COEN 346

Programming Assignment #1

Binary tree traversal to find defective lightbulbs using multi-threading

Consider there is a series of lightbulbs connected in a sequential manner. In this situation, if one of the bulbs is defective it will cause all the bulbs to be off. A potential solution to find quickly the faulty bulb(s) is to divide recursively the series into subseries and keep investigating the subseries that do not show light. We assume the subseries with no faulty bulb(s) will show light.

Goal: Write a recursive threading method to find the defective bulbs and the number of threads that have been created for this purpose

Your design and implementation should meet the following requirements:

- The main function should read an input text file and fill into an array of integers. The first line of input defines the size of the array (the number of bulbs) and status of each bulb is given in one line as: The input will consist of the state of each bulb:
    - 0 : to indicate the bulb is defective
    - 1: to indicate the bulb is functioning properly

- The main thread runs "FindDefective" function as a new thread and passes the input array to that thread. The main function should wait until FindDefective terminate and then print out the position in the array of the defective bulbs.

- The "FindDefective" function is responsible to select a "pivot" ($\frac{n}{2}$) and divide its input array (e.g. arr) into two sub-arrays (e.g. leftArr and rightArr). It will then call the "FindDefective" recursively in a new thread for leftArr and rightArr. The main requirement of this assignment is that the implementation should enable traversing concurrently leftArr and rightArr.

Here is an example of input file:
We have 8 bulbs:

```
Input.txt
              8
              1
              1
              0
              1
              1
              0
              1
              1
```

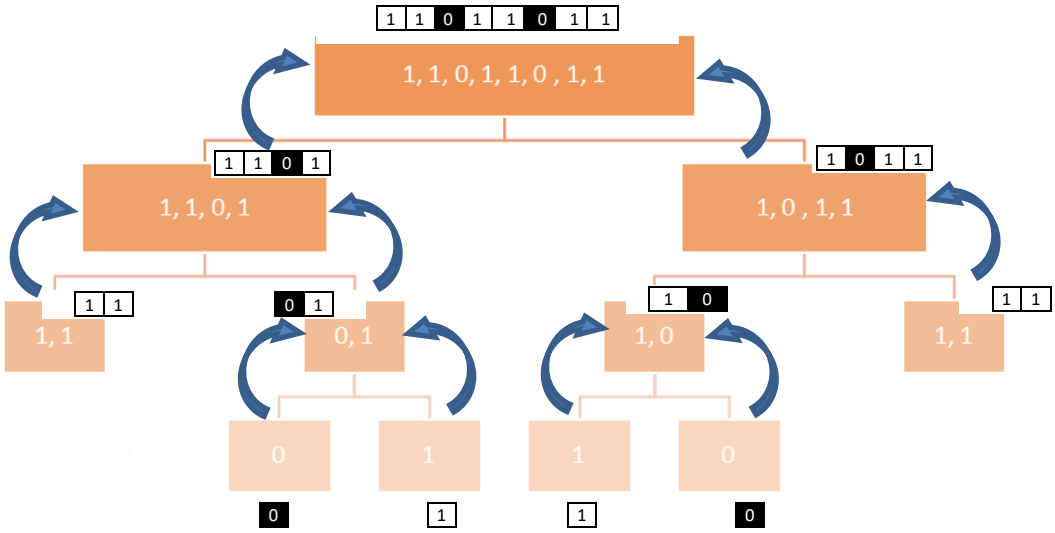
- The recursion should be invoked as long as there is at least one defective bulb in the sub-series and the subseries is not lightning up.

The assignment should be done in a group of two students. The deliverable consists of a well-commented code and a two pages report specifying the high level description of the code (description of the methods/functions/threads and the flow of the program). The report should also include a brief conclusion, discussing your experience with threading and your suggestion for an example application of threads other than the ones discussed so far.

This assignment will take 20% of your total mark for programming assignments. Also for this assignment 80% of the mark is dedicated to your code and 20% to your report.

The code and the report should be submitted through the EAS website (https://fis.encs.concordia.ca/eas/) by Thursday February 6th, 2020 (11 pm).
Also, you will have to demonstrate your work as a team to your TA.

An example of recursion and expected output is given below for the aforementioned input:



The correct output answer should be:
The bulbs: #3 and #6 are defective.
The number of threads for this problem was: 11