22ai501/22am501 Artificial Intelligence 24-25 PT1

DISCOURSE_BIT 1 October 1, 2024, 5:08am

1. Question

Ishita is designing a Robot Vacuum Cleaner that efficiently cleans a room without revisiting the same area multiple times. The robot has sensors to detect obstacles, walls, and dirt. It must navigate the room effectively to maximize cleaning coverage. The environment state of the robot vacuum cleaner is not fully observable.

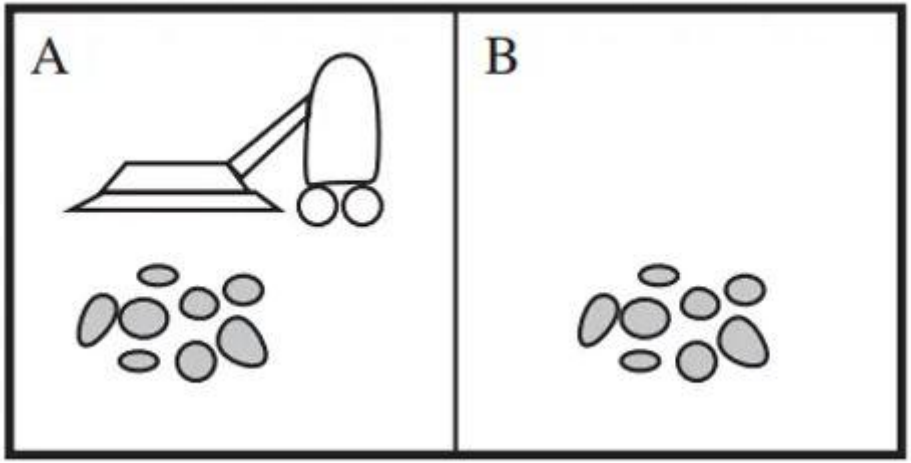


Figure: Robot Vacuum Cleaner

Based on the above Scenario, Rearrange the steps taken to solve the problem in Robot Vacuum Cleaner which is partially observable environment.

Step 1: Now get a path which connects several belief states.

Step 2: Solution is a path that leads to a belief state, all of whose members are goal states.

Step 3: Initial state is belief state which can further mapped to another belief state.

Step 4: Agent searches for belief state instead of physical state.

Step 5: Action is applied to belief state by taking union of the results obtained from applying the action to each physical state in the belief state.

Answer:

Step 1: Agent searches for belief state instead of physical state.
Step 2: Initial state is belief state which can further mapped to another belief state.
Step 3: Action is applied to belief state by taking union of the results obtained from applying the action to each physical state in the belief state.
Step 4: Now get a path which connects several belief states.
Step 5: Solution is a path that leads to a belief state, all of whose members are goal states.

2. Question

Identify which of the following is a characteristic of searching with partial information?
a) The agent has complete knowledge of the environment.
b) The agent has a perfect model of the state space.
c) The agent must make decisions based on uncertain or incomplete information.
d) The agent knows all possible actions and their outcomes.

Answer:

c) The agent must make decisions based on uncertain or incomplete information.

3. Question

Identify which of the following best describes a sensor model in the context of partial information search?
a) It defines the initial state of the agent.
b) It represents the transition between states.
c) It provides a mapping from states to observations.
d) It defines the goal state for the agent.

Answer:

c) It provides a mapping from states to observations.

4. Question

Sheela is working on a movie recommendation system for a streaming platform. The system suggests movies to users based on their past viewing history which is based on the Algorithm Selection, ratings, Complexity Analysis and other user data.
Based on the above Scenario, Complete the search algorithms with its complexity analysis.

S.No	Search algorithms	Time Complexity	Space Complexity
1	Breadth-first search	a) _____	O(b d)
2	Depth-first search	T(n) = 1+n2 +n3 +… +nm= O(nm)	b) _____
3	Depth-limited search algorithm	c) _____	O(b * l)

S.No	Search algorithms	Time Complexity	Space Complexity
4	Uniform-cost search	d) _____	O(b 1 + [C*/Σ]
5	Iterative deepening depth-first Search	O(b d)	e) _____
6	Bidirectional Search Algorithm	f) _____	O(b d)

Answer:

a) T(b) = 1+b2 +b3 +… +b d = O(b d)

b) O(bm)

c) O(bl)

d) O(bd)

e) O(b d)

5. Question

Sakthi was an AI developer who was developing an AI agent to participate in a treasure hunt within a complex maze. The maze is a grid of cells, some of which are blocked (walls), and some contain treasures. The agent starts at a given position and needs to find the shortest path to a treasure. The environment is static, meaning the maze layout does not change. Based on the above Scenario, answer the questions below.

