Dezyne École College

Bachelor of Computer Applications (BCA)

Third Year – 5th Semester Artificial Intelligence

Probable Question for Artificial Intelligence

Unit – 1

1. Define Artificial Intelligence. Give two examples of AI applications.
2. What is the difference between narrow AI and general AI?
3. List any four real-world applications of AI in different domains.
4. What is machine learning? How does it relate to AI?
5. Define knowledge-based systems. What are their main components?
6. What is the difference between data, information, and knowledge?
7. What are expert systems? Give two examples.
8. Define knowledge representation. Why is it important in AI?
9. What is knowledge acquisition? Name two methods of knowledge acquisition.
10. What is the knowledge engineering process?
11. Define propositional logic. Give an example of a proposition.
12. What are logical connectives? Name five logical connectives.
13. What is the difference between syntax and semantics in logic?
14. Define First-Order Predicate Logic (FOPL). How does it differ from propositional logic?
15. What are predicates and terms in FOPL?
16. What is a clause in logic? Give an example.
17. Define resolution principle. What is its purpose?
18. What are inference rules? Name any three inference rules.
19. What is clausal form? Why is conversion to clausal form necessary?
20. What is unification in FOPL? Give a simple example.

21. Discuss various applications of AI across different domains
22. Explain knowledge-based systems in detail:
    1. Architecture of knowledge-based systems
    2. Components (knowledge base, inference engine, user interface)
    3. Types of knowledge-based systems
    4. Expert systems and their characteristics
    5. Examples of successful knowledge-based systems
23. Describe knowledge representation and its importance in AI:
    1. What is knowledge representation and why is it needed?
    2. Characteristics of good knowledge representation
    3. Types of knowledge (declarative, procedural, meta-knowledge)
    4. Knowledge representation schemes (logical, semantic networks, frames, scripts)
24. Explain knowledge organization and acquisition processes
25. Discuss propositional logic comprehensively:
    1. Logical connectives (¬, ∧, ∨, →, ↔) and their truth tables
    2. Tautologies and contradictions
    3. Logical equivalence and logical implication 4. Normal forms (CNF, DNF) and their significance
26. Describe First-Order Predicate Logic (FOPL) in detail:
    1. Syntax of FOPL (terms, predicates, quantifiers, variables, constants)
    2. Atomic formulas and complex formulas in FOPL
    3. Universal quantifier (∀) and existential quantifier (∃)
    4. Scope of quantifiers and bound/free variables
27. Explain the conversion to clausal form and its significance with suitable example
28. Discuss inference rules and resolution principle in details with suitable example

29. Can a knowledge-based system function effectively without proper knowledge acquisition? Explain the paradox.
30. What happens when you try to represent temporal knowledge using only propositional logic?
31. In FOPL, what's the difference between ∀x P(x) → Q(x) and ∀x (P(x) → Q(x))?

Unit – 2

1. Define Bayes' theorem and write its mathematical formula.
2. What is the difference between prior probability and posterior probability?
3. Define conditional independence in Bayesian networks.
4. What is a Bayesian network? Give one example.
5. Explain the concept of evidence in Bayesian inference.
6. Define possible world semantics in AI.
7. What is the difference between necessity and possibility in modal logic?
8. Explain the concept of accessibility relation in possible worlds.
9. What are the advantages of possible world representation?
10. Define belief function in Dempster-Shafer theory.
11. What is the difference between belief and plausibility?
12. Explain the concept of mass function in D-S theory.
13. What is Dempster's rule of combination?
14. Define frame of discernment in D-S theory.
15. What are the main components of an expert system?
16. Distinguish between forward chaining and backward chaining.
17. What is the role of inference engine in expert systems?
18. Define certainty factor in expert systems.
19. What is tokenization in NLP?
20. Define part-of-speech tagging with example.
21. Given P(A) = 0.3, P(B|A) = 0.8, P(B|¬A) = 0.2, calculate P(A|B) using Bayes' theorem. Also explain the significance of each probability value.

22. Construct a Bayesian network for a medical diagnosis system with variables: Disease (D), Symptom1 (S1), Symptom2 (S2), Test Result (T). Define the conditional probability tables and perform inference to find P(D|S1, S2, T).

23. A spam email filter uses Bayesian classification. Given:

    1. P(Spam) = 0.4, P(Ham) = 0.6
    2. P("lottery"|Spam) = 0.8, P("lottery"|Ham) = 0.1
    3. P("money"|Spam) = 0.9, P("money"|Ham) = 0.2 Calculate the probability that an email containing both "lottery" and "money" is spam.

24. Represent the following statements using possible world semantics:

    1. "It is possible that it will rain tomorrow"
    2. "John necessarily knows that 2+2=4"
    3. "If it rains, then necessarily the ground will be wet" Create accessibility relations and evaluate truth conditions.

25. Design a possible world model for a robot navigation system where the robot can move between rooms. Define worlds, accessibility relations, and modal operators for statements like "The robot can possibly reach the kitchen" and "The robot must avoid obstacles."

