國立中正大學
112學年度碩士班招生考試
試 題

［第2節］

科目名稱	軟體設計
系所組別	資訊工程學系-甲組

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1. (10%) 請為下列各項撰寫單行 C 語言敘述式。
   (a) (5%) 以八進位制格式，並且以前面加 0 的方式，顯示十進位數值 100。
   (b) (5%) 連續讀入字元到陣列 n 中，直到遇到一個非數字字元為止。

2. (10%) 請回答以下 C 語言程式碼執行後在螢幕上顯示之結果。

```c
#include <stdio.h>

int main() {
    char s[]="01234";
    char *p=s;
    printf("%c",*p++);
    printf("%c",*++p);
    printf("%c",*(++p));
    printf("%c",*(p++));
    printf("%c",(*p)++);
    return 0;
}
```

3. (5%) 請回答以下 C 語言程式碼執行後在螢幕上顯示之結果。

```c
#include <stdio.h>

int main() {
    int x = 3, n = 6;
    for (int i=1; i<=n; i=i+1){
        for (int j=1; j<=n; j=j+1) {
            if ((i+j)==2)
                x = x + 3;
            if ((i+j)==3)
                x = x + 4;
            if ((i+j)==4)
                x = x + 5;
        }
    }
    printf ("%d\n", x);
    return 0;
}
```

4. (4%) John is annoyed that he always needs to keep track of the sizes of integer arrays that he passes around as pointers. He decides that to make things easier, he will NULL-terminate his integer arrays, just like strings are NULL-terminated. Specifically, he will use 4 NULL bytes, since on his machine integers are 4 bytes.

   Besides taking extra space, what is one issue with John's proposal?

5. (3%) (Check all that apply. NO partial credit is given.)

   Which of the following are declarations but **not** definitions?

(A) int i;　　(B) int i=1;　　(C) int foo(int);　　(D) int foo(int i);

(E) typedef string my_string;　　(F) None of the above

6. (12%) (Check all that apply. NO partial credit is given.)

甲. (3%) Which of the following is TRUE about the special variable "*this*"?

(A) It is a reference value.　　(B) You are allowed to change what it points to within a method.

(C) It is point to the calling instance of a method.　　(D) All of the above　　(E) None of the above

乙. (3%) For a class named *Thing*, what is the type of the implicit *this*?

(A) *Thing*　　(B) *Thing * const*　　(C) *const Thing * const*　　(D) *Thing **

(E) Depends on if the member function is *const*.　　(F) None of the above

丙. (3%) Which of the following are TRUE about a **const** variable?

(A) You can still assign a value to a **const** variable by using a reference variable associated with the **const** variable.

(B) It must be initialized at the time of declaration.

(C) You cannot add **const** to a reference variable associated with non-**const** variable.

(D) All of the above　　(E) None of the above

丁. (3%) Which of the following cause a string to be copied (presuming y is a string)?

(A) const string * x = y;　　(B) const string & x = y;　　(C) const string * const x = y;

(D) string & x = y;　　(E) string * x = y;　　(F) None of the above

7. (6%) (Select **all** correct answers. NO partial credit is given.)

甲. (3%) Constructors:

(A) Are called when the instance goes out of scope or is de-allocated.

(B) Can be used to set data members to a known initial value / state.

(C) Can be overloaded (i.e., multiple constructors with different argument lists)

(D) Are called automatically only when the instance is allocated dynamically with '*new*' and not when the instance is declared statically as a local variable.

(E) None of the above

乙. (3%) What is the return type of a class constructor?

(A) An instance of the class　　(B) No return on a constructor

(C) An *int* (the size of the class in bytes)　　(D) A *string* (the name of the class)

(E) None of the above

8. (10%) Please examine the five sentences and give your answer, true (T) or false (F), for each sentence. Two points are given for each correct answer.

 (1) (2%) The maximum number of nodes in a binary tree with nine levels is 511.

 (2) (2%) If $f_1(n) = O(g(n))$ and $f_2(n) = O(g(n))$, then $f_1(n) = f_2(n)$.

 (3) (2%) The lower bound of worst-case time complexity of comparison-based sorting algorithm is $\Omega(n \log n)$.

 (4) (2%) A bi-connected graph is a connected graph that has two articulation points.

 (5) (2%) Every binary tree can be uniquely defined by its pre-order and post-order sequences.

9. (15%) Please examine each question's four answer options and select the best one. Three points are given for each correct answer.

 (1) (3%) Which sequence will we get if we traverse the following graph with Depth-First Search from node 1? Note that the node with a smaller ID will be considered and visited first.

  a. 1, 12, 10, 6, 11, 2, 9, 5, 4, 3, 7, 8
  b. 1, 5, 8, 11, 12, 9, 7, 2, 6, 10, 3, 4
  c. 1, 12, 11, 8, 5, 10, 7, 6, 2, 9, 4, 3
  d. 1, 5, 9, 2, 6, 7, 8, 12, 10, 11, 3, 4
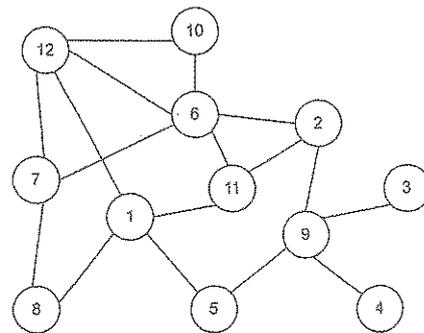
 (2) (3%) What will we get after we heapify the integer array {19, 5, 27, 3, 16, 11, 69, 18} to a Max Heap in $O(n)$ time? Note that we use the bottom-up method.

