Course Name – Artificial Intelligence
Course Code - BCA57203 (T)

***** Multiple Choice Type Questions *****

1.

(i) Which type of agent operates using "if-then" rules without utilizing any internal state?

a) Goal-based agent
b) Simple reflex agent
c) Utility-based agent
d) Learning agent

(ii) Identify the type of agent that uses performance feedback to improve its actions.

a) Model-based agent
b) Learning agent
c) Goal-based agent
d) Reflex agent

(iii) Recall which of the following is not a property used to describe environments.

a) Fully/Partially Observable
b) Deterministic/Stochastic
c) Sequential/Parallel
d) Static/Dynamic

(iv) Select the term for all possible sequences of actions and resulting states in a problem.

a) Knowledge base
b) Production system
c) State space
d) Transition model

(v) Identify the component name in a production system that contains rules.

a) Working memory
b) Conflict resolver
c) Rule base
d) Environment

(vi) Identify the type of agent that evaluates its success using a utility function.

a) Utility-based agent
b) Reflex agent
c) Model-based agent
d) Learning agent

(vii) Choose the correct pair that describes a complex real-world environment.

a) Fully observable, single-agent
b) Static, deterministic
c) Partially observable, dynamic
d) Deterministic, accessible

(viii) Define a "goal" in the context of problem solving.

a) A condition to avoid
b) A start state
c) A target state that satisfies desired conditions
d) An intermediate step

(ix) Identify the component that decides which rule to apply in a production system.

a) Rule base
b) Inference engine
c) Conflict resolution strategy
d) State base

(x) Select the agent that uses internal models to maintain world knowledge.

a) Utility-based agent
b) Model-based reflex agent
c) Goal-based agent
d) Simple reflex agent

(xi) Interpret the reason why a partially observable environment increases complexity for an intelligent agent.

a) The agent has access to all environmental details
b) The agent must act randomly due to unknown rules
c) The agent must deduce the actual state from incomplete percepts
d) The environment never changes over time

(xii) Select the correct interpretation of the following rule in a production system: IF \"light is red\" THEN \"stop\".

a) It is a procedural instruction
b) It is a goal state
c) It is a condition-action pair
d) It represents a utility function

(xiii) Choose the correct sequence of solving a state-space search problem.

a) Goal test → Define actions → Define state → Apply rules
b) Define state → Define actions → Apply goal test → Search
c) Define actions → Define state → Apply utility → Search
d) Define states → Define action → Apply utility → Apply Search

(xiv) Interpret the reason why a single-agent environment is easier to model.

a) All other agents cooperate
b) No competition or unpredictable behavior
c) Agents have partial access to other agents\' state
d) It allows for utility maximization

(xv) Relate the state-space representation to AI search problems.

a) It defines a performance function
b) It restricts agent communication
c) It organizes all possible states and transitions
d) It is used only in robotics

(xvi) Interpret the function of a performance measure.

a) It senses the environment
b) It acts like a controller
c) It evaluates how well the agent is doing
d) It modifies the rule base

(xvii) Identify how a state-space tree differs from a state-space graph.

a) A tree allows cycles
b) A graph stores duplicate nodes
c) A tree ensures unique paths for state
d) Graphs are only used in learning agents

(xviii) Differentiate between a reflex agent and a model-based reflex agent.

a) Model-based agent ignores sensors
b) Reflex agent uses memory
c) Model-based agent uses internal world model for decision making
d) Reflex agent learns from feedback

(xix) Differentiate the advantage of utility-based agents over goal-based agents.

a) Better in adversarial settings
b) More memory-intensive
c) Can evaluate degree of success, not just goal achievement
d) Simpler to design

(xx) Choose the correct order in a typical agent function cycle.

a) Perceive → Actuator → Environment → Sensor
b) Act → Sense → Learn → Environment
c) Sense → Decide → Act
d) Think → Feel → Respond

(xxi) Apply production system logic: If the initial state is A, and rules are: A → B, B → C, C → D, what is the final state after 3 applications?

a) A
b) B
c) C
d) D

(xxii) Given a binary state-space tree of depth 3, how many leaf nodes will there be?

a) 4
b) 6
c) 8
d) 16

(xxiii) Evaluate: A problem has 4 possible actions per state, and depth limit is 3. Total number of nodes in the state-space tree = ?

a) 12
b) 64
c) 21
d) 85

(xxiv) Calculate: A state-space graph has 6 states and 7 transitions. How many paths are there from the initial state if each state connects to exactly one new node?

a) 6
b) 7
c) 1
d) 5

(xxv) Match: Agent type ↔ Capability I. Reflex Agent – a) Uses model II. Model-Based Agent – b) Uses feedback III. Learning Agent – c) Reacts instantly

a) I-a, II-b, III-c
b) I-c, II-a, III-b
c) I-b, II-c, III-a
d) I-a, II-c, III-b

(xxvi) Apply goal test: Problem: You are in state S0. Goal is to reach S3. Transitions: S0 → S1, S1 → S2, S2 → S3. How many rule applications are needed?

