Report for Assignment 1: Monte Carlo Integral Computation

Haomin Lin
GTId: hlin374 (#903517898)

My program can work correctly by returning the value of specific integration and reacting to several unjustified situations.

I. Integration without undefined points with correct range

For integration involving nothing abnormal, my program will accept the range (a, b) input by user and calculate K, the upper border of the sample space. We define K as two times the maximum of the function in certain range. After that, it will ask for the number of random points (define it as N) they like to use:

```
This function computes the integral of a defined function
Enter the value of a: 1
Enter the value of b: 2
Enter the number of test points (enter 0 if you want to quit):
```

After that, my program will generate N random points and compare the values of them with the actual values of the function. If it's lower, the program will add 1 to a specific indicator to count the total number of lower points. The user can keep changing N or input 0 to end it.
According to Monte-Carlo method, by applying N, n, a, b, K to the equation Z = n * K * (b - a) / N, the program returns the value of Z as the final outcome of integration. Entering 0 as N can terminate the program.

```
Enter the value of a: 1
Enter the value of b: 2
Enter the number of test points (enter 0 if you want to quit): 100000
00
The value of integral with N = 1e+07:
2.3328838348
Enter the number of test points (enter 0 if you want to quit):
```

```
Enter the number of test points (enter 0 if you want to quit): 0
Thank you for trusting me!
lawn-143-215-55-81:Homework 1 humas$
```

As is seen above, the outcome for integration of x^2 in the range [1,2] is 2.3328838348, while the actual value is 7/3. The difference in percentage is around 0.02%.

II. Integration with incorrect range

If the integration comes across wrong inputs that leads to a unjustified range which is a > b, the program will ask the user to input another pair:

```
Enter the value of a: 2
Enter the value of b: 1
Sorry, this pair of inputs is incorrect, try another one
Enter the value of a:
```

Then the user needs to input another pair of a and b. Only when the input range is correct will the program go on.

When the integration range is justified, the program will begin integration like it does in I.

III. Integration with undefined points

If the function to be integrated has discontinuities that can't be integrated and the range happens to include them, the program will recognize them by finding unexpected increase or decrease, and offer two options: change the range or modify the function.

For example, when we want to calculate the integration of f(x) = 1/x in the range [0, 1], the program will report the case and ask for choices:

```
This function computes the integral of a defined function
Enter the value of a: 0
Enter the value of b: 1
We can't compute the integral, change the area or the function
Which one do you prefer, 1 for changing a & b,
2 for modifying your function:
```

If user chooses 1, the program will ask for another range:

```
This function computes the integral of a defined function
Enter the value of a: 0
Enter the value of b: 1
We can't compute the integral, change the area or the function
Which one do you prefer, 1 for changing a & b,
2 for modifying your function:
```

If user chooses 2, the program will be terminated:

```
We can't compute the integral, change the range or the function
Which one do you prefer, 1 for changing a & b,
2 for modifying your function: 2
Please motify the function.
Thank you for trusting me!
lawn-143-215-55-81:Homework 1 humas$
```

After are the issues has been addressed, with justified integration, the program will move on to calculation like it does in I.

It works the same when f(x) = 1/(x^2-4) with range [1, 3]:

```
Hi, I can compute the integral of a defined function
Enter the value of a: 1
Enter the value of b: 3
We can't compute the integral, change the range or the function
Which one do you prefer, 1 for changing a & b,
2 for modifying your function:
```

P.S. To change function, just edit .c file in the get_function_value function part and change the right part of “y = x * x”:

```
double get_function_value(double x)
{
    double y; /* define the return value */
    y = x * x; /* function expression */
    return y;
}
```