Roll No.												

PRESIDENCY UNIVERSITY
BENGALURU

School of Computer Science & Engineering

Mid - Term Examinations - November 2024

Semester: 5 **Date**: 04/11/2024

Course Code: CSE3208 **Time**: 02:00pm – 03:30pm

Course Name: Artificial Intelligence in Practice **Max Marks**: 50

Program: B.Tech. Computer Science and Engineering (AI& ML) (CAI) **Weightage**: 25%

Instructions:

1. *Read all questions carefully and answer accordingly.*
2. *Do not write anything on the question paper other than roll number.*
3. *Write Part A questions on the very first page of your answer script.*

Part A

Answer ALL the Questions. Each question carries 2 marks. **5Qx2M=10M**

1	State the recurrence for finding out the time complexity of ideal ordering in alpha-beta pruning.	**2 Marks**	**L1**	**CO1**
2	Name the algorithm which is used for finding out the expected utility when there are multiple players in a zero-sum game.	**2 Marks**	**L1**	**CO1**
3	Name the term that describes the meaning inferred from the logical sentence.	**2 Marks**	**L1**	**CO1**
4	Name any 2 properties which we use to measure the performance of uninformed search algorithms, OTHER than time and space complexity.	**2 Marks**	**L1**	**CO1**
5	Write down the Conjunctive Normal Form of the statement: P -> Q.	**2 Marks**	**L1**	**CO1**

Part B

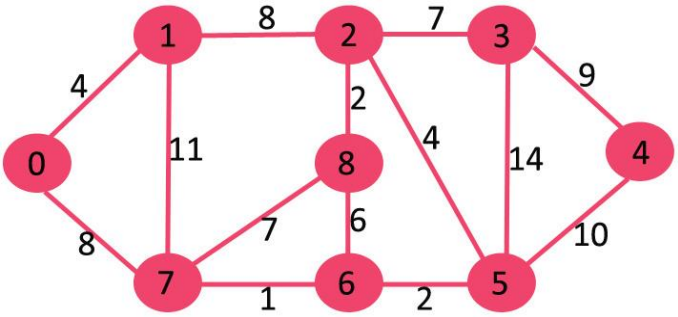
Answer ALL Questions. Each question carries 10 marks. **4QX10M=40M**

6	**6a.**	Name the 2 inference rules which are applicable in First Order Logic, but not Propositional Logic because of the Existential Quantifier.	**2 Marks**	**L1**	**CO2**
	6b.	Explain why the straight-line distance between 2 points on a map is **ALWAYS** an admissible heuristic.	**3 Marks**	**L2**	**CO3**

	6c.	We have discussed the solution of the 4-Queens Problem in class. Now solve the 5-Queens Problem!	5 Marks	L3	CO3