a) 1
b) 2
c) 3
d) 4

(xxvii) Simulate an agent\'s action selection in a partially observable environment. Agent has incomplete information. What should it use?

a) Reflex rules
b) Utility functions only
c) Internal state model
d) Goal satisfaction

(xxviii) Determine if the environment is stochastic: You press a switch, and a light turns on 70% of the time.

a) Fully observable
b) Static
c) Stochastic
d) Deterministic

(xxix) Evaluate a conflict resolution strategy: Rules: R1: If A then B; R2: If A then C. How should the system decide?

a) Execute both
b) Prioritize most recent
c) Use specificity or priority hierarchy
d) Use goal state

(xxx) Apply: An agent must choose between two paths: Path A has cost 5, utility 80 Path B has cost 2, utility 50 Which path should a utility-based agent choose (maximize utility/cost ratio)?

a) Path A
b) Path B
c) Both Path A and Path B
d) Neither Path A nor Path B

(xxxi) Define declarative knowledge.

a) Knowledge stored as actions
b) Knowledge about \"what is\
c) Control over hardware
d) Learned behavior

(xxxii) Identify the type of knowledge that includes heuristic rules.

a) Declarative
b) Meta-knowledge
c) Procedural
d) Heuristic

(xxxiii) Recognize the structure used in knowledge representation that consists of slots and fillers.

a) Script
b) Semantic Net
c) Frame
d) Conceptual Dependency

(xxxiv) Recall what a predicate in FOL represents.

a) A constant
b) A variable
c) A function
d) A property or relation

(xxxv) Define semantic network.

a) A neural-based learning system
b) A graphical representation of concepts and their relationships
c) A rule-based system
d) A decision-making matrix

(xxxvi) Identify the main component of a frame.

a) Rule
b) Slot
c) Node
d) Terminal

(xxxvii) Name the inference mechanism used in Bayesian networks.

a) Deduction
b) Probabilistic Inference
c) Induction
d) Monotonic Reasoning

(xxxviii) Select the type of reasoning used when conclusions can be withdrawn.

a) Monotonic
b) Deductive
c) Non-monotonic
d) Rule-based

(xxxix) Identify the core component of a case-based reasoning system.

a) Model parameters
b) Semantic structure
c) Knowledge base
d) Past cases

(xl) Define fuzzy logic.

a) Binary logic
b) Logic with absolute truth values
c) Logic based on degrees of truth
d) Rule-less logic

(xli) Recognize what the unification algorithm is used for.

a) Normalizing semantic networks
b) Rewriting frames
c) Matching predicates in FOL
d) Drawing conceptual maps

(xlii) Recall the function of inference engine.

a) Manage memory
b) Apply rules to known facts d) Store sensor data
c) Control user interface
d) A property or relation

(xliii) Identify the knowledge type which includes facts and relationships.

a) Heuristic knowledge
b) Structural knowledge
c) Declarative knowledge
d) Meta-knowledge

(xliv) Define conceptual dependency.

a) Grammar-based language parser
b) Language-independent representation of meaning
c) Temporal sequencing in a script
d) Truth table generator

(xlv) Recognize the meaning of prior probability in Bayes\' rule.

a) Probability after evidence
b) Probability before considering current evidence
c) The evidence probability
d) Maximum posterior

(xlvi) Interpret the benefit of frame-based representation.

a) Fixed rule ordering
b) Supports natural language processing
c) Enables procedural learning
d) Facilitates modular and hierarchical knowledge storage

(xlvii) Interpret the reason why non-monotonic reasoning is important in AI.

a) It simplifies proof trees
b) Real-world knowledge often changes over time
c) It requires no inference engine
d) It avoids probabilistic methods

(xlviii) Differentiate between script and frame.

a) Scripts are static, frames dynamic
b) Scripts capture sequences of events; frames represent objects
c) Frames are probabilistic; scripts are rule-based
d) Scripts represent slot values

(xlix) Choose which FOL expression represents \"All dogs are animals\".

a) $\exists x\ Dog(x) \rightarrow Animal(x)$
b) $\forall x\ Dog(x) \rightarrow Animal(x)$
c) $Dog(x) \leftrightarrow Animal(x)$
d) $\forall x\ Animal(x) \rightarrow Dog(x)$

(l) Illustrate the limitation of semantic networks.

a) Can\'t handle hierarchy
b) Can\'t model probability
c) Can\'t represent procedural rules
d) Can\'t handle ambiguity

(li) Interpret the fuzzy set membership function $\mu(x) = x/10$ for $x \in [0, 10]$. What is $\mu(7)$?

a) 0.5
b) 0.7
c) 1
d) 0.3

(lii) Identify the best example of case-based reasoning.