[Hint: cells —à node ,walls —à arrows , treasures —à cost of the node ; Starting cell(node) – A and Ending/Goal cell(Goal node) - K]

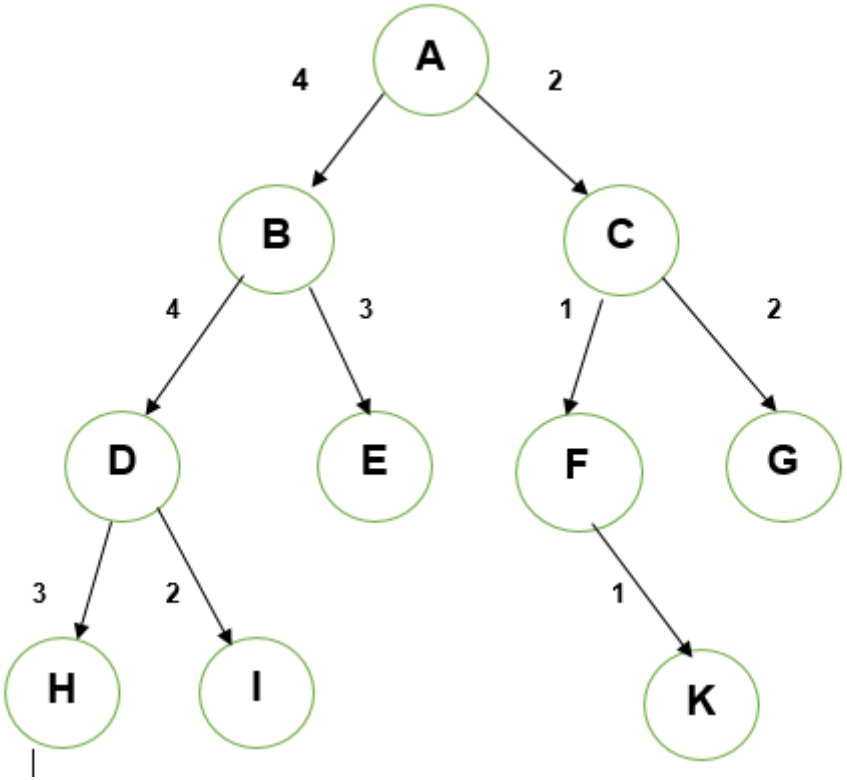


Figure: Treasure hunt(Searching Problem)

Consider the above Figure: Treasure hunt(Searching Problem), and Predict the output for

a) Breadth-first Search (Goal node E) [Hint]: A---->B---->C

b) Depth-first Search (Goal node E) [Hint]: A---->B---->D

c) Depth-limited Search (Goal node G) [Hint]: A---->B---->D

d) Iterative deepening depth-first search (Goal node E) [Hint]: A---->B---->C

e) Uniform cost search (Goal node K) [Hint]: A---->B---->C

Answer:

a) A-B-C-D-E

b) A-B-D-H-I-E

c) A-B-D-E-C-F-G

d) A-B-C-D-E or A-B-D-E

e) A-B-C-D-E or A-B-D-E

6. Question

Assertion (A): The uninformed search does not contain any domain knowledge such as closeness, the location of the goal. It operates in a brute-force way as it only includes information about how to traverse the tree and how to identify leaf and goal nodes.
Reason (R): As it applies in a way in which search tree is searched without any information about the search space like initial state operators and test for the goal, so it is also called blind search. It examines each node of the tree until it achieves the goal node.
Choose the correct option:
a) Both A and R are true and R is the correct explanation of A.
b) Both A and R are true but R is not the correct explanation of A.
c) A is false but R is true.
d) Both A and R are false.
Answer:
a) Both A and R are true and R is the correct explanation of A.
7. Question
Vidhya is going to build an AI agent for a city navigation system designed to find the shortest path between two locations in a large metropolitan area. The city is represented as a graph, where intersections are nodes and roads are edges with varying distances. The AI agent needs to efficiently navigate this graph to provide the shortest route between any two given locations.
Based on the above Scenario, is Vidhya using the bidirectional search algorithm is used. If yes, means justify with your answer.
Answer:
Yes.
Bidirectional search algorithm runs two simultaneous searches, one form initial state called as forward-search and other from goal node called as backward-search, to find the goal node. Bidirectional search replaces one single search graph with two small subgraphs in which one starts the search from an initial vertex and other starts from goal vertex. The search stops when these two graphs intersect each other. Bidirectional search can use search techniques such as BFS, DFS, DLS, etc.
8. Question
Which search algorithm uses both the cost to reach the node and the estimated cost to reach the goal to determine the next node to explore?
a) Uniform Cost Search
b) Depth-First Search
c) A* Search
d) Breadth-First Search

