國立中山大學 109 學年度
碩士暨碩士專班招生考試試題

科目名稱：資料結構【電機系碩士班丙組】

Note: There are 5 question sets, each containing 5 questions in it. Each question deserves 4 points. In each question set, the first 3 questions have one answer while the last two may have multiple answers. One quarter of points will be deducted for single-choice questions, and no deduction for multiple-choices questions.

請注意：此份考卷共有五個題組，每題組包含五題，每題 4 分。每題組的前三題是單選題，後兩題是複選題。單選題答錯倒扣 1/4，複選題答錯不倒扣。

Question set I

Suppose we have the following function:

```
kkk(A,i,n) {
        if (n>1) {
                Exchange the values of A[i] and A[i+n-1];
                kkk(A,i+1,n-2);
        }
}
```

Note that A is an integer array starting with index 0. Each integer occupies 4 bytes in the byte-addressable memory. Please answer the following questions.

1. If the address of A[2] is $00EC_{16}$, what is the address of A[5]? (a) $00EF_{16}$; (b) $00EC_{16}$; (c) $00F8_{16}$; (d) $00FF_{16}$.
2. How many times kkk will be called in the function body of kkk(A,0,4)? (a) 1; (b) 2; (c) 3; (d) 4.
3. What is the time complexity of this function? (a) $O(n)$; (b) $O(\log_2 n)$; (c) $O(n^2)$; (d) $O(n^3)$.
4. Let A=[20,80,30,40,10,70,50]. After executing kkk(A,0,7), which of the following are true? (a) A[0]=70; (b) A[2]=10; (c) A[4]=50; (d) A[6]=20.
5. Let A=[15,25,35,45,55,65,75,85]. After executing kkk(A,0,8), which of the following are true? (a) A[1]=75; (b) A[3]=55; (c) A[5]=35; (d) A[7]=65.

Question set II

Suppose we have a stack for storing integers. Initially, the stack is empty. We perform 10 operations push(1), push(2), pop(), push(3), pop(), pop(), push(4), push(5), push(6), and pop(). Please answer the following questions.

6. We use an array A of 10 elements to implement the stack. Which one is true for declaring the array in C? (a) integer A:10; (b) integer A[0,9]; (c) integer A[1,10]; (d) integer A[10].
7. We use the array A as defined above to implement the stack. We want to store the first integer at index=0. Let the latest input be stored at index=top. What is the value of top for the empty stack? (a) top=0; (b) top=1; (c) top=-1; (d) top=9.
8. We use the linked-based implementation for the stack. Let the latest input be stored at the location with address in first. What is the value of first for the empty stack? (a) first=-1; (b) first=0; (c) first=1; (d) first=2.
9. We use the array A as defined above to implement the stack. After executing the 10 operations in sequence, which of the following are true? (a) top=1; (b) A[0]=4; (c) A[1]=5; (d) The stack has 3 integers.
10. We use the linked-based implementation as defined above for the stack. After executing the 10 operations, which of the following are true? (a) first is not 0; (b) first contains the address where 5 is stored; (c) A[first]=4; (d) A -> first = 4.

Question set III

Suppose we have an array A containing 9 integers (with the first index being 0):

240, 119, 682, 341, 225, 556, 122, 661, 245

Please answer the following questions.

11. We use Bubble Sort to sort the array in ascending order. What is A[8] after the first pass? (a) 661; (b) 556; (c) 682; (d) 245.

12. We use Bubble Sort to sort the array in ascending order. What is A[7] after the second pass? (a) 122; (b) 661; (c) 556; (d) 225.

13. We use Quick Sort to sort the array in ascending order. For each partition, let the rightmost element be the pivot. Which one stores 245 after the first partition? (a) A[3]; (b) A[7]; (c) A[5]; (d) A[4].

14. We use Quick Sort to sort the array in ascending order. Which of the following are false after the first partition? (a) A[0]=240; (b) A[8]=682; (c) A[3]=341; (d) A[7]=661.

15. We use Heap Sort to sort the array in ascending order. But first, we have to convert the array into a maxheap. Which of the following are true in the resulting maxheap? (a) A[0]=682; (b) A[3]=341; (c) A[5]=240; (d) A[8]=245.

Question set IV

Let the height of a tree be the number of nodes along the longest path from the root node to the leaf nodes. Suppose we have 10 integers 35, 46, 30, 34, 99, 42, 75, 28, 70, 80. Please answer the following questions.

16. We create binary trees for these integers. What is the minimum height of all the possible trees? (a) 1; (b) 2; (c) 3; (d) 4.

17. We create binary trees for these integers. What is the maximum height of all the possible trees? (a) 10; (b) 9; (c) 8; (d) 7.

18. We create an AVL tree by considering the integers one by one, starting with the first one, 30. Which of the following is true? (a) The height of the resulting tree is 5; (b) The root of the resulting tree is 75; (c) The node for 46 has one child; (d) The parent of 99 is the node for 75.

19. We create a binary search tree by considering the integers one by one, starting with the first one, 30. Which of the following are true? (a) The node for 75 is a leaf node; (b) The node for 42 is an internal node; (c) The node for 99 has only one child; (d) The height of the resulting tree is 5.

20. Based on the binary search tree obtained in Question 19, we delete 99 from the tree. Which of the following are true? (a) The parent of 75 is the node for 46; (b) The node for 30 has two children; (c) The node for 70 is an internal node; (d) The height of the resulting tree is 4.

Question set V

Suppose we have an undirected graph G=(V,E), where V={a,b,c,d,e,f,g,i} and E={[(a,i), 2], [(a,b), 6], [(a,g), 4], [(b,c), 7], [(b,e), 9], [(c,d), 4], [(d,g), 5], [(e,g), 8], [(f,g), 2], [(f,i), 3]}. Note that [(x,y),w] indicates that there is an edge, with weight w, between vertices x and y. Please answer the following questions.

21. We find a spanning tree for the graph using the depth-first search algorithm, starting with vertex e. Note that if two or more vertices qualify, then the one with the least alphabetical order is selected. What is the sum of the weights involved in the resulting tree? (a) 31; (b) 32; (c) 33; (d) 34.

22. We find a spanning tree for the graph using the breadth-first search algorithm, starting with vertex e. Note that if two or more vertices qualify, then the one with the least alphabetical order is selected. What is the sum of the weights involved in the resulting tree? (a) 40; (b) 39; (c) 38; (d) 37.

23. We find a spanning tree for the graph using the Prim's algorithm, starting with vertex e. Note that if two or more vertices qualify, then the one with the least alphabetical order is selected. What is the sum of the weights involved in the resulting tree? (a) 30; (b) 29; (c) 28; (d) 27.

24. Which of the following are true for the resulting tree obtained in Question 21? (a) The node following node a is node g; (b) The edge (e,g) is contained in the tree; (c) The edge (c,d) is contained in the tree; (d) The edge (b,c) is contained in the tree.

25. Which of the following are true for the resulting tree obtained in Question 23? (a) The edge (a,g) is contained in the tree; (b) The edge (a,b) is contained in the tree; (c) The edge (b,c) is contained in the tree; (d) The edge (c,d) is contained in the tree.