a) Rule lookup
b) Decision trees
c) Solving a new problem by adapting a past similar case
d) Frame filling

(liii) Interpret how Bayes' theorem helps in reasoning under uncertainty.

a) Adds noise to the inference
b) Gives deterministic outcomes
c) Updates probability of hypothesis based on evidence
d) Avoids prior information

(liv) Differentiate rule-based from case-based reasoning.

a) Rule-based uses fixed data; case-based uses frames
b) Case-based adapts from past cases; rule-based uses pre-defined rules
c) Both rule-based and case-based reasoning use frames
d) Rule-based systems always fail in NLP

(lv) Interpret the need for unification in automated reasoning.

a) Verifies prior probabilities
b) Matches and substitutes variables in predicates
c) Simplifies Bayes nets
d) Optimizes rules

(lvi) Classify a probabilistic belief network.

a) Bayesian Network
b) Semantic Net
c) Frame
d) Case Model

(lvii) Determine the output of unifying knows(John, X) with knows(Y, AI).

a) Fail
b) {X/AI, Y/John}
c) {John/Y}
d) {X/Y}

(lviii) Compare model-based and rule-based reasoning.

a) Both model-based and rule-based reasoning depend on specific rules
b) Model-based uses structure of system; rule-based applies condition-action pairs
c) Rule-based lacks inference
d) Model-based ignores history

(lix) Choose the main advantage of using Bayesian networks.

a) Deterministic inference
b) Clear structure for uncertain knowledge
c) Pure logic-based reasoning
d) Eliminates need for learning

(lx) Interpret the reason how conceptual dependency helps in NLP.

a) Enables machine vision
b) Translates text to language-independent structures
c) Maps predicates to logic
d) Parses SQL

(lxi) Apply unification: unify likes(X, icecream) with likes(john, Y).

a) {X/john, Y/icecream}
b) {X/Y}
c) {Y/X}
d) No unification possible

(lxii) Calculate posterior probability using Bayes\' Rule: P(A|B) = [P(B|A) * P(A)] / P(B) If P(B|A)=0.7, P(A)=0.3, P(B)=0.6, find P(A|B).

a) 0.28
b) 0.35
c) 0.27
d) 0.36

(lxiii) Design a frame for a "Car" with 2 slots.

a) [Car: wheels, windows]
b) Car → Transport
c) Car: IF engine THEN start
d) Car = "fast vehicle"

(lxiv) Simulate fuzzy logic: μ(tall) = (height − 150)/50, for height in [150, 200] What is μ(175)?

a) 0.25
b) 0.5
c) 0.75
d) 1

(lxv) Choose best reasoning type for a medical diagnosis system.

a) Monotonic reasoning
b) Fuzzy reasoning
c) Conceptual dependency
d) Rule-based only

(lxvi) Apply Bayes rule to email classification: If 60% emails are spam and P(word="lottery"|spam)=0.8, P(word="lottery"|not spam)=0.1, classify an email with "lottery".

a) Spam
b) Not spam
c) Can't classify
d) Needs more data

(lxvii) Select reasoning type when a robot updates knowledge after learning object behavior.

a) Rule-based
b) Case-based
c) Model-based
d) Fuzzy logic

(lxviii) Determine if semantic net can represent \"John is father of Mary\".

a) No
b) Only in FOL
c) Yes, as a directed edge from John to Mary labeled \'father\'
d) Only through scripts

(lxix) Apply reasoning: Premise: All humans are mortal. Socrates is a human. Deduce conclusion.

a) Socrates is not human
b) Socrates is mortal d) Unknown
c) Socrates is logical

(lxx) Implement fuzzy logic rule: IF temperature is "high" THEN fan speed is "fast". Temperature = 80, μ(high)=0.6. What is μ(fast)?

a) 0.2
b) 0.4
c) 0.6
d) 1

(lxxi) Apply probabilistic inference to determine most probable cause of fever given probabilities of flu and malaria.

a) Choose one with highest prior
b) Choose one with highest P(fever|disease)
c) Compute posterior using Bayes
d) Skip evidence

(lxxii) Choose most effective representation for legal rules in law domain.

a) Frame
b) Rule-based
c) Case-based
d) Semantic Net

(lxxiii) Simulate FOL: Express \"Every student studies hard\".

a) ∀x (Student(x) → Studies(x))
b) ∃x (Student(x) → Studies(x))
d) ∀x (Studies(x) → Student(x))
c) Studies(x) ∧ Student(x)

(lxxiv) Use conceptual dependency for sentence: "John gave Mary a book." What is the main action primitive?

a) INGEST
b) PTRANS
c) ATRANS
d) MOVE

(lxxv) Apply reasoning when the agent uses both rules and probabilities to make decisions.

a) Hybrid reasoning
b) Monotonic logic
c) Conceptual dependency
d) Deduction only

