<center>

長庚大學資訊工程學系

2020 Fall Data Structure and Algorithm I

First Quiz

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注意：請勿作弊，違者嚴懲

1. (10%) Write the definition of $f(n)=O(g(n))$ and $f(n)=\theta(g(n))$ and use the diagram to present them respectively.

2. (10%) What is the time complexity of the Knuth-Morris-Pratt algorithm?

3. (15%) Please describe three ways to represent the polynomial. To explain how to run polynomial addition in each way and the complexity of time and space.

4. (15%) Please write a function "**bubble sort**" using templates function. And try to write a main function to use your template function for sorting an array of floating point numbers and an array of integer numbers respectively.

5. (20%) Give an analysis of the running time (Big-Oh will do) of each of the following program fragments. Briefly explain your answers briefly yet convincingly.

(1)
```
sum=0;
for(i=0, i<n, i++)
    sum++;
```

(2)
```
sum=0;
for(i=0, i<n, i++)
    for(j=0;j<n*n, j++)
        sum++;
```

(3)
```
sum=0;
for(i=0, i<n, i++)
    for(j=0;j<i, j++)
        sum++;
```

(4)
```
sum=0;
for(i=1, i<n, i++)
    for(j=1;j<i*i, j++)
        if(j%i==0)
            for (k=0; k<j, k++)
                sum++;
```

6. (20%) For sparse matrix representation, we would like to use an array of triples <row, column, value>.
   (1) Please use an array of triples to present the following matrix
   (2) Please describe the time complexity to transposing a sparse matrix when we employee the algorithm of "FastTranspose" listed in our textbook. <Hint: rowstart, rowsize>.

$$\begin{bmatrix} 0 & 1 & 5 & 0 & 0 \\ 3 & 0 & 0 & 0 & 0 \\ 0 & 0 & 7 & 0 & 9 \\ 0 & 0 & 0 & 4 & 0 \\ 0 & 2 & 0 & 0 & 8 \end{bmatrix}$$

7. (10%) Given the following equalities:
   E1: $n^{K+a} + n^K \lg n = \Theta(n^{K+a})$ for all fixed K and a, K>=0 and a>0
   E2: $n^3 2^n + 6n^2 3^n = O(n^3 2^n)$

   Which of the following is true?
   (A) E1 is correct and E2 is correct.
   (B) E1 is correct and E2 is not correct.
   (C) E1 is not correct and E2 is correct.
   (D) E1 is not correct and E2 is not correct.