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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

February / March 2023 Semester End Main Examinations

Programme: B.E. **Semester: V**
Branch: Computer Science and Engineering **Duration: 3 hrs.**
Course Code: 20CS5PCAIP **Max Marks: 100**
Course: Artificial Intelligence **Date: 21.02.2023**

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

UNIT - I

1 a) Demonstrate and explain which agent can be used to design "**route recommendation system**" with appropriate diagrams. **07**

b) Give the complete problem formulation for the following cases. Choose a formulation that is precise enough to be implemented. **08**
i) You have 3 jugs, measuring 12 gallons, 8 gallons, and 3 gallons, and a water faucet/tap. You can fill the jugs up or empty them out from one to another or onto the ground. You need to measure out exactly one gallon.
ii) A 3-foot-tall monkey is in a room where some bananas are suspended from the 8-foot ceiling. He would like to get the bananas. The room contains 2 stackable, movable, climbable 3-foot-high crates/wooden cases.

c) Describe any five properties of the task environment. **05**

OR

2 a) Describe the features required for a machine to pass Turing test. **05**

b) Write the PEAS description for the following **08**
i) Medical diagnosis system
ii) Satellite Image analysis system
iii) Part-picking robot
iv) Refinery controller

c) The missionaries and cannibals problem is as follows. Three missionaries and three cannibals are on one side of a river, along with a boat. The boat can hold one or two people (and obviously cannot be paddled to the other side of the river with zero people in it). The goal is to get everyone to the other side, without ever leaving a group of missionaries outnumbered by cannibals. Your task is to formulate this as a search problem. **07**
(a) Define a state representation for the given problem.
(b) Give the initial and goal states in this representation.
(c) Define the successor function in this representation.
(d) What is the cost function in your successor function?
(e) What is the total number of reachable states?

UNIT - II

3 a) Prove that "If a heuristic is consistent, it must be admissible." Construct an admissible heuristic that is not consistent. **05**

b) Apply the A*search algorithm for 8 Puzzle problem with Start state and Goal state shown below. Also draw the states resulted from the Start state to the Goal state. **10**

Initial State

Final State

c) Analyze the Breadth first search algorithm with respect to completeness, optimality, time and space complexity. **05**

UNIT - III

4 a) Formalize the following and, by writing truth tables for the premises and conclusion, determine whether the arguments are valid. **08**

(a)Either John isn't stupid and he is lazy, or he's stupid.
John is stupid.
Therefore, John isn't lazy.
(b)The butler and the cook are not both innocent.
Either the butler is lying or the cook is innocent.
Therefore, the butler is either lying or guilty.

b) Consider the following axioms: **08**

All hounds howl at night.
Anyone who has any cats will not have any mice.
Light sleepers do not have anything which howls at night.
John has either a cat or a hound.
The clauses written for the above axioms are shown below, using LS(x) for `light sleeper'.

∀ x (HOUND(x) → HOWL(x))
∀ x ∀ y (HAVE (x,y) ∧ CAT (y) → ¬ ∃ z (HAVE(x,z) ∧ MOUSE (z)))
∀ x (LS(x) → ¬ ∃ y (HAVE (x,y) ∧ HOWL(y)))
∃ x (HAVE (John,x) ∧ (CAT(x) ∨ HOUND(x)))
LS(John) → ¬ ∃ z (HAVE(John,z) ∧ MOUSE(z))

Prove by Resolution "**If John is a light sleeper, then John does not have any mice**".

c) Infer the English sentences from the following Predicate logic statements. **04**

i) ∀xStudent(x) ∧ Study(x) → GetGoodGrade(x)
ii) ∀xMountain(x) → ¬Higher(x, x)
iii) ∃x(Sharp(x) ∧ Boy(x) ∧ Intelligent(x))
iv) ¬∃x [glitter(x) ∧ gold(x)]

OR

5 a) With relevant examples explain how the complexity of reasoning reduces with horn clause compared to CNF. Show that the horn clause is linear in the size of the KB for the following clause using forward chaining. **08**

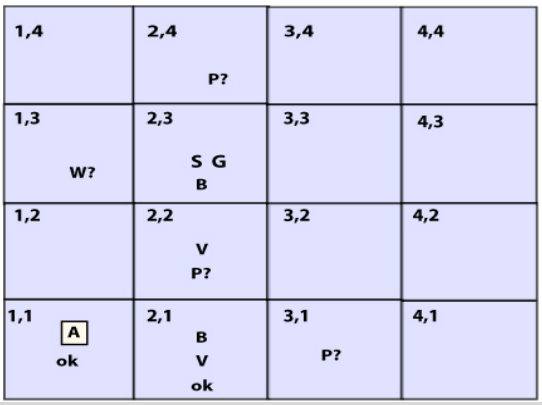
P=>Q
L∧M=>P
B∧L=>M
A∧P=>L
A∧B=>L
A
B

b) Convert the following into First Order Logic. **04**

i) Ruma dislikes children who drink tea.