(lxxvi) Identify the number of nodes evaluated in a full binary tree of depth 3 using the Minimax algorithm without pruning.

a) 7
b) 8
c) 15
d) 16

(lxxvii) Recall the time complexity of Minimax in a game tree of branching factor b and depth d.

a) O(b^2)
b) O(d^b)
c) O(b^d)
d) O(b + d)

(lxxviii) Recognize the depth at which Iterative Deepening Search completes its last iteration if solution is found at level 3.

a) 1
b) 2
c) 3
d) 4

(lxxix) State the best-case scenario for alpha-beta pruning in terms of node ordering.

a) Worst-to-best
b) Random
c) Best-to-worst
d) Best-first

(lxxx) Calculate the number of leaf nodes in a ternary game tree (each node has 3 children) of depth 2.

a) 9
b) 6
c) 27
d) 12

(lxxxi) Estimate the effective branching factor for a game tree where alpha-beta pruning skips 60% of nodes in a binary tree of depth 4.

a) 2
b) 1.6
c) 1.2
d) 0.8

(lxxxii) Interpret the improvement in node evaluation if alpha-beta pruning is applied to a tree of b = 3 and depth d = 4. What's the ideal node count?

a) 81
b) 40 d) 9
c) 27

(lxxxiii) Analyze the number of times the root node is revisited during Iterative Deepening Search when the search depth increases from 0 to 2.

a) 1
b) 2
c) 3
d) 4

(lxxxiv) Evaluate the game tree given values [4, 7, 6, 5] using Minimax with alpha-beta pruning. What is the returned value at the root?

a) 5
b) 6
c) 7
d) 4

(lxxxv) Compare the number of nodes explored by Minimax vs. Alpha-Beta pruning for depth 4 in a binary tree.

a) Equal
b) Alpha-Beta explores more
c) Alpha-Beta explores fewer
d) Depends on evaluation function

(lxxxvi) Apply the Minimax algorithm on the following values at the leaf nodes: [3, 12, 8, 2] for a two-level game tree. What is the minimax value at the root node?

a) 3
b) 8
c) 12
d) 2

(lxxxvii) Solve for the number of nodes pruned when alpha-beta pruning is applied to a perfectly ordered binary tree of depth 4.

a) 8
b) 10
c) 11
d) 12

(lxxxviii) Calculate the number of evaluations saved by alpha-beta pruning in a game tree of 3 levels (binary) with optimal ordering.

a) 4
b) 5
c) 6
d) 7

(lxxxix) Derive the number of nodes expanded in Iterative Deepening with branching factor 2 and depth 3.

a) 14
b) 15
c) 16
d) 17

(xc) Compute the maximum number of comparisons saved by alpha-beta pruning in a binary tree of depth 5.

a) 16
b) 24
c) 28
d) 30

(xci) Define the term syntax in Natural Language Processing.

a) Meaning of a sentence
b) Structure and grammatical rules of sentences
c) Speech recognition process
d) Sentiment attached to words

(xcii) Identify the component that deals with the literal meaning of a sentence.

a) Pragmatic analysis
b) Discourse analysis
c) Semantic analysis
d) Syntactic parsing

(xciii) Recall which phase of NLP addresses \"contextual meaning\" in conversation.

a) Lexical Analysis
b) Pragmatic Processing
c) Morphological Analysis
d) Named Entity Recognition

(xciv) Recognize the role of discourse processing in NLP.

a) Grammar correction
b) Understanding multi-sentence relationships
c) Sentence tokenization
d) Speech-to-text conversion

(xcv) Identify the algorithm often used for syntactic parsing.

a) Backpropagation
b) CYK Parser
c) A* Search
d) ID3

(xcvi) Recall the data structure most commonly used in syntax trees.

a) Queue
b) Heap
c) Graph
d) Tree

(xcvii) Recognize what Part-of-Speech (POS) tagging assigns to each word.

a) Named entities
b) Sentiment
c) Probability
d) Grammatical category

(xcviii) Recall which level of language deals with \"intent\" behind utterances.

a) Syntax
b) Semantics
c) Pragmatics
d) Morphology

(xcix) Define the task that determines the relationship between sentences.

a) Pragmatic analysis
b) Morphological analysis
c) Discourse analysis
d) Statistical parsing

(c) Which of the following is a commonly used library for NLP in Python?

a) Pandas
b) NumPy
c) Matplotlib
d) NLTK

(ci) Interpret the reason why syntactic parsing is essential in NLP.

a) It determines meaning of text
b) It breaks speech into syllables
c) It determines grammatical structure
d) It helps correct spelling

(cii) Interpret the output of a POS tagging algorithm on the sentence “She can fish.”

