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**Assignment 6**

**Problem Statement:** Implementation of Basic Search Strategies – 8-Queens Problem

**Introduction:**

The **8-Queens problem** is a classic example of a **constraint satisfaction and search problem** in Artificial Intelligence. The goal is to place eight queens on a standard 8×8 chessboard such that no two queens threaten each other — meaning no two queens share the same row, column, or diagonal. This problem is often used to demonstrate different **search algorithms** such as depth-first search (DFS), breadth-first search (BFS), and backtracking.

**Objective:**

The main objective of this experiment is to:

* Understand and implement **basic search strategies** in AI.
* Apply these strategies to solve the **8-Queens problem** efficiently.
* Compare different approaches (DFS, BFS, Backtracking) in terms of their performance and solution generation.
* Gain hands-on experience with **state-space representation** and **constraint-based problem solving**.

**Theory:**

The 8-Queens problem can be represented as a **state-space search problem**, where each state represents a configuration of queens on the chessboard. The solution is a goal state where all 8 queens are placed without conflicts.

**Search Strategies Used:**

1. **Depth-First Search (DFS):**
   * Explores one branch of the search tree as deep as possible before backtracking.
   * It is memory efficient but may get stuck in deep, invalid branches.
2. **Breadth-First Search (BFS):**
   * Explores all nodes at the current depth before moving to the next level.
   * Guarantees the shortest solution but requires large memory.
3. **Backtracking (Improved DFS):**
   * Places a queen row by row. If a conflict occurs, it backtracks to the previous row and tries a new position.
   * More efficient as it prunes invalid states early, reducing unnecessary exploration.

**State Representation:**

* Each state can be represented by a **1D array** of size 8, where the index represents the row, and the value at each index represents the column position of the queen in that row.  
  Example: [0, 4, 7, 5, 2, 6, 1, 3]

**Goal Test:**

* A solution is valid when no two queens share the same column or diagonal.

**Conclusion:**

The implementation of basic search strategies for the 8-Queens problem demonstrates how AI algorithms can systematically explore possible solutions in a **state-space search**. Among these, the **Backtracking approach** proves to be the most efficient due to early pruning of invalid configurations. This experiment strengthens the understanding of **search techniques**, **problem representation**, and **AI-based constraint satisfaction** methods.