Homework 11

(Select three at least, more will be extra points 任選三題,多作當成加分題)

(You can use dynamic array or static array in the following problems. But dynamic array prefer)

第一題:Design a program to simulate 100 rolls of a six-sided die: Count the number of times each side of die appears and for each count use "*" to print out. The output format will be:

```
1.:**********
2.:**********
3.:**********
4.:**********
5.:**********
6.:**********
```

第二題: Design a program to print out the result of matrix multiplication.

Example:

$$\begin{bmatrix} 2 & 1 & 3 & 4 \\ 1 & 2 & 1 & 1 \\ 3 & 1 & 1 & 3 \end{bmatrix} \times \begin{bmatrix} 1 & 3 & 2 \\ 2 & 1 & 1 \\ 1 & 4 & 2 \\ 1 & 2 & 1 \end{bmatrix} = \begin{bmatrix} 11 & 27 & 15 \\ 7 & 11 & 7 \\ 9 & 20 & 12 \end{bmatrix}$$

第三題:

We have the following score data, the last one represents the end of mark, not the data.

72,23,38,86,62,29,99,96,67,78,87,76,65,58,86,69,93,34,45,55
52, 7,74,48,83,39,90,18,82,26,65,53,39,96,66,-1

(a). Calculate the average score of the data.

(b). Count the number of data in each interval. The difference between each interval is 10 point. (統計各區間人數, 區間差距為 10 分) That is
0~9, 10~19, 20~29, 30~39, 40~49,50~59, 60~69,70~79, 80~89, 90~100

(c). Count the number of data above the average and below the average.

(d).The output format will be:

```
*****SCORE REPORT*****
```

MEAN = ##.###
ABOVE MEAN = ##
BELOW MEAN = ##

0~ 9: *
10~ 19: *
20~ 29: ***
30~ 39: ****
40~ 49: **
50~ 59: ****
60~ 69: ******
70~ 79: ****
80~ 89: ****
90~ 100: *****

第四題:

Find specified-length palindromic sequences of nucleotide pairs in a portion of a DNA molecule whose complementary strands are represented as strings. Note that palindromic regions are of great interest to researched studying the transmission of the genetic information encoded in DNA.

Although we recall that a palindrome is a string that reads the same forward and backward, such as "Madam, I'm Adam" or "Able was I ere I saw Elba", we must first see how closely this definition applies to the palindromes of DNA molecules.

DNA is a double-stranded molecule composed of pairs of the nucleotide Adenine, Thymine, Cytosine, and Guanine. Adenine always pairs with Thymine and Cytosine pairs with Guanine. The following figure shows a portion of a DNA molecule in which the complementary strands are ATCGCAT… and TAGCGTA…

A-T-C-G-C-A-T-G-C-G-T-A-G
T-A-G-C-G-T-A-C-G-C-A-T-C

The molecule portion shown contains a palindromic sequence of 8 nucleotide pairs.This region is palindromic because the sequence of nucleotides along the top strand, C-G-C-A-T-G-C-G, is exactly the reverse of the sequence along the bottom strand, G-C-G-T-A-C-G-C.

Given string representing the complementary strands and a length value,

find all palindromic sequences of the specified length.

Execution:

Enter on strand of DNA molecule segment:
ATCGCATGCGTAG
Enter complementary strand:
TAGCGTACGCATC
Enter length of palindromic sequence: 8

The DNA:
ATCGCATGCGTAG
TAGCGTACGCATC

Palindromes of length is 8

Palindrome at position 2
CGCATGCG
GCGTACGC

第五題:

Write a program to generate all possible permutations of n distinct numbers. For example, there are six permutations of the set {1,2,3}, namely (1,2,3), (1,3,2), (2,1,3), (2,3,1), (3,1,2), and (3,2,1).

第六題:

An interesting method of encoding data is to load a message to be encoded into a two-dimensional array and then interchange rows and interchange columns a number of times. The resulting sequence of characters is the encoded message.

I		H	A	V	E	
B	U	T		O	N	E
	L	I	F	E		T

In order to decode the message, the sequence of steps used in the encoding process is followed in reverse order. For example, consider the message I HAVE BUT ONE LIFE TO GIVE FOR MY COUNTRY.
Let us load the message into a 6×7 array:

Now consider the following encoding process:

O		G	I	V	E	
F	O	R		M	Y	
C	O	U	N	T	R	Y

(1). Interchange rows 1 and 3 (2) Interchange columns 2 and 5

	L	I	F	E		T
B	U	T		O	N	E
I		H	A	V	E	
O		G	I	V	E	
F	O	R		M	Y	
C	O	U	N	T	R	Y

	E	I	F	L		T
B	O	T		U	N	E
I	V	H	A		E	
O	V	G	I		E	
F	M	R		O	Y	
C	T	U	N	O	R	Y

(3). Interchange rows 4 and 6 (2) Interchange columns 1 and 5

	E	I	F	L		T
B	O	T		U	N	E
I	V	H	A		E	
C	T	U	N	O	R	Y
F	M	R		O	Y	
O	V	G	I		E	

L	E	I	F			T
U	O	T		B	N	E
	V	H	A	I	E	
O	T	U	N	C	R	Y
O	M	R		F	Y	
	V	G	I	O	E	

The resulting string is LEIF TUOT BNE VHAIE OTUNCRYOMR FY VGIOE. In order to decode the message, the encoding process is reversed; i.e., the encoded message would be loaded into a 6×7 array

And then the following interchanges would be performed:

Columns 1 and 5
Rows 4 and 6
Columns 2 and 5
Rows 1 and 3

Write a main program to encode and decode messages, using subroutines to perform the column interchange and row interchange operations.