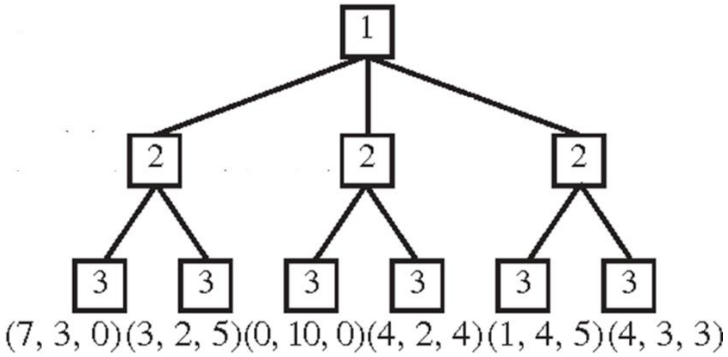
Or

7	7a.	Name the 2 inference rules which are applicable in First Order Logic, but not Propositional Logic because of the Universal Quantifier.	2 Marks	L1	CO2
	7b.	Explain why we use BFS for solving the water-jug problem, instead of DFS.	3 Marks	L2	CO3
	7c.	Consider that you have a 2 litre jug and a 3 litre jug. Demonstrate how you would measure out 4 litres of water.	5 Marks	L3	CO3
8	8a.	Explain why the straight-line distance between 2 points on a map is **ALWAYS** admissible.	3 Marks	L2	CO3
	8b.	Consider a map with 6 regions (R1, R2, R3, R4, R5, and R6). We have to colour the regions using at most 4 colours (C1, C2, C3, and C4). Explain the variables and the domains of each variable. Your answer should be ideally no longer than 2 sentences.	3 Marks	L2	CO3
	8c.	Perform Dijkstra's Single Source Shortest Path from the node 0 (leftmost node) to every other node in the given graph.	4 Marks	L3	CO3

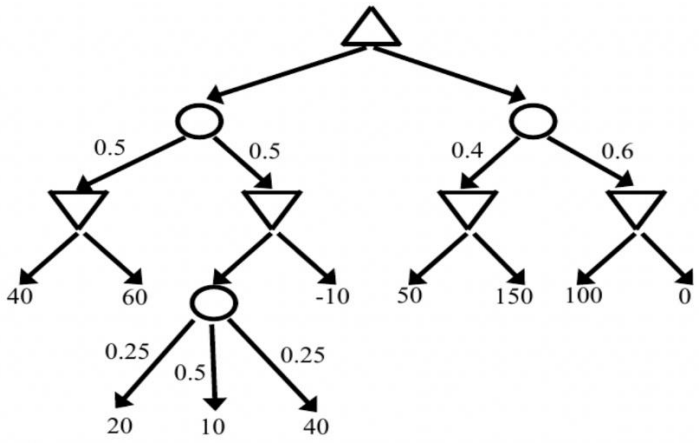


Or

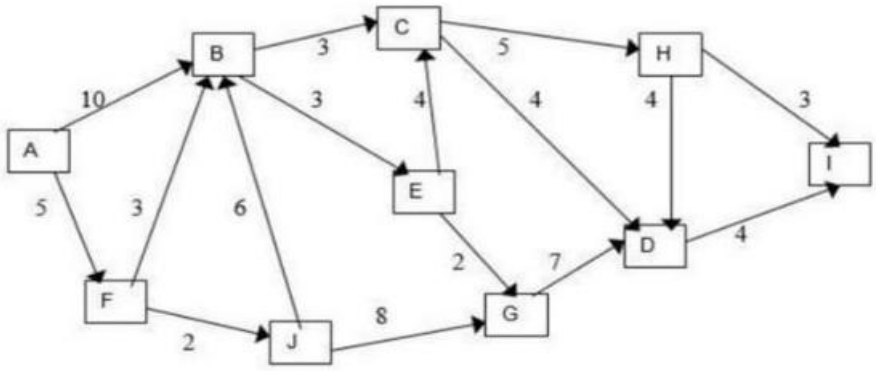
9	9a.	Compute the value that player 1 can expect, assuming that his opponents – Players 2 and 3 – play optimally.	3 Marks	L2	CO3



9b. Compute the value of the root node. Here, upper-facing triangles are maximizing nodes, lower-facing triangles are minimizing nodes, and circles are chance nodes. **3 Marks** **L2** **CO3**



9c. Use Dijkstra's SSSP Algorithm to find the shortest distances from the node A to every other node: **4 Marks** **L3** **CO3**



10 **10a.** For any 3 predicates P(x,y,z), Q(x,y,z), and R(x,y,z) write down the **Conjunctive Normal Form** of: P(x,y,z) **AND** (Q(x,y,z) **OR** R(x,y,z)) **1 Marks** **L1** **CO2**

10b. Consider the predicate: **1 Marks** **L2** **CO2**

- teacher(x) = "x is a teacher"

Convert the sentence "Sam is a teacher" to **First Order Logic.**

10c. Consider the following situation: **8 Marks** **L3** **CO2**

- Every child sees some witch.
- No witch has both a black cat and a pointed hat.
- Every witch is good or bad.
- Every child who sees any good witch gets candy.
- Every witch that is bad has a black cat

Classify each of the following terms as either a constant, predicate, function or variable. If it is a function / predicate, describe it. (Eg. rat(x) = x is a rat.)

