CMP-210 Data Structures and Algorithms
BSSE Fall 2012
Assignment - 02

Issue Date: 31-Mar-2014
Subm. Date: 06-Apr-2014
Subm. Time: 23:59:59

Objective

- Focuses on Arrays representation and manipulation in memory.
- Learn to represent floating point representation in memory.
- And learn the meaning of cipher text.

Q. # 1.   **(05)**

Extend your N-Dimensional Array ADT developed in Practice-03 such that it should support the option of starting index of each dimension to be different than zero.
E.g. for a 3-D array: first dimension index starts from -3, second dimension index from 0 and 3rd dimension index starts from 11.

Sample Run

```
int dimSize[3]={5,3,10};
int startingIndex[3] = {-3,0,10};
NDArray arr(3, dimSize, startingIndex);
                        // first parameter = number of dimension
                        // second parameter = size of each dimension
                        // third parameter is the starting index in each dimension
int indexSet[3]={-1,2,15};

arr.setValue( indexSet , val);
cout<<arr.getValue(indexSet)
```

Q. # 2.   **(15)**

Read the article at the following link:
http://en.wikipedia.org/wiki/Single-precision_floating-point_format
And implement a console-based version of the program/software at the following link:
http://www.h-schmidt.net/FloatConverter/ using the algorithm devised by IEEE-754 floating-point format.
So you will implement two function:
  1. Floating-point number to binary representation
  2. Binary representation to floating-point number?

Motivation: You will get to know the following after completing this assignment
  ➢ How the floating-point values are stored in computer.
  ➢ Problems related to comparing floating point values.
  ➢ What is the meaning of single precision or double precision?

Sample Run

Press 1: Floating-Point Number to Binary Number
*   2: Binary Number to Floating-Pointer Number*
*   1*
Enter Number to get Single Precision Floating Point Representation: 3.1

01000000010001100110011001100110

Do you want test another number [Y/N] Y

CMP-210 Data Structures and Algorithms
BSSE Fall 2012
Assignment - 02

Issue Date: 31-Mar-2014
Subm. Date: 06-Apr-2014
Subm. Time: 23:59:59

Q. # 3. (08)

The Vigenère Cipher is a simple alphabet substitution Cipher. It uses a matrix that contains 26 different lines. Each line of the matrix is a complete alphabet but the alphabet is shifted right by one each level so that at level 2 (the second line) the alphabet was shifted twice.

```
 0 - A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
 1 - B C D E F G H I J K L M N O P Q R S T U V W X Y Z A
 2 - C D E F G H I J K L M N O P Q R S T U V W X Y Z A B
 3 - D E F G H I J K L M N O P Q R S T U V W X Y Z A B C
 4 - E F G H I J K L M N O P Q R S T U V W X Y Z A B C D
 5 - F G H I J K L M N O P Q R S T U V W X Y Z A B C D E
 6 - G H I J K L M N O P Q R S T U V W X Y Z A B C D E F
 7 - H I J K L M N O P Q R S T U V W X Y Z A B C D E F G
 8 - I J K L M N O P Q R S T U V W X Y Z A B C D E F G H
 9 - J K L M N O P Q R S T U V W X Y Z A B C D E F G H I
10 - K L M N O P Q R S T U V W X Y Z A B C D E F G H I J
11 - L M N O P Q R S T U V W X Y Z A B C D E F G H I J K
12 - M N O P Q R S T U V W X Y Z A B C D E F G H I J K L
13 - N O P Q R S T U V W X Y Z A B C D E F G H I J K L M
14 - O P Q R S T U V W X Y Z A B C D E F G H I J K L M N
15 - P Q R S T U V W X Y Z A B C D E F G H I J K L M N O
16 - Q R S T U V W X Y Z A B C D E F G H I J K L M N O P
17 - R S T U V W X Y Z A B C D E F G H I J K L M N O P Q
18 - S T U V W X Y Z A B C D E F G H I J K L M N O P Q R
19 - T U V W X Y Z A B C D E F G H I J K L M N O P Q R S
20 - U V W X Y Z A B C D E F G H I J K L M N O P Q R S T
21 - V W X Y Z A B C D E F G H I J K L M N O P Q R S T U
22 - W X Y Z A B C D E F G H I J K L M N O P Q R S T U V
23 - X Y Z A B C D E F G H I J K L M N O P Q R S T U V W
24 - Y Z A B C D E F G H I J K L M N O P Q R S T U V W X
25 - Z A B C D E F G H I J K L M N O P Q R S T U V W X Y
```

It uses a key of n integers, each of these integers having a value between 1 and 26. There is no constraint on the length of the key. Each integer of the key stands for one line of the matrix.

