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**Assignment 8**

**Problem Statement:** Implementation of Backward Chaining Algorithm

**Introduction:**

The **Backward Chaining algorithm** is a **goal-driven inference technique** used in Artificial Intelligence, particularly in **expert systems** and **knowledge-based reasoning**. Unlike Forward Chaining, which starts from known facts, Backward Chaining starts from the **goal (hypothesis)** and works backward to determine whether the goal can be satisfied by the available rules and facts. This approach is especially useful in diagnostic and problem-solving systems such as medical or troubleshooting expert systems.

**Objective:**

The objectives of this experiment are:

* To understand the working principle of the **Backward Chaining inference method**.
* To implement the algorithm to deduce whether a particular goal can be concluded from a given set of rules and facts.
* To demonstrate **goal-driven reasoning** using rule-based logic.
* To explore its applications in **AI-based expert systems**.

**Theory:**

Backward Chaining is a **goal-driven reasoning technique**, which means it starts with a goal and tries to find the rules and facts that support it. It checks whether the desired conclusion (goal) can be proven true based on the knowledge base.

**Key Concepts:**

1. **Knowledge Base:**  
   A collection of rules and facts represented in the form:  
   IF (conditions) THEN (conclusion)  
   Example:
2. IF A and B THEN C
3. IF C THEN D

Known facts: A, B

1. **Goal:**  
   The proposition we want to prove.  
   Example: Prove D.
2. **Working Principle:**
   * Start with the **goal (D)**.
   * Search for rules whose **THEN part** matches the goal.
   * For each such rule, try to prove all **IF conditions**.
   * If all antecedents are known facts or can be proven recursively, the goal is satisfied.
   * Continue until the goal is confirmed or no rule can justify it.
3. **Algorithm Steps:**
   1. Start with a goal.
   2. Check if the goal exists in the known facts. If yes, succeed.
   3. Otherwise, find rules whose conclusion matches the goal.
   4. For each such rule, check if all antecedents can be proven true (recursively apply the same process).
   5. If all antecedents are proven, add the goal to known facts.
   6. If no rule can support the goal, fail.

**Example:**

Knowledge Base:

IF A and B THEN C

IF C THEN D

Facts: A, B

Goal: D

Reasoning:  
To prove D, check rule IF C THEN D → need to prove C.  
To prove C, check rule IF A and B THEN C → both A and B are facts → therefore C is true → hence D is true.

**Applications:**

* Medical diagnosis systems
* Fault detection and troubleshooting
* Legal reasoning systems
* Intelligent tutoring systems

**Conclusion:**

The **Backward Chaining algorithm** provides an efficient method of **goal-driven reasoning**, starting from a hypothesis and tracing back through available rules to find supporting evidence. It is particularly effective in diagnostic and advisory systems, where reasoning starts from a problem or query and seeks causes or explanations. Implementing this algorithm strengthens understanding of **logic-based AI reasoning** and its practical use in **expert systems**.