(a) child, (b) sees, (c) witch, (d) black-cat, (e) pointed-hat, (f) good, (g) bad, (h) candy

Or

11	**11a.**	For any 3 predicates P(x,y,z), Q(x,y,z), and R(x,y,z) write down the **Disjunctive Normal Form** of: P(x,y,z) **OR** (Q(x,y,z) **AND** R(x,y,z)).	**1 Marks**	**L1**	**CO2**
	11b.	Consider the predicate: • teacher(x) = "x is a teacher" Convert the sentence "Sam is a teacher" to **Conjunctive Normal Form.**	**1 Marks**	**L2**	**CO2**
	11c.	Consider the following situation: • Anyone who can read is not stupid • Anyone who is not poor and is not stupid is also happy • John can read and is not poor • Happy people have exciting lives • People having exciting lives get chocolates • John gets chocolates. Classify each of the following terms as either a constant, predicate, function or variable. If it is a function / predicate, describe it. (Eg. rat(x) = x is a rat.) (a) read, (b) stupid, (c) poor, (d) happy, (e) has, (f) exciting-life, (g) John, (h) gets-chocolates	**8 Marks**	**L3**	**CO2**
12	**12a.**	Consider a situation where we have a map of 3 regions, A, B and C, where A borders B and C, B borders A and C, and C borders A and B. However, we have only 2 colours (lets say RED and GREEN). It is therefore obvious that the map cannot be coloured. However, prove that the constraint graph for this problem is **arc-consistent**.	**4 Marks**	**L2**	**CO3**
	12b.	God Fuhrer King Sam the Wise, the Blessed Emperor of the Badshah Empire had 7 sons, named Adam (A), Benjamin (B), Caleb (C), Daniel (D), Ephraim (E), Frank (F) and Gideon (G). As he was nearing the end of his life, he called his cartographer (a.k.a. map-maker) Praddy the Prudent to divide the 7 regions of his Empire among his children. However, to prevent his sons from fighting each other, he had constraint - the territories of 2 brothers should share a border only if they are friends. The following table lists the brothers and their friends:	**4 Marks**	**L3**	**CO3**

Son	Friends	No. of Friends
Frank	B, C, E, G	4
Benjamin	A, C, F	3

Ephraim	A, D, F	3
Adam	B, E	2
Caleb	B, F	2
Daniel	E	1
Gideon	F	1

Praddy the Prudent decides to colour the regions of the Badshah Empire using 3 colours - **GREEN**, **YELLOW**, and **PURPLE** - in that order. To select the region, he first uses the **LRV** heuristic. In case of ties, he uses the **Maximum Degree Heuristic**. If ties still persist, he would use select the region **alphabetical order** (i.e. Adam will be chosen before Caleb). Predict the colours which would be assigned to each of the 7 sons and complete the below table:

Son	**Friends**
Adam	
Benjamin	
Caleb	
Daniel	
Ephraim	
Frank	
Gideon	

12c. State true or false. The cryptarithmetic problem A – B = C (where A, B, and C are strings) will always have no solution if A is equal to B. **2 Marks** **L1** **CO3**

Or

13 **13a.** If the statement in **12.c** is true, prove it. If the statement is false, then explain why it is so. **4 Marks** **L2** **CO3**

13b. Solve the cryptarithmetic puzzle **SATURN + URANUS = PLANETS**. Then find out the number which is encoded as **STELLAR**. **4 Marks** **L3** **CO3**

13c. State the domains of each variable in a cryptarithmetic puzzle in **Base B** (where B is a number). **2 Marks** **L1** **CO3**