

國立中正大學

114 學年度碩士班招生考試

試題

[第 3 節]

科目名稱	計算機概論(含程式設計)
系所組別	資訊工程學系-乙組

— 作答注意事項 —

※作答前請先核對「試題」、「試卷」與「准考證」之系所組別、科目名稱是否相符。

1. 預備鈴響時即可入場，但至考試開始鈴響前，不得翻閱試題，並不得書寫、畫記、作答。
2. 考試開始鈴響時，即可開始作答；考試結束鈴響畢，應即停止作答。
3. 入場後於考試開始 40 分鐘內不得離場。
4. 全部答題均須在試卷（答案卷）作答區內完成。
5. 試卷作答限用藍色或黑色筆（含鉛筆）書寫。
6. 試題須隨試卷繳還。

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科目名稱：計算機概論(含程式設計)

本科目共 5 頁 第 1 頁

系所組別：資訊工程學系-乙組

1. (5%) Please answer the following **true-or-false** questions and select the correct set of answers from the provided options.
- I. If the height of a tree equals to the number of nodes, the tree is a complete binary tree.
 - II. In a singly linked list, each node has a pointer to both its next and previous nodes.
 - III. The minimum number of nodes in a binary tree of depth 10 is only 10.
- A. False, False, False B. False, False, True C. False, True, False
D. False, True, True E. True, False, False F. True, False, True
G. True, Ture, False H. Ture, True, True
2. (5%) Please answer the following **true-or-false** questions and select the correct set of answers from the provided options.
- I. Linked lists are better than arrays for random access operations.
 - II. In a queue, insertion occurs at the front and deletion occurs at the rear.
 - III. A binary tree with n nodes has exactly $n-1$ edges.
- A. False, False, False B. False, False, True C. False, True, False
D. False, True, True E. True, False, False F. True, False, True
G. True, Ture, False H. Ture, True, True
3. (5%) Please answer the following **true-or-false** questions and select the correct set of answers from the provided options.
- I. Finding an arbitrary element in a heap with n elements takes $O(\log n)$ time in the worst case.
 - II. Merge sort is a stable sorting algorithm.
 - III. If there are negative edges in a graph, but no negative cycles, Dijkstra's algorithm still runs correctly.
- A. False, False, False B. False, False, True C. False, True, False
D. False, True, True E. True, False, False F. True, False, True
G. True, Ture, False H. Ture, True, True
4. (5%) Please answer the following **true-or-false** questions and select the correct set of answers from the provided options.
- I. The time complexity of bubble sort in the worst case is $O(n \log n)$.
 - II. Quick sort as a worst-case time complexity of $O(n^2)$.
 - III. In an AVL tree, the height difference between the left and right subtrees of any node cannot exceed 2.

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科目名稱：計算機概論(含程式設計)

本科目共 5 頁 第 2 頁

系所組別：資訊工程學系-乙組

- A. False, False, False B. False, False, True C. False, True, False
 D. False, True, True E. True, False, False F. True, False, True
 G. True, Ture, False H. Ture, True, True

5. (5%) Please answer the following **true-or-false** questions and select the correct set of answers from the provided options.

- I. The adjacency matrix representation of a graph is more memory-efficient than the adjacency list for sparse graphs.
 II. Breadth-first search (BFS) always finds the shortest path in weighted graphs.
 III. A new node that is inserted into a binary search tree is not always at a leaf node.

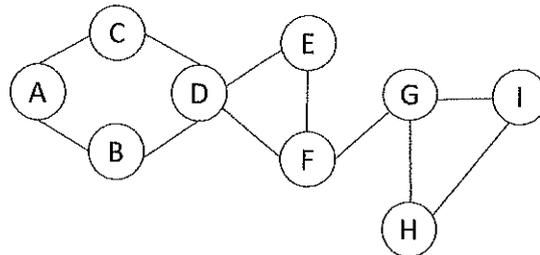
- A. False, False, False B. False, False, True C. False, True, False
 D. False, True, True E. True, False, False F. True, False, True
 G. True, Ture, False H. Ture, True, True

6. (5%) Given the fully parenthesized arithmetic expression provided below, construct its expression tree and answer the level-order traversal of the tree.

$$((((A * B) - (C * D)) - (E / F)) + G) - (H / I)$$

- A. -+/-GHI-/*EFABCD
 B. -+---*AB*/CDEFG/HI
 C. -+---*AB*CD/EF G/HI
 D. -+//GHI-F*E-D*CAB
 E. None of the above

7. (5%) What are the output value of the $low(v)$ for each vertex v (in the order of $A, B, C, D, E, F, G, H, I$) in the given graph, when determining articulation points? As part of the process of computing depth-first numbers, you must start with vertex A and select the one with the smaller alphabetical order first when performing the depth-first search.

