17482

# BRAINWARE UNIVERSITY

**Term End Examination 2025-2026**
**Programme – BCA-Hons-2024**
**Course Name – Artificial Intelligence**
**Course Code - BCA30203**
**( Semester III )**



**Full Marks : 60** **Time : 2:30 Hours**

[The figure in the margin indicates full marks. Candidates are required to give their answers in their own words as far as practicable.]

## Group-A

(Multiple Choice Type Question) 1 x 15=15

1. *Choose the correct alternative from the following :*

(i) Recall which component of a learning agent is responsible for suggesting exploratory actions to gain new and informative experiences.

a) The Performance Element b) The Learning Element
c) The Problem Generator d) The Utility Function

(ii) What does a rational agent aim to do?

a) Store data b) Maximize performance
c) Act randomly d) Take rest

(iii) Select the field in which state space representation is used.

a) Problem solving b) Learning
c) Perception d) Knowledge

(iv) What is the first step in problem-solving in AI?

a) Solution testing b) Problem formulation
c) Rule creation d) Goal setting

(v) What does state space contain?

a) Only initial states b) Set of states and actions
c) Goals only d) Results only

(vi) Translate first-order logic into natural language.

a) $\forall x$ Dog(x) $\Rightarrow$ Mammal(x) means "All dogs are mammals". b) It means dogs are cats.
c) It means some mammals are dogs. d) It means cats are dogs.

(vii) Translate a logical rule to first-order logic: "If it rains, roads are wet."

a) Rain(x) $\Rightarrow$ Wet(x) b) Rains $\rightarrow$ Roads
c) Rain & Wet d) Water & Rain

(viii) Translate the syntactic structure "NP $\rightarrow$ Det + N" into natural language.

a) Sentence = verb + object
b) Noun phrase = determiner + noun
c) Adjective phrase = adverb + noun
d) Pronoun phrase = verb + adverb

(ix) Translate semantic meaning into FOL.

a) Love(x, y) means x loves y
b) F(x, y) = z
c) Logic is false
d) Words are ignored

(x) Apply the semantic network approach to represent: "A car is a vehicle, and vehicles have wheels."

a) car → IS-A → vehicle; vehicle → HAS-A → wheels
b) vehicle → IS-A → car; wheels → HAS-A → vehicle
c) car → HAS-A → wheels; vehicle → IS-A → car
d) wheels → HAS-A → vehicle; car → IS-A → wheels

(xi) Apply Bayes' Rule: If P(R)=0.3, P(T|R)=0.9, and P(T)=0.6, what is P(R|T)?

a) 0.45
b) 0.25
c) 0.15
d) 0.5

(xii) Analyze which reasoning type is being used: "A doctor diagnoses a patient with pneumonia after recalling a previous patient with the same symptoms and treatment outcome."

a) Model-based reasoning
b) Case-based reasoning
c) Rule-based reasoning
d) Probabilistic reasoning

(xiii) Interpret the key distinction between an "agent function" and an "agent program" in AI.

a) The agent function executes actions, while the agent program perceives the environment.
b) The agent function is for learning agents, while the agent program is for reflex agents.
c) The agent function is an abstract mathematical description mapping percept sequences to actions, whereas the agent program is the concrete implementation of this function running within a physical system.
d) The agent function is designed by the programmer, while the agent program is learned autonomously.

(xiv) Apply existential generalization to the fact: Loves (John, Mary). Which of the following is correct?

a) ∃x ∃y Loves(x, y)
b) ∃x ∀y Loves(x, y)
c) ∀x ∃y Loves(x, y)
d) ∀x ∀y Loves(x, y)

(xv) Apply the semantic network approach to represent: "A robin is a bird, and birds have wings."

a) A → robin, bird, wings hierarchy
b) robin → IS-A → bird; bird → HAS-A → wings
c) bird → IS-A → robin; wings → HAS-A → bird
d) robin → HAS-A → wings; bird → IS-A → robin

## Group-B

(Short Answer Type Questions) 3 x 5=15

2. Identify two specific limitations inherent to Simple Reflex Agents, particularly in environments that are not fully observable. (3)
3. Summarize the application of Bayesian networks in reasoning under uncertainty. (3)
4. Outline the process of discourse analysis in Natural Language Processing (NLP). (3)
5. In a spam detection system, the probability that a message is spam is 0.3. The probability that "free" appears in spam is 0.9 and in non-spam is 0.1. Calculate the probability that a message is spam given that it contains "free". (3)
6. Calculate the total number of directed edges in a semantic network with 4 classes (Animal, Bird, Fish, Penguin), 3 "is-a" relations (Penguin → Bird, Bird → Animal, Fish → Animal), and 3 property links (Bird → can fly, Penguin → cannot fly, Fish → swims). (3)

**OR**

Calculate the probability that it rains and the grass is wet in a Bayesian Network, given that the probability of rain is 0.2 and the probability that the grass is wet given it rains is 0.9. (3)

## Group-C

(Long Answer Type Questions) 5 x 6=30

7. Explain the different types of agents in Artificial Intelligence with suitable examples. (5)
8. Compare First-Order Logic (FOL) and Propositional Logic in knowledge representation with suitable examples. (5)
9. Demonstrate the use of Part-of-Speech (POS) tagging in syntactic processing with a suitable example. (5)
10. Judge the effectiveness of dependency parsing over constituency parsing in syntactic analysis, highlighting their advantages and limitations. (5)
11. Dissect a two-joint planar robotic arm with link lengths $L_1 = 2$ units and $L_2 = 1.5$ units. If the end-effector is located at ($x = 2.5$, $y = 0.5$), compute the joint angles $\theta_1$ and $\theta_2$ using inverse kinematics. (5)
12. Calculate the total number of nodes in the semantic network constructed using the concepts LivingThing, Animal, Plant, Bird, Mammal, Sparrow, and Tiger, based on the "is-a" relationships [Animal is-a LivingThing, Plant is-a LivingThing, Bird is-a Animal, Mammal is-a Animal, Sparrow is-a Bird, Tiger is-a Mammal]; calculate how many edges are used for these "is-a" relationships; and calculate how many directed edges exist if each "is-a" link is represented as a directed edge. (5)

**OR**

Calculate the joint probability that it rains and the sprinkler is on, $P(Rain \wedge Sprinkler)$, given the following information from a Bayesian Network: the probability of rain is $P(Rain)=0.2$, the probability of the sprinkler being on given that it rains is $P(Sprinkler|Rain)=0.01$, the probability of the sprinkler being on given that it does not rain is $P(Sprinkler|\neg Rain)=0.4$, and the probability of the grass being wet given that it is raining and the sprinkler is on is $P(GrassWet|Rain,Sprinkler)=0.99$. Show all steps clearly. (5)

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