ii) Any person who is respected by every person is a king.

c) Consider the Wumpus world problem below: **08**



(R1) $\neg S_{11} \rightarrow \neg W_{11} \wedge \neg W_{12} \wedge \neg W_{21}$

(R2) $\neg S_{21} \rightarrow \neg W_{11} \wedge \neg W_{21} \wedge \neg W_{22} \wedge \neg W_{31}$

(R3) $\neg S_{12} \rightarrow \neg W_{11} \wedge \neg W_{12} \wedge \neg W_{22} \wedge \neg W_{13}$

(R4) $S_{12} \rightarrow W_{13} \vee W_{12} \vee W_{22} \vee W_{11}$

Assume that the agent has moved from room [1, 1], to room [2,1]
Prove that Wumpus is in the room [1, 3].

UNIT - IV

6 a) Convert the following statements into First-order logic (FOL) and write the same in conjunctive normal form (*CNF*) form. Clearly show all the steps: **10**

First, a brick is on something that is not a pyramid; second, there is nothing that a brick is on and that is on the brick as well; and third, there is nothing that is not a brick and also is the same thing as the brick.

b) Problem Statement: - **10**

1. Ravi likes all kind of food.
2. Apples and chicken are food
3. Anything anyone eats and is not killed is food
4. Ajay eats peanuts and is still alive
5. Rita eats everything that Ajay eats

Prove by resolution that " **Ravi likes peanuts**".

UNIT - V

7 a) Given the full joint distribution as shown in table below, calculate the following: **10**

a. P(Toothache)
b. P(Cavity)

c. P(Toothache | Cavity)
d. P(Cavity | Toothache ∨ Catch)

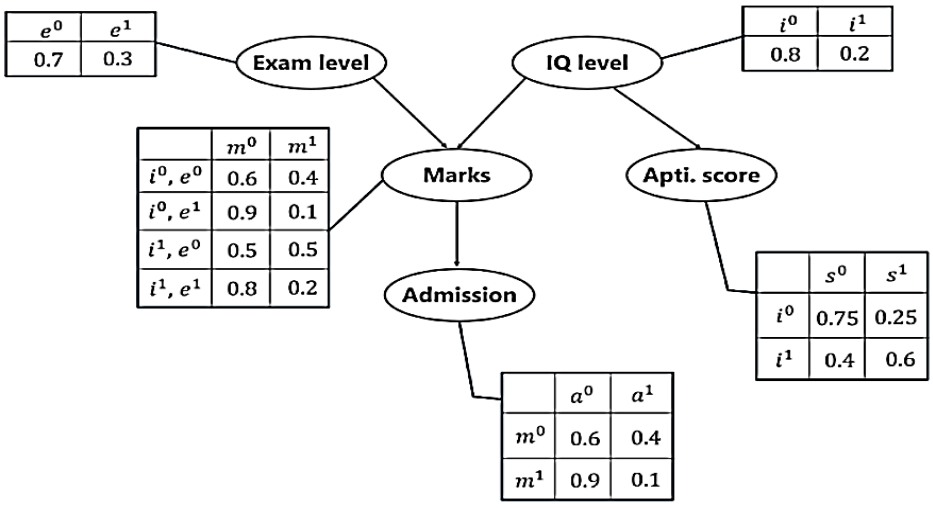
	toothache		*¬toothache*	
	catch	*¬catch*	*catch*	*¬catch*
cavity	0.108	0.012	0.072	0.008
¬cavity	0.016	0.064	0.144	0.576

b) Let us imagine that you are given the task of modelling a student's marks (m) for an exam he has just given. From the given Bayesian Network Graph below, we see that the marks depend upon two other variables. They are, **10**

Exam Level (e)– This discrete variable denotes the difficulty of the exam and has two values (0 for easy and 1 for difficult)

IQ Level (i) – This represents the Intelligence Quotient level of the student and is also discrete in nature having two values (0 for low and 1 for high)

Additionally, the IQ level of the student also leads us to another variable, which is the Aptitude Score of the student (s). Now, with marks the student has scored, he can secure admission to a particular university.



1. Write the formula to calculate the Joint Probability Distribution of the 5 variables given.
2. Calculate the probability that in spite of the exam level being difficult, the student having a low IQ level and a low Aptitude Score, manages to pass the exam and secure admission to the university.
3. Calculate the probability that the student has a High IQ level and Aptitude Score, the exam being easy yet fails to pass and does not secure admission to the university.

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