國立虎尾科技大學九十五學年度研究所（碩士班）入學試題

科目：資料結構

所別：資訊管理系碩士班

注意事項：(1)本試題共有二大題，共計一百分。

(2)請務必作答於答案卷中，並將題號標示清楚，否則不予計分。

I. 單選題(60%，每題 3 分，不倒扣)

(   ) 1. X is a one dimensional array. The address of X[20] is decimal 102 and X[30] is 182. How many bytes are occupied for each element of X?

(A) 4　　　　　　　　(B) 8　　　　　　　　(C) 16

(D) 32　　　　　　　(E) none of the above.

(   ) 2. Which of the following statements is incorrect?

(A) Each step of an algorithm must be unambiguous.

(B) An algorithm must have one or more inputs.

(C) An algorithm must terminate after a finite number of steps.

(D) An algorithm must have one or more outputs.

(E) none of the above.

(   ) 3. Let *T* be a tree with *n* nodes. Which of the following statements is incorrect?

(A) The maximum number of nodes on level *i* of a binary tree is 2^i-1, for *i*

(B) A node with degree one is a leaf or terminal node.

(C) A full binary tree of depth *k* is a binary tree of depth k having 2^k-1 nodes, for $k \geq 0$.

(D) A binary tree is a finite set of nodes that is either empty or consists of a root and two disjoint binary trees.

(E) none of the above.

(   ) 4. Suppose the preorder and inorder traversals of a binary tree are ABCDEF and DCBEAFG, respectively. What is the postorder traversal?

(A) DCEBGFA　　　　(B) CDBEFGA　　　　(C) DCEBFGA

(D) CDEBGFA　　　　(E) none of the above.

(   ) 5. Assume that A = 1, B = 2 and C = 3. Which of the following values is the result in evaluating postfix expression ABC+*CBA－+*?

(A) 15　　　　　　　(B) 20　　　　　　　(C) 24

(D) 16　　　　　　　(E) none of the above.

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（　　）6. How many different binary trees are there with n vertices?

(A) n　　　　　　　　　(B) 2^n-1　　　　　　　(C) $\frac{1}{n}\binom{2n}{n}$

(D) $\frac{1}{n+1}\binom{2n}{n}$　　　　　　　(E) none of the above.

（　　）7. Which of the following statements is incorrect?

(A) A complete undirected graph with n vertices has $n(n-1)/2$ edges.

(B) Eulerian walk is a walk starting at any vertex, going through each edge exactly once, and terminating at the starting vertex if and only if the degree of each vertex is odd.

(C) A simple path is a path in which all vertices, except possibly the first and last, are distinct.

(D) A cycle does not contain any cut vertex (articulation point)

(E) none of the above.

（　　）8. What kind of strategy be used for Merge Sort?

(A) Divide and Conquer　　　(B) Greedy method　　　(C) Dynamic programming

(D) Probabilistic method　　　(E) none of the above.

（　　）9. Let $G(V,E)$ be an undirected graph with n vertices, where $n \geqq 1$ and M be the adjacent matrix of G. Which of the following statement is incorrect?

(A) M is a two dimensional $n \times n$ array.　　　(B) $\sum_{i=1}^{n}\sum_{j=1}^{n}M(i,j)$ is even.

(C) $\sum_{j=1}^{n}M(i,j)$ is the degree of vertex i.

(D) $\sum_{i=1}^{n}\sum_{j=1}^{n}M(i,j)$ is the number of edges of G　　　(E) none of the above.

（　　）10. Let $G(V, E)$ be an undirected graph with n vertices and e edges. For the minimum spanning tree problem, which of the following statement is incorrect?

(A) Kruskal's algorithm is a greedy method.

(B) The time complexity of Prim's algorithm is $O(n^2)$.

(C) The time complexity of Kruskal's algorithm is $O(nlogn)$.

(D) Prim's algorithm is a greedy method

(E) none of the above.

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Question 11-13: Use of the following java program to answer questions 11~13.

```
for (i = 0; i < n-1; i++) {
    position = i;
    for (j = i+1; j < n; j++)
        if (a [j] < a [position])
            position = j;
    double temp = a [i];
    a [i] = a [position];
    a [position] = temp;    }
```

(　　)11. For the inner for statement, when i = 0, j takes on values from 1 to n – 1, and so there are n – 1 iterations of the inner for statement when i = 0. How many iterations are there when i = 2?

(A) n-1　　　　　　　　(B) n-2　　　　　　　　(C) n-3

(D) n-4　　　　　　　　(E) none of the above.

(　　)12. Determine, as a function of n, the total number of iterations of the inner for statement as i takes on values from 0 to n – 2.

(A) n^2　　　　　　　(B) n(n-1)　　　　　　(C) n(n-1)/2

(D) n(n-1)/3　　　　　(E) none of the above.

(　　)13. Use Big-O notation to estimate the time complexity.

(A) $O(n^2)$　　　　　　(B) $O(n)$　　　　　　(C) $O(n log n)$

(D) $O(2^n)$　　　　　　(E) none of the above.

(　　)14. Compute the result of the following java program when n=3.