Answer:

c) A* Search

9. Question

Identify which of the following steps involves evaluating the potential sequences of actions to achieve the goal?

a) Goal formulation

b) Problem formulation

c) Search for solutions

d) Execute the solution

Answer:

c) Search for solutions

10. Question

Which step involves defining the actions, states, and their transitions in a problem-solving agent?

a) Goal formulation

b) Problem formulation

c) Search for solutions

d) Execute the solution

Answer:

b) Problem formulation

11. Question

When an agent uses a sensor to gather information about its environment, which type of search is it performing?

a) Online search

b) Offline search

c) Heuristic search

d) Uniform Cost Search

Answer:

a) Online search

12. Question

Ishita is designing a Robot Vacuum Cleaner that efficiently cleans a room without revisiting the same area multiple times. The robot has sensors to detect obstacles, walls, and dirt. It must navigate the room effectively to maximize cleaning coverage. The environment state of the robot vacuum cleaner is not fully observable.

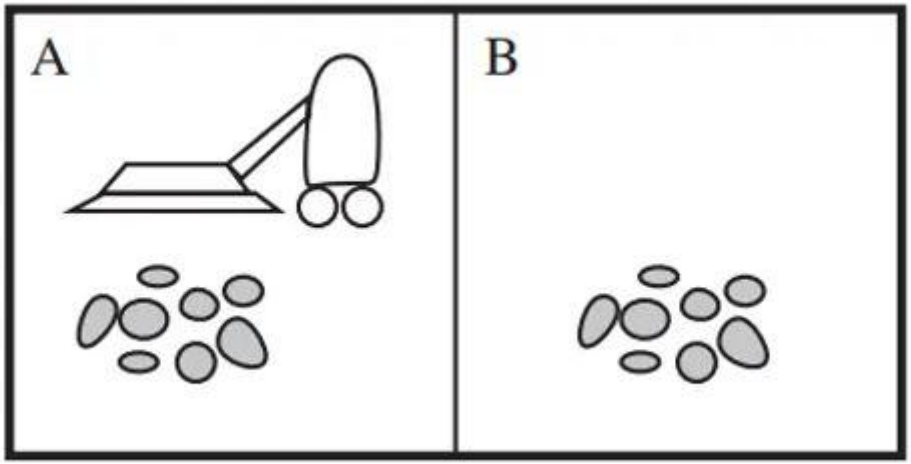


Figure: Robot Vacuum Cleaner

Based on the above Scenario, identify the three distinct types of problems of partially observable Robot Vacuum Cleaner.

[Hint]: Sensor less problems

Answer:

a) Sensor less problems

b) Contigency problems

c) Exploration problems

[Note: Can be in any order]

13. Question

Which of the following algorithms is commonly used to solve CSPs?

a) Minimax Algorithm

b) Backtracking Search

c) Breadth-First Search

d) Gradient Descent

Answer:

b) Backtracking Search

14. Question

Consider a local search algorithm which are not just another tool in the AI toolbox; they are the guiding stars in the vast universe of optimization and problem-solving. Their significance can be summarized in a few key points. Based on this scenario, answer the questions below.

