



## INDIAN INSTITUTE OF INFORMATION TECHNOLOGY, SRI CITY

### TERM-III EXAMINATION – SPRING 2024

#### Artificial Intelligence

**CSE: UG2 (PC)**

**Date: 24-04-2024**

**Duration: 90 Mins (03:30-05:00 PM)**

**Max. Marks: 25**

**Instructions:**

- - - - - ... .... Roll No: \_\_\_\_\_

1. This is a **closed-book exam**. You can use a **calculator** if necessary.
2. **Please Write/Draw legibly!** If we can't understand what you have written, we can't grade it.
3. **Don't use Pencils** for answering/drawing. The final answer **must** be in blue or black ink.
4. Mention the question number before the answer.
5. ***It is Mandatory to read all the notes/instructions given in the question and answer accordingly. Any irrelevant answers will not be evaluated and awarded with zero marks.***

#### Section-A

|   |   |                   |
|---|---|-------------------|
| 1 | (a) What is the difference between clustering and classification ?<br>(b) What is Reinforcement Learning? Explain with an Example.  | <b>[3 Marks]</b>  |
| 2 | Answer the following true/false. Solve step by step.<br>(a) $\forall x P(x) \Leftrightarrow \neg \exists x \neg P(x)$<br><br>(b) $\exists x P(x) \Leftrightarrow \neg \forall x \neg P(x)$  | <b>[4 Marks]</b>  |
| 3 | a) Write the given sentences ( I to VI) in first-order logic. (3M)<br>b). Convert the sentences written in first-order logic (question 3. a)) to the Conjunctive Normal Form. (3M)<br>c). Apply resolution to prove that “ <b>Scrooge is not a child</b> ” and draw the resolution graph. (4M)<br><br>i. <b>Every child loves Santa.</b><br>ii. <b>Everyone who loves Santa loves any reindeer.</b><br>iii. <b>Rudolph is a reindeer, and Rudolph has a red nose.</b><br>iv. <b>Anything which has a red nose is weird or is a clown.</b><br>v. <b>No reindeer is a clown.</b><br>vi. <b>Scrooge does not love anything which is weird.</b><br><br><b>Prove by resolution graph that: Scrooge is not a child.</b> | <b>[10 Marks]</b> |
|   | <b>Note:</b> This is a connected question if a) is correct then b) will be evaluated, and if a) and b) both are correct then c) will be evaluated.  |                   |

|   |  |           |
|---|--|-----------|
| 4 | Suppose an RT-PCR test for the SARS-COV2 (COVID-19)-XE variant virus is 95% accurate. The test gives a positive result for 95% of those taking the test who are COVID-19 positive. Also, the test gives a negative result for 95% of those taking the test who are not COVID-19 positive. In Country X, forty percent of the residents are COVID-19 positive. Suppose a random resident of Country X takes the RT-PCR test and tests positive, what is the probability using Bayes theorem that the person is infected given that they have tested positive? | [5 Marks] |
|---|--|-----------|

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### **Key Answers**

1. (a)

| CLASSIFICATION   | CLUSTERING  |
|--|---|
| used for supervised learning   | used for unsupervised learning  |
| process of classifying the input instances based on their corresponding class labels           | grouping the instances based on their similarity without the help of class labels |
| it has labels so there is need of training and testing dataset for verifying the model created | there is no need of training and testing dataset                                  |

1 (b)

Reinforcement learning is an autonomous, self-teaching system that essentially learns by trial and error. It performs actions with the aim of maximizing rewards, or in other words, it is learning by doing in order to achieve the best outcomes.

**Example:**

1. Robotics: Robots with pre-programmed behavior are useful in structured environments, such as the assembly line of an automobile manufacturing plant, where the task is repetitive in nature.
2. A master chess player makes a move. The choice is informed both by planning, anticipating possible replies and counter replies.
3. An autonomous driving system must perform multiple perception and planning tasks in an uncertain environment. Some specific tasks where RL finds applications include vehicle path planning and motion prediction.

