S) :- possible_fire(S), no_person_detected(S)
   • trigger_alarm_only(S) :- possible_fire(S), person_detected(S)

   Using the above facts and rules, answer the following: Show each step of the inference, starting from the known facts, applying the relevant rules, and concluding with the final action.
   a) Use forward chaining to determine what specific action the smart home system will take for the kitchen_sensor based on the given facts and rules. Will the system raise an alert or trigger an alarm only? (6 Marks)
   b) Use backward chaining to verify whether the system will raise an alert for the kitchen_sensor. If a new fact is added: **person_detected(kitchen_sensor)**, how does that affect the conclusion? (9 Marks)

   [15] (CO4/K1)

08. Given the Belief network with seven node elements.
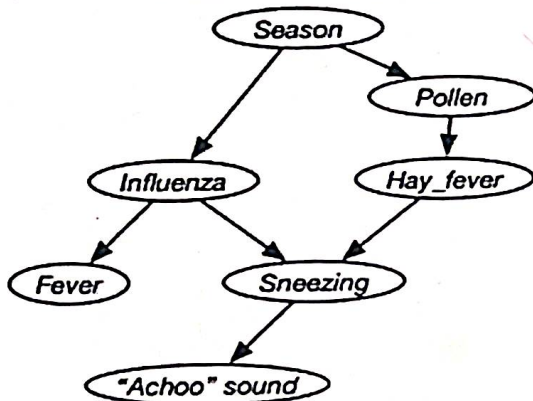
   a) Construct the conditional probability table for each node. (6 Marks)

   b) Calculate the probability of "Achoo sound" because of sneezing through Hay-fever and without influenza. (4 Marks). If additional information arrives (e.g., a medical test confirms Influenza), how would a non-monotonic reasoning system update its beliefs? (5 Marks)

   [15] (CO5/K3)

BL-Bloom's Taxonomy Levels – (K1-Remembering,K2-Understanding,K3-Applying,K4-Analysing,K5-Evaluating,K6-Creating)

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