

# Greedy algorithms

Wednesday, 1 November 2023 7:22 AM

## ① Introduction to Greedy

— used for optimization problems

Consider infinite supply of the following value coins:

10 5 2 1

If someone asks for an amount, how will you give this amount using minimum coins?

eg: Amount 52  
2 x 10 + 1 x 2

def minCoins(coins, amount):

coins.sort(reverse=True)

res = 0

for x in coins:

if x <= amount:

c = amount // x

res += c

amount -= c \* x

if amount == 0:

break

return res

amount = 57

coins = [5, 10, 2, 1]

After sorting: [10, 5, 2, 1]

res = 0

x = 10

c = 5, res = 5, amount = 7

x = 5

c = 1, res = 6, amount = 2

x = 2

c = 1, res = 7, amount = 0

## General Structure of Greedy Algo

def getOptimal(arr):

res = 0

while (All items are not considered):

i = selectAnItem()

if feasible(i):

res = res + i

return res

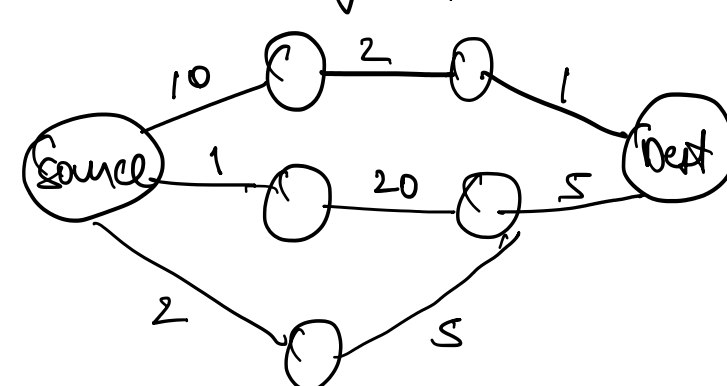
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Greedy algo may not work always!

consider: coins[] = {18, 1, 10}

amount = 20

Another ex: longest path



## Applications

→ Finding optimal solutions

— Activity selection

— Fractional Knapsack

— Job sequencing

— Prim's Algo

— Kruskal's Algo

— Dijkstra's Algo

— Huffman Coding

→ Finding close to optimal solution for NP Hard problems like travelling salesman problem

## ② Activity Selection Problem

I/P: {(2,3), (1,4), (5,8), (6,10)}

O/P: 2

— Maximum no. of activities that can happen on a single tasking machine

Name: Consider every activity as first activity

— exponential time

Greedy:

① Sort according to finish time

{(1, 3), (2, 4), (3, 8), (10, 11)}

② Initialize solution as first activity

③ Do following for remaining activities:

(a) if current activity overlaps with last picked activity in solution, ignore current activity

(b) Else add the current activity to the solution

def maxActivity(arr):

n = len(arr)

arr.sort(key=lambda x: x[1])

prev = 0

res = 1

for curr in range(1, n):

if arr[curr][0] >= arr[prev][1]:

res += 1

prev = curr

return res

## ③ Fractional Knapsack Problem

	I <sub>1</sub>	I <sub>2</sub>	I <sub>3</sub>
weight	50	20	20
value	600	500	400

knapsack capacity = 70

O/P: 1140 → I<sub>2</sub> + I<sub>3</sub> + I<sub>1</sub> \* 20/50  
= 500 + 400 + 600 \* 20/50  
= 1140

① Calculate ratio (value/weight) for every item.

② Sort them in decreasing order of ratio.

③ Initialize, res = 0, curr\_cap = given\_cap

④ Do following:

(a) if (I.weight <= curr\_cap):

curr\_cap -= I.weight

res += I.value

(b) Else { res += (I.value \* (curr\_cap / I.weight)) }

return res

⑤ return res

## ④ Job Sequencing Problem

## ⑤ Huffman Coding

— used for lossless compression

— variable length coding