Data Structure Homework 1

1. Please derive the corresponding time complexity (Big-O) for each of the following program segments. (20%)

   (a) k = 0;
   ```
   for (i=0; i<n; i++)
       k++;
   ```

   (b) k = 0;
   ```
   for (i=0; i<n; i++)
       for (j=0; j<5*n; j++)
           k++;
   ```

   (c) k = 0;
   ```
   for (i=0; i<n; i++)
       for (j=0; j≤i*i; j++)
           k++;
   ```

   (d) If the time complexity of **Sort**() is expressed as O(nlogn)
   ```
   i = 1;
   while (i<=n) {
       Sort();
       i = i * 3;
   }
   ```

2. Assume that each **int** element of an array occupies 4 units of storage and each **double** element of an array occupies 8 units of storage. Suppose that the first element of array A is A[0][0] and its address is 120. Please give the **address** of the indicated element in each of the following cases. (20%)

   (a) int A[5][3] with column-major order, please find the address of element A[4][1]

   (b) double A[4][6] with row-major order, please find the address of element A[2][3]

3. (a) Please derive the time complexity of the polynomial function f(n) is $O(n^k)$. (10%)

   $$f(n) = a_k n^k + a_{k-1} n^{k-1} + a_{k-2} n^{k-2} + \ldots + a_1 n^1 + a_0 n^0$$

   (b) Please explain why the time complexity of the function x(n) and y(n) are O(logn) . (10%)

$$x(n) = \log_a n \; ; \; y(n) = \log_b n \; ; \quad a, b \; are \; constants$$

4. Determine the value of the following postfix expressions when the variables have the following values: A is 32, B is 16, C is 4, D is 3, E is 5, and F is 2.

    Show its evaluation steps (also show the stack of buffer values during execution). (20%)

    (a)   A B C /* D - E % F +

    (b)   A B C D + * E F * % +

5. There are five sequentially input data {A, B, C, D, E}. When we perform the PUSH(X) or POP(), which situation(s) of output will not happen? Please explain your answer step by step. (20%)
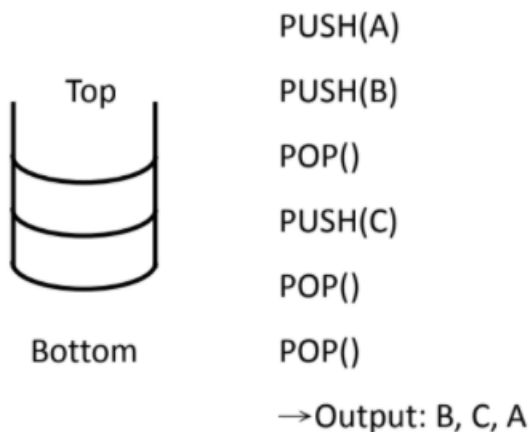
    (a)   E, D, C, B, A

    (b)   A, C, D, B, E

    (c)   B, A, C, E, D

    (d)   C, E, D, A, B

    (e)   C, B, A, D, E

    Example:

    Top

    Bottom

    PUSH(A)
    PUSH(B)
    POP()
    PUSH(C)
    POP()
    POP()
    →Output: B, C, A

Notices

1. 繳交方式: 手寫(A4)
2. 繳交時間: 3/29(一)下課前(18:00)放置教室前方的小箱子，請勿遲交
3. 請在 A4 右上方附上姓名、學號、系級
4. 請附上詳細計算過程，若未附上該題零分計算