

國立中央大學 114 學年度碩士班考試入學試題

系所： 資訊管理暨大數據分析類

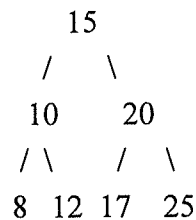
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科目： 資料結構

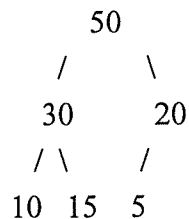
*本科考試禁用計算器

【題型說明：皆依題意為問答題或程式設計題】

1. Explain how to detect a cycle in a singly linked list by fast and slow pointers. What is the time and space complexity of your approach? Write a C++ style pseudocode. (12%)
2. Given the following binary search tree (BST):



- (a) Perform an in-order traversal of the tree and write down the sequence of values. (5%)
 - (b) If you delete the node with value 15, explain step by step how the BST is restructured. (5%)
3. You are given the following max-heap:



- (a) Perform the insertion of the value 60 into the heap and explain the steps to maintain the max-heap property. (5%)
- (b) After the insertion, remove the maximum element from the heap. Explain the process of restoring the max-heap property after the removal. (6%)

注意:背面有試題

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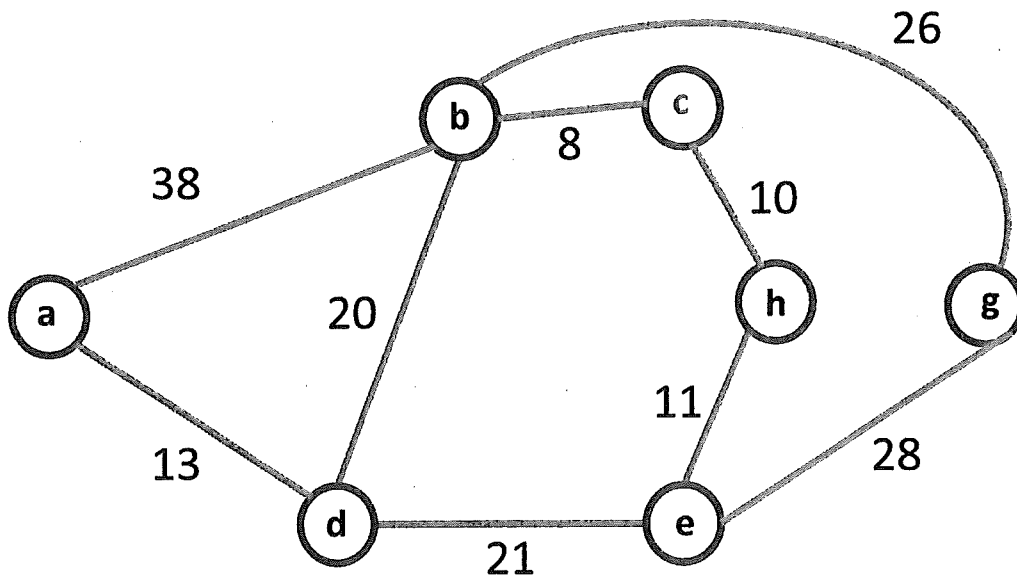
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4. Consider the following graph.

- (a) Without considering the edge weight, please draw DFS and BFS spanning tree (Start from b, and visited in the lexical order). (6%)
- (b) Please show the order in which the edges are added to the minimum cost spanning tree using Kruskal's algorithm (6%), and what is the sum of all the edge weights in the computed minimum spanning tree (2%).
- (c) Please show the order in which the edges are added to the minimum cost spanning tree using Prim's algorithm (6%) and what is the sum of all the edge weights in the computed minimum spanning tree (2%).



5. Assuming a three-dimensional array $C[1:4,1:5,1:6]$, where the first element $C[1,1,1]$ is located at memory address 1344. Each element occupies 2 bytes. Answer the following questions:
- (a) If **row-major order** is used, what is the address of $C[3,4,5]$? (3%)
 - (b) If **column-major order** is used, what is the address of $C[3,4,5]$? (3%)
6. Given $A=3, B=4, C=5, D=7, E=9, F=-12$.
Let the value of the postfix expression: $AB+D*EFAD*+ / +C+$ by x . Then, $x \bmod 7 = ?$ (5%)

注意:背面有試題

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7. File systems often rely on tree-based structures for efficient storage and data retrieval. B-trees and B+ trees are two commonly used data structures in this context.
- (a) Describe two scenarios where a B-tree might be preferred over a B+ tree in file systems. (8%)
- (b) Consider a scenario where a file system needs to handle both frequent point lookups and range queries. Would you recommend a B-tree or a B+ tree? Justify your answer by evaluating the trade-offs between these structures in terms of: (9%)
- Space efficiency.
 - Read/write performance.
 - Complexity of maintaining the structure during insertions and deletions.
8. How does the choice of block size (node size) affect the performance of B-tree and B+ tree in file systems? (7%)
9. Here is a file index stored in a B-tree structure with a minimum degree of 3. Illustrate the result of each insertion operation for the following keys: 26, 29, 2, 10, 9. Write your answers in the following format: (10%)

Operation 1: insert 26

...

Operation 2: insert 29

...

...

Operation 5: insert 9

...

