

CS 305
Design and Analysis of Algorithms

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Today's Topics

- Questions / Comments?
- Greedy algorithms
- Recursive Change Making algorithm
- Memoization
- Analyze the memoized change making algorithm
- Dynamic Programming problem characteristics
- Solutions to Dynamic Programming problems and how to devise them

Greedy Algorithms

- Greedy algorithms
 - make a locally optimal (aka greedy) choice
 - expecting this to lead to a globally optimal solution

 - In fewest coins change making problem:
greedy choice was to take as many coins
of the highest denomination first
 - Expecting this to yield the fewest coins in
change overall

Dynamic Programming

- Characteristics of a problem that dynamic programming can be used to solve
 1. It is an OPTIMIZATION problem. (a minimization or maximization problem)
 2. It has OPTIMAL SUBSTRUCTURE. (that is, the overall answer to the problem is only based on answers to smaller subproblems)
 3. It contains OVERLAPPING SUBPROBLEMS. (that is, when subproblems share the same subproblems)

Dynamic Programming

- Characteristics of a dynamic programming solution
 1. Define the value of the optimal solution recursively.
 2. Compute the values “bottom-up” (Base Case(s) first) in a table.
 3. Compute the solution based on the value table.

Dynamic Programming

- Suggested recipe for solving dynamic programming problems.
 1. Determine if the problem meets the characteristics of a problem suited for D.P. If it does ...
 2. Figure out how many *parameters* are needed
 3. Create a *choice, subproblem, immediate cost/reward table*
 - 3.a. list out all choices, what subproblems they cause and what the immediate cost/reward is for the choice
 4. Create the *value function* based on the table created in 3 --- should be recursive b/c of the subproblems
 5. Determine when *base case(s)* happen (i.e. which values of the parameters) and what the value function is for them
 6. Build the *value table* from the value function *starting at the base case(s)* and continuing (upwards).
 7. *Determine solution* to problem based on the value table