※ 考生請注意：本試題 □可 ☑不可 使用計算機

一 選擇題 (30%)

1) What is the formula for finding the entry in the *i*th row and *j*th column of a two-dimensional array if it is stored in row major order rather than row major order? Assuming the number of elements per row is *c*.
A. (c * j) + i B. (c * i) + j C. c * (i + j) D. c + i * j

2) Suppose T(N) = Ω(g(N)). What does that mean?
A. The growth rate of T(N) is greater than that of g(N).
B. The growth rate of T(N) is greater than or equal to that of g(N).
C. The growth rate of T(N) is smaller than or equal to that of g(N).
D. The growth rate of T(N) is smaller than that of g(N).

3) A class in C++ consists of its members. These members can be either data or _____.
A. heaps B. stacks C. methods D. None of the above

4) A _____ variable is a variable that stores the address where anther object resides.
A. constructor B. list C. vector D. pointer

5) Determine, for the typical algorithm that you use to perform calculations by hand, the running time to multiply two N-digit integers
A. O(1) B. O(N) C. $O(N^2)$ D. $O(N^3)$

6)Which of the following trees is identical to a binary search tree, except that for every node in the tree, the height of the left and right subtrees can differ by at most 1?
A. B^+ tree B. AVL tree C. Splay tree D. Red-Black tree

7) In object-oriented programming (OOP), _____ is a way to form new classes (instances of which are called objects) using classes that have already been defined.
A. polymorphism B. overloading C. inheritance D. none of the above

8) _____ is a method where the solution to a problem depends on solutions to smaller instances of the same problem.
A. Dynamic programming B. Greedy method C. Amortization D. Recursion

9)Quick sort is based on which of the following techniques?
A. dynamic programming B. divide and conquer C. amortization D. backtracking and search

10) _____ is a method of mathematical proof typically used to establish that a given statement is true of all natural numbers.
A. Proof by contradiction B. Combinatorial proof C. Mathematical induction D. Proof by construction

(背面仍有題目,請繼續作答)

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二 問答題

1. Explain the following terms. A. abstract data type B. binary search tree C. halting problem. D. hash collision (16%)
2. Suppose a tree has four nodes A, B, C, and D. If A and C are siblings and D's parent is A, which nodes are leaf nodes? Which node is the root? (6%)
3. Write a recursive function that returns the number of 1's in the binary representation of N. Use the fact that this is equal to the number of 1's in the representation of N/2, plus 1, if N is odd. (6%)
4. Write a pseudo code to swap two adjacent elements by adjusting only the links (and not the data) using singly linked lists. (10%)
5. a. Show the result of inserting 3, 1, 4, 6, 9, 2, 5, 7 into an initially empty binary search tree. (8%)
   b. Show the result of deleting the root. (2%)
6. The following is an example written in pseudo code that explains the problem of memory leak. (5%)

```
When a button is pressed.
  Get some memory, which will be used to remember the floor number; Put the
  floor number into the memory
  Are we already on the target floor?
    If so, we have nothing to do: finished
    Otherwise:
      Wait until the lift is idle
      Go to the required floor
      Release the memory we used to remember the floor number
```

Explain when memory leak will occur in this code?

7. Consider the following function that returns the address of a stack-allocated local variable: (3%)

```
int * A ( void )
{
    int num = 1234;
    /* ... */
    return &num;
 }
```

Explain a problem that may occur when function A returns?

8. Write a pseudo code for heap sort and show that its time complexity is $O(n \log_2 n)$. (14%)