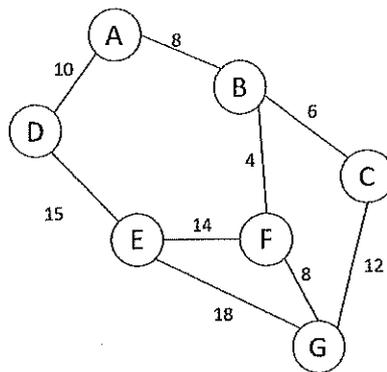


- A. (1, 1, 1, 1, 3, 3, 6, 6, 6)
 B. (1, 1, 1, 1, 1, 1, 1, 1, 1)
 C. (1, 1, 1, 3, 3, 3, 6, 6, 6)
 D. (1, 1, 1, 3, 3, 3, 1, 1, 1)
 E. None of the above

8. (5%) Please find the articulation points in the graph provided in the previous question.

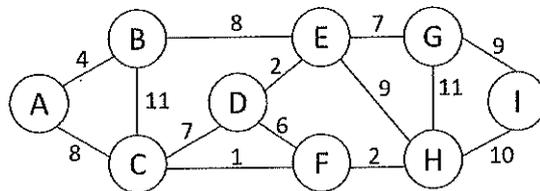
- A. (A, C, E, G)
- B. (B, F, G, I)
- C. (A, B, G)
- D. (D, F, G)
- E. None of the above

9. (5%) Find the vertices in order while performing **Dijkstra algorithm** on the graph below, starting from source vertex *A*. If two unvisited vertices have the same distance during the algorithm, choose the vertex with the smaller alphabetical order first.



- A. (A, D, B, E, F, C, G)
- B. (A, B, F, G, C, D, E)
- C. (A, D, B, F, G, C, E)
- D. (A, B, D, F, C, G, E)
- E. None of the above

10. (5%) Find the sequence in which Prim's algorithm adds edges to the minimum spanning tree for the graph shown below, starting with vertex *A*. If two unvisited vertices have the same cost during the algorithm, chose the one with the smaller alphabetical order. Use the format (node1, node2) to represent each edge.



- A. (C, F), (D, E), (F, H), (E, H), (A, B), (E, G), (A, C), (G, I)
- B. (A, B), (B, E), (E, D), (D, F), (C, F), (F, H), (H, I), (G, I)
- C. (A, B), (A, C), (C, D), (C, F), (D, E), (F, H), (E, G), (G, I)
- D. (A, B), (B, E), (D, E), (E, H), (F, H), (C, F), (E, G), (G, I)
- E. None of the above

11. (10%)

- (a) (3%) Convert the binary value 1101011.01 to base ten.
- (b) (3%) Convert the base ten number 17.625 to binary value.
- (c) (4%) Find the two's complement representation for the base ten number -120, assuming it is represented as a 16-bit number. Write the value in hexadecimal.

12. (16%) What is the output of each program?

```
#include <stdio.h> (1)
void func(int k, char* value)
{
    value[k] = 'A';
    k = k + 1;
}
int main(void)
{
    int key;
    char data[]="abcde";
    key = 2;
    func(key, data);
    printf("%d %s\n", key, data);
    return 0;
}
```

```
#include <stdio.h> (2)
void func(int* k, char* value)
{
    value[*k] = 'A';
    *k = *k + 1;
}
int main(void)
{
    int key;
    char data[]="abcde";
    key = 2;
    func(&key, data);
    printf("%d %s\n", key, data);
    return 0;
}
```

```
#include <iostream> (3)
#include <string>
void func(int &k, std::string value)
{
    value[k] = 'A';
    k = k + 1;
}
int main(void)
{
    int key;
    std::string data("abcde");
    key = 2;
    func(key, data);
    std::cout << key << " " << data << std::endl;
    return 0;
}
```

```
def func(k, value): (4)
    value[k] = 'A'
    k = k + 1
data=list("abcde")
key = 2
func(key, data)
print(key, "".join(data))
```

- (a) (4%) The program in (1) is written in C. What is the output of the program?
- (b) (4%) The program in (2) is written in C. What is the output of the program?
- (c) (4%) The program in (3) is written in C++. What is the output of the program?
- (d) (4%) The program in (4) is written in Python. What is the output of the program?

13. (12%) The following code fragment are 32-bit ARM instructions, where r0, r1, and r2 are 32-bit general-purpose registers. The table gives a description of the instructions. The immediate value is represented by a hexadecimal value with a leading "0x". Assume that r1 is 0x100 and r0 is 0x12345678.

```
STR  r0, [r1]    /* S1 */
LDRB r2, [r1]    /* S2 */
```

Instruction	Description
LDRB Rt, [Rn]	Load the register Rt with a byte-sized value from the memory address specified by Rn.
STR Rt, [Rn]	Store the word-sized value from the register Rt into the memory address specified by Rn.

- (a) (6%) In a **little-endian**, byte-addressable memory system, after executing the code fragment, what are the contents of the memory addresses 0x100, 0x101, 0x102, and 0x103? Additionally, what is the value of the register r2? Provide your answer in hexadecimal.
- (b) (6%) In a **big-endian**, byte-addressable memory system, after executing the code fragment, what are the contents of the memory addresses 0x100, 0x101, 0x102, and 0x103? Additionally, what is the value of the register r2? Provide your answer in hexadecimal.

14. (12%) Consider the following control-flow graph, with entry node 1.

- (a) (4%) What are the dominators of node 4?
- (b) (4%) Which nodes are dominated by node 6?
- (c) (4%) What is its dominator tree?

