

(S1-21_DSECLZG519)
(Data Structures and Algorithms Design)
Academic Year 2020-2021

Assignment 2 – PS15 - [Fastfood Joint] - [Weightage 13%]

1. Problem Statement

You have recently opened a fast-food joint in one of the most crowded markets of your city. Since the area is an expensive one, the shops are not too large and you have a tight fund to stick to. Through extensive research and surveys, you have identified certain preparations that might work in your area. You need to allocate funds for food preparations. Since different food preparations use different ingredients, their costs differ. Through your surveys and research, you also have an estimate of the profit you might obtain on the given food preparation while remaining competitive in your area. Excluding rent and other utilities, you have a total of 15 lakhs to be allocated to different food preparations for a month. Here your task would be to select as many preparations as possible with the fund constraints such that the total profit is maximized. If there are multiple solutions with same profit, choose the one which results in maximum utilization of funds and selection of preparations as well, as more variety in food is generally preferred.

Requirements:

1. Formulate an efficient recursive algorithm using Dynamic Programming to determine how to select the preparations to be funded and maximize PROFIT.
2. Analyse the time complexity of your algorithm.
3. Implement the above problem statement using Python 3.7

Sample Input:

For example, if there are 10 different preparations in total and their fund requirements and values are given as shown:

Preparations (i)	Cost C_i (lakhs)	PROFIT P_i
1	3	6
2	1.7	3.5
3	2	5.5
4	1	4
5	1.3	6.6
6	1	2

7	1.6	3.5
8	2.5	5
9	1.5	7
10	1.8	1

Input should be taken in through a file called “**inputPS15.txt**” which has the fixed format mentioned below using the “/” as a field separator:

<Preparation Name i> / < Cost Ci(crores)> / < PROFIT Ri>

Ex:

1 / 3 / 6
 2 / 1.7 / 3.5
 3 / 2 / 5.5
 ...

Sample Output:

The preparations that should be funded: 1,2,3,4,5,7,8,9
 Total PROFIT: 41.1
 Fund remaining: 0.4

Display the output in **outputPS15.txt**.

Note that the input/output data shown here is only for understanding and testing, the actual file used for evaluation will be different.

2. Deliverables

1. Word document **designPS15_<group id>.docx** detailing your design and time complexity of the algorithm.
2. **[Group id]_Contribution.xlsx** mentioning the contribution of each student in terms of percentage of work done. Download the Contribution.xlsx template from the link shared in the Assignment Announcement.
3. **inputPS15.txt** file used for testing
4. **promptsPS15.txt** file used for testing (If applicable)
5. **outputPS15.txt** file generated while testing
6. **.py file** containing the python code. Create a single *.py file for code. Do not fragment your code into multiple files

Zip all of the above files including the design document and contribution file in a folder

with the name:

[Group id]_A2_PS15_FastfoodJoint.zip and submit the zipped file.

Group Id should be given as **Gxxx** where xxx is your group number. For example, if your group is 26, then you will enter G026 as your group id.

3. Instructions

1. It is compulsory to make use of the data structure(s) / algorithms mentioned in the problem statement.
2. Ensure that all data structure insert and delete operations throw appropriate messages when their capacity is empty or full. Also ensure basic error handling is implemented.
3. For the purposes of testing, you may implement some functions to print the data structures or other test data. But all such functions must be commented before submission.
4. Make sure that you read, understand, and follow all the instructions
5. Ensure that the input, prompt and output file guidelines are adhered to. Deviations from the mentioned formats will not be entertained.
6. The input, prompt and output samples shown here are only a representation of the syntax to be used. Actual files used to evaluate the submissions will be different. Hence, do not hard code any values into the code.
7. Run time analysis is to be provided in asymptotic notations and not timestamp based runtimes in sec or milliseconds.
8. Please note that the design document must include
 - a. The data structure model you chose with justifications
 - b. Details of each operation with the time complexity and reasons why the chosen operations are efficient for the given representation
 - c. One alternate way of modelling the problem with the cost implications.
9. Writing good technical report and well document code is an art. Your report cannot exceed 4 pages. Your code must be modular and quite well documented.

Instructions for use of Python:

1. Implement the above problem statement using Python 3.7.
2. Use only native data types like lists and tuples in Python, do not use dictionaries provided in Python. Use of external libraries like graph, numpy, pandas library etc. is not allowed. The purpose of the assignment is for you to learn how these data structures are constructed and how they work internally.
3. Create a single *.py file for code. Do not fragment your code into multiple files.
4. Do not submit a Jupyter Notebook (no *.ipynb). These submissions will not be evaluated.
5. Read the input file and create the output file in the root folder itself along with your .py file.

Do not create separate folders for input and output files.

4. Deadline

1. The strict deadline for submission of the assignment is **Saturday, 12th Mar, 2022.**
2. The deadline has been set considering extra days from the regular duration in order to accommodate any challenges you might face. No further extensions will be entertained.
3. Late submissions will not be evaluated.

5. How to submit

1. This is a group assignment.
2. Each group has to make one submission (only one, no resubmission) of solutions.
3. Each group should zip all the deliverables in one zip file and name the zipped file as mentioned above.
4. Assignments should be submitted via Canvas > Assignment section. Assignment submitted via other means like email etc. will not be graded.

6. Evaluation

1. The assignment carries 13 Marks.
2. Grading will depend on
 - a. Fully executable code with all functionality working as expected
 - b. Well-structured and commented code
 - c. Accuracy of the run time analysis and design document.
3. Every bug in the functionality will have negative marking.
4. Marks will be deducted if your program fails to read the input file used for evaluation due to change / deviation from the required syntax.
5. Use of only native data types and avoiding libraries like numpy, graph and pandas will get additional marks.
6. **Plagiarism will not be tolerated. Copy / Paste's from web resources / or your friends' submission will attract severe penalty to the extent of awarding negative 10 percent. We will not measure the extent of such blatant copy pastes and details of who copied from whom and such details while awarding the penalties. It's the responsibility of the team to solve and protect your original work.**
7. Source code files which contain compilation errors will get at most 25% of the value of that question.

7. Readings

Text book: Algorithms Design: Foundations, Analysis and Internet Examples Michael T. Goodrich, Roberto Tamassia, 2006, Wiley (Students Edition). **Chapters:** 5.3