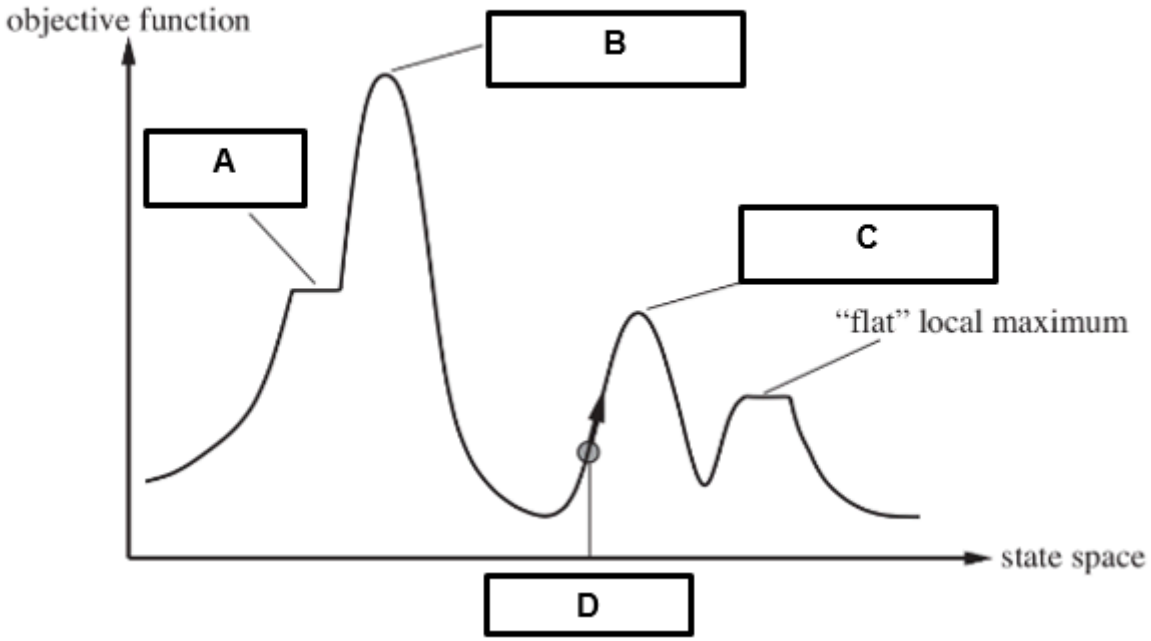


Figure: Local Search

Based on the above Figure: Local Search, identify the missing parts A, B, C and D of the local search algorithm.

Answer:

A - Shoulder

B - Global maximum

C - Local maximum

D - Current state

15. Question

Consider a problem of preparing a schedule for a class of student. What type of problem is this?

a) Search Problem

b) Backtrack Problem

c) CSP

d) Planning Problem

Answer:

c) CSP

16. Question

Which of the following is a common technique to improve the efficiency of backtracking in CSPs?
a) Depth-First Search
b) Hill-Climbing
c) Forward Checking
d) Random Restart
Answer:
c) Forward Checking
17. Question
Let's consider a simplified Sudoku puzzle to illustrate the problem-solving process step by step. It includes:
Variables: 9x9 grid cells
Domains: Numbers from 1 to 9
Constraints: No number can repeat in the same row, column, or 3x3 sub grid.
[Hint]: Step 1: Start with an empty Sudoku grid.
Based on the above condition, Complete the problem-solving steps for 9x9 Sudoku grid cells.
Step 2: _____
Step 3: _____
Step 4: _____
Answer:
Step 2: Apply the initial constraints for the given numbers, reducing the domains of variables based on the puzzle's clues.
Step 3: Use constraint propagation to narrow down the domains further. For example, if a row has two cells with domains {2, 5}, and the constraint specifies that these two cells cannot have the same number, we can eliminate the possibility of 5 for one of them.
Step 4: Continue applying constraints and propagating until the domains of variables are either empty or filled with single values. If they are all filled, you have a valid solution. If any variable's domain is empty, you backtrack to the previous step and try an alternative assignment.
18. Question
Match the domains of a variable in a Constraint satisfaction problem with its description and functionalities.

S.No	Domain	Description	Functionalities
1	Finite domains	infinite number of possible values	Backtracking, forward checking, and local search

S.No	Domain	Description	Functionalities
2	Infinite domains	complete assignment of values to all the variables	coefficients of a polynomial function
3	Continuous domains	finite number of possible values	real numbers
4	Notion of the Solution	set of all possible configurations of variable assignments	colors or integers
5	State-space	finite set of parameters	scheduling problem

Answer:

S.No	Domain	Description	Functionalities
1	Finite domains	finite number of possible values	colors or integers
2	Infinite domains	infinite number of possible values	real numbers
3	Continuous domains	finite set of parameters	coefficients of a polynomial function
4	Notion of the Solution	complete assignment of values to all the variables	scheduling problem
5	State-space	set of all possible configurations of variable assignments	Backtracking, forward checking, and local search

19. Question

What is the purpose of constraint propagation in backtracking search?

a) To randomly assign values to all variables

b) To prune the search space by enforcing constraints locally and reducing domains of variables.

c) To explore all possible variable assignments simultaneously

d) To maximize the number of constraints that are violated

Answer:

b) To prune the search space by enforcing constraints locally and reducing domains of variables.

