

考 試 科 目	計算機概論	系 別	資管系/ 資管組	考 試 時 間	2 月 23 日 第 1 節
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I Answer Yes (O) or No (X) for the following descriptions (30%):

1. 28 in a binary representation is 11100
2. Number overflow occurs when the value cannot fit into the number of bits we have allocated for the result
3. A binary search on a sorted array (n elements) take  $O(\log n)$  time
4. To sort n elements, adopting merge sort algorithm takes  $O(n \log n)$  space; while adopting selection sort takes  $O(n)$  space
5. In object-oriented design, an object is a specific combination of data and the methods that can process and communicate that data. The type of an object is defined by a class
6. The type of fields can be different among different instances (objects) from the same generic class
7. In java, the “friendly” class modifier describes a class that can only be used by the classes in the same package
8. In java, the “protected” variable modifier indicates that only methods of the same class (not methods of a subclass) can access instance variables
9. With Abstract Data Type, we know what the operations are and what they do, but not how the operations are implemented
10. Inheritance allows the design of general classes to be specialized to more particular classes with code reused
11. An interface is a collection of method declarations with no data and no bodies
12. The height of a tree is the maximum depth of its node, where the depth of a node is the number of its ancestors
13. The minimum spanning tree of a weighted graph may not include the edge that has the minimum weight
14. In a min-heap, any value in the left subtree of a node is less than any value in the right subtree of the

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<p>same node</p> <p>15. Add(k) (add a node with key k) takes <math>O(n)</math> time in a balanced binary search tree with n nodes.</p> <p>16. An AVL tree is a binary search tree where for every internal node, the heights of its children have at most one difference.</p> <p>17. Multiple entries with the same key are allowed in dictionaries but not in maps</p> <p>18. While using an array to implement a map, get(k) (find the entry with the key k) takes <math>O(1)</math> time</p> <p>19. While using an array to implement a map, remove(k) (remove the entry with the key k) takes <math>O(1)</math> time</p> <p>20. A skip list is a series of lists where each list has only fewer (or equal) and overlapped elements of its previous list</p> <p>21. In a (randomized) skip list with n entries, the expected space complexity is <math>O(n^2)</math></p> <p>22. An edge in a graph is a self loop if it has the same end vertices</p> <p>23. A list-based queue takes <math>O(n)</math> time for dequeue() and enqueue() when the first element of the queue is implemented as the tail of the singly linked list.</p> <p>24. A list-based stack takes <math>O(n)</math> time for push(k) and pop() when the top of the stack is implemented as the tail of the singly linked list</p> <p>25. A "static" variable in Java is declared as a variable that is associated with an individual instance (object) of the class.</p> <p>26. According to Big-Oh rules, <math>8929 n \log n + 300 n^2</math> is <math>O(n \log n)</math></p> <p>27. A graph consists of a set of vertices and a set of edges; both can be used to store elements</p> <p>28. The number of edges in an directed graph is less or equal to <math>n(n-1)/2</math> (n is the number of vertices in the graph)</p> <p>29. Checking whether an edge is incident to a vertex can be done in <math>O(n)</math> time in an edge-list graph</p>					

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30. Removing an edge in an adjacency-matrix graph takes  $O(1)$  time ( $n$  is the number of vertices in the graph)

II Answer the following questions (70%):

1. Describe the **output** for the following sequence of

1.1. (5%) Stack operations: push(7), push(5), pop(), push(8), pop(), pop(), pop()

1.2. (5%) Queue operations: enqueue(9), enqueue(5), dequeue(), enqueue(3), dequeue()

1.3. (5%) Deque operations: addFirst(2), addFirst(9), addLast(6), addLast(5), first(), removeLast(), last(), removeFirst()

2. (20%) Consider a hash table storing integer keys that handles collision with **double hashing**. Let  $N=17$ . Let  $h(k) = k \bmod 17$  be the hash function, and  $d(k) = 13 - (k \bmod 13)$  be the second hash function for collision. Show the result step by step while inserting the following keys: 9, 29, 28, 19, 6, 2, 23, 8, 25, 26, 33, 36, 50