a) PRONOUN–MODAL–VERB
b) NOUN–VERB–NOUN
c) PRONOUN–VERB–NOUN
d) VERB–NOUN–VERB

(ciii) Summarize the primary purpose of semantic analysis in NLP.

a) Translate text
b) Assign grammar rules
c) Determine the meaning of sentences
d) Determine sentence boundaries

(civ) Distinguish between syntax and semantics in NLP.

a) Syntax is about meaning; semantics is about rules
b) Both syntax and semantics in NLP deal with grammar
c) Syntax is grammar; semantics is meaning
d) Syntax is harder to analyze than semantics

(cv) Estimate the number of possible syntactic trees for the sentence: \"The old man the boats.\" (Ambiguity exists)

a) 1
b) 2 d) 4
c) 3

(cvi) Classify the following sentence type: “Although it was raining, they went out.”

a) Simple
b) Compound
c) Complex
d) Imperative

(cvii) Compare the focus of discourse analysis and pragmatic analysis.

a) Both discourse analysis and pragmatic analysis focus on individual sentence meaning
b) Discourse focuses on context between sentences; pragmatics focuses on speaker intent
c) Pragmatic is lexical-level only
d) Discourse is limited to word-level analysis

(cviii) Interpret the following ambiguity: \"He saw the man with the telescope.\" Which process resolves it?

a) Syntax
b) Semantics
c) Discourse
d) Pragmatics

(cix) Explain the impact of syntactic ambiguity on NLP models.

a) Reduces accuracy in grammar checking
b) Increases word error rate
c) Causes multiple parse trees
d) Causes single parse trees

(cx) Estimate how many POS tags are typically used in Penn Treebank Tagset.

a) 10
b) 20
c) 36
d) 45

(cxi) Apply dependency parsing on the sentence "John gave Mary a book." What is the dependency of "Mary"?

a) Subject
b) Indirect object
c) Direct object
d) Modifier

(cxii) Solve the ambiguity in the sentence: "I saw her duck." Which word is ambiguous?

a) I
b) Saw
c) Her
d) Duck **)**

(cxiii) Compute the total number of 2-grams (bigrams) for the sentence "Natural Language Processing is fun."

a) 3
b) 4
c) 5
d) 6

(cxiv) Apply semantic role labeling to the sentence "Alice baked a cake." What is the role of "a cake"?

a) Agent
b) Theme d) Instrument
c) Source

(cxv) Compute the number of possible token combinations for 4 tokens if order matters and repetition is not allowed.

a) 4
b) 16
c) 24
d) 256

(cxvi) Solve using a statistical language model: If P("is fun") = 0.01 and P("fun") = 0.03, what is P("is" | "fun")?

a) 0.33
b) 0.01
c) 0.3
d) 0.1

(cxvii) Apply a rule-based grammar to identify the main verb in: "They might have been singing."

a) Might
b) Been
c) Singing
d) Have

(cxviii) Compute cosine similarity for word vectors A = [1,2] and B = [2,3].

a) 0.983
b) 1
c) 0.75
d) 0.85

(cxix) Solve the dependency of "yesterday" in the sentence "She arrived yesterday."

a) Root
b) Temporal Modifier
c) Direct Object
d) Subject

(cxx) Apply semantic analysis to determine the sentiment of: "This film was surprisingly good."

a) Positive
b) Negative
c) Neutral
d) Ambiguous

(cxxi) Define the role of the inference engine in an expert system.

a) Data storage
b) Rule application
c) Decision-making using knowledge base
d) User input handling

(cxxii) Identify the main component responsible for knowledge acquisition in an expert system.

a) Inference engine
b) Knowledge engineer
c) User interface
d) Rule base

(cxxiii) Recall the first successful expert system developed in the medical domain.

a) PROLOG
b) MYCIN
c) ELIZA
d) DENDRAL

(cxxiv) List the types of knowledge commonly used in expert systems.

a) Declarative, Object-Oriented
b) Declarative, Procedural, Heuristic
c) Functional, Relational
d) Linear, Fuzzy

(cxxv) Name the mathematical model frequently used for robot kinematics.

a) Bayes Theorem
b) Matrix transformation
c) Graph theory
d) Neural model

(cxxvi) Define line-following robots based on their path strategy.

a) Robots that follow a predefined path using sensors
b) Robots that move randomly
c) Robots that use fuzzy logic
d) Robots that use speech recognition

(cxxvii) Identify the component responsible for movement in a robot.

a) Actuators
b) Sensors
c) Microprocessor
d) Controller

(cxxviii) Select the most appropriate application of expert systems.

a) Mechanical assembly
b) Medical diagnosis
c) Physical simulation
d) Compiler design

(cxxix) State which of the following is a characteristic of expert systems.

a) Domain-specific knowledge
b) Universal applicability
c) Random behavior
d) Human-free processing

(cxxx) Define the function of sensors in robotic systems.

a) Data computation
b) Environment detection
c) Language translation
d) Memory management