26. Given two mass functions:

    1. m1({A}) = 0.6, m1({B}) = 0.3, m1({A,B}) = 0.1
    2. m2({A}) = 0.4, m2({B}) = 0.4, m2({A,B}) = 0.2 Apply Dempster's rule of combination to find the combined mass function. Calculate belief and plausibility values for all subsets.

27. A security system uses D-S theory for threat assessment. Frame of discernment Θ = {No_Threat, Low_Threat, High_Threat}. Given evidence from three sensors with their mass functions, combine the evidence and determine the final threat assessment with belief and plausibility intervals.

28. Design a complete expert system for car troubleshooting with:

    1. Knowledge base with at least 10 rules
    2. Inference engine using forward chaining
    3. Certainty factors for each rule
    4. Sample consultation showing the reasoning process

29. Compare forward chaining and backward chaining inference strategies in expert systems. Implement both approaches for a simple medical diagnosis system with rules for diagnosing flu, cold, and allergy based on symptoms.
30. Develop a complete NLP pipeline for sentiment analysis of movie reviews:
    1. Tokenization and preprocessing
    2. Feature extraction (bag of words, TF-IDF)
    3. Classification algorithm
    4. Evaluation metrics Show the implementation with a sample movie review and classify it as positive/negative with confidence score.

Unit – 3

1. Define deep learning and explain how it differs from traditional machine learning.
2. What is the vanishing gradient problem in deep neural networks?
3. Explain the concept of activation functions. Name three commonly used activation functions.
4. What is the purpose of weight initialization in neural networks?
5. Define overfitting and underfitting in the context of deep learning.
6. What is backpropagation algorithm? Write its basic steps.
7. Explain the chain rule of calculus in context of backpropagation.
8. What is the difference between batch gradient descent and stochastic gradient descent?
9. Define learning rate and explain its impact on training.
10. What is a Generative Adversarial Network (GAN)? Name its two main components.
11. Define Markov Decision Process (MDP) with its four components.
12. What is the difference between RNN and feedforward neural networks?
13. Explain the vanishing gradient problem specifically in RNNs.
14. What does LSTM stand for? What problem does it solve?
15. What is GRU and how does it differ from LSTM?
16. Explain bidirectional neural networks and their advantages.
17. What is the difference between shallow and deep neural networks?

18. What is the objective of the 8-puzzle problem in AI?
19. State the missionaries and cannibals problem constraints.
20. Explain hill climbing algorithm and its main limitation.
21. Derive the backpropagation algorithm for a 3-layer neural network with sigmoid activation functions. Show the mathematical steps for computing gradients for weights and biases. Include the forward pass, loss calculation, and backward pass with detailed equations.
22. Compare different weight initialization techniques (Zero initialization, Random initialization, Xavier/Glorot initialization, He initialization). Implement a neural network in pseudocode showing how each initialization method affects training convergence. Analyze their impact on gradient flow.
23. Design a deep neural network architecture for image classification with the following specifications:
    1. Input: 28×28 grayscale images
    2. Hidden layers: 3 layers with 512, 256, 128 neurons
    3. Output: 10 classes
    4. Include dropout, batch normalization, and appropriate activation functions Show the forward propagation equations and calculate the total number of parameters.
24. Explain the complete GAN architecture with Generator and Discriminator networks. Derive the minimax loss function for GANs. Show how the training alternates between generator and discriminator. Discuss the challenges in GAN training including mode collapse and training instability.
25. Formulate a robot navigation problem as a Markov Decision Process:
    1. Define states, actions, transition probabilities, and rewards
    2. Show the Bellman equation for this problem
    3. Implement value iteration algorithm with at least 3 iterations
    4. Calculate the optimal policy for reaching the goal state
26. Design and implement an LSTM network for sequence prediction:
    1. Show the complete LSTM cell equations (forget gate, input gate, output gate, cell state)
    2. Compare LSTM with vanilla RNN for handling long sequences
    3. Implement backpropagation through time (BPTT) for LSTM

4. Discuss the computational complexity

27. Compare RNN, LSTM, GRU, and Bidirectional RNN architectures:
    1. Draw the network diagrams for each
    2. Analyze their advantages and disadvantages
    3. Implement a simple sentiment analysis model using each architecture
    4. Show how bidirectional processing improves performance
28. Implement a complete sequence-to-sequence model using encoder-decoder architecture:
    1. Design the encoder (LSTM/GRU based)
    2. Design the decoder with attention mechanism
    3. Show the training process with teacher forcing
    4. Apply it to a machine translation problem (English to Hindi)
29. Implement the 8-puzzle problem solution using A* search algorithm in MATLAB:
    1. Define the state representation and goal state
    2. Implement Manhattan distance heuristic function
    3. Show the complete A* algorithm with open and closed lists
    4. Trace through the solution path for a given initial state
    5. Compare with other search strategies (BFS, DFS, Hill Climbing)
30. Explain the following problems and show the MATLAB implementations:
    1. Water Jug Problem: 4-liter and 3-liter jugs to measure exactly 2 liters
    2. Missionaries and Cannibals: 3 missionaries, 3 cannibals, boat capacity 2
    3. Hill Climbing: Implement steepest ascent hill climbing for function optimization
    4. Show state space representation, successor function, and complete solution trace for each problem
    5. Compare hill climbing with simulated annealing for optimization problems