

ENGG1111 Computer Programming and Applications

Assignment 2: Save Farmer Peter!

Due date: 5-May-2018, 23:00. Late submission: 10% discount per day.

One day, farmer Peter woke up from a nightmare. In his dream he was kidnapped by a group of aliens, locked in a prison cell and subjected to a series of strange experiments. He was frightened and woke up. He believed that this is a prophecy dream. Although he cannot recall every detail about his dream, he remembered that he has to unlock the electric door of the cell and fuel a space shuttle in order to escape from the alien's spaceship. As his best friend, he asks you a favor to write a program to solve these two puzzles.

A. Electric lock

The lock of Peter's cell is an electric lock with one "push on" knob which can turn clockwise or anticlockwise with various steps. To unlock the door, Peter needs to turn the knob (figure 1) with correct order which involves a sequence of turns (clockwise and/or anticlockwise) with predefined steps (1-26).

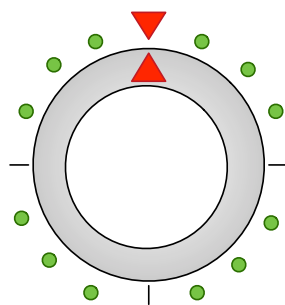


Figure 1

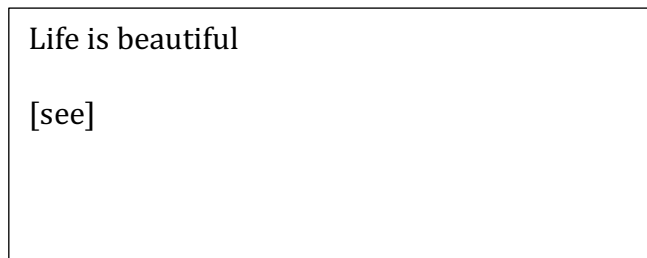


Figure 2

After few observations, Peter found that the correct order is hidden in the message and passcode (enclosed by a pair of square brackets) written on a whiteboard (figure 2) hanged outside the cell.

The following steps show how to decrypt the order from the message shown in figure 2. The process is case insensitive.

1. Sort the characters in the message according to the alphabet order. Ignore space and punctuation mark.

e.g. Life is beautiful -> abeeffiiillstuu

2. With the string obtained in 1 with length N, select the character in the middle position as the reference letter. In case N is an even number, the middle position will be $N/2+1$. The reference letter in this example is 'i'.

abeeffi*i*illstuu

3. Remove all the repeated characters from the string in 2:

abefilstu

4. Number the letter according to their relative positions with respect to the reference letter. This number is the steps the knob should be turned. If the number is a positive number, turn the knob in clockwise direction. If the number is a negative number, turn the knob in anticlockwise direction.

a	b	e	f	i	l	s	t	u
-4	-3	-2	-1	0	1	2	3	4

5. The sequence to unlock the lock is the numbers of each character in the passcode. In this example, the passcode is "see" and the unlock order is:

clockwise 2 steps
anticlockwise 2 steps
anticlockwise 2 steps

6. If the passcode contains any character which is not found in the string in 1, the passcode is a fake passcode and should not be used to unlock the lock. The Aliens use this trick to see who plans to escape.
7. If the passcode contains the reference letter, it is also a fake passcode.

Input:

The input consists of two lines of text. The first line is the message (string terminated with '\n') and the second line is the passcode, which is a single word with letter only. The maximum size of passcode is 10. You may assume the input of message and passcode is always valid (passcode that cannot be decrypted is also a valid input).

Output:

The program should output the unlock order, line by line. Print "acw" for anticlockwise and "cw" for clockwise, followed by a colon (':') and the number of steps the knob should be turned.

Sample Input / Output

"↵" character is added to the inputs below to show the "\n" characters in user input.

Input		Output
1	Life is beautiful↵ fee↵	acw:1 acw:2 acw:2
2	Success is not final, failure is not fatal: it is the courage to continue that counts↵ Winston↵	Invalid code: Don't break it!
3	Please turn off the light when you leave this room↵ egg↵	acw:6 acw:4 acw:4
4	abcd↵ aad	acw:2 acw:2 cw:1

1. Basic Level (40%)

Write a program to work out the unlock order with maximum message size 50 characters.

2. Intermediate Level (10%)

Write a program to work out the unlock order with unlimited message size.

B. The way home

After unlocked the lock, Peter found a space shuttle on the docking port of the space ship. Peter manages to use the autopilot program to bring himself home. However, the shuttle requires a special compound (Niu) with molecular formula A_2H_2Z as fuel. The compound can be extracted from the ores stored in the spaceship and the shuttle has equipment to extract the compound from the ores. The only problem is that Peter can only bring limited amount of ores with him due to the loading capacity of the shuttle and the content of Niu could be very different from ore to ore. Peter found an atom scanner nearby which scans the atom arrangement in an ore. Niu can be found if five consecutive atoms contain two A, two H and one Z. In order to have enough fuel home, Peter ask you to write a program to determine the content of Niu in those ores quickly.

There are three types of ores found in the spaceship: Amber, Berry and Coil.

In Amber, Niu is perfectly aligned with another compound (Meta) with molecular formula B_2HZ_2 and the atom structure is always in AAHHZ. The ore contains only these two compounds.

e.g. AAHHZBBZZHAAHHZAAHHZBBZZH

In Berry, Niu is still perfectly aligned with Meta but atoms are randomly structured within a compound.

e.g. AHAZHBBHZZAHAHZHBBZZHHAHZHBZBZ

In Coil, Niu is aligned with unknown compounds and atoms are randomly structured within a compound.

e.g. AHAZHBCHZCAHAHZEHHAAZHBZBZHHAAZAAHHZBAAAAHHHHZZBEWWAAHHZ

Sample Input/Output

The input of the program is the scan result of an ore obtained from the atom scanner. It is a string with letter in uppercase only and terminated with a '\n'. The output of the program is the number of Niu found in the ore. You may assume that the scan results are always valid.

Test Case	Input	Output
1	<u>AAHHZ</u> CCAHCWCW <u>HHZAACE</u> CSALEWOPNPOEWZNFADAH <u>↵</u>	2
2	AHAZHBCHZCAHAHZ <u>EHHAAZ</u> HBZB <u>ZHHAAZAAHHZ</u> BAAAAHHHHZ ZBEWW <u>AAHHZ</u> <u>↵</u>	6
3	AHBCDWAAH <u>↵</u>	0

" ↵ " character and underline are added to the above inputs for illustration only.

1. Basic Level (40%)

Write a program to determine the content of Niu in Amber.

2. Intermediate Level (5%)

Write a program to determine the content of Niu in Berry.

3. Advance Level (5%)

Write a program to determine the content of Niu in Coil.

string (C++ object) and any other library (not covered in lectures) that could store unlimited numbers of characters should not be used in any part of this assignment.

II. Submission

Virtual Programming Lab (VPL) will be setup for each part. However, we encourage you to test your program with your own test cases before submit your program. Your program should generate the output based on the specifications, i.e. without extra text/space. We may mark your program with test cases different from those found in VPL.

Plagiarism (detected by the system) will get zero marks, apply to the source providers as well.