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**PRESIDENCY UNIVERSITY
BENGALURU**

SCHOOL OF ENGINEERING

MAKE-UP EXAMINATION JAN-2023

Course Code: CSE 5006

Course Name: Knowledge Engineering and Expert Systems

Program & Sem: M.Tech(AIE)

Date: 20/01/2023

Time: 9:30 AM to 12:30 PM

Max Marks: 100

Weightage: 50%

Instructions:

- (i) Read the all questions carefully and answer accordingly.
- (ii) Part A consists of **multiple response questions**. More than one option is correct. Write down **ALL the correct options** to get the full 4 marks.
- (iii) For Question 11, please use the predicates mentioned in the paper. **DO NOT COME UP** with your own predicates! They are quite likely to be incorrect.

Part A [Memory Recall Questions]

Answer all the Questions. Each question carries FOUR marks.

(8Q x 4M = 32 Marks)

1. Out of the following options, select the parts of a fuzzy logic system.

- a) Fuzzifier
- b) Knowledge base
- c) Inference engine
- d) Defuzzifier

(C.O.1) [Knowledge]

2. Select the correct statement(s) among the following:

- a) Syntax rules define how to write the logic.
- b) Inference rules define how to derive new knowledge from existing knowledge
- c) Syntax rules define how to learn new knowledge from a knowledge base
- d) Semantic rules define how to write the logic of the system.

(C.O.1) [Knowledge]

3. Select the element(s) of formal systems from the following:

- a) Inference rules
- b) Axioms
- c) Theorems
- d) Symbols

(C.O.1) [Knowledge]

4. In AI, frame concepts are analogous to object-oriented concepts in OOP. Select the **correct** frame concepts for the following OOP terms:

- (a) Frame is analogous to Class
- (b) Slot is analogous to Attribute
- (c) Accessors are analogous to Setters
- (d) Mutators are analogous to Getters

(C.O.1) [Knowledge]

5. Consider the following rule: “**IF** the season is autumn **AND** the sky is cloudy **AND** the forecast is drizzling, **THEN** the **advice** is “Take an umbrella”.” Select the type of rule that this is:

- a) Relation
- b) Recommendation
- c) Heuristic
- d) Directive

(C.O.1) [Knowledge]

6. Select the different types of content words that are present on WordNet.

- a) Noun
- b) Verb
- c) Adjective
- d) Adverb

(C.O.1) [Knowledge]

7. Select the different inference rules used in first-order logic, which are **NOT present** in propositional logic.

- a) Universal generalization
- b) Universal instantiation
- c) Existential instantiation
- d) Existential introduction

(C.O.1) [Knowledge]

8. Select the different elements in repertory grids.

- a) The Topic
- b) Set of Elements
- c) Set of Constructs
- d) Set of Ratings of elements on the constructs

(C.O.1) [Knowledge]

Part B [Thought Provoking Questions]

Answer all the Questions. Each question carries FOURTEEN marks. (2Q x 14M = 28 Marks)

9. Consider the water-jug problem. You are given 2 jugs of capacities 3 litres and 6 litres without any markings for smaller measurements on them. Find out **ALL** the ways you can measure volumes of water from 3 litres to 9 litres in steps of 1 litre (i.e. how you can measure 3 litres, 4 litres, 5 litres, 6 litres, 7 litres, 8 litres, and 9 litres). In case you can't measure out a corresponding volume of water, write “Not possible”.
[14 M] (C.O.2) [Comprehension]

10. Consider the following propositions.

P: It is sunny in the afternoon.

Q: It is colder than yesterday.

R: We go swimming

S: We will take a canoe trip.

T: We will be home by sunset

Let the knowledge base contain the following statements:

- a. It is not sunny this afternoon and it is colder than yesterday.
- b. If we go swimming, then it is sunny in the afternoon.
- c. If we do not go swimming, then we will take a canoe trip.
- d. If we take a canoe trip, then we will be home by sunset.

Prove that “We will be home by sunset” using propositional resolution by:

- a) Converting the statements into propositional logic using the propositions given
- b) Converting the propositional logic statements to conjunctive normal form
- c) Negating the conclusion
- d) Adding the negated conclusion to the knowledge base
- e) Reaching a contradiction.

(C.O.3) [Application]

Part C [Problem Solving Questions]

Answer all the Questions. Each question carries TWENTY marks. (2Q x 20M = 40 Marks)

11. Consider the following statements in the knowledge base:

- a. Every child loves every candy.
- b. Anyone who loves some candy is not a fitness fanatic.
- c. Anyone who eats pumpkin is a fitness fanatic.
- d. Anyone who buys any pumpkin either eats it or carves it.
- e. John buys a pumpkin.
- f. Lifesavers is a candy.

Prove that: "If John is a child, then John carves a pumpkin."

Use **only** the following predicates:

- Child(x): x is a child.
- Candy(x): x is a candy.
- Loves(x, y): x loves y.
- FitnessFanatic(x): x is a fitness fanatic.
- Pumpkin(x): x is a pumpkin.
- Eat(x, y): x eats y.
- Buy(x, y): x buys y.
- Carve(x, y): x carves y.

(C.O.3) [Application]

12. Schubert's Steamroller is a complicated puzzle which involves multiple predicates and statements in the knowledge base. So much so, that in 1984, Christopher Walther published a paper at the prestigious AAAI conference (rated A* on CORE) detailing an efficient solution with **over 100 steps!** Here are the statements in the knowledge base:

- Wolves, foxes, birds, caterpillars, and snails are animals, and there are some of each of them.
- There are some grains, and grains are plants.
- Every animal either likes to eat all plants or all animals much smaller than itself that like to eat some plants.
- Caterpillars and snails are much smaller than birds.
- Birds are much smaller than foxes.
- Foxes are much smaller than wolves.
- Wolves do not like to eat foxes or grains.
- Birds like to eat caterpillars but not snails.
- Caterpillars and snails like to eat some plants.
- There is an animal that likes to eat a grain-eating animal.

To make life easy for you, for each of the following terms, you should only define an appropriate predicate. For example, if you have the proposition "every child ...", child(x) is a predicate defined as "child(x): x is a child":

- (a) Animal (b) Bird (c) Caterpillar (d) Wolf (e) Eat (f) Fox (g) Grain
(h) Plant (i) Snail (j) Smaller (C.O.4) [Comprehension]