2. a) True b) False

3. Conversion of each sentence into FOL will get 0.5 Mark

i. Every child loves Santa.

$$\forall x (\text{CHILD}(x) \rightarrow \text{LOVES}(x, \text{Santa}))$$

ii. Everyone who loves Santa loves any reindeer.

$$\forall x (\text{LOVES}(x, \text{Santa}) \rightarrow \forall y (\text{REINDEER}(y) \rightarrow \text{LOVES}(x, y)))$$

iii. Rudolph is a reindeer, and Rudolph has a red nose.

*REINDEER(Rudolph)  $\wedge$  REDNOSE(Rudolph)*

iv. Anything which has a red nose is weird or is a clown.

$\forall x (REDNOSE(x) \rightarrow WEIRD(x) \vee CLOWN(x))$

v. No reindeer is a clown.

$\neg \exists x (REINDEER(x) \wedge CLOWN(x))$

or

- . - - - . - - .. - ....

$\forall x (REINDEER(x) \rightarrow \neg CLOWN(x))$

vi. Scrooge does not love anything which is weird.

$\forall x (WEIRD(x) \rightarrow \neg LOVES(Scrooge, x))$

b). Conversion of each sentence into CNF will get 0.5 Mark

i.  $\forall x (CHILD(x) \rightarrow LOVES(x, Santa))$

*R1:  $\neg CHILD(x) \vee LOVES(x, Santa)$*

ii.  $\forall x (LOVES(x, Santa) \rightarrow \forall y (REINDEER(y) \rightarrow LOVES(x, y)))$

*R2:  $\neg LOVES(p, Santa) \vee \neg REINDEER(q) \vee LOVES(p, q)$*

iii. *REINDEER(Rudolph)  $\wedge$  REDNOSE(Rudolph)*

*R3: REINDEER(Rudolph)*

*R4: REDNOSE(Rudolph)*

iv.  $\forall x (REDNOSE(x) \rightarrow WEIRD(x) \vee CLOWN(x))$

*R5:  $\neg REDNOSE(s) \vee WEIRD(s) \vee CLOWN(s)$*

v.  $\neg \exists x (REINDEER(x) \wedge CLOWN(x))$

*R6:  $\neg REINDEER(t) \vee \neg CLOWN(t)$*

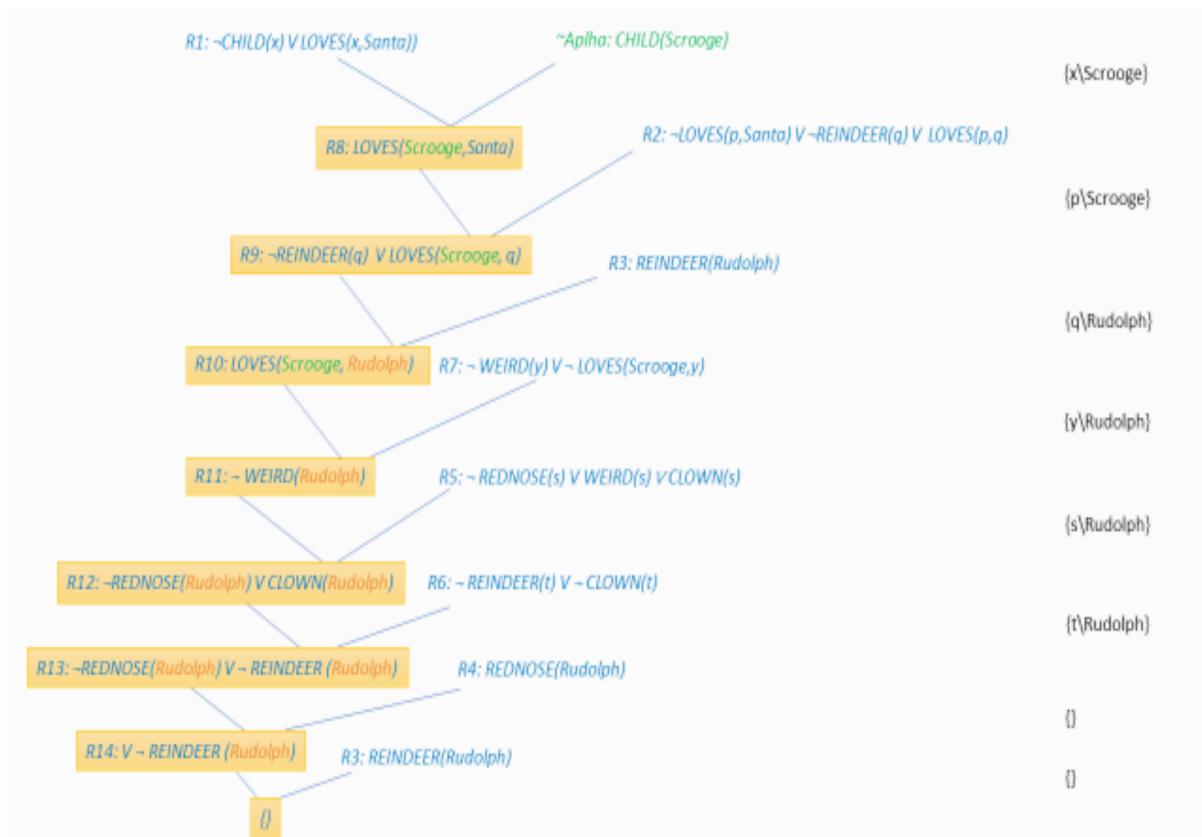
vi.  $\forall x (WEIRD(x) \rightarrow \neg LOVES(Scrooge, x))$

