Integral University, Lucknow

Artificial Intelligence (CS-422)

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Assignment-02

Q1) What do you understand by logical agent?

Ans.) Logical agents, in the content of AI, are agents that use formal logic to represent and manipulate knowledge. These agents typically employ propositional or first-order logic to express facts, rules and reasoning about the world. They make use of logical inference to derive new information from existing knowledge and update their beliefs. Logical agents often consist of the following components:

1) Knowledge Base (KB): The KB stores the agents current knowledge, represented using logical statements or facts.

2) Inference Engine: The inference engine performs logical reasoning on the knowledge base to draw conclusions or make decisions. It typically uses deduction or other logical reasoning mechanisms.

3.) Actuators: These are responsible for carrying out the actions or responses determined by the logical reasoning of the agent.

4.) Sensors: Sensors provide input to the agent by

perceiving the environment or receiving external information.
logical agents are used in various AI applications, including expert systems, knowledge-based systems, and certain problem-solving domains where formal logic provides a suitable representation for reasoning about the world.

Q2) What is Wumpus world Problem? Explain with example.

Ans) The Wumpus world is a classical problem in AI that serves as a benchmark for testing intelligent agent systems. It was introduced by Peter Norvig and includes elements of knowledge representation, reasoning and planning.

The Wumpus World:

Imagine a cave consisting of 16 interconnected rooms, each representated by a grid coordinate. The cave is inhabited by a wumpus, a beast that devours any agent who enters its room. There are also bottomless pits scattered throughout the cave, and if an agent falls into a pit, it is lost forever. In addition, there is a treasure room hidden somewhere in the cave.

The Agent :

An agent is tasked with exploring the cave, finding the treasure, and returning safely to the starting point. The agent has limited sensory capabilities : it can only detect a breeze if it is adjacent to a pit and faint stream if it is adjacent to the Wumpus's room. The agent also has a single arrow, which can be used to kill the Wumpus if the agent is facing it.

The Challenge :

The Wumpus world problem is challenging because the agent must make decisions in an environment with incomplete information and potential hazards. The agent needs to use its limited sensory inputs and knowledge of the cave's layout to infer the presence of pits and the Wumpus and to plan a safe path to treasure.

Example :- Let's say, agent starts in room (1,1). The agent moves to room (2,1). It senses a breeze, so it knows there is a pit in either room (1,1) or (2,2). The agent moves to room (3,1). It doesn't sense a breeze, so there must be a pit in room (2,1). The agent moves to room (3,2). It senses a glimmer, so the gold must be in room (3,3). It finds the gold! The agent leaves the cave safely.

Q3.) Differentiate between Forward Chaining and Backward Chaining.

Forward Chaining	Backward Chaining
1.) Forward chaining starts from known facts and applies inference rule to extract more data unit it reaches to the goal.	1.) Backward Chaining starts from the goal and works backward through inference rules to find the required facts that support the goal.
2.) It is a bottom-up approach.	2.) It is a top-down approach.
3.) It is known as data-driven inference technique as well reach to the goal using the available data.	3.) It is known as goal-driven technique as we start from the goal and divide into subgoal to extract facts.
4.) Forward chaining reasoning applies a breadth-first search strategy.	4.) Backward Chaining reasoning applies a depth-first search strategy.
5.) It tests for all the available rules.	5.) It only tests for few required rules.
6.) It is suitable for the planning, monitoring, control, and interpretation application.	6.) It is suitable for diagnostic, prescription, and debugging application.
7.) It can generate an infinite number of possible conclusions.	7.) It generates a finite number of possible conclusions.
8.) It operates in the forward direction and is aimed for any conclusion.	8.) It operates in the backward direction and is only aimed for the required data.

Q4) What do you understand by Propositional Logic?

Ans.) → Propositional logic, also known as sentential logic or propositional calculus, is a branch of formal logic that deals with propositions statements that are either true or false. In propositional logic, complex statements are formed by combining simpler statements using logical connectives.

→ Propositional logic provides a set of rules for combining propositions using logical connectives, such as "and", "or", "not", "if-then", and "if-and-only-if". These rules can be used to construct compound propositions, which are propositions that are made up of two or more simpler propositions.

→ Propositional logic is a formal system, which means that it is based on a set of axioms and inference rules

→ Propositional logic is a fundamental part of many area of computer science and A.I. including:

- Natural language Processing
- Expert Systems.
- Robotics

→ Propositional logic is a powerful tool for reasoning about the world. It can be used to solve a wide variety of problems.

Q5) Explain Bayesian Networks.

Ans.) A bayesian network, also known as bayes net, or causal network or belief network, is a probabilistic graphical model that represents a set of variables and their conditional dependencies via a directed acyclic graph (DAG). It is a powerful tool for reasoning about certain situations and making decisions under uncertainty.

→ Key Components of a Bayesian Network are:

- Nodes - Represent random variables, which can be discrete or continuous.
- Directed edges - Represent conditional dependencies between variables. The direction of the edge indicates the causal relationship between the variables.
- Conditional Probability Tables (CPT's) - Specify the conditional probability distribution for each node, given its parents in the graph.

Example - Consider a Bayesian network representing the relationship between weather, grass wetness, and the use of a sprinkler.

- Nodes - Weather (W), Sprinkler (S), Grass wet (G)
- Edges - $W \rightarrow S$, $W \rightarrow G$, $S \rightarrow G$

The network implies that:

- The state of the weather influences both the use of the sprinkler and the wetness of the grass.

- The use of sprinkler influences the wetness of the grass.

Applications :

→ Medical Diagnosis : Bayesian network can model the dependencies between symptoms and diseases.

→ Risk Assessment : They are used to assess risk in various domains, such as finance and engineering.

They are powerful tools for modelling and reasoning about uncertain systems in a variety of fields. They offer a structured way to represent and update knowledge based on evidence and prior beliefs.