

CSC 230: Elementary Data Structures and Algorithms

Fall 2022

Assignment 3

- General programming guidelines:
 - Create a separate NetBeans project with the name **QuestionXX**, where **XX** is the question number.
 - Do not forget necessary javadoc comments before classes and methods.
 - You should use *single line* or *multiline* comments, **if it is required**. Do not put unnecessary comments (Do not state the obvious!!!).
 - Use meaningful identifier.
 - Throw `IllegalArgumentException` if appropriate after argument checking.
 - Don't forget to check the parameters of your methods and throw appropriate exceptions as necessary.
 - **Creating correct NetBeans projects, zipping your final assignment folder, and testing it before uploading are your responsibilities. If any of these steps fails, you will receive a grade of zero.**
- Academic integrity policy
 - You are **not** allowed to use any online resources EXCEPT the book, class lecture notes and Java documentation.
 - All programs/ code must be your own work.
 - You should be able to clearly explain every line of your code, if instructor requests you to do so.
 - Any violation of these policies will be considered as plagiarism and dealt accordingly.

Question 1 (30 points) As we know Java arrays are not dynamically expandable at run time. Write a Java program to read unlimited number of inputs from console (each is separated by the carriage return), store them in an array of **Strings** and print them. Program should terminate after you input an empty string. You may need to have the following methods in your program.

`static String [] getStrings()` – this will read unlimited number of strings and return them as an array of strings.

`static String [] resize(String [] array, int newSize)` – this supporting method may need to be called inside `getStrings` to resize the array as needed.

Note: For this program, you should use “regular” arrays. Do not use any other data structure. **You need only CSC 130 knowledge to complete this problem.**

Question 2 (50 points) Write a method to return the “second maximum” of an integer array. You should start with pseudo code (needed for question 3).

Definition. *The second maximum is the second greatest element of a sequence of integers. i.e. the second maximum is strictly greater than or equal to every element, but strictly less than the greatest element.*

You should use the following code to test the correctness of your method. Note that what I have provided is not an exhaustive list of test cases.

```
int[] a1 = { 1 };
int[] a2 = { 1, 1 };
int[] a3 = { 1, 1, 1, 1, 1 };
int[] a4 = { 2, 1 };
int[] a5 = { 3, 2, 1 };
int[] a6 = { 1, 2, 3 };
int[] a7 = { 1, 2, 3, 3, 4, 1, 10 };
```

```

/*
 * output: java.lang.IllegalArgumentException: No second max for arrays of size
 * less than 2!!!
 */
try {
    System.out.println(secMax(a1));
} catch (Exception e) {
    System.out.println(e.toString());
}

/*
 * output: java.lang.IllegalArgumentException: The array has the same element.
 * No second maximum!!!!
 */
try {
    System.out.println(secMax(a2));
} catch (Exception e) {
    System.out.println(e.toString());
}

/*
 * output: java.lang.IllegalArgumentException: The array has the same element.
 * No second maximum!!!!
 */
try {
    System.out.println(secMax(a3));
} catch (Exception e) {
    System.out.println(e.toString());
}

System.out.println(secMax(a4)); // output: 1
System.out.println(secMax(a5)); // output: 2
System.out.println(secMax(a6)); // output: 2
System.out.println(secMax(a7)); // output: 4

```

Question 3 - Asymptotic Analysis (20 points) This question needs a written answer. Do not forget to put your answer inside your assignment folder with above programming question before you zip and upload. If you are submitting a scanned copy of a handwritten answer, make sure it is legible.

Just by looking at the pseudo code written above (no cost assignment), answer the following questions. Assume you are dealing with an array of length n .

1. Do we have cases for this specific problem (best, worst)? (5 points)
2. What kind of running time function you expect - linear, quadratic, etc... (you do not require to do cost assignment and calculate it, but it will be helpful and educational if you do so)? (5 points)
3. When you design this (refer to your pseudo code), you have no reason to have nested loops, but you may have two sequential loops. Does that alter the shape of the running time function for the algorithm? e.g. say from linear to quadratic or quadratic to cubic, etc... (5 points)
4. Do not forget to submit your pseudo code written for question 2. (5 points)