

Assignment 3

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Title :- Fractional Knapsack problem using greedy method

Aim :-

Write a program to solve a fractional Knapsack problem using a greedy method.

Objectives :-

- 1) To understand Knapsack problem
- 2) To analyze how it can be solved using greedy method.

Pre-requisites :-

- 1) Basic knowledge of DSA.
- 2) Understanding of greedy and Knapsack

Theory :-

The greedy algorithm could be understood very well with a well-known problem referred to as Knapsack problem.

• Knapsack problem :-

The Knapsack problem is a combinational optimization problem.

It appears as a sub-problem in many, more complex mathematical models of real-world problems.

One general approach to difficult problem is it to identify the most restrictive constraint, ignore the others, solve a knapsack problem and somehow adjust the solution to satisfy the ignored constraints.

- Fractional Knapsack -

Let's understand this concept by using  and program and example.

There are some things to be considered for better understanding

- 1) There are 'n' items in the store.
- 2) Weight of i^{th} item $w_i > 0$
- 3) Profit for i^{th} item $P_i > 0$
- 4) Capacity of the knapsack is W .

- Algorithm:-

Greedy - Fractional - Knapsack ($w[1 \dots n]$)

for $i=1$ to n

do $x[i] = 0$

weight = 0

for $i=1$ to n

if $\text{weight} + w[i] \leq W$ then

$x[i] = 1$

$\text{weight} = \text{weight} + w[i]$

else

$$x[i] = (\omega - \text{weight}) / w[i]$$

$$\text{weight} = w$$

break

return x

Analysis -

If the provided items are already sorted into a decreasing order of p_i/w_i , then the while loop takes a time of $O(n)$. Therefore, the total time including the sort is in $O(n \log n)$.

Example -

Let ' ω ' be the capacity of the knapsack, $\omega = 60$, and the list of provided items are shown in the following table.

Item	A	B	C	D
Profit	100	280	120	120
Weight	10	40	20	24
Ratio (p_i/w_i)	10	7	6	5

After sorting p_i/w_i , we will get table as follows.

Item	A	B	C	D
Profit	100	280	120	120
Weight	10	40	20	24
Ratio (p_i/w_i)	10	7	6	5

1. ~~not exceed the capacity. This problem~~

Now, let's solve this.

First of all B is chosen as weight of B which is less than the capacity of the knapsack.

Next A is chosen, as the available capacity of the knapsack is greater than the weight of A.

Now, 'c' is chosen as next item.

However, the whole item cannot be chosen as the remaining capacity of the knapsack which is less than the weight of c.

Hence,

fraction of c i.e. $(60 - 50)/20$ is chosen.

The total weight of the selected items is -

$$10 + 40 + 20$$

And, the total profit is $100 + 280 + 120 * (10/20)$
 $= 440$

This is the optimal solution, we cannot gain more selecting only different combination of items.

Conclusion:-

Hence, we understood knapsack problem using greedy method and also implemented program.

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