CSC 411. Spring 2023

Homework #1

Due date: 11:59 pm on January 31, 2023 (Tuesday)

1. Textbook #2.2-5 (20 Points)

5. List the following functions according to their order of growth from the lowest to the highest:

$$(n-2)!, \quad 5\lg(n+100)^{10}, \quad 2^{2n}, \quad 0.001n^4 + 3n^3 + 1, \quad \ln^2 n, \quad \sqrt[3]{n}, \quad 3^n.$$

2. Textbook #2.3-5 (50 Points)

5. Consider the following algorithm.

ALGORITHM $Secret(A[0..n-1])$
    //Input: An array $A[0..n-1]$ of n real numbers
    $minval \leftarrow A[0]; maxval \leftarrow A[0]$
    for $i \leftarrow 1$ **to** $n-1$ **do**
        if $A[i] < minval$
            $minval \leftarrow A[i]$
        if $A[i] > maxval$
            $maxval \leftarrow A[i]$
    return $maxval - minval$

Answer questions (a)–(e) of Problem 4 about this algorithm.

a. What does this algorithm compute?

b. What is its basic operation?

c. How many times is the basic operation executed?

d. What is the efficiency class of this algorithm?

e. Suggest an improvement, or a better algorithm altogether, and indicate its efficiency class. If you cannot do it, try to prove that, in fact, it cannot be done.

3. Textbook #2.4-4 (30 Points)

4. Consider the following recursive algorithm.

ALGORITHM $Q(n)$
    //Input: A positive integer n
    if $n = 1$ **return** 1
    else return $Q(n-1) + 2*n - 1$

a. Set up a recurrence relation for this function's values and solve it to determine what this algorithm computes.

b. Set up a recurrence relation for the number of multiplications made by this algorithm and solve it.

c. Set up a recurrence relation for the number of additions/subtractions made by this algorithm and solve it.