第七題:

Please define the following functions:

1. Input data for one vector (1-d array 1×m or n×1)

2. Output data for one vector (1-d array 1×m or n×1)

3. Input data for a matrix (2-d array n×m)

4. Output data for a matrix (2-d array n×m)

5. Multiplying a matrix by a vector:

(a). Multiplying on the right

$$\begin{bmatrix} 1 & 1 & 1 \\ 2 & 3 & 1 \\ 1 & 1 & 1 \\ 0 & 2 & 1 \end{bmatrix} \times \begin{bmatrix} 1 \\ 2 \\ 2 \end{bmatrix} = \begin{bmatrix} 5 \\ 10 \\ 5 \\ 6 \end{bmatrix}$$

(b) Multiplying on the left.

$$\begin{bmatrix} 2 & 0 & 1 & 1 \end{bmatrix} \times \begin{bmatrix} 1 & 1 & 1 \\ 2 & 3 & 1 \\ 1 & 1 & 1 \\ 0 & 2 & 1 \end{bmatrix} = \begin{bmatrix} 3 & 5 & 4 \end{bmatrix}$$

6. The transpose of a matrix.

$$A = \begin{bmatrix} 2 & 4 \\ 6 & 8 \\ 8 & 12 \end{bmatrix} \qquad A^t = \begin{bmatrix} 2 & 6 & 10 \\ 4 & 8 & 12 \end{bmatrix}$$

7. Matrix Addition

8. Matrix Multiplication

9. You can define other operations for the vector and matrix

10. Please write a main program (using the switch structure) and let the user to choose the operation that he wants to execute.

11. You can put all the functions in 1 ~ 9 to create your heading file and include this heading file in the main program to execute.

第八題:

Plotting a graph

The plotting function is

$$f(x)=\sin^2\left(\Pi\frac{x}{10}\right) \quad 0 \leqq x \leqq 10$$

Plotting a Graph

1. Generate a table of number pairs :

t	*p(t)*	
0	30.0	
1	27.1	
2	22.6	
…	…	(for *t*= 0,…, n-1)

Or

i	x_i	y_i	
0	0.0	0.0	
1	2.0	32.0	
2	3.0	72.0	
…	…	…	(x_i , y_i for i=0,…, n-1)

These numbers may represent experimental data, say position *p(t)* vs. time *t* for a falling object or may be generated from a particular functional relation between *x* and *y* as $y(x)=8x^2$

2. Determine the range of both x_i and y_i

A determination of both the minimum and maximum values of *x* and *y* in the data set :

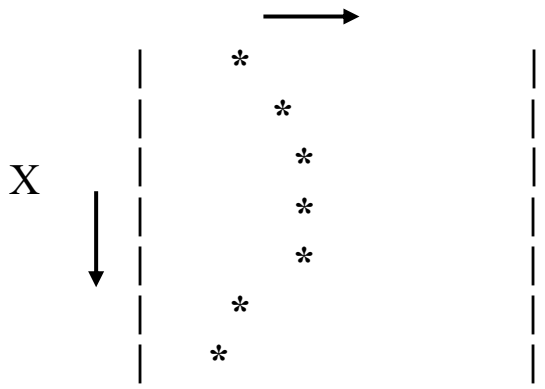
$$(\text{Range})_x=(x_{max} - x_{min})$$

$$(\text{Range})_y=(y_{max} - y_{min})$$

These values are then used for scaling the *x* and *y* axes. That is, adjusting the scales of the axes so that the graph fits neatly on the graph paper.

3. Step through the points and graph them one by one.

Y



Note:

1. When one line is displayed, 80 or so characters will be printed for a particular value of ***x***.
2. All of these characters will be blanks except one.
3. The position corresponding to ***y*** will contain some symbol --- e.g.,an asterisk.
4. To determine the proper placement of asterisk, consider the following:

$$y_{max} = 16.38 \qquad y_{min} = -7.21$$

so

$$(Range)_y = 16.38 - (-7.21) = 23.59$$

Problem:
If at x= 3.0, y(3.0)=12.2,
where in the horizontal line is the asterisk to be printed?

If the y axis is to be 81 columns wide, we could first define

$$\textbf{Ratio} = \frac{y(3) - y_{min}}{y_{max} - y_{min}}$$

Notice that ratio is between 0.0 and 1.0.
The appropriate column(position) for the asterisk is

IY = ceil (80 * Ratio)

For the particular choice of numbers above , y(3) =12.2
We obtain:

$$\textbf{Ratio} = \frac{12.2 - (-7.21)}{23.59} = 0.82281$$

IY =ceil(80 * 0.82281) = ceil(65.8248) =66

Where double ceil(double x)
Return 大於 x 值的最小整數

Note:

1. When y(i)= y_{min} **Ratio =0 then IY=80*0=0**
2. When y(i)= y_{max} **Ratio =1 then IY=80*1=80**
3. **最小值落在第 0 行，最大值落在第 80 行**
   因此總共有 81 行