PARSHWANATH CHARITABLE TRUST'S
A.P. SHAH INSTITUTE OF TECHNOLOGY
Department of Computer Science and Engineering
Data Science

CSE DATA SCIENCE

UNIT TEST-II

Class: TE   **Semester: V**   **Subject: AI**

Date:20/10/2023   **Time:10:00am-11:30am**   **Max marks: 40**

Note the following instructions

1. **Attempt all questions.**
2. **Draw neat diagrams wherever necessary.**
3. **Write everything in Black ink (no pencil) only.**
4. **Assume data, if missing, with justification.**

Q.N	Questions	MARKS	CO	Blooms Taxonomy Level	PO
Q.1.	Attempt any two.				
a.	Compare and Contrast problem solving agent and planning agent.	[5]	CO6	L3	PO1, PO12
b.	Classify the following examples into supervised, unsupervised and semi supervised learning: • Email Filtering • Pattern Recognition • Speech Recognition • Image and Speech Analysis • Fraud Detection	[5]	CO6	L3	PO1, PO12
c.	Develop an MYCIN expert system.	[5]	CO6	L3	PO1, PO12
d.	Identify the partial order planning solution for the following block world problem. 	[5]	CO6	L3	PO1, PO12
Q.2.	Attempt any two				

a.	Consider the following set of sentences: ● Whoever can read is literate. ● Birds are not literate. ● Some birds are intelligent. Prove that " some who are intelligent cannot read" using resolution.	[10]	CO4	L3	PO1, PO12
b.	Write FOPL for following statements: ● Anand likes only comedy films ● The culprit has to be one from Tinker, Tailor and Butler. ● Alice does not like chemistry and history. ● Every child loves santa ● Some birds cannot fly.	[10]	CO4	L3	PO1, PO12
c.	Convert the following propositional logic statements into CNF ● $A \rightarrow (B \leftrightarrow C)$ ● $A \rightarrow (B \rightarrow C)$	[10]	CO4	L3	PO1, PO12
Q.3.	**Attempt any one.**				
a.	A patient goes to the doctor for a medical condition, the doctor suspects three diseases as the cause of the condition. The three diseases are D1, D2, D3, which are marginally independent from each other. There are four symptoms S1, S2, S3, S4 which the doctor wants to check for presence in order to find the most probable cause of the condition. The symptoms are conditionally dependent on the three diseases as follows: S1 depends only on D1, S2 depends on D1 and D2. S3 depends on D1 and D3, whereas S4 depends only on D3. Assume all random variables are Boolean, they are either 'true' or 'false'. 1. Draw the Bayesian network for this problem. 2. Write down the expression for the joint probability distribution as a product of conditional probabilities.	[10]	CO5	L3	PO1, PO12

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b.	Find the probabilistic inference by enumeration of entries in a full joint distribution table shown in following figure	[10]	CO5	L3	PO1, PO12

	toothache		¬toothache	
	catch	¬catch	catch	¬catch
cavity	.108	.012	.072	.008
¬cavity	.016	.064	.144	.576

(i) No cavity when toothache is there
(ii) p(Cavity! toothache or catch)

Q. 1 Attempt any two.   10M

1. Compare and Contrast problem solving agent and planning agent.   5M
   Ans:

Problem Solving	Planning
Problem solving is the process of diminution or abolishment of the divergence	Planning represents this process of finding out the necessary steps
In contrast to a task, the necessary steps to take that transform the original state into the final state are not yet known and must still be figured out.	The steps are represented in a Plan.
Problem solving involves planning, as just a stage	Planning can be seen as a part of the problem solving process which is completed by the execution process.
If problems during plan execution occur, the plan may be altered during run time.	Execution itself might not be a completely predefined process.
DPS should enable the agents to work together in solving problems that are beyond a single agent's scope.	Distributed Planning activities involve a group of agents in the planning process.

2. Classify the following examples into supervised, unsupervised and semi supervised learning: 5M
   a. Email Filtering : Supervised learning
   b. Pattern Recognition : Unsupervised learning
   c. Speech Recognition : Supervised learning

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    d.   Image and Speech Analysis : Semi Supervised

    e.   Fraud Detection: Unsupervised learning

3. Develop an MYCIN expert system.   5M

Ans:

● Firstly, ES should be fed with expert knowledge. In the case of MYCIN, human experts specialized in the medical field of bacterial infection, provide information about the causes, symptoms, and other knowledge in that domain.

● The KB of the MYCIN is updated successfully. In order to test it, the doctor provides a new problem to it. The problem is to identify the presence of the bacteria by inputting the details of a patient, including the symptoms, current condition, and medical history.

● The ES will need a questionnaire to be filled by the patient to know the general information about the patient, such as gender, age, etc.

● Now the system has collected all the information, so it will find the solution for the problem by applying if-then rules using the inference engine and using the facts stored within the KB.

● In the end, it will provide a response to the patient by using the user interface.

