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Lab Submission 5

I have chosen the fractional knapsack problem and implemented the function “knapsack” in python.

Overview:

I have given three inputs as dictionaries. The structure of dictionary follows {value:weight}. The function accepts a dictionary and a weight value as parameters.

The function first sorts the dictionary based on the ratio value:weight in descending order. It then starts choosing the values with highest ratios.

The complexity of **sorted** in python is $O(n\log n)$. The complexity of the traversal of dictionary is n at max so the max complexity would be $O(n\log n)$ if we consider the sorting complexity too. The space complexity is $O(n)$.

Inputs :

```
example1 = {50:10,60:20,80:30}
W1 = 40
example2 = {10: 2,5: 3,15: 5,7: 7,6: 1}
W2 = 10
example3 = {100: 20,60: 10,120: 40,50: 30}
W3 = 50
```

Output:

```
shash@LAPTOP-74LO6U0H MINGW64 /c/Mahindra Notes and schedule/semester 5/DAA/Assignment week 5 (main)
$ python fractional_knapsack.py
Profit for {50: 10, 60: 20, 80: 30} is 136.66666666666666
Profit for {10: 2, 5: 3, 15: 5, 7: 7, 6: 1} is 34.333333333333336
Profit for {100: 20, 60: 10, 120: 40, 50: 30} is 220.0
```

Cross check on paper

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1) $50:10, 60:20, 80:30$ $w=40$
 $\frac{5}{5} \quad \frac{3}{3} \quad \frac{2666}{2666}$

Sort: $50:10, 60:20, 80:30$

$\Rightarrow 50+60=110$ $w=30, 40-30=10$

fraction $\frac{10}{30} \times 80 = 26.66$

Profit = 136.666 ...

2) $10:2, 5:3, 15:5, 7:7, 6:1$ $w=60$
 $\frac{5}{5} \quad \frac{1.66}{1.66} \quad \frac{3}{3} \quad \frac{1}{1} \quad \frac{6}{6}$

Sorted = $6:1, 10:2, 15:5, 5:3, 7:7$

$\Rightarrow 6+10+15=31$ $10-8=2$

$\frac{2}{3} \times 5 = 3.33$

Profit = 34.733 ...

3) $100:20, 60:10, 120:40, 50:30$ $w=50$
 $\frac{5}{5} \quad \frac{6}{6} \quad \frac{3}{3} \quad \frac{1.66}{1.66}$

Sorted = $60:10, 100:20, 120:40, 50:30$

$= 60+100 = 160$

$\frac{120}{50} = 2.4$ $w=20$
 $\frac{20}{40} \times 120 = 60$

Profit = 160 + 60 = 220