20. Question

Kaviya is working on a scheduling system for a small conference. The system needs to assign time slots to different sessions, taking into account the availability of the rooms, the preferences of the speakers, and potential conflicts between sessions.

Say True or false:

Is back tracking being possible in the above scenario; If yes or No means justify with your answer.

Answer:

Yes,

Backtracking is possible. It is well-suited for this problem because it systematically explores possible assignments and prunes those that violate constraints. It is particularly effective when:

- Constraints are complex: Constraints like room availability, time slot conflicts, and speaker preferences can be efficiently managed through backtracking.
- Search Space is large: Backtracking helps in narrowing down the search space by eliminating infeasible assignments early.
- Solution is incremental: The problem allows for incremental assignment, where partial solutions can be extended or retracted based on constraints.

By using backtracking, you ensure that you explore all possible valid schedules and find a solution that satisfies all constraints. It balances between exploring potential solutions and avoiding invalid ones, making it a practical approach for scheduling problems with multiple constraints.

21. Question

Ajay have been hired as a consultant for a company that is developing an advanced AI system to optimize the layout of various components on a large circuit board. The problem of placing components on the board is similar to the classic N-Queens problem, where no two components (queens) should interfere with each other. This involves in the process of backtracking. The constraints in this scenario involve ensuring that components do not interfere with each other's signals, while also minimizing the distance between connected components for efficiency.

Based on the above Scenario, identify the real time applications of Constraint Specification Problem.

a) CSP problem is how to efficiently and effectively schedule resources like personnel, equipment, and facilities.

b) A I algorithms seamlessly combine and interpret data from these sensors, enabling robots to comprehend their surroundings, identify obstacles, recognize objects, and analyze intricate scenarios

c) The constraints specify each vehicle's capacity, delivery locations, and time windows, while the variables indicate the routes taken by the vehicles.

d) In this field, the variables stand in for the tasks, while the constraints specify the knowledge, capacity, and workload of each person or machine.
e) Drones integrate various sensors, such as cameras, LiDAR (Light Detection and Ranging), radar, and infrared detectors.
f) The well-known puzzle game Sudoku can be modelled as a CSP problem.
g) The quality of an image into areas with various qualities can be treated as a 4 CSP issue in computer vision
Answer:
a) CSP problem is how to efficiently and effectively schedule resources like personnel, equipment, and facilities.
c) The constraints specify each vehicle's capacity, delivery locations, and time windows, while the variables indicate the routes taken by the vehicles.
d) In this field, the variables stand in for the tasks, while the constraints specify the knowledge, capacity, and workload of each person or machine.
f) The well-known puzzle game Sudoku can be modelled as a CSP problem.

22. Question

What is the key feature of Hill Climbing that differentiates it from other search algorithms?
a) It uses a heuristic function
b) It allows backtracking
c) It only moves to neighboring states with higher value
d) It explores all possible states
Answer:
c) It only moves to neighboring states with higher value

23. Question

Identify the correct and incorrect statements of Constraint Satisfaction Problem.
a) Various algorithms, including backtracking, forward checking, and local search, can be used to search the state space and find a solution to the Constraint Satisfaction Problem.
b) Constraint satisfaction problem in AI has a wide range of applications, including scheduling, resource allocation, and automated reasoning.
c) Solving a Constraint satisfaction problem in AI typically does not involves in searching.INC
d) CSPs offer an unstructured and general framework for representing and solving problems, making them versatile in problem-solving applications.INC
e) Algorithms for propagating constraints are a class that uses local consistency and inference to condense the search space.
Answer:
a) Correct

b) Correct
c) Incorrect
d) Incorrect
e) Correct

24. Question

In backtracking search, what happens when a variable assignment violates a constraint?

a) The algorithm restarts with a new set of variables
b) The algorithm backtracks to the previous variable assignment and tries a different value
c) The algorithm terminates immediately
d) The algorithm ignores the violation and proceeds with the search

