Simulated Annealing Problem

Overview

Simulated Annealing is a search algorithm that finds good solutions by allowing "bad" moves to escape local minima. The likelihood of such moves is controlled by a parameter called **temperature**. As the temperature decreases, the algorithm becomes more greedy and accepts fewer bad moves.

This approach is useful for solving hard problems where standard local search may get stuck.

Problem Statement

Given a problem where we need to find a good arrangement or path, apply the **Simulated Annealing** algorithm.

Steps:

1. Start with a random solution.
2. Modify the state to create a new solution.
3. If it is better, accept it.
4. If it is worse, accept it with some probability based on the temperature.
5. Gradually reduce the temperature until it becomes very small.

The goal is to reach a near-optimal solution without getting trapped in local minima.

Example (8-Queens Problem)

The board has 8 columns; a state can be represented as a vector $[q_1, \ldots, q_8]$, where q_i is the row of the queen in column i.

- Start with a placement $[2, 7, 4, 8, 1, 3, 6, 5]$.
- Modify the state by moving one queen within its column or by swapping two columns.
- If the number of conflicts (attacking pairs) decreases, accept the move. If conflicts increase, accept it with some probability depending on the temperature.
- As the temperature decreases, fewer bad moves are accepted.

Finally, the algorithm should find a zero-conflict placement — a valid solution to the 8-Queens problem.