3. Bob plans to build connections of Taiwan. Below is the cost between two places (undirected).  
 (Taipei, Kaoshinug, 650), (Taipei, Taidong, 750), (Taipei, Hualian, 500), (Hualian, Taidong, 350),  
 (Hualian, GreenIsland, 850), (Taidong, Kaoshiung, 450), (Taidong, GreenIsland, 800), (Kaoshiung, Kenting, 400), (Taidong, Kenting, 300), (Taipei, Taichung, 400), (Taichung, Nanto, 300), (Nanto, Hualian, 400).

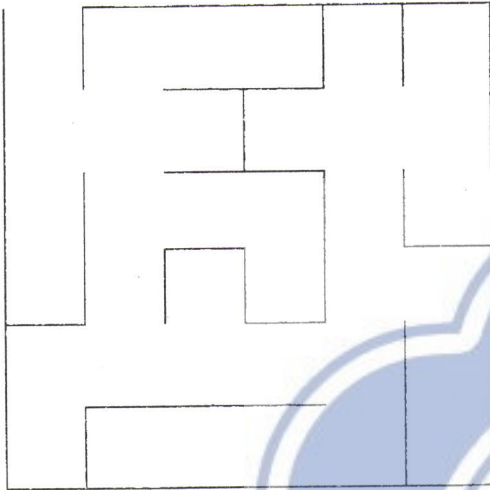
3.1 (10%) Please help Bob find the way that covers all the places with the **minimum cost**.

3.2 (15%) Describe your algorithm with pseudo code.

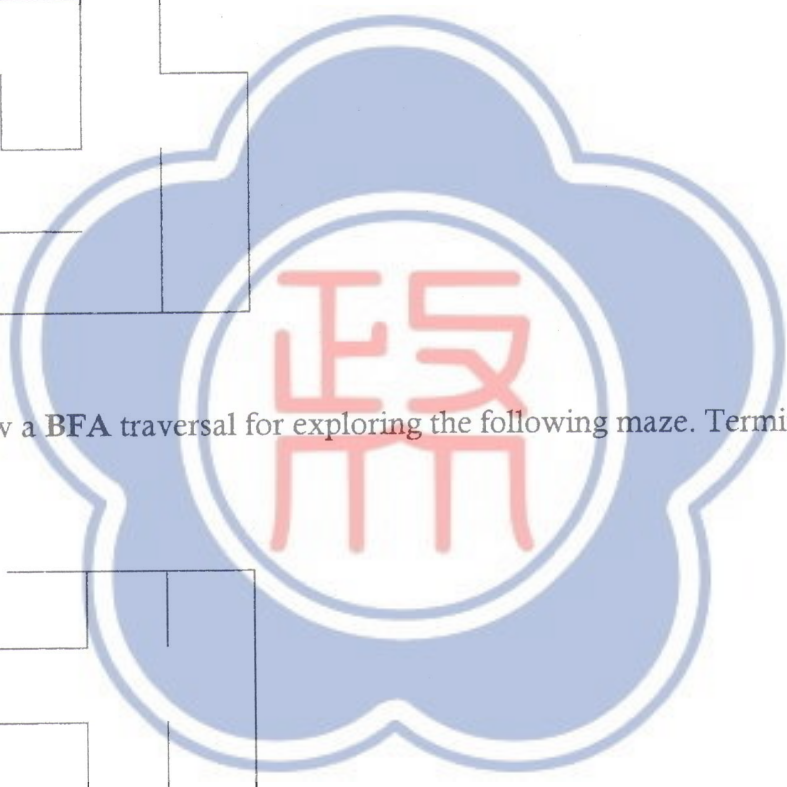
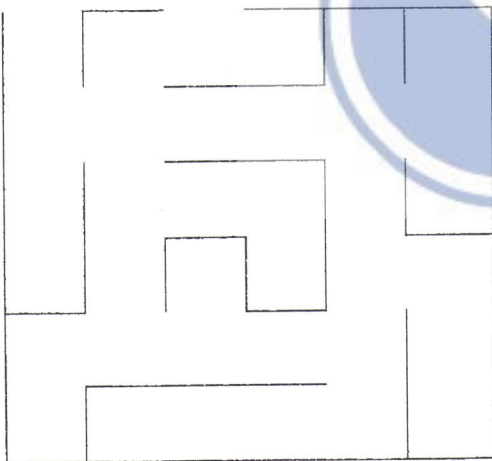
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4. Graph Traversal