4. Identify the partial order planning solution for the following block world problem. 5M

Ans:

    For the given problem, Start → Goal can be achieved by the following sequence:

    1.   Unstack(A,C)

    2.   Putdown(A)

    3.   Pickup(B)

    4.   Stack(B,C)

    5.   Pickup(A)

    6.   Stack(A,B)

Q.2 Attempt any two.   20M

1. Consider the following set of sentences: 10M

    ● Whoever can read is literate.

    ● Birds are not literate.

    ● Some birds are intelligent.

    Prove that " some who are intelligent cannot read" using resolution.

    Ans:

1. Whoever can read is literate.

   $\forall x \quad read(x) \longrightarrow literate(x)$
   $\neg read(x) \lor literate(x)$

2. Birds are not literate.

   $\forall x \quad bird(x) \longrightarrow \neg literate(x)$
   $\neg bird(x) \lor \neg literate(x)$

3. Some birds are intelligent

   $\exists x \quad bird(x) \land intelligent(x)$
   $Bird(x)$
   $Intelligent(x)$

Goal 4. Some who are intelligent cannot read

   $\exists x \quad intelligent(x) \land \neg read(x)$

   ‖ negation

   $\forall x \quad \neg intelligent(x) \lor read(x)$

4. $\neg intelligent(x) \lor read(x)$

Resolution tree:

$\neg read(x) \lor literate(x)$ ... $\neg bird(x) \lor \neg literate(x)$

$\neg read(x) \land \neg bird(x)$ ... $bird(x)$

$\neg read(x)$ ... $\neg intelligent(x) \lor read(x)$

$\neg intelligent(x)$ ... $intelligent(x)$
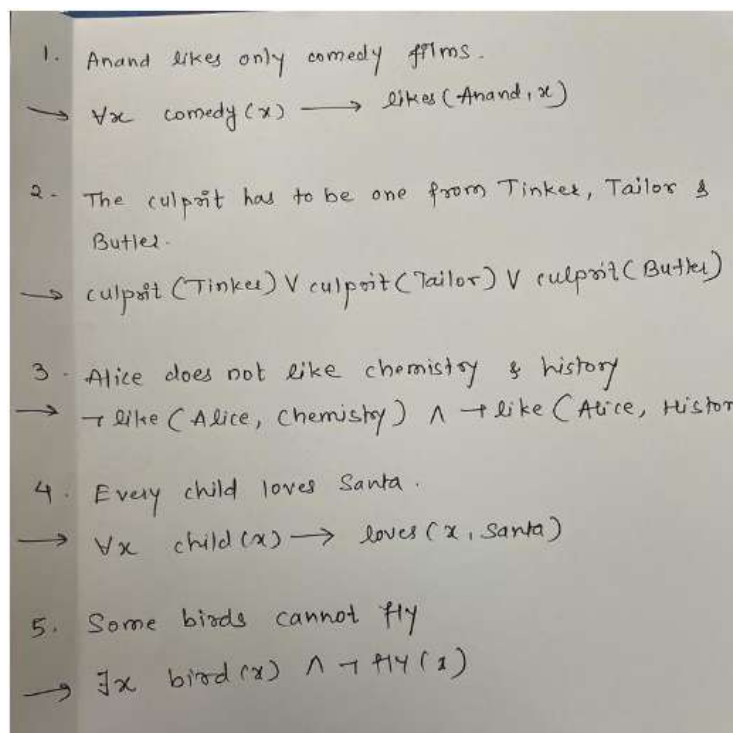
null.
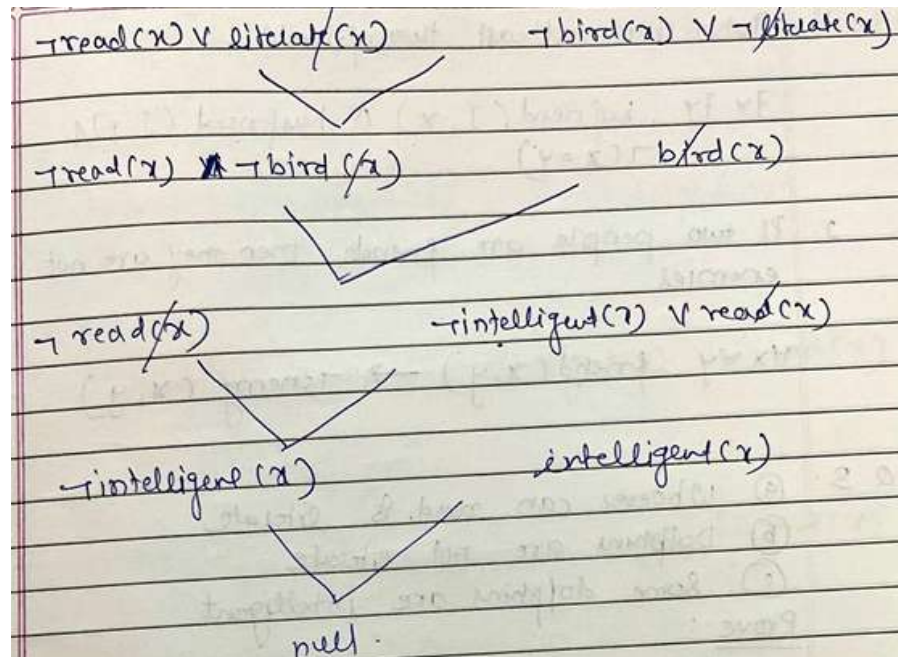
2. Write FOPL for following statements: 10M
   - Anand likes only comedy films
   - The culprit has to be one from Tinker, Tailor and Butler.
   - Alice does not like chemistry and history.
   - Every child loves santa
   - Some birds cannot fly.

