Section 6	**Test 1**	**Autumn-2024**
PDS Lab	**SET A**	**10.09.2024**

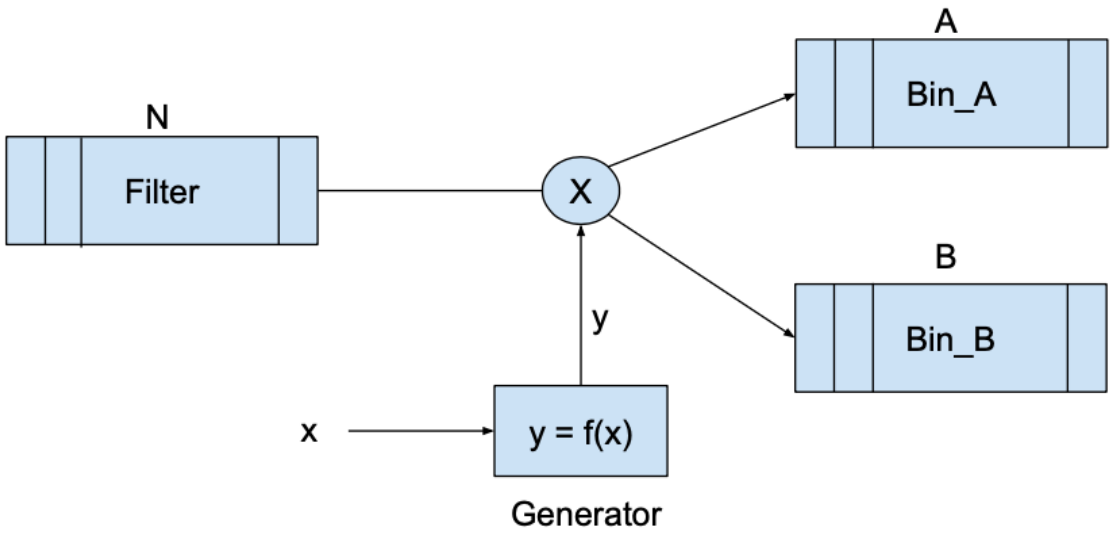
Instructions:

- You should save the program with the file name as specified as <Test#>-<Set#>-<Roll#>.c. For example, **01-A-24NA10006.c** to save Test1 of Set A with Roll Number 24NA10006.
- You should upload the program to the Moodle system. Also, copy + paste your program to the text window on the test page.
- There is one problem and the maximum time allowed is 120 minutes.

In this problem, you have to work with the following three 1-D Arrays. :

a. `Filter` **: An array of floating-point values of size** `N`**.**
b. `Bin_A` **: An array of integer values of size** `A`**.**
c. `Bin_B` **: An array of integer values of size** `B`**.**

A system with these arrays is shown in the figure given below.



Your task is to populate these arrays following the strategies as stated below.

1. **Filling the filter** `Filter`**:**
   a. **Given a generator as shown below, which takes a value** x **and produces an output** y**.**

$$y = \sum_{k=1}^{x} \frac{(-1)^{k+1}.k^2}{2k+1} + cos(\frac{x}{2})$$

   b. **Generate a value** x **as a random number in the range [1 to 100].**
   c. **Compute** y **by using the above generator.**
   d. **Repeat the above two steps** `N` **times to fill the array** `Filter`**.**

2. **Entering values into** `Bin_A`**:**
   a. **Generate a random number** x **in the range [1 to 100].**
   b. **Calculate** y **for the value** x**.**
   c. **If** y **is greater than any value in** `Filter`**, store** x **into** `Bin_A`**.**
   d. **If** y **is smaller than any value in Filter, store** x **into** `Bin_B`**.**

3. **Repeat Steps 2, until either** `Bin_A` **or** `Bin_B` **is full.**
4. **Display the values in the arrays.**

Note:

1. You should define the values of N, A, B and other values in the generator as constant.
2. For the calculation of cos(x) , include `math.h` and use the `cos()` function. (Use `gcc <Test#>-<Set#>-<Roll#>.c **-lm**` to execute the program)
3. The code for random number generator in the range 1 to 100 is given below:

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

int main() {
// Random number generator with a fixed seed (42) to check
    the test cases
srand(42);
int randomNumber = rand() % 100 + 1;
printf("Random Number: %d\n", randomNumber);
return 0;
}
```

```c
// Code creator: Nishkal Prakash (nishkal@iitkgp.ac.in)
#include <stdio.h>
#include <stdlib.h>
#include <time.h>
#include <math.h>

#define N 10
#define A 5
#define B 5

// Random number generator with a fixed seed (42) to check the test
cases
int r() {
    return rand() % 100 + 1;
}

// Generator function
float f(int x) {
    float y = 0;
    for(int j = 1; j <= x; j++)
        y += pow(-1, j + 1) * j * j / (2 * j + 1);
    y += cos(x / 2);
    return y;
}


// Main function
int main() {
    // Random number generator with a fixed seed (42)
    srand(42);
    // Defining the arrays
    float Filter[N];
    int Bin_A[A], Bin_B[B];
    // Loop variables and other variables
    int i;
    float y, x;

    // Filling the Filter array
    for(i = 0; i < N; i++)
        Filter[i] = f(r());

    // Computing the maximum and minimum values in Filter
    float maxFilter = Filter[0], minFilter = Filter[0];
    for(i = 1; i < N; i++) {
        if(Filter[i] > maxFilter)       maxFilter = Filter[i];
        if(Filter[i] < minFilter)       minFilter = Filter[i];
```

```
    }
    // printf("Max: %.2f, Min: %.2f\n", maxFilter, minFilter);

    // Entering values into Bin_A and Bin_B
    int A_len = 0, B_len = 0;
    while(1) {
        // Loop until either Bin_A or Bin_B is full
        x = r();
        y = f(x);

        // if y > minFilter, store x in Bin_A
        if (y > minFilter)              Bin_A[A_len++] = x;
        if (y < maxFilter)              Bin_B[B_len++] = x;
        if(A_len == A || B_len == B)    break;
    }

    // Printing the arrays
    printf("Filter: [");
    for(int i = 0; i < N-1; i++)
        printf("%.2f, ", Filter[i]);
    printf("%.2f]\n", Filter[N-1]);

    printf("\nBin_A: [");
    for(i = 0; i < A_len-1; i++)
        printf("%d, ", Bin_A[i]);
    printf("%d]\n", Bin_A[A_len-1]);

    printf("\nBin_B: [");
    for(i = 0; i < B_len-1; i++)
        printf("%d, ", Bin_B[i]);
    printf("%d]\n", Bin_B[B_len-1]);

    return 0;
}

/* Sample Output:
Filter: [-17.99, 1.33, -18.35, 13.34, -21.35, -20.61, 4.16, 10.31,
-2.17, -18.35]

Bin_A: [10, 51, 72, 37, 26]

Bin_B: [10, 72, 100, 37, 26]

*/
```