

Assignment -2: Dynamic Programing**IIIT-DELHI****Due Date: 6th September 12.00 pm****Total(50 points)****Instructor: Debarka Sengupta**

Plagiarism: All submitted codes are expected to be the result of your individual effort. You should never misrepresent someone else's work as your own. In case any plagiarism case is detected you will get one grade reduction in final examination. Cite the resource wherever using other's code.

Instructions:

- 1) Allowed programming language are python and C . **No external libraries would be allowed.** If you see an ambiguity or inconsistency in a question, please seek a clarification from the teaching staff.
- 2) You must submit your working solution on backpack on the deadlines page from where you have downloaded this assignment instructions sheet. **No extensions on deadline. If you fail to submit within the time limit then your solution will not be evaluated.**
- 3) **Mention your enrollment no and name at starting of the each file . Write a clean code with proper comments at appropriate places as it will be checked.**
- 4) Store the each problem with **rollno_problemX_Y.py** or **rollno_problemX_Y.c** where X is the problem no and Y is task no and upload a zip folder with **rollno_name_assignmentX.zip** containing all the codes and assignment report. **Codes won't be checked if they don't follow the guidelines.**

Hardware and Software Resources:

It is mandatory that you should do version controlling of all your homeworks. We will be using <https://bitbucket.org/> for this purpose. Get a login id for free on bitbucket and create the homework repository. All homeworks should be saved inside the repository named hw_1 with your roll number as suffix. If your roll number is 1234 then the repository name will be hw1_1234. Every homework repository should have access level set as "private". You have to use the "share" option for your homework repository to share it with both of your TAs. You can share using their email ids. We will not entertain any date extension requests if you are not doing version controlling and accidentally deleted your homework. You can also use HPC for doing your homework if your machine can't handle large files.

Problem 1: Rod Cost problem [25 points]

1] Assume a company buys long iron rods and cuts them into shorter rods for sale. If each cut is free and rods of different lengths are sold for different prices, implement a program to find the cuts that would maximize the profit. Only dynamic programming based solutions will be considered. Report both final selling price and the cuts. Reporting one solution suffices if there are multiple equivalent solutions. **[8 points]**

Example:

For the below instance the maximum obtainable value is Rs. 20. [The rod can be either cut at either 1 or 2 to yield the maximum selling price. In the first case the logs will be of sizes 1 and 6. In the second case the logs will be of sizes 2 and 5.]

Length	1	2	3	4	5	6	7
Cost (Rs.)	1	2	8	9	18	19	14

2] Assume the company modifies the earlier strategy as follows:

In addition to a cost C for each iron rod, each cut incurs a cost of c. The final income associated with a solution is now the sum of the costs of the pieces minus the costs of making the cuts. Report both final selling price and the cuts. Reporting one solution suffices if there are multiple equivalent solutions. **[12 points]**

Example: If length of the rod is 7 and the cost of different pieces are given as following, then the maximum obtainable value is 19.[by cutting in two pieces of lengths 1 and 6 [$1+19=20$ and -1 to cut the rod of length 6]

Length	1	2	3	4	5	6	7
Cost	1	2	8	9	18	19	14
Cut Cost(RS)	0	1	1	1	1	1	1

3] Explain the strategy used by you to solve both the problem. Mention the time complexity of the problem. Justify why your strategy is best? **[5 points]**

Problem 2:String alignment [25 points]

1] Implement Needleman–Wunsch algorithm to align two sequences with a gap penalty of -2, match score of 2 ,mismatch score of 1.The output should display the final score and final alignment. **[10 points]**

2] Modify the code written in problem 1 where all the score are multiplied by -1.**[10 points]**

3] Bacteria have circular DNA molecules. Consider the global alignment problem for two such molecules, which can be represented as circular strings of length m and n. One way to solve this problem is to consider all possible linearizations of each circular string (m linearizations for one string and n for the other) and then solve the global alignment problem for each pair. This will require considering mn pairs for a total work of $O(m^2n^2)$. Find a more efficient way to solve this problem.Write an algorithm for the same and analyze it time complexity.Do give a justification about your solution. **[5 points]**