1. Anand likes only comedy films.

   $\rightarrow \forall x \ comedy(x) \longrightarrow likes(Anand, x)$

2. The culprit has to be one from Tinker, Tailor & Butler.

   $\rightarrow culprit(Tinker) \lor culprit(Tailor) \lor culprit(Butler)$

3. Alice does not like chemistry & history

   $\rightarrow \neg like(Alice, chemistry) \land \neg like(Alice, History)$

4. Every child loves Santa.

   $\rightarrow \forall x \ child(x) \rightarrow loves(x, santa)$

5. Some birds cannot fly

   $\rightarrow \exists x \ bird(x) \land \neg fly(x)$

3. Convert the following propositional logic statements into CNF   10M
   - A→(B↔C)
   - A→(B→C)

1) $A \longrightarrow (B \longleftrightarrow C)$
$\neg A \lor [(B \to C) \land (C \to B)]$
$\neg A \lor [(\neg B \lor C) \land (\neg C \lor B)]$
$(\neg A \lor \neg B \lor C) \land (\neg A \lor \neg C \lor B)$

2) $A \longrightarrow (B \to C)$
$\neg A \lor (B \to C)$
$\neg A \lor [\neg B \lor C]$
$(\neg A \lor \neg B) \lor (\neg A \lor C)$

Q. 3 Attempt any one.   10M

1. A patient goes to the doctor for a medical condition, the doctor suspects three diseases as the cause of the condition. The three diseases are D1, D2, D3, which are marginally independent from each other. There are four symptoms S1, S2, S3, S4 which the doctor wants to check for presence in order to find the most probable cause of the condition. The symptoms are conditionally dependent on the three diseases as follows: S1 depends only on D1, S2 depends on D1 and D2. S3 depends on D1 and D3, whereas S4 depends only on D3. Assume all random variables are Boolean, they are either 'true' or 'false'.   10M
   - Draw the Bayesian network for this problem.

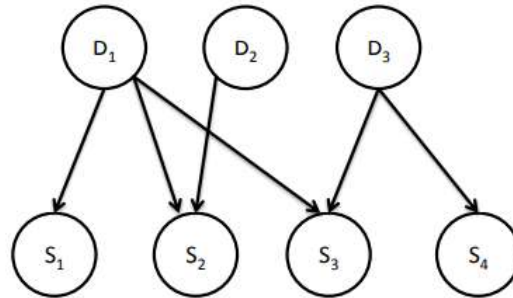★ **SOLUTION:** The Bayesian network is shown in Figure 2.

Figure 2: The Bayesian network for disease symptom problem.

- Write down the expression for the joint probability distribution as a product of conditional probabilities.

  ★ **SOLUTION:**

  $\mathbf{P}(D_1, D_2, D_3, S_1, S_2, S_3, S_4) = \mathbf{P}(D_1)\mathbf{P}(D_2)\mathbf{P}(D_3)\mathbf{P}(S_1 \mid D_1)\mathbf{P}(S_2 \mid D_1, D_2)\mathbf{P}(S_3 \mid D_1, D_3)\mathbf{P}(S_4 \mid D_3)$

2. Find the probabilistic inference by enumeration of entries in a full joint distribution table shown in following figure   10M

	toothache		¬toothache	
	catch	¬catch	catch	¬catch
cavity	.108	.012	.072	.008
¬cavity	.016	.064	.144	.576

 (i) No cavity when toothache is there
(ii) p(Cavity! toothache or catch)

1. **No cavity when toothache is there**

$P(¬cavity|toothache) = P(¬cavity^t oothache)/P(toothache)$
$$= (0.016 + 0.064)/(0.108 + 0.012 + 0.016 + 0.064)$$
$$= 0.4$$

2. **p(Cavity|toothache or catch)**

$$= P(Cavity|toothache) + p(catch)$$
$$= [P(cavity\hat{t}\,oothache)/P(toothache)] + P(catch)$$
$$= [(0.108 + 0.012)]$$
$$/[(0.108 + 0.012 + 0.016 + 0.064 + (0.108 + 0.016 + 0.072 + 0.144)$$
$$= 0.96$$