Computer Science and Engineering Department
Indian Institute of Technology Kharagpur

Programming and Data Structure Laboratory: CS19003
1st Year: 1st Semester

Assignment – 6: 2D array, dynamic memory allocation *Marks: 100*
Assign Date: *Oct 15, 2024* Submit Date: *16:45, Oct 15, 2024*

1 General Instruction

- Create a folder with folder name $RollNoAsgn6$.
- Give the name of the program as $p1.c$, and $p2.c$. Store all the programs of this week under $RollNoAsgn6$.
- Zip the folder $RollNoAsgn6$ and upload the zip file to the Moodle course web page latest by 4:45 PM (without penalty). The cutoff time will be till 5:00 PM with a penalty of 25% on your secured marks (i.e., if you secured 80 marks, after penalty you will get 60 marks). Beyond 5:00 PM, the moodle system will not allow you to submit, as a result you will get zero.
- Attemp all the problems. Coding will be in C programming language. Code with compilation error will not be evaluated. DO NOT USE ANY GLOBAL VARIABLE. The data (in the 1D/2D array) must be filled with the random numbers.
- There will be ZERO tolerance for plagiarism (copy from anywhere) cases.

2 Problem 1

Problem Statement: Given a list of integer elements and a threshold value, you need to report how many elements are on and above the threshold value. [**Marks: 30**]

The steps of your implementation will be:

- Read an integer n from the user to (dynamically) allocate an array of integers of size n, report and exit if there is an issue in memory allocation.
- Fill the array of integers by n number of random numbers varying from 0 to max, where max is an user input. Use the following code (after careful modification) so that the array contains only positive integers in the range of 0 to max.
- The piece of code to generate n random numbers ranging from 0 to $RAND\_MAX$ is (where $RAND\_MAX$ is a defined maximum number that you are not supposed to change).

```
#include <time.h>
#include <stdlib.h>

srand(time(NULL));   // Initialization
for(i=0;i<n;i++) {
    r=rand(); // Returns a pseudo-random integer between 0 and RAND_MAX
    printf("%d ",r);
}
```

- Read a threshold integer value from the user and report the number of elements in the array which are equal to or above the threshold value. Free the dynamically allocated memory

3 Problem 2

Problem Statement: Given a gray scale image, compute the histogram of the image. [**Marks: 70**]

Elaboration: A gray scale image is defined by an integer matrix where each cell position indicates the intensity value. The histogram of an image is defined as the frquency of the occurrence of an intensity value in an image. Given an input image, compute the histogram of the image.

Steps:

- Assume that your image is a square integer matrix, where the dimension is mentiond as a macro ($\#define$). Therefore, the matrix can be defined statically. The intensity value varies from 0 (minimmum) to $2^k - 1$ (maximum), where k is a positive integer. Read k from the user with the constraint $2 \leq k \leq 8$.
- Generate the content of the image using the above psedue-random number generator program.
- Write a function $myFun()$, which will compute the frequence of the occurrence of each intensity value. Add the required parameters that need to be passed to the function and the return type of the function. Do not use any global variable.
- Print the ferquency of the intensity values in the following format from the function $main()$. Also, print the total number of cells in the matrix and the sum of the frequency values from your computation (both will be the same).
- Example for a matrix of size 4×4,

```
1. Declare a matrix
- - - -
- - - -
- - - -
- - - -

2. Use random function to fill the data with maximum intensity 15.

3 4 1 2
3 0 8 1
9 6 7 1
5 4 6 7

3. Print
Int. Freq.
0    1
1    3
2    1
3    2
4    2
5    1
6    2
7    2
8    1
9    1
10   0
11   0
12   0
13   0
14   0
15   0

The size of the matrix is 16 and the sum of the frequency values is 16.
```