Bihar Engineering University, Patna

B.Tech 5th Semester Examination, 2024

Course: B.Tech | *Time: 03 Hours*

Code: 105501 | *Subject: Artificial Intelligence* | *Full Marks: 70*

Instructions:-

(i) The marks are indicated in the right-hand margin.

*(ii) There are **NINE** questions in this paper.*

*(iii) Attempt **FIVE** questions in all.*

*(iv) Question No. **1** is compulsory.*

Q.1 ***Choose the correct option / answer the following (Any seven question only):*** **[2 x 7 = 14]**

(a) Which of the following best defines the Turing Test?

(i) A method to calculate machine efficiency

(ii) A test for machine learning algorithms

(iii) A test to determine if a machine can exhibit human-like intelligence

(iv) A benchmark for robotic speed

(b) *The A** algorithm guarantees optimality if the heuristic used is

(i) Arbitrary

(ii) Inconsistent

(iii) Admissible and consistent

(iv) Random

(c) Which of these search strategies is *not* complete in infinite-depth spaces?

(i) Breadth-First Search

(ii) Depth-First Search

(iii) DFID

(iv) A* Search

(d) In an AND/OR graph, solving an AND node means:

(i) Solving one child node is enough

(ii) All child nodes must be solved

(iii) The node is ignored

(iv) Any node can be skipped

(e) Minimax is used in game playing to:

(i) Maximize randomness

(ii) Minimize evaluation time

(iii) Make optimal moves assuming the opponent plays optimally

(iv) Store all possible states

(f) Alpha-beta pruning improves Minimax by:

(i) Increasing the depth

(ii) Ignoring non-optimal branches

(iii) Doubling the search time

(iv) Reducing the score of nodes

(g) Propositional logic cannot express which of the following?

(i) True/false statements

(ii) Compound statements

(iii) Logical connectives

(iv) Variables and functions

(h) Bayesian networks are especially useful in situations with:

(i) Complete knowledge and logic

(ii) No uncertainty

(iii) Deterministic processes

(iv) Probabilistic and uncertain information

(i) Which of the following is most likely used in deep learning?

(i) Decision Trees

(ii) Shallow neural networks

(iii) Multi-layered neural networks

(iv) K-Means algorithm

(j) Which of the following is a key step in a genetic algorithm?

(i) Regression

(ii) Cross-validation

(iii) Crossover

(iv) Tokenization

Q.2 (a) A chatbot consistently passes the Turing Test during short conversations but fails at longer ones. What does this imply about the limitations of the test? Suggest an enhancement to the test. [7]

(b) Explain how an agent's architecture affects its ability to operate in a partially observable, stochastic environment. Provide a practical example. [7]

Q.3 (a) Show that Hill Climbing can get stuck in local maxima, plateaus, and ridges. Suggest at least two variations or techniques to overcome these issues and explain how they help. [7]

(b) Heuristics are designed to guide search algorithms efficiently, but they can sometimes mislead the search. Describe a situation in which **A*** search performs worse than an uninformed search due to a poorly chosen heuristic. [7]

Q.4 (a) Define a basic Constraint Satisfaction Problem (CSP) involving three variables and solve it using backtracking. Also explain the role of domain and constraints. [7]

(b) Describe how Particle Swarm Optimization (PSO) works with a simple analogy (e.g., birds flocking). Show how particles update their positions and velocities. [7]

Q.5 (a) Create a simple two-player game tree (3 levels) and show how the Minimax algorithm selects the best move for the maximizing player. [7]

(b) Compare probabilistic reasoning using Bayesian Networks with logical reasoning. In what situations is probabilistic reasoning more appropriate? Give examples. [7]

Q.6 (a) What is partial-order planning? Explain with a block-world example, showing how actions can be arranged without a strict linear order. [7]

(b) Explain resolution in First-Order Logic (FOL). Using a simple knowledge base (e.g., "All humans are mortal, Socrates is a human"), derive a conclusion using resolution refutation. [7]

Q.7 (a) Construct a simple decision tree from the given dataset: [7]

Weather	Temp	Play?
Sunny	Hot	No
Sunny	Cool	Yes
Rainy	Cool	Yes
Rainy	Hot	No

Explain your attribute selection criteria.

(b) How can semi-supervised learning be useful in real-world scenarios like email spam detection? Describe its working with an example involving labeled and unlabeled data. [7]

Q.8 (a) Discuss how backpropagation helps train a neural network. Use a small example with two layers and a loss function to explain weight adjustment. [7]

(b) What are the limitations of K-means clustering? Discuss two scenarios where K-means performs poorly and suggest possible improvements or alternatives. [7]

Q.9 (a) What is a Genetic Algorithm (GA)? Outline the basic steps of a GA such as selection, crossover, and mutation using an example of solving a simple optimization problem. [7]

(b) Explain the working of rule-based Expert Systems. Create a small rule base for diagnosing common cold vs. flu using IF-THEN rules. [7]