CS 300 Data Structures and Algorithms – Spring 2011
Homework #1 (SOLUTIONS)

1. (5 points) Write a pseudocode statement to add 1 to a number 'num'.

    increment num   OR

    add 1 to num

2. (5 points) List all atomic data types and composite data types in C programming language.

    Atomic – void, character(char), integer (long, int, short), floating point (float, double, long double)

    Composite – struct, array, union, enum

3. (5 points) Reorder the following efficiencies from smallest to largest: 2^n, n!, n^5, 1000, nlog(n), log(n)

    1000, log(n), nlog(n), n^5, 2^n, n!

4. (10 points) If the efficiency of the algorithm doIt can be expressed as $O(n) = n^5$, calculate the efficiency of the following program segment:

    for (i = 1; i <= n; i++)
        for (j = 1; j <= n; j++)
            doIt(…)

    $n^2 \cdot n^5 = n^7$

5. (10 points) An algorithm processes a given input of size n. If n is 4096, the run time is 512 milliseconds. If n is 16384, the run time is 8192 milliseconds. What is the efficiency of the algorithm in big-O notation.

$f(N_1) = 512$; $N_1 = 4096$

$f(N_2) = 8192$; $N_2 = 16384 = 4*N_1$

$=> f(4*N_1) = 8192 = 16*512 = 16*f(N_1)$

$=> f(4*N_1) = 16*f(N_1)$

$=> f(N_1) = (N_1)^2$

Because n becomes 4 times larger while f(n) becomes 16 times larger, the efficiency is quadratic.

6. Consider the following algorithm:

algorithm fun2 (x, y)

1   if (x < y)

  1   return -3

2   else

  1   return (fun2 (x – y, y + 3) + y)

3   end if

end fun2

What would be returned if fun2 is called as

(A) (5 points) fun2 (2, 7)   - 3

(B) (5 points) fun2 (5, 3)   3 + fun2(2, 6) = 3 – 3 = 0

(C) (5 points) fun2 (15, 3)   3 + fun2(12, 6) = 3 + 6 + fun2(6, 9) = 3 + 6 – 3 = 6