Assignment No: - 8

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Problem Statement

Implement the Backward Chaining Algorithm for reasoning in a knowledge-based system.

Objectives

- To understand the concept of goal-driven reasoning in AI.
- To study the Backward Chaining algorithm as an inference mechanism.
- To apply rules to check if a goal can be satisfied from a knowledge base.
- To demonstrate logical reasoning using IF–THEN rules.

Theory

Introduction

In Artificial Intelligence, knowledge-based systems use inference engines to derive conclusions.

- Backward Chaining is a goal-driven reasoning approach.
- It starts with the goal and works backwards, checking whether known facts or rules support achieving the goal.
- Commonly used in expert systems and rule-based reasoning.

Backward Chaining Mechanism

- Works with IF–THEN rules.
- Starts with a query/goal.
- Searches for rules whose conclusion matches the goal.
- Checks if the premises of those rules are satisfied:
    - If yes → goal is satisfied.
    - If not → recursively check sub-goals (premises) until facts are reached.

Example

Knowledge Base:

1. IF it rains THEN the ground is wet.
2. IF the ground is wet THEN the game is cancelled.

Goal: Is the game cancelled?

Backward Chaining Reasoning:

- Goal = Game is cancelled → check rule 2.
- Premise = Ground is wet → check rule 1.
- Fact = It rains → premise satisfied → goal achieved.

Algorithm (Backward Chaining)

1. Start with the goal G.
2. If G is a known fact → return TRUE.
3. Else, find rules with conclusion G:
   a. For each rule:
      i. Check if all premises of the rule are satisfied.
      ii. If a premise is not a known fact → recursively apply backward chaining on that premise.
      iii. If all premises satisfied → return TRUE.
4. If no rule satisfies G → return FALSE.

Characteristics

- Type: Goal-driven inference.
- Direction: From goal → facts.
- Control: Focuses only on relevant rules to achieve the goal.

Advantages

- Efficient for goal-specific queries.
- Reduces unnecessary reasoning by ignoring irrelevant facts.
- Useful in expert systems, diagnosis, and decision-making systems.

Limitations

- Can be inefficient if rules form long chains.
- May enter recursive loops if not properly controlled.
- Completeness depends on the structure of the knowledge base.

Applications

- Expert systems (MYCIN, DENDRAL).
- Medical diagnosis (finding disease from symptoms).
- Decision support systems in business and engineering.
- Problem-solving in AI where goals are clearly defined.

Conclusion

The Backward Chaining Algorithm is a goal-driven reasoning technique that starts with a query and works backward to check if it can be satisfied by known facts and rules. It is efficient for goal-specific queries, reduces unnecessary computation, and is widely used in expert systems and AI reasoning applications.