4.1 (5%) Draw a **DFA** traversal for exploring the following maze. Terminate when getting out.



4.2 (5%) Draw a **BFA** traversal for exploring the following maze. Terminate when getting out.



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1. Present a case of strategic information systems and analyze its impact on business performance. (15%)
2. Should all major retailing and manufacturing companies switch to RFID? Why or why not? (15%)
3. How can organizations take advantage of social networks? What are the costs and benefits of the investment of social networks? Please give case examples to support your answer. (20%)
4. If you were setting up the Web site for an organic food store, what management, organization, and technology issues might you encounter? And, how are you going to implement this project? (20%)
5. Draw a flowchart depicting the information flow and cash flow of purchasing a high speed rail tickets on the MMK (Multi Media Kiosk) with POS (point of sales) in a convenience store. (15%) Analyze the applications and impacts of the MMK in retail industry. (15%) The MMK is called as ibon in 7/11, FamiPort in Family Mart and Life-ET in Hi-Life.

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考試科目：計算機概論

考題分三部分：一、程式設計部分，二、資料庫部分，三、訊息傳遞技術部分。

一、程式設計部分（可採用任何程式語言，但希望優先採用 Java 或 C#）

1. Singleton pattern 是一種設計樣型 (design pattern)，singleton pattern 保證一個類別只會有一個實例。請撰寫一個類別 A 符合 singleton pattern 的要求。(20%)

2. Command pattern 是一種設計樣型，維基百科對 command pattern 的定義如下：

In object-oriented programming, the command pattern is a behavioural design pattern in which an object is used to represent and encapsulate all the information needed to call a method at a later time. This information includes the method name, the object that owns the method and values for the method parameters.

請撰寫一個類別 B，符合 command pattern 的要求。(25%)

3. 請整合上述 singleton pattern 以及 command pattern，撰寫一個類別 C，成為服務的單一入口。(20%)

二、資料庫部分

4. 試以「老師開多門課，一門課有多位學生選修，一位學生會選修多門課」為例，說明實體關係模型中「一對多」、「多對多」的處理方法，並繪出上例之實體關係圖。(20%)

三、訊息傳遞技術部分

5. 試說明 JSON 傳輸格式，並比較 JSON 與 XML 的優劣。(15%)

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註 試題隨卷繳交

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I Answer Yes (O) or No (X) for the following descriptions (30%):

1. A list-based queue takes  $O(1)$  time for `dequeue()` and `enqueue()` when the first element of the queue is implemented as the head of the singly linked list.
2. A list-based stack takes  $O(1)$  time for `push(k)` and `pop()` when the top of the stack is implemented as the head of the singly linked list.
3. A “static” variable in Java is declared as a variable that is associated with the class, not with an individual instance (object) of the class.
4. According to Big-Oh rules,  $10000 n \log n + 4000 n^2$  is  $O(n \log n)$ .
5. Two vertices in a graph are adjacent if there exists an edge having these two vertices as its end vertices.
6. The sum of the degrees of all vertices is equal to the number of edges in a graph.
7. The number of edges in an undirected graph is less than  $n(n-1)$  ( $n$  is the number of vertices in the graph).
8. Checking whether two vertices are adjacent can be done in  $O(1)$  time in an adjacency-matrix graph.
9. Checking whether an edge is incident to a vertex can be done in  $O(1)$  time in an edge-list graph.
10. Removing an edge in an adjacency-matrix graph takes  $O(n)$  time ( $n$  is the number of vertices in the graph).
11. The type of fields can be different among instances from the same generic class.
12. A tree is a connected graph with cycles.
13. The height of a tree is the maximum depth of its node, where the depth of a node is the number of its descendants.
14. The minimum spanning tree of a weighted graph must include the edge that has the minimum weight.
15. The idea of “Greedy approach” is to find the optimum solution by exhaustively searching all possible

