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

Autonomous Institute Affiliated to VTU

September / October 2023 Supplementary Examinations

Programme: B.E. **Semester: V**
Branch: Computer Science and Engineering **Duration: 3 hrs.**
Course Code: 20CS5PCAIP **Max Marks: 100**
Course: Artificial Intelligence **Date: 16.09.2023**

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

UNIT - I

1	a)	Describe the structure of learning-based agents.	**6**
	b)	Write the PEAS description for i) Vacuum Cleaner Agent ii) Chess Playing Agent iii) Automated Teller Machine iv) Online Payment System	**10**
	c)	Give the task environment properties for Voice activated Mobile Assistant.	**4**

OR

2	a)	A monkey enters a room via the door. In the room, near the window, is a box. In the middle of the room hangs a banana from the ceiling. The monkey wants to grasp the banana, and can do so after climbing on the box in the middle of the room. Give the initial state, goal test, operators, and path cost function for the monkey banana problem. Also write the state space diagram.	**10**
	b)	Differentiate the Automated Taxi driving agent implemented using goal based architecture and utility based architecture.	**6**
	c)	Differentiate tree based and graph based Search space.	**4**

UNIT - II

3	a)	Write the algorithm for Recursive Best First Search and illustrate with an example.	**10**
	b)	Apply A* search algorithm for 8 Puzzle problem with Start state and Goal state shown below. Use the heuristic function h1 as the number of misplaced tiles and h2 as the Manhattan distance between current state and the goal state. Also draw the states resulted from the Start state to the Goal state in each of the heuristics.	**10**

1	2	3
	4	6
7	5	8

START STATE

1	2	3
4	5	6
7	8	

GOAL STATE

UNIT - III

4 a) Represent the following statements in First Order Logic: **8**

i) Everyone who walks is calm.
ii) Every bag contains at least one book.
iii) Horses are faster than dogs.
iv) Two regions overlap just in case they share a common part.

b) Analyze whether the following statements are a tautology, contradiction, or neither? **6**

i) $(A \vee B) \wedge (\neg B \vee C) \Rightarrow (A \vee C)$
ii) $(A \Rightarrow B) \Leftrightarrow (\neg B \Rightarrow \neg A)$
iii) $\neg (\neg gas\_in\_tank \wedge (gas\_in\_tank \vee \neg car\_starts) \Rightarrow \neg car\_starts)$

c) You are walking and all of a sudden you find yourself in front of three possible roads: the road on your left is paved with gold, the one in front of you is paved with marble, while the one on your right is made of small stones. Each street is protected by a guard. You talk to the guard and this is what they tell you: **6**

- The guard of the gold street: "This road will bring you straight to the center. Moreover, if the stones take you to the center, then also the marble takes you to the center."
- The guard of the marble street: "Neither the gold nor the stones will take you to the center."
- The guard of the stone street: "Follow the gold and you'll reach the center, follow the marble and you will be lost."

Given that you know that all the guards are liars, can you choose a road being sure that it will lead you to the centre? If this is the case, which road you choose? Formalize the puzzle in Propositional Logic and solve using truth table.

OR

5 a) Convert the following into CNF form: **4**

i) $(P \rightarrow (Q \rightarrow R)) \rightarrow (P \rightarrow (R \rightarrow Q))$
ii) $(P \rightarrow Q) \rightarrow ((Q \rightarrow R) \rightarrow (P \rightarrow R))$

b) Infer the English sentences from the following First Order Logic Sentences **10**

i) **$\forall x$ Student(x) $\wedge$ Hasgoodgrade(x)$\Rightarrow$ Brilliant(x) $\vee$ Studies(x)**
ii)**$\forall x$ Bought(Ram,x) $\Rightarrow$ Bought(Shyam,x)**
iii)**$\neg\exists x$ talk(x)**
iv)**$\forall x$ Human(x) => $\exists y$ Brain(y) $\Rightarrow$Has(x,y)**
v) **$\exists x, \exists y$,Mountain(x) $\wedge$ Mountain(y) $\wedge$ InIndia(x) $\wedge$ InIndia(y) $\wedge$ x $\neq$ y**

c) Check if the following entailments hold by constructing truth tables for each formula. **6**

i) $P \wedge Q \models P \vee Q$
ii) $P \Rightarrow (P \wedge Q) \models P \vee \neg Q$
iii) $P \wedge \neg P \models Q$

UNIT - IV

6 a) Given the facts **8**

- Whoever can read is literate
- Dolphins are not literate
- Some Dolphins are intelligent

Design a reasoning system using resolution prove that "Some who are intelligent cannot read".

b) Justify why unification is essential for inferencing using First order logic? **4**

c) The facts of the knowledge base are as follows **8**

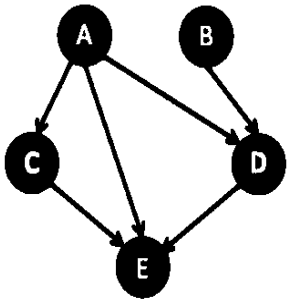
- Steve only likes easy courses.
- Science courses are hard.
- All the courses in the basketweaving department are easy.
- BK301 is a basketweaving course.

Design a forward reasoning system to answer the query " What course would Steve like?"

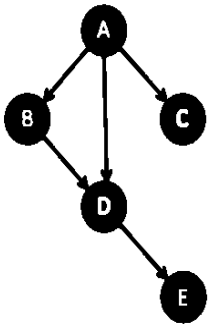
UNIT - V

7 a) Three industries produce ICs to supply the market. Industry X produces 20%, 50% of the ICs are produced in Y industry and 30% in Industry Z. 2% of the ICs produced in X, 1% of the ICs produced in Y and 3% of the ICs produced in Z are defective. An IC is selected at random in the market and found to be defective. what is the probability that this was produced by Y? **6**

b) You are given two different Bayesian network structures 1 and 2, each consisting of 5 binary random variables A, B, C, D, E. Each variable corresponds to a gene, whose expression can be either "ON" or "OFF". **8**



Network 1



Network 2

Write the expression for the joint probability distribution as a product of conditional probabilities and also calculate the number of parameters required to in both network1 and network 2.

Using Network 2 and the probabilities given below, calculate the probability of the following

i) P(A=ON, B=ON, C=ON, D=ON, E=ON)

ii) P(E = ON | A = ON)

$$P(A=ON)=0.6$$

$$P(B=ON|A)=\begin{cases}0.1, & A=OFF\\ 0.95, & A=ON\end{cases}$$

$$P(C=ON|A)=\begin{cases}0.8, & A=OFF\\ 0.5, & A=ON\end{cases}$$

$$P(D=ON|A,B)=\begin{cases}0.1 & A=OFF,B=OFF\\ 0.9 & A=ON,B=OFF\\ 0.3 & A=OFF,B=ON\\ 0.95 & A=ON,B=ON\end{cases}$$

$$P(E=ON|D)=\begin{cases}0.8, & D=OFF\\ 0.1, & D=ON\end{cases}$$

c) Explain any three sampling methods used in Bayesian networks. **6**

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