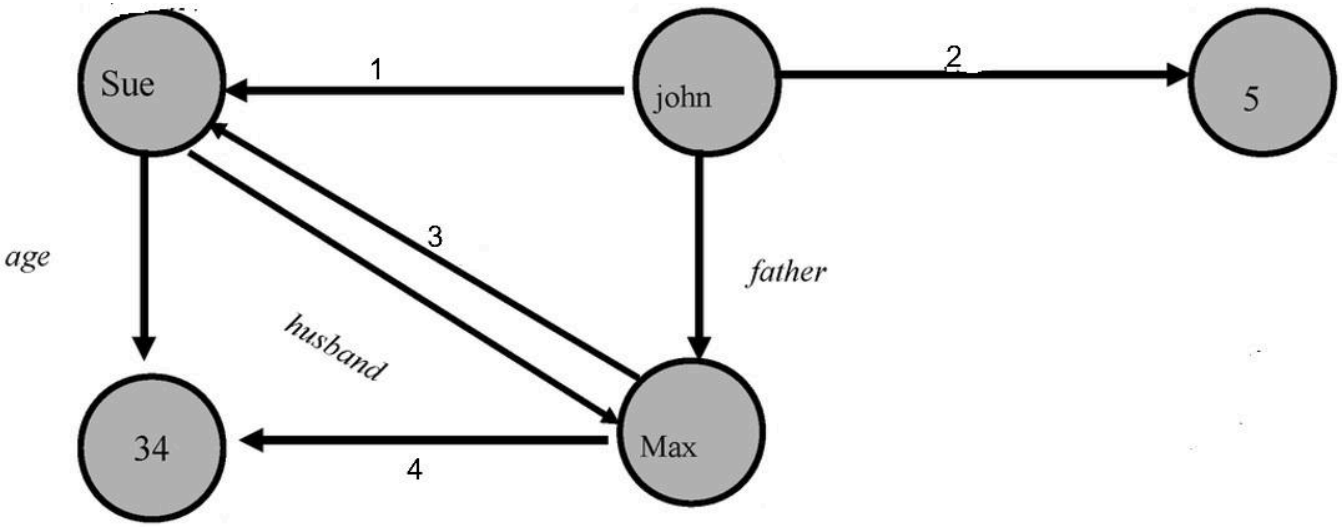
Answer:

b) The algorithm backtracks to the previous variable assignment and tries a different value

25. Question

Predict the missing relationship (1, 2, 3 and 4) in the following ontological graph using given logic code below.

1)Mother(john,sue)
2)Age(john,5)
3)Wife(sue,max)
4)Age(max,34)



Answer:

1)mother

2)age
3)wife
4)age

26. Question

Predicate	**Interpretation**
valuable(gold)	Gold is valuable
owns(john,gold)	?
father(john,mary)	?
gives (john,book,mary)	?
Predict the logic statement for the given predicate in the above table.	
Answer:	
Predicate	Intrepretation
—	—
valuable(gold)	Gold is valuable
owns(john,gold)	John owns gold
father(john,mary)	John is the father of Mary
gives (john,book,mary)	John gives the book to Mary

27. Question

Which inference mechanism is more suitable for tasks that involve real-time reasoning and decision-making?

