**GROUP – A**

**Assignment No: 03**

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Title:-

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

=====================================================================Objective:-

-To learn about fractional knapsack

-To understand greedy method

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Theory:-

In fractional knapsack, the items are broken in order to maximize the profit. The problem in which break the item is known as a Fractional knapsack problem.

* What is fractional knapsack?

The fractional knapsack problem is a classic problem in combinatorial optimization. If a set of items are given, each with a weight and a value, the goal is to select a subset of the items that maximises the value while keeping the total weight below or equal to a given limit.

* How fractional knapsack using greedy method works?

In fractional knapsack using greedy approach, first calculate the ratio value/weight for each item and then sort the item on the basis of this ratio. Take the item with the highest ratio and add them until it can’t add the next item as a whole and at the end add the next item as much as possible which will always be the optimal solution to this problem.

The greedy algorithm described below always gives an optimal solution to the job sequencing problem-

* Step-01: For each item, compute its value / weight ratio.
* Step-02: Arrange all the items in decreasing order of their value / weight ratio.
* Step-03: Start putting the items into the knapsack beginning from the item with the highest ratio.
* Practice problem based on fractional knapsack using greedy method
* Problem : For the given set of items and knapsack capacity = 16 kg, find the optimal solution for the fractional knapsack problem making use of greedy approach.

|  |  |  |
| --- | --- | --- |
| **Item** | **Weight** | **Value** |
| I1 | 6 | 6 |
| I2 | 10 | 2 |
| I3 | 3 | 1 |
| I4 | 5 | 8 |
| I5 | 1 | 3 |
| I6 | 3 | 5 |

* Step 1: Compute the value/weight ratio for each item, which is also called “Density”.

|  |  |  |  |
| --- | --- | --- | --- |
| **Item** | **Weight** | **Value** | **Density (V/W)** |
| I1 | 6 | 6 | 1.000 |
| I2 | 10 | 2 | 0.200 |
| I3 | 3 | 1 | 0.333 |
| I4 | 5 | 8 | 1.600 |
| I5 | 1 | 3 | 3.000 |
| I6 | 3 | 5 | 1.667 |

* Step 2: Sort all the items in decreasing order of their density value

|  |  |  |  |
| --- | --- | --- | --- |
| **Item** | **Weight** | **Value** | **Density (V/W)** |
| I5 | 1 | 3 | 3.000 |
| I6 | 3 | 5 | 1.667 |
| I4 | 5 | 8 | 1.600 |
| I1 | 6 | 6 | 1.000 |
| I3 | 3 | 1 | 0.333 |
| I2 | 10 | 2 | 0.200 |

* Step 3: Start filling the knapsack by putting the items into it one by one with the help of Total weight and Total value for each item brought.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Item** | **Weight** | **Value** | **Total Weight** | **Total brought weight** |
| I5 | 1 | 3 | 1.000 | 3.000 |
| I6 | 3 | 5 | 4.000 | 8.000 |
| I4 | 5 | 8 | 9.000 | 16.000 |
| I1 | 6 | 6 | 15.000 | 22.000 |
| I3 | 3 | 1 | 16.000 | **22.333** |

Now,

knapsack will contain the following items-

< I5 , I6 , I4 , I1, I3 >

Total cost of the knapsack : 3.000+8.000+16.000+22.000+0.333= 22.333 units.

* **Algorithm**: Algorithm GREEDY\_FRACTIONAL\_KNAPSACK(X, V, W, M)

// Description : Solve the knapsack problem using greedy approach

// Input:

X: An array of n items

V: An array of profit associated with each item

W: An array of weight associated with each item

M: Capacity of knapsack

// Output :

SW: Weight of selected items

SP: Profit of selected items

// Items are presorted in decreasing order of pi = vi / wi ratio

S ← Φ // Set of selected items, initially empty

SW ← 0 // weight of selected items

SP ← 0 // profit of selected items

i ← 1

while i ≤ n do

if (SW + w[i]) ≤ M then

S ← S ∪ X[i]

SW ← SW + W[i]

SP ← SP + V[i]

else

frac ← (M - SW) / W[i]

S ← S ∪ X[i] \* frac // Add fraction of item X[i]

SP ← SP + V[i] \* frac // Add fraction of profit

SW ← SW + W[i] \* frac // Add fraction of weight

end

i ← i + 1

end

* The time complexity of fractional knapsack using greedy method is O(NlogN).

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Conclusion:-

Thus we have studied to how fractional knapsack using greedy method works. The use of greedy method is solving a problem by selecting the best option available at the moment

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