Let's take an example of the encipher principle:

Let's choose the following key: {12 20 3}
and the text to encipher : "HELLO"

Let's consider all the characters of the original text one by one :
character 1: H
character 2: E
character 3: L
character 4: L
character 5: O

Now as the key's length is 3, we will have to map the key onto the string to encipher as follows:
0 1 2 0 1
H E L L O

This means that the character 'H' is assigned the first integer of the key.
The 'E' is assigned the second integer of the key, and so on.

And if we consider that in order we have :
key (0) = 12

CMP-210 Data Structures and Algorithms
BSSE Fall 2012
Assignment - 02

Issue Date: 31-Mar-2014
Subm. Date: 06-Apr-2014
Subm. Time: 23:59:59

key (1) = 20
key (2) = 3

So the actual association becomes:
12 20 3 12 20
H E L L O

So now every character of the string to encipher was assigned an integer using
the chosen key, we said previously that these integers were actually line numbers
of the matrix, so now all we have to do to encipher is to find the crossing point
between the line associated with a given character, and this character.
Let's follow up with our example :
character 1: 'H', line associated with it : 12 => 'H' enciphered into 'T'
character 2: 'E', line associated with it : 20 => 'E' enciphered into 'Y'
character 3: 'L', line associated with it : 3 => 'L' enciphered into 'O'
character 4: 'L', line associated with it : 12 => 'L' enciphered into 'X'
character 5: 'O', line associated with it : 20 => 'O' enciphered into 'I'
To find the enciphered value, consider the integer associated with the character
to encipher, this integer is the line of the matrix you must use.
Then look at the top line of the matrix where you can see the character to
encipher. From this column go down until you reach the line previously found.
The character located at the intersection between this line and this column is
the enciphered character.

So the text "HELLO" is enciphered as "TYOXI" with the key **{12 20 3}**

Decipher principle

To decipher the text "TYOXI" using the secret key **{12 20 3}** you must do as follows :
The key's length is 3, so we will do as when we enciphered: we will associate a part of
the key with each character of the text to encipher :
0 1 2 0 1
T Y O X I

And if we consider that in order we have :
key (0) = 12
key (1) = 20
key (2) = 3

So the actual association becomes :
12 20 3 12 20
T Y O X I
So now every character of the string to decipher was assigned an integer using
the chosen key, we said previously that these integers were actually line numbers
of the matrix. The only thing to do is to consider for each line of the matrix
associated with the enciphered character which character of the top first line
of the matrix gives this enciphered character: for example for the first character:
'T', consider the line 20 of the matrix: follow this line until you find a 'T', now
follow upward the column containing this 'T' until you reach the top of the matrix.
The character at the top line of the matrix in this column is the deciphered character.

So in our example:
following line 12, the column that gives a 'T' has a 'H' as top first character.
following line 20, the column that gives a 'Y' has a 'E' as top first character.
following line 3, the column that gives a 'O' has a 'L' as top first character.
following line 12, the column that gives a 'X' has a 'L' as top first character.
following line 20, the column that gives a 'I' has a 'O' as top first character.

CMP-210 Data Structures and Algorithms
BSSE Fall 2012
Assignment – 02

Issue Date: 31-Mar-2014
Subm. Date: 06-Apr-2014
Subm. Time: 23:59:59

<u>Some More Examples</u>: (First line represents key and second line contains text to cipher)

Input: rose The Internet never retreats.	Output: kvw zbliibwx bwzvf vvhjirhk.
Input: rose THIS IS A CODED MESSAGE.	Output: kvaw wk r ususv dskwruw.
Input: penguin I've been there but I didn't do it!	Output: x'ik jrtr zbmet oan v hvjh'g hb cb!

For any further details you can look at: http://en.wikipedia.org/wiki/Vigen%C3%A8re_cipher

To get full marks in Q. No. 3, you must not store matrix of alphabets in memory.

How to submit?
1. Create two folders named as Q1 and Q2.
   a. Place all your code files related to Q. No. 1. in folder named as 'Q1', and code files related to Q. No. 2. in folder Q2, and code files of Q. No. 3 in folder Q3.
2. Put all folders Q1, Q2, and Q3 in a folder named as rollno-Assignment-2. Example folder name bsef12m001-Assignment-2.
3. Compress the folder.
4. Send the compressed folder to course email with email subject as rollno-Assignment-2.
5. If you have any queries/confusions in submitting the assignment then feel free to discuss but discuss in time.

Twenty years from now you will be more disappointed by the things you didn't do than by the ones you did. So throw off the bowlines, Sail away from the safe harbor. Catch the trade winds in your sails. Explore. Dream. Discover.