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* Fractional Knapsack problem using greedy approach:

- Given weights and values of n items, we need to put these items in a knapsack of capacity W to get the maximum total value in the knapsack.
- In fractictional knapsack, we can break items for maximizing the total values of knapsack.
- This problem in which we can break an item is also called the fractional knapsack.
- The basic idea of the greedy approach is to calculate the ratio value/weight for each item and sort the item on the basis of the ratio.
- Then take the item with the highest ratio and add them until we get can't add the next item as a whole and at the end add the next item as much as we can.

* Algorithm :-

```
for i = 1 to n
    calculate Profit/weight
Sort objects in decreasing order of P/w Ratio
for i = 1 to n
  if M > 0 and wi ≤ M
      M = M - wi
      P = P + Pi
  else
      break;
  if (M > 0)
      P = P + Pi (M / wi)
```

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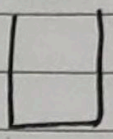
* Example :-

objects	ob1	ob2	ob3
Profit	25	24	15
weight	18	15	10

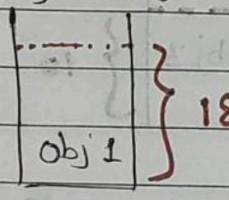
Knapsack capacity (M) = 20



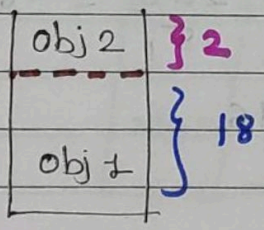
Soln ⇒

1) Greedy about profit

- In this we will put the object in the knapsack whose profit is maximum.
- In our e.g. obj 1 has highest profit.



- But still there is 2 unit space is remaining. So we again choose an object whose profit is maximum.
- In our case now we have object 2 with highest profit



There calculating profit

$$= 24 + \frac{2}{15} \times 24$$

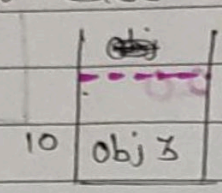
$$= 25 + \frac{48}{15} \quad 3.2$$

$$= 25 + 3.2$$

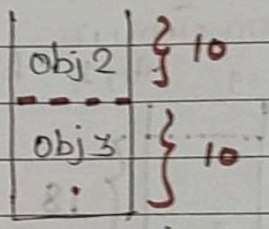
Overall profit = 28.2

2) Greedy about weight :-

- Now we are placing objects in the knapsack whose weights are minimum so that we can place more objects into the knapsack.
- In our case obj3 has minimum weight.



- Now still 10 unit space is remaing now we again add another object whose weight is minimum.



Therefore calculating profit

$$= \cancel{10+}$$

$$= 15 + \frac{10}{15} \times 24$$

$$= 15 + \frac{240}{15} = 16$$

$$= 15 + 16$$

$$P = 31$$

- These two are not optimal solution because we are only considering weight and profits individually.
- The optimal solution would be that considers both weights as well as profit. Therefore we have to take ratio of P/W.

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3) Greedy about the ratio of P/W :-

- for this approach we have to divide profit by weight to get ratio.
- Therefore the ratios for our given three objects are as follows.

1) obj 1 = $\frac{25}{18}$ = 1.3

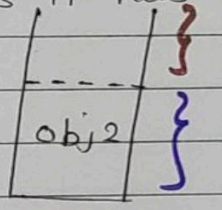
2) obj 2 = $\frac{24}{15}$ = 1.6

3) obj 3 = $\frac{15}{10}$ = 1.5

- After calculating the ratio we have to arrange objects in descending order according to their P/W ratio.

objects	obj 2	obj 3	obj 1
profit	24	15	25
weight	15	10	18
P/W ratio	1.6	1.5	1.3

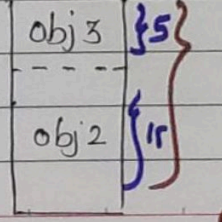
1) Adding obj 2 as it has highest p/w ratio i.e. 1.6



5 remaining.

15

2) As there is still 5 unit space is remaining now we can add another objects whose P/W ratio is higher.



5

15

20

= ~~15~~ + = 24 + $\frac{5}{10}$ × 15

= 24 + $\frac{75}{10}$

= 24 + 7.5

optimal soln ⇒ = 31.2