

CS 101 - Algorithms & Programming I

FALL 2024 - HOMEWORK 2

Due: November 21, 2024

The aim of this assignment is to emphasize the fact that the same problem can be solved in different ways, some of which are more efficient than others in terms of computational resources such as time.

Your task is to implement static methods that find the most commonly occurring value within a set of values.

Two algorithms to carry out this task are described below.

Algorithm A

Sorts the array in increasing order, using the merge sort algorithm. You do not have to implement merge sort, the code is given in the file `mergeSort.txt`. Once sorted, find the most commonly occurring integer value (longest run of values).

Algorithm B

Create an array of counters of the same size as the original array. For each element, traverse the array and count how many other elements are equal to it, updating its counter. Then find the maximum count.

Implement Algorithms A & B

Now, implement/define the static methods described, calling them `findMostCommonA` and `findMostCommonB`, respectively.

Measure Running Times

Now measure the running times of these methods as n increase (use the `nanoTime` method mentioned [here](#)). So, write a main method that does the following:

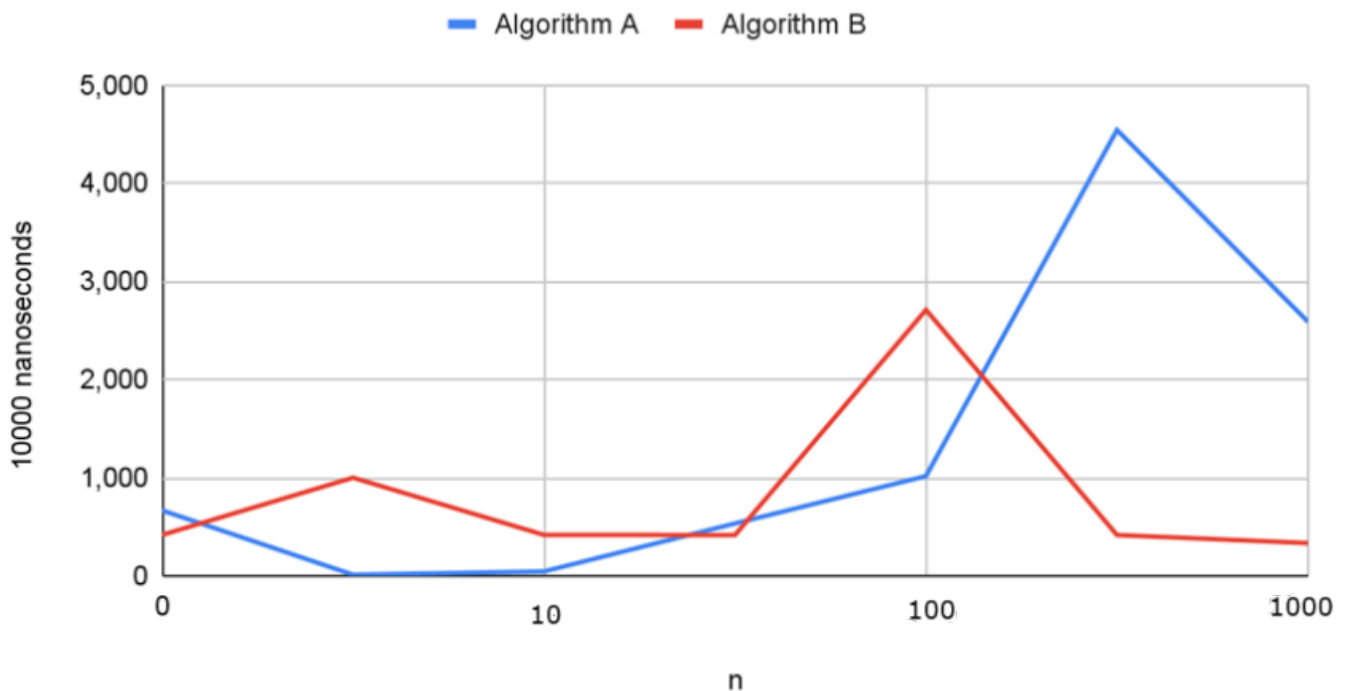
1. Repeatedly creates arrays of size n , (from $n = 10$ to $n = 100000$), where n increases by a factor of 10 each time (see sample output/run) and fills the arrays of size n with random values between 1 – 10.
2. For each array of size n , makes calls to `findMostCommonA(a1)` and stores the running time of each algorithm in an array `algorithmA`.
3. For each array of size n , makes calls to `findMostCommonB(a2)` and stores the running time of each algorithm in an array `algorithmB`.
4. Outputs the running time of each algorithm as show below:

	algorithm A	algorithm B
10	13000	5200
100	64300	231700
1000	957400	7846100
10000	3207500	42955500
100000	23458400	2453717300

Discuss Results

[10pts] Plot the performance of both algorithms graphically (n vs time) in a single plot. A good way to format your plot is shown below (note that these are not expected results but a **sample format** to present the results):

Comparison of two algorithms



Contrast the performance of the two algorithms for small and large values of n , in at most a few sentences and briefly comment on why this might be the case. Feel free to research this on the Internet but make sure to properly cite any references you make use of.

If you repeat the execution, chances are you will not get the exact same runtime results. Briefly discuss why this might be the case.

Submission

You are to submit a single .java file (containing both methods along with your main method that performs these tests) and a PDF document (no handwritten documents) that contains: the results of the tests (text output of your test code, a plot for the output) and discussion.