(cxxxi) Interpret the reason why rule-based systems are preferred in certain expert systems.

a) Easy to implement randomness
b) Clear logical reasoning and traceability
c) Supports real-time data mining
d) Minimizes domain specificity

(cxxxii) Interpret the relationship between knowledge base and inference engine.

a) The inference engine derives conclusions from the knowledge base
b) The inference engine builds the knowledge base
c) The knowledge base executes user inputs
d) Both knowledge base and inference engine operate independently

(cxxxiii) Differentiate between forward and backward chaining in expert systems.

a) Forward: Goal-driven; Backward: Data-driven
b) Forward: Data-driven; Backward: Goal-driven
c) Both forward and backward chaining are random
d) Both forward and backward chaining are linear search

(cxxxiv) Distinguish between physical and soft robots.

a) Physical robots perform actions; soft robots are virtual agents
b) Both physical and soft robots are virtual
c) Both physical and soft robots use same processing units
d) No real distinction

(cxxxv) Illustrate how a robot calculates its next position using transformation matrices.

a) By summing angles
b) By adding sensor data
c) By multiplying rotation and translation matrices
d) Using probabilistic tables

(cxxxvi) Interpret the role of feedback in robotic motion control.

a) Ensures accurate movement based on sensor data
b) Enhances fuzzy logic
c) Reduces CPU cycles
d) Simulates randomness

(cxxxvii) Interpret the benefit of modular design in expert systems.

a) Hard-coded decision flow
b) Easy updating and scalability
c) Prevents user interaction
d) Reduces output generation

(cxxxviii) State the need for domain experts in expert system development.

a) Provide domain-specific heuristics and rules
b) Build inference engine
c) Manage file systems
d) Evaluate user inputs

(cxxxix) Identify types of robots used in industry.

a) Static, dynamic
b) Fixed, mobile, autonomous
c) Manual, robotic
d) Online, ofline

(cxl) Interpret the reason why knowledge engineering is a bottleneck in expert systems.

a) Requires no logic
b) Involves capturing tacit human knowledge
c) Needs only sensors
d) Uses constant feedback

(cxli) Calculate the final position of a 2D robot arm using translation matrix [2, 3] and rotation matrix of 90°. What's the final coordinate of point (1, 1)?

a) (2, 4)
b) (3, 2)
c) (1, 5)
d) (5, 1)

(cxlii) Apply Bayes Theorem: If P(Disease) = 0.01, P(Positive|Disease) = 0.99, P(Positive|No Disease) = 0.05, find P(Disease|Positive).

a) ≈ 0.166
b) 0.05
c) 0.0099
d) 0.5

(cxliii) Construct a decision tree for an expert system with rules: If fever and cough → flu If fever and no cough → viral What is the output for: fever = yes, cough = no?

a) viral
b) flu
c) cold
d) unknown

(cxliv) Evaluate robot movement: Robot takes 2 seconds per step, 15 steps in a minute. What is its average speed if each step is 0.4 m?

a) 6 m/min
b) 6.5 m/min
c) 7.5 m/min
d) 5.5 m/min

(cxlv) Apply fuzzy membership: If temperature = 35°C, with fuzzy sets: Cold: μ = 0.2 Hot: μ = 0.8 Which category does it mostly belong to?

a) Cold
b) Hot **(Correct Answer)**
c) Moderate
d) Uncertain

(cxlvi) Construct a truth table for a rule: If A AND B → C. What is C if A = 1, B = 0?

a) 1
b) 0
c) 2
d) 3

(cxlvii) Apply matrix math: For a robot base at (0,0), after applying T = [3, 0] and rotating 90°, what's the new coordinate?

a) (0, 3)
b) (3, 0)
c) (-3, 0)
d) (0, -3)

(cxlviii) Predict output of a line-following robot using 3 sensors (Left=0, Center=1, Right=0):

a) Move forward
b) Turn left
c) Stop
d) Turn right

(cxlix) Apply fuzzy rules: Rule 1: If dirty and full → wash Rule 2: If not full → wait State: dirty = true, full = false. Action?

a) wait
b) wash
c) ignore
d) clean

(cl) Solve: A robot completes 10 tasks in 5 mins. If each task requires 3 movements, how many actuator operations/min?

a) 30
b) 6
c) 2
d) 10

*** Short Answer Type Questions ***

2. **Define Artificial Intelligence in simple terms. Also explain its main types and give two real-life examples where AI is used**

3. **List the main branches of Artificial Intelligence. Describe the main branches of Artificial Intelligence in brief**

4. **What are the key applications of Artificial Intelligence in daily life?**

5. **Define an AI agent. Describe its working with a suitable example.**

.

6. **Name the different types of intelligent agents in AI.**

7. **Label the structure of an intelligent agent with its core components.**

8. **Who is known as the father of Artificial Intelligence? Write the names of five branches of Artificial Intelligence.**

9. **Which component of an agent interacts with the environment?**

10. **Tell the difference between autonomous and non-autonomous agents.**

11. **Show the state space representation for a simple problem (e.g., 8-puzzle).**

12. Explain how AI differs from traditional software systems.

13. Compare intelligent agents and problem-solving agents.

14. Illustrate the structure of a typical intelligent agent.

15. Interpret the role of state space in solving AI problems.

16. Contrast goal-based and reflex-based agents.

17. Demonstrate how a production system works in problem-solving.

18. Summarize the major applications of AI in real-world systems.

19. Relate the concept of autonomy to intelligent agents.

20. Classify the types of environments in which intelligent agents operate.

21. Outline the key steps in solving a problem using state space representation.

22. Explain the purpose of knowledge representation in AI.

23. Illustrate how frames represent knowledge in AI systems.

24. Compare semantic networks and frames.

25. Summarize the concept of first-order logic in AI.

26. Define a frame for Hospital with at least four slots: name, location, number of doctors, number of patients.

27. Classify the different types of reasoning used in AI.

28. Demonstrate how fuzzy logic handles uncertainty.

29. Interpret the role of Bayesian networks in probabilistic reasoning.

30. **Categorize the different reasoning techniques used in AI and briefly state their function.**

31. **Distinguish between probabilistic inference and rule-based reasoning with examples.**

32. **Evaluate the usefulness of Bayesian Networks in decision-making systems.**

33. **Justify the use of fuzzy logic in reasoning when compared to classical logic.**

34. **Distinguish between model-based and case-based reasoning in AI.**

35. **Distinguish between minimax search and alpha-beta pruning.**

36. **Explain the role of syntactic processing in natural language understanding.**

37. **Compare semantic and syntactic analysis in NLP.**

38. **Classify the levels of language processing in NLP.**

39. **Illustrate with an example how anaphora resolution works in discourse analysis.**

40. **Evaluate the role of pragmatics in improving the accuracy of voice assistants or chatbots**

41. **Demonstrate how a sentence can be syntactically correct but semantically ambiguous.**

42. **Summarize the purpose of discourse analysis in NLP.**

43. **Outline the steps involved in semantic role labeling.**

44. **Relate the concept of pragmatics to chatbot communication.**

45. **Translate a sentence into its syntactic parse tree format.**

46. **Distinguish between discourse analysis and pragmatic analysis in NLP.**

47. Categorize the linguistic components involved in syntactic and semantic processing.

48.

Fuzzy Set Problem

A fuzzy set B represents the concept of 'Hot Day' with the following temperatures in °C: 25, 30, 35, 40, 45

The membership function for the fuzzy set B is defined as:
$\mu B(T) = (T-25)/20$, for $25 \leq T \leq 45$

Questions:

1. Calculate the membership value for each temperature in the fuzzy set B.
2. Represent the fuzzy set B in roster form with the membership values.

49.

A disease affects 2% of a population. A medical test detects the disease with:
True Positive rate = 95%
False Positive rate = 5%

Question: If a person tests positive, calculate the probability that the person actually has the disease using Bayes' theorem.

50. In a medical Bayesian network:

Disease (D) → Fever (F)

Given probabilities:

$P(D = T) = 0.01$

$P(F = T \mid D = T) = 0.9$

$P(F = T \mid D = F) = 0.05$

Question: If a patient has a fever, calculate the probability that the patient has the disease using Bayes' theorem:
$P(D = T \mid F = T)$

51. Construct a semantic network for the statements:

A sparrow is a bird.

A bird can fly.

52. Analyze how the characteristics of an expert system make it different from a traditional decision-support system.

53. Examine why knowledge representation is critical in expert system development. What problem arises if representation is weak?

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54. Differentiate between sensor-based control and pre-programmed control in robotics with suitable examples.

.

55. Investigate how alpha-beta pruning in a decision tree could be analogous to optimization in robot path planning.

56. Compare the applicability of expert systems in medical diagnosis with robotics in surgery. What common analytical challenges do they share?

*** Long Answer Type Questions ***

57. **Define Artificial Intelligence and list its main branches and applications.**

58. **Recall the timeline of AI and explain the different types of intelligent agents.**

59. **Discuss about the different types of intelligent agents and explain when each type is suitable.**

60. **Explain the use of state space representation in problem-solving and interpret its advantages.**

61. **Discuss the major knowledge representation techniques in Artificial Intelligence. Compare their structures and highlight suitable use cases for each.**

62. **Explain the foundations of probabilistic reasoning in AI. Demonstrate the use of Bayes' Rule in sequential inference and argue how it enables adaptive learning in dynamic systems with uncertain inputs.**

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63. **Analyze the structure of semantic networks and compare them with frames.**

