COL100 Assignment 5

Due date: 31th Jan, 2021

You are required to follow general assignment guidelines as specified previously. There are three questions all of which need to be submitted.

1 (8 points) Play with Grid

Rishabh is playing a board game where a $M \times N$ grid G is given with non-negative penalty values at each point $G(i, j)$. Rishabh starts at the top left corner $(0, 0)$. To complete this game, he needs to reach the opposite corner $(M-1, N-1)$. At each step he can go either vertically, horizontally or diagonally one step in the direction of the destination (i.e. from a given cell (i, j) Rishabh can traverse only to cells $(i+1, j)$ or $(i, j+1)$ or $(i+1, j+1)$). Every time Rishab steps into a cell, he will face penalty of the cell he has entered.

Rishabh objective is to pick a route with least total penalty. (Total penalty is Sum of all the penalties in traversing cells along route)

Example:

- Input : grid =[[8,1,6],[3,5,7],[4,9,2]]
  Output: 15

```
8 1 6
3 5 7
4 9 2
```

Explanation: The path 8→5→2 minimizes the total penalty.

1. **(4 points)** Write a function *gridPlay(grid)*, which takes a grid(list of list of integers) MxN as an input and returns a single integer representing the minimum penalty Rishabh has to face so he can complete the game. [Hint: use Dynamic Programming]

2. **(2 points)** Give a worst case polynomial time complexity.

3. **(2 points)** Prove all your assertions and invariants.

2 (8 points) String Problem

Given two string A and B consisting of lower case letters, find if A can be converted to B with minimum number of edits as follows:

1. Insert a character in A.

2. Delete a character from A.

3. Replace a character in A subject to restriction: (a) a vowel can be replaced with only a vowel, (b) a consonant may be replaced with either vowel or consonant.

Let us explain with the help of an **example**. Let Input:A= "bplpcd" and B= "apple" then edits performed are:

1. A[0] is a consonant & B[0] is a vowel. A[0] is changed to vowel i.e "bplpcd" $\rightarrow$ "aplpcd".

2. A[2] & B[2] are both consonants. A[2] is changed to B[2] i.e "aplpcd" $\rightarrow$ "apppcd".

3. A[3] & B[3] are both consonants. A[3] is changed to B[3] i.e. "apppcd" $\rightarrow$ "applcd".

4. A[4] is a consonant & B[4] is a vowel. A[4] is changed to vowel i.e. "applcd" $\rightarrow$ "appled". Changes made = 4

5. A[5] is a consonant & B has ended. Remove A[5] i.e "appled" $\rightarrow$ "apple". Changes made = 5

Even though there are multiple answers to the same inputs, your output **must be the smallest number of changes** that will change A into B. For our example, the correct answer is 4.

Test cases If $A =$ "*orange*" and $B =$ "*apple*", then result is 5. If $A =$ "*xyz*" and $B =$ "*y*", then result is 2.

1. **(4 points)** Write a function *stringProblem(A,B)* in python which returns a number of changes that have to be performed to convert string A into B
2. **(2 points)** Give a worst case time complexity.
3. **(2 points)** Prove all your assertions and invariants.

3 (4 points) Calendar Problem

Let us print out a calendar. Given a year, our target is to print a calendar to a text file in a formatted way. The calendar must print all 12 months and days of the week in a single page in a nice formatted manner that one can print for use. You do not need to mark holidays. See example calendar below (Notice the text formatting, ignore fonts). A single-column output will result in partial points.

You need to correctly compute the day for 1st of January (use the wikipedia entry of the Gregorian Calendar to figure this out.

`https://en.wikipedia.org/wiki/Leap_year#Gregorian_calendar`

You may assume that the input to the function is greater than 1753.

1. **(4 points)** Write a function *printCalendar*(*year*), that takes in an integer as the input year and creates a file calendar.txt on the system in the same directory as your python code file.

4 Submission and other logistics

As usual, you should submit two files to the Moodle assignment page.

1. One file should be a PDF file containing all your written work, i.e. correctness and efficiency analysis, etc. This can be handwritten with pen and paper and then scanned with your mobile, or it can be typed on your device using MS Word or LaTeX or any other software. The only requirement is that it should be clearly legible.

2. The other file should be a Python file containing all your code. Put your solutions to all four programming problems into a single file, along with any helper functions they require. We should be able to run any of the required functions by running your code in a Python console and then typing in a function call.

The filenames of your submitted files should be exactly the same as your entry number. For example, if your entry number is 2017CS10389, you should name your Python file as `2017CS10389.py` and your PDF file as `2017CS10389.pdf`. Your submission should consist of only these two files, uploaded individually. There should be no sub-folders or zip files in the submission on Moodle.

Failure to comply with these submission instructions will lead to a penalty.

Please ask any queries related to the assignment on the COL100 Piazza page (https://piazza.com/iit_delhi/fall2020/col100).

2021

-JANUARY-

M	T	W	T	F	S	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

-FEBRUARY-

M	T	W	T	F	S	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28

-MARCH-

M	T	W	T	F	S	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

-APRIL-

M	T	W	T	F	S	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

-MAY-

M	T	W	T	F	S	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

-JUNE-

M	T	W	T	F	S	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

-JULY-

M	T	W	T	F	S	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

-AUGUST-

M	T	W	T	F	S	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

-SEPTEMBER-

M	T	W	T	F	S	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

-OCTOBER-

M	T	W	T	F	S	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

-NOVEMBER-

M	T	W	T	F	S	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

-DECEMBER-

M	T	W	T	F	S	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

Figure 1: Calendar