*R7:  $\neg \text{WEIRD}(y) \vee \neg \text{LOVES}(\text{Scrooge}, y)$*

c) alpha: Scrooge is not a child. (Proof by a graph with at least 4 steps get full marks otherwise 1 mark for each resolvent step)

$\neg \text{CHILD}(\text{Scrooge})$

**Negation of alpha ( $\neg \text{alpha}$ ):  $\text{CHILD}(\text{Scrooge})$**



*The statement "Scrooge is not a child" is True.*

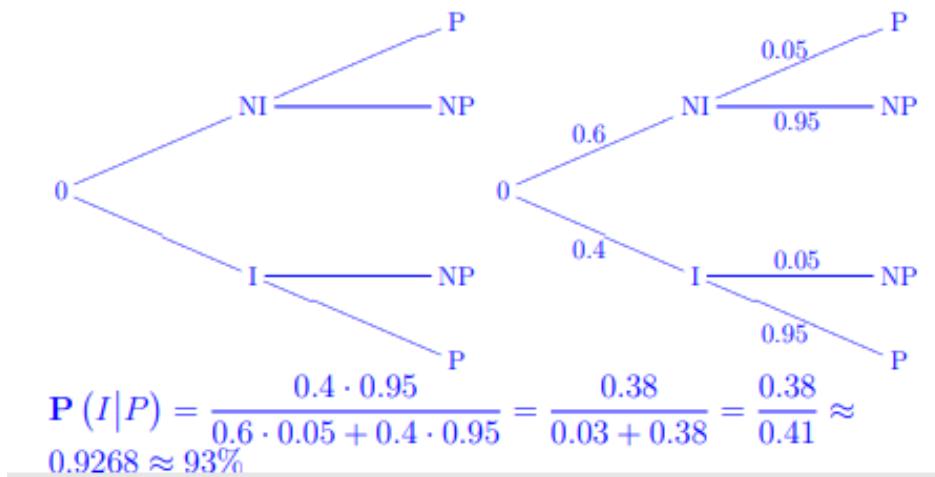
4. “O” total population

“I” Infected

“NI” Not Infected

“P” Positive

“NP” not positive



They need to calculate Infected given that Tested positive

I.e,  $P(I|P)$

Note: If they have not used Baye's theorem and still calculated the answer then deduct 2.5 Marks for the correct answer.

If they solved correctly using Bayes' 5M

Incorrect answers get 0M