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DESIGN AND ANALYSIS OF ALGORTHIMS

Dynamic programming (DP) and greedy algorithms are two important approaches for solving optimization problems. Here's a simplified overview of each:

Dynamic Programming (DP)

Dynamic programming is used for problems that can be broken down into overlapping subproblems with optimal substructure (i.e., the problem's optimal solution can be built from the solutions of its subproblems). It typically involves solving each subproblem once and storing the solution to avoid redundant computations.

- Key Ideas:
    - Overlapping Subproblems: Subproblems repeat during the solution process, making it efficient to store results and reuse them.
    - Optimal Substructure: The optimal solution of the problem can be constructed from the optimal solutions of its subproblems.
    - Memoization: Store already computed solutions to subproblems to avoid re-computation.
    - Bottom-up Approach: Build the solution from smaller subproblems upwards.
- Example Problem:
    - Fibonacci Sequence: Solving the Fibonacci sequence using DP stores intermediate results to avoid redundant calculations.
- Common Problems Solved with DP:
    - Longest Common Subsequence (LCS)
    - Knapsack Problem
    - Coin Change Problem

Greedy Algorithms

Greedy algorithms build up a solution by making the best choice (local optimum) at each step with the hope of finding the global optimum. They do not consider future consequences of the current choice but focus on immediate benefits.

- Key Ideas:
    - Locally Optimal Choices: At each step, choose the option that looks the best at the moment.
    - Greedy Choice Property: A global optimum can be arrived at by selecting local optima.
    - No Backtracking: Once a decision is made, it is not reconsidered, which makes greedy algorithms faster than dynamic programming.
- Example Problem:
    - Activity Selection: Choosing the maximum number of non-overlapping activities by selecting the activity that ends the earliest.

- Common Problems Solved with Greedy Algorithms:
    - Huffman Coding
    - Dijkstra's Algorithm (Shortest Path)
    - Prim's Algorithm (Minimum Spanning Tree)