Spring 2023 CSDS 410 Analysis of Algorithms
Prof. Dianne Foreback Assignment 1

Due Sunday, Sept. 17, 2023 before 11:59 p.m. in Canvas

Directions:
Please upload your Assignment 1 into Canvas and make certain that the quality of the upload is clear. Also, enumerate your answers; e.g. before your answer for problem 1, preceded it with 1a, 1b, 1c, etc.

Please double check that your assignment is properly submitted into Canvas and is visible. Since file dates can be modified, and out of fairness to all, assignments not uploaded into Canvas by the final due date will not be accepted. That is, if your file is on a Google Drive but you forgot to place it into Canvas, it will not be accepted even if the file date shows an acceptable modify date.

Note that this assignment **may** be handwritten providing your writing is easily read.

Assignment Material:
The first assignment covers primitive operation counts and asymptotic notations (big-Oh and relatives) along with their interpretation, and sorting.

Problems:

1. Solve the following problems in the textbook **using the limit rule** as appropriate. The limit rule is defined on Canvas Module 1 in the Big-Oh Cheat Sheet. Your work must be shown for credit.
    a. R-1.12
    b. R-1.13
    c. R-1.14
    d. R-1.15

2. Solve the following problems in the textbook **using the limit rule** as appropriate. The limit rule is defined on Canvas Module 1 in the Big-Oh Cheat Sheet. Your work must be shown for credit.
    a. R-1.20
    b. R-1.21
    c. R-1.22
    d. R-1.23
    e. R.1-24

3. R.1-25

4. Solve the following problems in the textbook **using the limit rule** as appropriate. The limit rule is defined on Canvas Module 1 in the Big-Oh Cheat Sheet. Your work must be shown for credit.
    a. Is $3^x = O(2^x)$
    b. Is $\log_3 x = \log_2 x$?

5. The following problems give the closed form of the recurrence equations. For no points, convince yourself that the closed form is correct (do not submit this). Now, for points, complete exercises:
    a. C-1.6
    b. C-1.7

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6. An array A of n elements contains unique integers in the range of [0, n]. Thus, one integer in the range from [0, n] is missing. E.g. If n = 5, then A might contains "4, 1, 0, 5, 2" so 3 is missing. Hint: there is a little trick to this problem. How could you easily determine that number 3 is missing? Only one loop is required for an efficient solution. Can you figure it out?
    a. Give a O(n)-time algorithm (pseudocode) for finding that number. You are allowed to use only O(1) additional space besides the array A itself.
    b. Explain the main concept of your algorithm and why it solves the problem.
    c. Give an example of running your algorithm.
    d. Explain why its runtime is O(n).
    e. Explain why your extra space usage is only O(1).

7. C-8.3
    a. Explain the major concept of your algorithm.
    b. Give pseudocode.
    c. Give an example of running your algorithm.
    d. Give and justify its runtime.
    e. Justify its correctness.

8. C-9.12
    a. Explain the major concept of your algorithm.
    b. Give pseudocode.
    c. Give an example of running your algorithm.
    d. Give and justify its runtime.
    e. Justify its correctness.