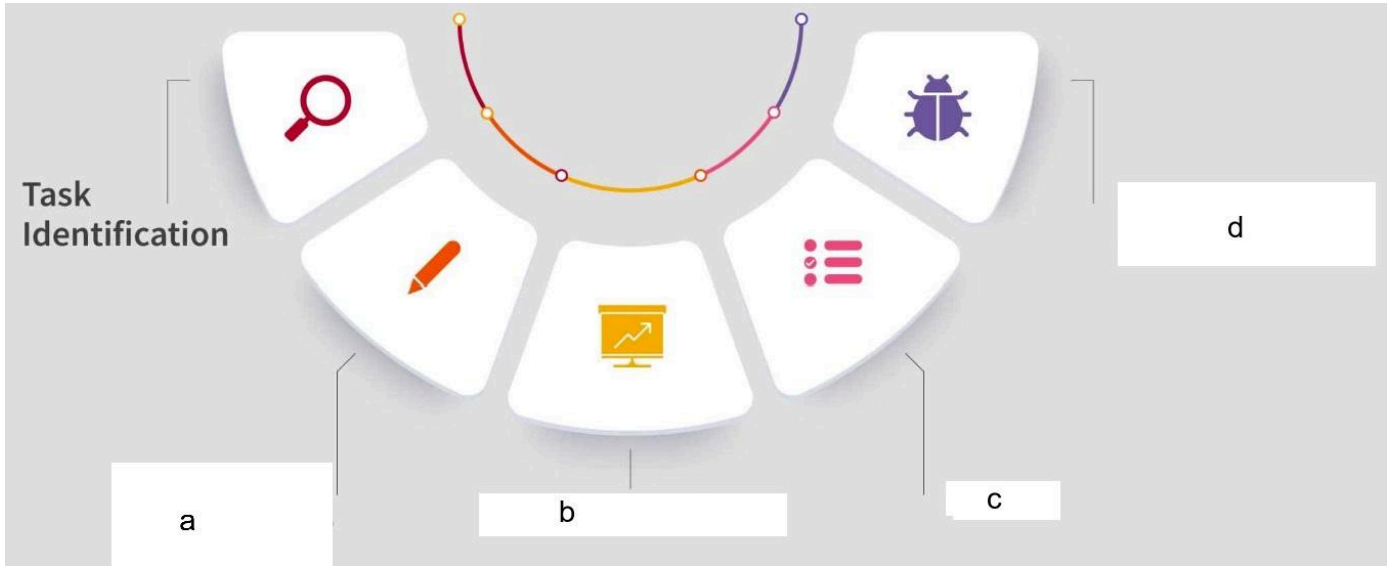
a) Forward chaining
b) Backward chaining
c) Both forward and backward chaining
d) Neither forward nor backward chaining

Answer:

a) Forward chaining

28. Question

Predict the missing fields (a, b, c and d) in the following knowledge engineering process.



Answer:

a) Acquisition of knowledge

b) Prepare a road map

c) Encode

d) Evaluate and debug

29. Question

A smart home system can control various appliances based on user preferences and environmental conditions. The system considers three conditions:

P: The living room light is ON.

Q: The door is locked.

R: The security alarm is activated.

Infer the following truth table for the following propositional logic expression:

Expression: (P∧Q)→R

P	Q	R	(P ∧ Q) → R
T	T	T	T
T	T	F	?
T	F	T	?

P	Q	R	(P ∧ Q) → R
T	F	F	?
F	T	T	?
F	T	F	?
Answer:			

P	Q	R	(P ∧ Q) → R
T	T	T	T
T	T	F	F
T	F	T	T
T	F	F	T
F	T	T	T
F	T	F	T

30. Question

In forward chaining process, which of the following factors that starts with?

a) A goal

b) Known facts

c) Rules

d) A hypothesis

Answer:

b) Known facts

31. Question

Which inference mechanism is more suitable for tasks that require working backward from a goal?

a) Forward chaining

b) Backward chaining

c) Both forward and backward chaining

d) Neither forward nor backward chaining

Answer:

b) Backward chaining

32. Question

Which of the following could the Existential instantiation of ∃x Cap(x) ^ OnHead(x, Johnny)?

a) Cap (John) ^ OnHead(John, Jonny)

b) Cap (y) ^ OnHead(y, y, x)

c) Cap(x) ^ OnHead(x, Jonny)

d) None of these

Answer:

a) Cap (John) ^ OnHead(John, Jonny)

33. Question

Infer the following statements whether it is forward chaining or backward chaining.

a) Given a set of symptoms (e.g., cough, fever, fatigue), determine which diseases (e.g., flu, cold, pneumonia) are possible based on existing rules about symptoms and diseases.

b) Begin with a desired conclusion (e.g., the suspect is guilty of theft) and work backwards to find the necessary facts that must be true to support this conclusion (e.g., was there a witness?).

c) The robot starts from its initial position and uses sensor data (e.g., walls, open paths) to infer a sequence of moves until it reaches the exit.

d) If a student wants to qualify for a specific career (e.g., software engineer), the system works backward to identify which prerequisite courses and electives they must take to meet that goal.

Answer:

a) Forward chaining

b) Backward chaining

c) Forward chaining

d) Backward chaining

34. Question

Which of the following is a key difference between unification and lifting?

a. Unification matches specific values, while lifting generalizes rules.

b. Unification combines rules, while lifting derives new facts.

c. Unification derives new facts, while lifting matches specific values.

d. Unification generalizes rules, while lifting combines rules.

Answer:

a. Unification matches specific values, while lifting generalizes rules.

2 Likes