

Module 11 - Recursion

CMPT220L

Due on Dec 4, 2020 by 11:59 PM

Points: 100

Problems

1. (*0/1 knapsack problem*) Given n items with weights w_1, w_2, \dots, w_n , and a bag with a weight capacity of w , the problem of finding the items with the maximum total weight to store in the bag is called the 0/1 knapsack problem. Let $m(i, w)$ denote the total weight of the best solution of placing the first i items into a bag with weight capacity w . The problem can be solved using the following recursion:

$$\begin{aligned} m(0, \text{weightLimit}) &= 0; \\ m(i, 0) &= 0; \\ m(i, w) &= m(i-1, \text{weightLimit}); \text{ if } w_i > \text{weightLimit} \\ m(i, w) &= \max(m(i-1, \text{weightLimit}), w_i + m(i-1, \text{weightLimit} - w_i)); \end{aligned}$$

Write a recursive method for computing $m(i, w)$ using following method header:

```
public static double m(int i, double weightLimit, double[] w)
```

where w is an array of the weights for items. Write a test program that prompts the user to enter the number of the items and weight for each item and the weight capacity of the bag, and displays the maximum total weight of the items that can be placed in the bag. Here is a sample run:

```
Enter the number of items: 5
Enter the weights for each item: 3 7 3 9 2
Enter the weight limit for the bag: 6
The maximum weight of the items placed in the bag is 6.0
```

2. (*0/1 knapsack problem*) Revise the preceding problem to find the items placed in the bag. *Hint:* Use the following recursive method to return an `ArrayList` that consists of the elements in the bag:

```
public static ArrayList<Integer> m(int i, double weightLimit, double[] w)
```

Write a test program that prompts the user to enter the number of the items and weight for each item and the weight capacity of the bag, and displays the maximum total weight of the items that can be placed in the bag. Here is a sample run:

```
Enter the number of items: 5
Enter the weights for each item: 3 7 3 9 2
Enter the weight limit for the bag: 6
The maximum weight of the items placed in the bag is 6.0
The items in the bag are #1 #3
The weights of the items in the bag are 3.0 3.0
```

Submission

Make sure you create one Java file per project. Place your `.java` files under the corresponding folder in your local copy of the GitHub repository, commit and push it to the remote repository. Make sure that the professor has access to the repository (`jfac65-marist`).

```
cmpt220lastname\  
  hw\  
    11\  
      Problem1.java  
      Problem2.java
```