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64. **Examine the fundamental differences between fuzzy logic-based reasoning and classical logic approaches in the context of uncertainty handling and decision-making**

65. **Illustrate the internal structure of a rule-based reasoning system by examining the roles and interdependencies of its key components. How do these components collectively support context-sensitive reasoning, manage rule conflicts, and maintain scalability across complex and dynamic problem domains?**

66. **Analyze how case-based reasoning and conceptual dependency models can be integrated into the design of an intelligent AI tutoring system to adapt to individual students' learning styles and past performance. How do these techniques contribute to personalized instruction and real-time decision-making?**

67. **Summarize the effectiveness of case-based reasoning compared to rule-based systems.**

68. **Explain the importance of knowledge representation structures like frames and semantic networks in AI applications.**

69. **Design a reasoning framework for uncertain environments using Bayesian networks. Explain how you would construct, organize, and implement its components to support intelligent decision-making in real-world AI applications.**

.

70. **Develop a reasoning model for a smart home system by combining suitable techniques (e.g., rule-based, case-based, model-based, or probabilistic). Compose a justification for your design based on system requirements like adaptability and context-awareness.**

71. **Compare minimax and iterative deepening strategies.**

72. **Break down the alpha-beta pruning process into its fundamental steps. Examine how it improves the performance of minimax search in two-player games.**

73. **Examine the function of the evaluation function in a minimax-based game-playing agent.**

74. **Contrast the combined approach with classical minimax search in terms of performance and depth coverage.**

75. **Design a two-player game tree search model that integrates alpha-beta pruning to enhance efficiency. Compose an explanation of how this technique reduces time complexity and reconstruct the minimax process to include pruning, highlighting the improvements over the standard approach.**

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76. **Develop a time-efficient search strategy for game-playing agents in constrained environments by incorporating iterative deepening. Explain how your design balances depth of search with available time and compose a rationale for choosing iterative deepening over fixed-depth or breadth-first approaches.**

77. **Formulate a comprehensive gameplay strategy tailored for two-player adversarial environments by synthesizing appropriate search algorithms and evaluation techniques. Prepare a reasoned explanation to support your selection.**

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78. **Explain the importance of the evaluation function in non-terminal game positions.**

79. **Distinguish between syntactic, semantic, and pragmatic processing in NLP. Explain each with suitable examples, and indicate where each is typically used in practical NLP systems**

80. **Describe the application of discourse analysis and explain its significance in Natural Language Processing (NLP).**

81. **Explain the importance of semantic role labeling and relate it to natural language understanding.**

82. **Classify the functions of syntactic parsing, semantic tagging, and pragmatics within the architecture of an NLP system.**

83. **Examine how syntactic ambiguity affects semantic interpretation with examples.**

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84. **Categorize the steps involved in the NLP pipeline and point out how each contributes to language understanding.**

85. **Compare rule-based parsing with statistical parsing techniques.**

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86. **Analyze the function and relationships between syntax, semantics, and pragmatics in language understanding.**

87. **Explain the significance of pragmatic processing by constructing its role in natural language understanding.**

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88. **Develop a framework that combines syntactic, semantic, and discourse levels in an NLP pipeline, and explain its significance.**

89. **Construct a description that explains how Semantic Role Labeling (SRL) contributes to improving machine comprehension.**

90. **Compose a summary that highlights the importance of pragmatic processing in natural language understanding.**

91. **Analyze various NLP techniques (syntax, semantics, and pragmatics) to identify which best supports user intent recognition in chatbots, and relate it to real-world examples.**

.

92. **Examine the role of knowledge engineering in expert system development and point out its key contributions.**

93. **Appraise the contribution of robotics to modern manufacturing industries and categorize its impact areas.**

94. **Compare and contrast expert systems and robotics based on their decision-making processes and control strategies.**

95. **Differentiate between line flow and general-purpose robots and illustrate a real-world scenario where the former is more effective.**

96. **Analyze the impact of robotics on labor markets and infer whether the benefits outweigh the associated challenges.**

97. **Break down the essential components of an expert system and diagram how they interact to enable functionality**

98. **Appraise the contribution of mathematics in robotics control and navigation systems.**

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99. **Evaluate the effectiveness of an expert system designed for medical diagnosis and explain the function of its key components.**

100. **Develop a plan for implementing robotics in a warehouse automation system.**

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101. Judge different approaches for improving the accuracy of expert systems and defend the most effective one with reasoning.

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102. Predict how robotics could contribute to disaster recovery and appraise their value in critical emergency operations.

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103. Describe and interpret the workflow of a robot designed for object detection and sorting, and evaluate its efficiency.

104. Assess the improvements made by adding real-time alert functionality to an expert system for plant disease detection and support your evaluation with examples.

105. Interpret the interaction between robotics sensors and actuators and relate it to overall system performance.

106. Predict future trends in robotics and expert systems and justify their potential impact on the development of smart cities.

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