CS146 HW Assignment 1

(Hardcopy due before lecture on **Thursday, February 22, 2018.)**

Please note: All HW assignments are giving you opportunities to learn and to verify the concepts from the topics in the lectures. They are for individual work only. You must work on your own. **You are not allowed to consult with any other people and you cannot copy or receive answers from any people (students or tutors for example) or internet.** You are not allowed to work as a team. Usually, some questions may have different correct solutions with the same concept. Always drop me an email if you have any questions or problems.

1. (10%) Draw a diagram of the multiple-array representation for the sequence array [20, 5, 9, 18, 6, 10] stored as a doubly linked list. Also draw a diagram of the single-array representation for the same sequence array.

2. (10%) Assume that algorithm A_1 takes time roughly $T_1(n) = 3n^2 + 2n + 6$ and algorithm A_2 takes time roughly $T_2(n) = 3n \lg(n) + 10$, and suppose that computer A's CPU runs 10^8 instructions/sec. When the input size equals to 10^4 and 10^{12} respectively, how long will algorithm A_1 take to finish for each input size? How long will algorithm A_2 take to finish for each input size? (Hint: Big O)

3. (32%) For each of the following "=", identify the corresponding constants C1, C2, n_0 as appropriate. For each of "≠", lines, show they cannot possibly exist.

(3.1) $\frac{n^2}{4} - 8n + 12 = \Theta(n^2)$

(3.2) $3 + 50/n = \Theta(1)$

(3.3) $\lg(2n) \neq \Theta(n)$

(3.4) $n^{100} = O(2^n)$

(3.5) $10n - 7 = O(n^2)$

(3.6) $4n^{1/2} \neq o(n^{1/2})$ (note the little-o)

(3.7) $\frac{n^3}{3} \neq \omega(n^3)$

(3.8) $123n + 321 = \Theta(n)$

4.(10%) Answer Problem 3-1 (asymptotic behavior of polynomials) on page 61 of textbook.

5. (18%) Identify and EXPLAIN all elements F of the set { O, Ω, Θ, ω, o } such that the $f(n) = F(g(n))$ for each of the following asymptotic relations. Thus that if $f(n) = O(g(n))$ and $f(n) = \Omega(g(n))$ and $f(n) = \Theta(g(n)$ are the only three valid asymptotic relationships between f and g, answer O, Ω, Θ.

(5.1) $f(n) = n^2 + 5,\ g(n) = 3n^2 + 4n$

(5.2) $f(n) = 2\log_2 n,\ g(n) = \log_3(2n)$

(5.3) $f(n) = 2^n + 3n,\ g(n) = 3^n + 2n + 1$

(5.4) $f(n) = \sqrt{n}\ ,\ g(n) = 4\log n$

(5.5) $f(n) = n^2 + 1,\ g(n) = 3n - 2$

(5.6) $f(n) = 2n + 1,\ g(n) = 3\log^2 n + 2$

6. (20%) Convert the pseudo codes of the INSERTION-SORT(A) algorithm on page 18 and pseudo codes of the MERGE-SORT(A,p,r) algorithm on page 34 of the textbook respectively into executable Java codes to sort array A[18, 25, 6, 9, 15, 12, 5, 20, 11, 30]. Show all your source codes for both algorithms and take screen shots of each intermediate step of sorting results. (Note: 0 point will be received if you did not use the pseudo codes from the textbook.)