(A) 1/2　　　　　　　　(B) 3/4　　　　　　　　(C) 4/3

(D) 5/3　　　　　　　　(E) none of the above.

```
public long ftest (int n)
{
if (n == 1)
    return 1;
else
    return n*ftest( n-1) / (n+1);
}
```

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(　　)15. In an execution trace of the move method in the Towers of Hanoi application as the following java program, the number of steps is equal to the number of recursive calls to the move method plus the number of direct moves. Because each call to the move method includes a direct move, the number of recursive calls to the move method is always one less than the number of direct moves. How many steps would there be for an execution trace with n = 4?

(A) 15 　　　　　　　　　(B) 21 　　　　　　　　　(C) 25

(D) 29 　　　　　　　　　(E) none of the above.

```java
public static String move (int n, char orig, char dest, char temp)
{
final String DIRECT_MOVE=
        "Move disk " + n + " from " + orig + " to " + dest + "\n";
If (n<=0) throw new IllegalArgumentException();
If (n==1) return DIRECT_MOVE;
String result=move(n-1, orig, temp, dest);
result+=DIRECT_MOVE;
result+-move(n-1, temp, dest, orig);
return result;   }
```

(　　)16. Suppose that elements "a", "b", "c", "d", "e" are pushed, in that order, onto an initially empty stack, which is then popped four times, and as each element is popped, it is enqueued into an initially empty queue. If one element is then dequeued from the queue, what is the *next* element to be dequeued?

(A) a 　　　　　　　　　(B) b 　　　　　　　　　(C) c

(D) d 　　　　　　　　　(E) e 　　　　　　　　　(F) none of the above.

(　　) 17. Suppose you want a sort method whose worstTime(n) is linear-logarithmic in n, but requires only linear-in-n time for an already sorted collection. Which one of the sorts in this chapter has those properties? (worstTime(n) is the maximum number of statements executed in a trace of the method)

(A) Bubble Sort 　　　　　(B) Merge Sort 　　　　　(C)Insertion Sort

(D) Selection Sort 　　　　(E) none of the above.

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(　　) 18. What is the minimum number of black elements in a red-black tree of height 4?

(A) 30　　　　　　　　(B) 31　　　　　　　　(C) 32

(D) 33　　　　　　　　(E) none of the above.

(　　) 19. Use the following Huffman tree to translate the bit sequence 11101011111100111010 back into letters 'a' ... 'g'. The result is:

(A) bag　　　　　　　(B) feed　　　　　　　(C) decade

(D) dabge　　　　　　(E) none of the above.

(　　) 20. Which of the following trees is not a binary search tree?
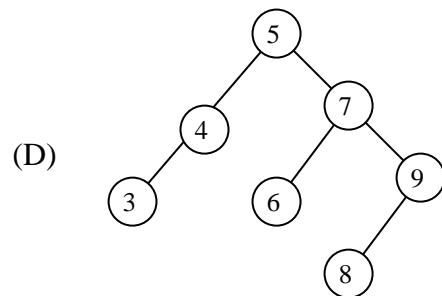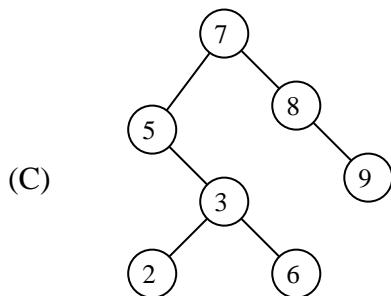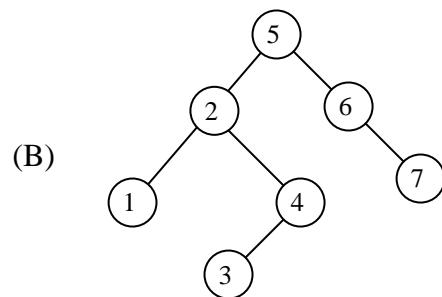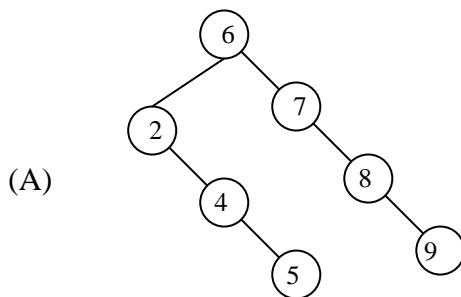
(E) none of the above

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II. 問答題(40%，每題 10 分)

1. (a) What is the maximum number of leaves in a binary tree with 10 elements? Construct such a tree. (5%)

   (b) What is the minimum number of leaves in a binary tree with 10 elements? Construct such a tree. (5%)

2. Suppose we define $\max_h$ to be the maximum number of elements in an AVL tree of height h.
   (a) Calculate $\max_3$. (3%)
   (b) Determine the formula for $\max_h$ for any $h \geq 0$. (3%)
   (c) What is the maximum height of an AVL tree with 100 elements? (4%)

3. What is the time complexity of the following formulas?

   (a) $\sum_{i=1}^{n} 2^i$　(5%)

   (b) $\sum_{i=1}^{n} i^2$　(5%)

4. The figure below illustrates a railroad switching network. Railroad cars numbered 1, 2, …, n are at the right. Each car is brought into the stack and removed at any time. For instance, if $n = 3$, we could move in 1, move in 2, move in 3, and then take the cars out, producing the new order 3, 2, 1. For $n = 4$, what are the **impossible** permutations of the cars that can be obtained? (Please list 10 impossible permutations.)(10%)