  a. {69, 27, 19, 18, 16, 11, 5, 3}   b. {69, 18, 27, 5, 16, 11, 19, 3}
  c. {69, 18, 27, 16, 5, 11, 19, 3}   d. {3, 5, 11, 16, 18, 19, 27, 69}

 (3) (3%) Please select the result after we add the integers {89, 70, 52, 4, 25, 99, 59, 20, 79, 62, 44, 38} sequentially to an AVL tree.

c.　　　　　　　　　　　　　　　　　　　　d.
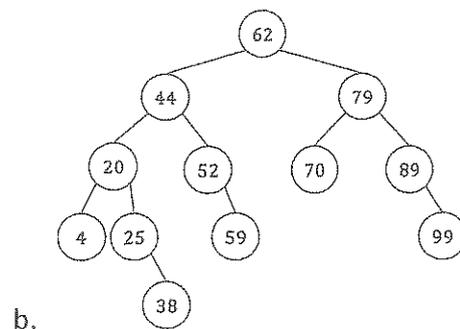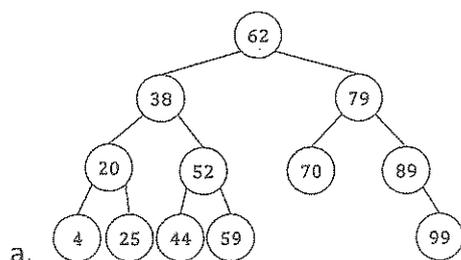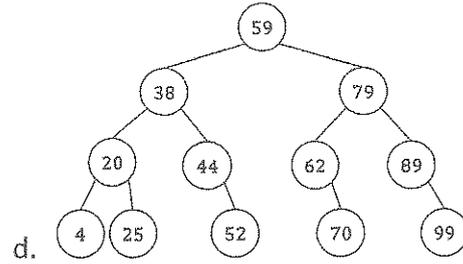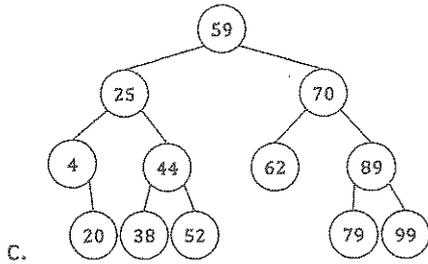
(4) (3%) Please select the correct number of distinct binary trees with 8 nodes.

a. 1430　　　　　　b. 132　　　　　　c. 429　　　　　　d. 4862

(5) (3%) Please select the result after we add the integers {50, 10, 80, 90, 70, 60, 65, 62} sequentially to a red-black tree. Note that the following white and black circles represent the red and black nodes in red-black trees, respectively.


a.　　　　　　　　　　　　　　　　　　　　b.

c.　　　　　　　　　　　　　　　　　　　　d.
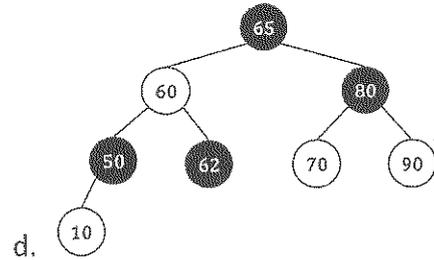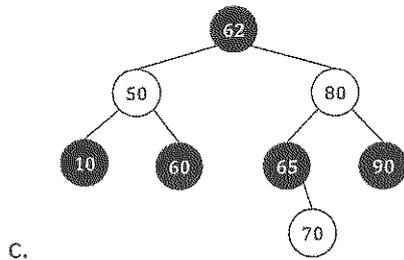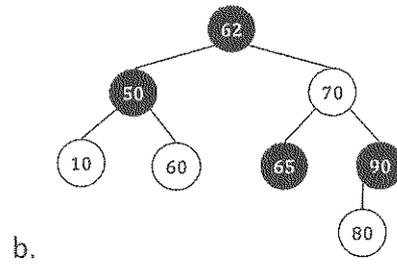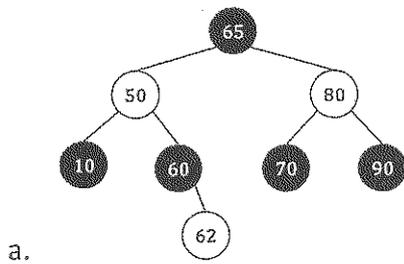
10. (8%) True or False

(a) (2%) Quicksort is asymptotically optimal.

(b) (2%) When sorting N numbers, if a series of pivot selections make the partitioning of Quicksort maximally unbalanced at every recursive level, the corresponding decision tree is a full binary tree.

(c) (2%) Insertion sort is in-place but not stable.

(d) (2%) Counting sort has both stable and in-place properties.

11. (11%) Yes/No questions about the graph at the right side. Write down your reasoning. A simple yes/no answer will not get any point.

(a) (2%) To find a shortest path from node a to node d, is Dijkstra algorithm applicable?

(b) (2%) If all the edges have weight 1, is breadth-first search applicable to find a shortest path from node a to node d?

(c) (2%) If all the edges have weight 1, is topological sort applicable to the graph?

(d) (5%) Reweight the graph to make all the edges nonnegative.
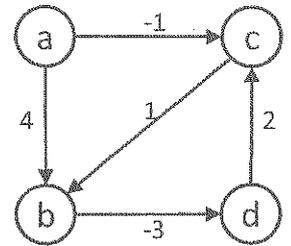
12. (6%) What is the output when applying Ford-Fulkerson algorithm to the following graph? Write down your derivation.