CSE221 - Short Assignment
Section 20

1. Karen started a website that displays different advertisements. She wants to maximize her advertisement revenue. Each month she receives a list of advertisements, each with a certain value (revenue) and a size (space taken on the webpage). The webpage has a limited amount of space, and she selects a subset of advertisements to display in order to maximize her total revenue, while staying within the available space. No advertisement is selected more than once, and each advertisement that is selected has to be displayed in full.
For example, following is a list of advertisements she received for the month of August:

Advertisements: Ad 1 - Value: \$10, Size: 2 Ad 2 - Value: \$8, Size: 1 Ad 3 - Value: \$15, Size: 3 Ad 4 - Value: \$6, Size: 2 Maximum Space Available: 5	Solution: Select Advertisements: Ad 1, Ad 3 Total Revenue: \$10 + \$15 = \$25 Space Occupied = 2 +3 = 5

a) Suppose, you are trying to come up with a Dynamic Programming approach to solve this problem. You build a table, each cell representing the solution (optimal revenue value) to a subproblem. **Give** the formula for filling up each entry of the table. **[3]**

b) Suppose in the month of September, she received the following list of advertisements:

Advertisements:
Ad 1 - Value: \$12, Size: 4
Ad 2 - Value: \$8, Size: 2
Ad 3 - Value: \$9, Size: 3
Ad 4 - Value: \$7, Size: 2
Ad 5 - Value: \$5, Size: 1
The maximum available space is 5.

Fill the following table according to the formula you developed in question (a). Then write the set of advertisements Karen should select. **[6]**

Value	Size	Item	Maximum Available Space					
			0	1	2	3	4	5
-	-	0						
12	4	1						
8	2	2	0	0	8	8	12	12
9	3	3						
7	2	4						
5	1	5						

c) [CO3] Suppose, Karen discovered that the top half of some of the advertisements contain nothing. So, from the month of October she is implementing a new feature, the size of at most K items can be changed to half of its original size. Revenue will stay the same. For example,

    There are four advertisements to select from,
    Value = [10, 12, 8, 6]
    Required Space = [4, 5, 6, 6]
    Max Available Space = 7
    K = 1

    Output: 22
    Explanation: Without changing the required space of any item, the solution would be taking only Ad-2, giving a revenue of 12. But if we change the size of Ad-1 into half of its original size, we can take both Ad-1 and 2. Then the total revenue is 22, which is the maximum.

Think about how you would solve this problem using a Dynamic Programming approach. Then, **write** a recursive formulation of your solution **OR**
explain your idea in pseudocode/flow-chart/step-by-step instructions format. **[4]**

2. Read the questions carefully before attempting. If a question has more than one correct answer, then you have to write all of the correct answers in your script. (Only writing the correct options will be enough) **[3]**

1. What is true about Greedy algorithms?
    a. Guarantees optimal solution for all problems
    b. Makes locally optimal choices at each step with the hope of finding global optimum
    c. Search through all possible solutions
    d. Relies on backtracking to find the optimal solution
2. Which of the following problems can be solved using the Greedy approach?
    a. Longest Common Subsequence
    b. Single Source Shortest Path in a Graph
    c. Fractional Knapsack
    d. 0/1 Knapsack
3. In which approach the function fibonacci(n) is implemented?
    a. Brute Force
    b. Top Down DP
    c. Bottom Up DP
    d. Greedy Approach

```
def fibonacci(n):
    if n <= 1:
        return n
    fib = [0] * (n + 1)
    fib[1] = 1
    for i in range(2, n + 1):
        fib[i] = fib[i - 1] + fib[i - 2]
    return fib[n]
```