Data Structures (CS201)

Lab Assignment 2 (Graded)

August 07, 2023

Instructor: Anil Shukla
Due: August 13, 11:59 pm Total Marks: 20

Note: Graded means the marks will be counted for the final grading. Place proper comments in your source code. Write in C only. C++ is not allowed.
Note: Plagiarism is strictly prohibited. An appropriate disciplinary action will be taken if you are found to be involved in plagiarism.
Note: The instructions for submiting the assignment is mentioned in the google classroom. Carefully read the same and follow the instructions.
Note: At the end, find some test cases for each problem.

Question 1:

Write a C-program which does the following based on the user choice of 'a' or 'b':

a. Reads a text file (like the ExampleFile.txt provided). Stores it in an array named 'Arr[]' of the appropriate size (the size here should not be hard-coded).

b. Takes the user input of an array and stores it in an array named 'Arr[]' of appropriate size (the size here should not be hard-coded).

Assume that the zeroth element of Arr contains a 0. Then runs the following queries on function_1 and function_2 (defined ahead) sequentially and compute the running-time each query takes (see test cases below):

- *Query_1:* increment the first index element of the array with a value of +5.
- *Query_2:* find the sum of the first n-5 elements in the array.

function_1:
This function takes as input the array Arr[] and builds it's cumulative frequency array named CIarr[] of appropriate size. It then performs the queries on this new CIarr array. Make sure that after running Query_1, CIarr contains the correct value in all of it's indices.

function_2:
This function takes as input the array Arr[] and builds the 'Binary Indexed Tree' as another array named BItree[] of appropriate size. It runs the respective queries through this new BItree array. Make sure that after running Query_1, BItree contains the correct value in all of it's indices.

The output of your program should be the timings and values of running the following in this sequence:

- query_1 on function_1,
- query_2 on function_1,
- query_1 on function_2,
- query_2 on function_2

For help on 'File handling in C' see: https://www.geeksforgeeks.org/basics-file-handling-c/
For help on 'timing functions in C' see: https://www.geeksforgeeks.org/how-to-measure-time-taken-by-a-program-in-c/

For a running example: (bold is user input, italics is program output). The timing mentioned below are written randomly. Your program are not supposed to output them exactly.
./a.out
Please enter a choice: **a**
The array size is 10000
By function_1:
The time taken for query_1 by function_1 is 3.0359 seconds
The incremented value of the first index element is 20
The time taken for query_2 by function_1 is 0.0245 seconds
The sum of first n-5 elements is 498570
By function_2:
The time taken for query_1 by function_2 is 1.523 seconds
The incremented value of the first index element is 25

The time taken for query_2 by function_2 is 1.732 seconds
The sum of first n-5 elements is 498575

./a.out
Please enter a choice: **b**
Please input an integer array with space-separator and press Enter when done: **0 2 3 5 6 8 9 11 12 13 14 15 16 17 18 19 20**
The array size is 17
By function_1:
The time taken for query_1 by function_1 is 0.0002 seconds
The incremented value of the first index element is 7
The time taken for query_2 by function_1 is 0.0003 seconds
The sum of first n-5 elements is 103
By function_2:
The time taken for query_1 by function_2 is 0.0003 seconds
The incremented value of the first index element is 12
The time taken for query_2 by function_2 is 0.0004 seconds
The sum of first n-5 elements is 108