本試卷共十題，每題十分。請依序標明題號作答。

1. (10%) There is a two dimensional integer array M, if the address of M(0, 0), M(0, 3) and M(1, 2) are 100, 106 and 120 respectively. What is the address of M(4, 5)?

2. (10%)
   a. What is the time complexity of the following function **rsum**?
   ```
   float rsum(float list[], int n){
     if(n>0)
        return rsum(list, n-1) + list[n-1];
     return list[0];
   }
   ```

   b. The following is a recursive function definition. Give the values of **func(3, 8)** and **func(8, 3)**.
   ```
   int func( int a, int b){
      if ( a > 100 && b > 100 )
         return (func(a+1, b+1) + 1);
      else
         return 1;
   ```

3. (10%) About the complexity, prove the following theories.
   a、 The big-O complexity of $n^3 + 20 n^2 \log n + 1900n$ is $O(n^3)$.
   b、 The big-O complexity of $n^4 + 20 n^2$ is not $O(n^3)$.

4. (10%)
   a. Write the postfix form of the following two expressions:
   (I)   (A+B)*D+E/(F+A*D)+C
   (II)   A and B or C or not (E>F)
   b. Suppose we have the pre-order sequence DAFIBEGHC and in-order sequence AFDBIGHEC. Construct the corresponding binary tree.

5. (10%) Specify the operations step by step to delete a node (denoted by the variable X) in a doubly linked circular list. Suppose that each node three data members for data, left link and right link respectively: int DATA, Node *LLINK, Node *RLINK.

6. (10%) Given the following directed graph,
   a. Represent it using adjacent matrix and adjacent list.
   b. Briefly describe how to use the representations to find out the in-degree and out-degree of each node.
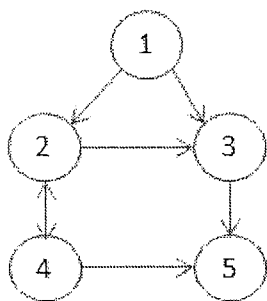
7. (10%) Please answer the following questions.
   a、 What is **stable sort**? What is **unstable sort**?
   b、 For the following sort algorithms, which are stable sort?
      Quick Sort, Insert Sort, Bubble Sort, Selection Sort, Heap Sort, Merge Sort.
   c、 What is the lower bound (big-O) of a comparison-based sort algorithm?

8. (10%) An AVL-tree is a balanced binary search tree. Please describe how to keep the height balance when the flowing valued nodes are sequentially inserted. 30, 40, 50, 60, 20, 55, 70, 45, 25.

9. (10%) Using max heap, describe the sequence of heap sort with the following data sequence: 7, 5, 10, 20, 55, 23, 48.

10. (10%) Read the following data in the given order, and show the 2-3 tree: 7, 8, 9, 2, 1, 5, 3, 6, 4.