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solutions

16. The idea of “Dynamic Programming” is to divide the problem into sub problems that can be solved independently, and conquer the results of sub problems, e.g., merge sort
17. In a min-heap, any value in the left subtree of a node is less than any value in the right subtree of the same node
18. A postorder traversal of a binary search tree visits the keys in an increasing order
19. A preorder traversal of a binary search tree visits the keys in a decreasing order
20. Remove(k) (remove a node with key k) takes  $O(n)$  time in a balanced binary search tree with n nodes.
21. An AVL tree is a binary search tree where for every internal node, the heights of its children have at most one difference.
22. In a splay tree, splaying a node means moving the node to the root
23. Multiple entries with the same key are allowed in dictionaries but not in maps
24. While using an array to implement a map, get(k) (find the entry with the key k) takes  $O(n)$  time
25. While using an array to implement a map, remove(k) (remove the entry with the key k) takes  $O(n)$  time
26. In a hash table, collision occurs when the same element is mapped to different cells
27. Separate chaining handles collisions on a hash table by putting the colliding items in the next available table cell
28. A skip list is a series of lists where each list has no overlapped elements
29. In a (randomized) skip list with n entries, the expected search, insertion and deletion time is  $O(n \log n)$
30. Two edges in a graph are parallel if they have different end vertices.

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II Answer the following questions (70%):

1. (20%) Parenthesis matching is checking whether a sequence has all its grouping symbols matched. E.g., for an expression  $(5+3)*(3+6)$ , the sequence is  $(, 5, +, 3, ), *, (, 3, +, 6, )$ . The grouping symbols are  $(, )$ ,  $(, )$ , and are matched in this case. Complete the following pseudo code of Parenthesis Matching using **stack**.

**Algorithm** ParenMatch(X,n):

**Input:** An array X of n tokens, each of which is either a grouping symbol, a variable, an arithmetic operator, or a number

**Output:** true if and only if all the grouping symbols in X match

2. Evaluate and represent an arithmetic expression:

- 2.1 (10%) Represent the expression  $7 * 5 + 8 < 15 - 9 * 2 + 10$  using a binary tree. (An internal node stores an operator, e.g.,  $*$ ,  $+$ , and an external node stores a value, e.g., 7, 2.)
- 2.2 (10%) Complete the following pseudo code that prints a binary tree expression with correct parentheses, i.e.,  $((7 * 5) + 8) < ((15 - (9 * 2)) + 10)$ .

**Algorithm:** printExpression(T, v)

**Input:** A binary tree T and a node v in T

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3. Multiply  $n$  elements in an array  $A$ .

3.1 The first idea is using a loop that iteratively times the value of each element to result.

(10%) Write the pseudo code and analyze its time complexity.

**Algorithm:** IterativeMultiply( $A, i, n$ ):

**Input:** an array  $A$  and two integers  $i$  and  $n$

**Output:** The multiplication of  $n$  consecutive elements in  $A$  (start from the index  $i$ )

3.2. The second idea is to divide  $n$  elements to two parts, recursively multiply the first half of  $A$  and multiply the second half of  $A$ , and then multiply the two results together.

(10%) Write the pseudo code of BinaryMultiply().

(10%) Analyze the time complexity with its recurrence equation.

**Algorithm:** BinaryMultiply( $A, i, n$ ):

**Input:** an array  $A$  and two integers  $i$  and  $n$

**Output:** The multiplication of  $n$  consecutive elements in  $A$  (start from the index  $i$ )

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試題隨卷繳交