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. Putas many items as you can into the knapsack.

Example:

Find the optimal solution for the fractional knapsack problem making use of greedy approach. Consider-

n = 5

w = 60 kg

(w1, w2, w3, w4, w5) = (5, 10, 15, 22, 25)

(b1, b2, b3, b4, b5) = (30, 40, 45, 77, 90)

Solution-

Step-01:

Compute the value / weight ratio for each item-

Items	Weight	Value	Ratio
1	5	30	6
2	10	40	4
3	15	45	3
4	22	77	3.5
5	25	90	3.6

Step-02:

Sort all the items in decreasing order of their value / weight ratio-

I1 I2 I5 I4 I3

(6) (4) (3.6) (3.5) (3)

Step-03:

Start filling the knapsack by putting the items into it one by one.

Knapsack Weight	Items in Knapsack	Cost
60	Ø	0
55	I1	30
45	I1, I2	70
20	I1, I2, I5	160

Now,

- Knapsack weight left to be filled is 20 kg but item-4 has a weight of 22 kg.
- Since in fractional knapsack problem, even the fraction of any item can be taken.
- So, knapsack will contain the following items-

< I1 , I2 , I5 , (20/22) I4 >

Total cost of the knapsack

= 160 + (20/27) x 77

= 160 + 70

= 230 units

Algorithm- Fractional knapsack

- **Greedy-fractional-knapsack (*w, v, W*)**

```
1.  for i =1 to n
2.    do x[i] =0
3.  weight = 0
4.  while weight < W
5.    do i = best remaining item
6.    if weight + w[i] ≤ W
7.      then x[i] = 1
8.      weight = weight + w[i]
9.    else
10.     x[i] = (w - weight) / w[i]
11.     weight = W
12. return x
```

Time Complexity-

- The main time taking step is the sorting of all items in decreasing order of their value / weightratio.
- If the items are already arranged in the required order, then while loop takes O(n) time.
- The average time complexity of Quick Sort is O(nlogn).
- Therefore, total time taken including the sort is O(nlogn).

Viva Questions:

1. What is Greedy Approach?
2. Explain concept of fractional knapsack
3. Difference between Fractional and 0/1 Knapsack.

Conclusion: In this way concept of Fractional Knapsack is explained using greedy method.