**CS 248 – Object-Oriented Programming and Data Structures**

**HW3: 100 points**

**Objective:**

The objective of this homework is to learn about:

1. Develop knowledge regarding different level of efficiency of the algorithm
2. Developing a new algorithm with better order
3. Visual demonstration of the run time efficiency of different algorithms

**Task 1:**   Write a function as follows:

public static int inefficient\_find\_max(int [][]a)

**Input**: 2d array created from the file (a file named HW3.txt is given where the first number denotes the number of rows and columns followed by the matrix)

**Output**: return the maximum number of ones in a row.

**Task 2:**   Call the function inefficient\_find\_max 100000000 times and record the total time taken for this execution.

**Task 3:**   Write a function as follows:

public static int efficient\_find\_max(int [][]a)

**Input**: 2d array created from the file

**Output**: return the maximum number of ones in a row.

**Task 4:**   Repeat Task 2 for this function.

**Task 5:**   Along with the code, submit a write up with the following:

* 1. What is the Big O of the function int inefficient\_find\_max(int [][]a)? Explain.
  2. What is the Big O of the function int efficient\_find\_max(int [][]a)? Explain.
  3. Plot a X-Y graph (X axis: size of matrix, Y axis: Average time taken) for 3 different sized matrices for these two functions. Write comments regarding the graph explaining and showing how fast (or not) your function got as a result of the optimization.

**HW Grading:**

1. 10% - Follows style guidelines, including header and correct filename.

1. 30% - Compiles without errors
2. 50% - Correct implementation of all functions
3. 10% - Report shows explanation of the order and execution time with plots and discussion

**Sample input:**

(from file HW3.txt)

10

1 1 1 1 0 0 0 0 0 0

1 1 1 1 1 1 0 0 0 0

1 1 1 0 0 0 0 0 0 0

1 1 0 0 0 0 0 0 0 0

1 1 1 1 1 1 1 1 0 0

1 1 1 1 0 0 0 0 0 0

1 0 0 0 0 0 0 0 0 0

1 1 1 1 1 1 0 0 0 0

1 1 1 1 1 1 1 1 1 0

1 1 1 1 1 1 1 1 1 1

**Sample output:**

Inefficient function:

Max no of 1 is 10

Elapsed time: 28625

Efficient function:

Max no of 1 is 10

Elapsed time: 8813

**Helpful links/tips:**

1. How to pass a 2 D array in a function:

<https://takeuforward.org/arrays/passing-2d-arrays-as-arguments-in-java/#google_vignette>

2. How to calculate elapsed time:

<https://www.geeksforgeeks.org/java-lang-system-currenttimemillis-method-with-examples/>

3. **Input matrices:**

Matrix 1:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 |
| 1 | 1 | 1 | 0 | 0 |
| 1 | 1 | 0 | 0 | 0 |
| 1 | 1 | 1 | 1 | 1 |

Matrix 2:

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 |
| 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |

Matrix 3:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |