Design and Analysis of Algorithms
Unit -4

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DESIGN AND ANALYSIS OF ALGORITHMS

Unit 4: Greedy Technique

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The Greedy Approach

The greedy approach suggests constructing a solution through a sequence of steps, each expanding a partially constructed solution obtained so far, until a complete solution to the problem is reached. On each step, the choice made must be:

-*feasible*: it has to satisfy the problem's constraints

-*locally optimal*: it has to be the best local choice among all feasible choices available on that step

- *irrevocable*: once decision was made, it cannot be changed on subsequent steps of the algorithm

Examples of Greedy Algorithms:

- Coin-change problem
- Minimum Spanning Tree (MST)
  - Prim's Algorithm
  - Kruskal's Algorithm
- Single-source shortest paths
  - Dijkstra's Algorithm
- Huffman codes

Coin Change Problem

A greedy algorithm to find the minimum number of coins for making the change of a given amount of money. Usually, this problem is referred to as the change-making problem.

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Change Making Problem

- In the change-making problem, we're provided with an array, D = { d1, d2, d3,.....dm} of m distinct coin denominations.
- Now we need to find an array(subset) s having minimum number of coins that add up to a given amount of money **n**, provided that there exists a viable solution.
- Let's consider a real-life example for a better understanding of the change-making problem.
- Let's assume that we're working at a cash counter and have an infinite supply of **D ={1,2,5,10}** valued coins.
- A person buys things worth **Rs. 72** and gives a **Rs. 100** bill. How does the cashier give change for **Rs. 28**?

Change Making Problem

Change-making problem:

How can a given amount of money be made with the least number of coins of given denominations?

Example:

Change for Rs. **28**

Option	Choosen Coins
28-10 = 18	10
18-10 =8	10 10
8-5 =3	10 10 5
3-2 = 1	10 10 5 2
1-1 =0	10 10 5 2 1

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Change Making Problem

Iteration 1
D ={1,2,5,10}
n = 28 and i=4

Select D[3] =10 as 28>= 10
Decrease n by 10 (n= 18)
Add 10 to set S = {10}

Iteration 2
D ={1,2,5,10}
n = 28 and i=3

Select D[3] =10 as 18>= 10
Decrease n by 10 (n= 8)
Add 10 to set S = {10, 10}

Iteration 3
D ={1,2,5,10}
n = 8 and i=2

Select D[2] =5 as 8>= 5
Decrease n by 5 (n= 3)
Add 5 to set S = {10, 10,5}

Iteration 4
D ={1,2,5,10}
n = 3 and i=1

Select D[1] =2 as 3>= 2
Decrease n by 2 (n= 1)
Add 2 to set S = {10, 10, 5,2}

Iteration 5
D ={1,2,5,10}
n = 1 and i=0

Select D[0] =1 as 1>= 1
Decrease n by 1 (n= 0)
Add 1 to set S = {10, 10, 5,2,1}

Summary

The ***greedy technique*** suggests constructing a solution to an optimization problem through a sequence of steps, each expanding a partially constructed solution obtained so far, until a complete solution to the problem is reached.

On each step, the choice made must be ***feasible***, ***locally optimal***, and ***irrevocable***.

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Text Books

Chapter 9 ,Introduction to The Design and Analysis of Algorithms by Anany Levitin

THANK YOU

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