CT102 Algorithms

Assignment 1

Date: Monday 14th February 2022

Due: on or before ~~Monday 28th February 2022 via Blackboard~~

Extended to: Monday 7th March 2022 via Blackboard

Total Marks: 15 (6+3+6)

QUESTION 1 (6 MARKS)

Given the following function which, given two integer arrays, arrA and arrB, both with unique values in ascending sorted order, the function counts, and returns, the number of values in common between the two arrays. For example, given the following arrays, the function returns 3.

```
A[7] = {13, 27, 35, 40, 49, 55, 59};
B[10] = {17, 35, 39, 40, 55, 58, 60, 61, 63, 70};
```

```
19
20 // Function to count and return the number of duplicates in 2 integer arrays
21 // Data sorted and unique in the arrays
22 int countDuplicates (int arrA[], int sizeA, int arrB[], int sizeB) {
23
24         int i, j, k, count;
25         i = j = count = 0;
26
27         while (i < sizeA && j < sizeB) {
28             if (arrA[i] < arrB[j]) {
29                 i++;
30             }
31             else if (arrB[j] < arrA[i]) {
32                 j++;
33             }
34             else if (arrB[j] == arrA[i]) {     // found a duplicate!
35                 count++;
36                 i++;
37                 j++;
38             }
39         } //end while
40         return(count);
41 }
42
```

(a) Calculate the number of timesteps in the function `countDuplicates()` as a function of the input size of the arrays.

(b) Analyse, with respect to Big-O notation, the algorithmic time complexity of the function.

QUESTION 2 (3 MARKS)

Given the following function which checks if an integer array, with associated size, has values in (ascending) sorted order (line numbers are included):

```
L1 bool check (int arrA[], int size)
L2 {
L3     int i;
L4     bool sorted = true;
L5
L6     for (i = 0; i < size - 1 && sorted; i++) {
L7        if ( arrA[i] > arrA[i + 1] ) {
L8            sorted = false;
L9        }
L10      }
L11      return (sorted);
L12 }
```

With the use of some sample data, and with respect to the algorithmic time complexity of the function `check()`, distinguish between the best and worse case situations, explaining your answer.

QUESTION 3 (6 MARKS)

Given three sorting functions, Bubble, Insertion, and Selection (available on Blackboard), and two sample input files, each containing 5000 integers:

5000Ints.txt and 5000sortedInts.txt

Answer the following questions

(a) Output the time taken, number of swaps/data moves and number of comparisons when you run each function with the file 5000Ints.txt. Summarise your results in terms of the relative advantages and disadvantages of each function given the results you receive.

(b) Output the time taken, number of swaps/data moves and number of comparisons when you run each function with the file 5000sortedInts.txt. Summarise your results in terms of the relative advantages and disadvantages of each function with this file, and also in comparison to the results in part (a), given the results you receive.

QUESTION 4

***** Please include the following plagiarism declaration in your solution if applicable:

Plagiarism Declaration:

"I am aware of what plagiarism is and include this here to confirm that this work is my own"

Please note that any suspected cases of plagiarism, or absence of a plagiarism declaration, will not receive a mark until assurances can be given in person as to the origins of the solution.