

Due: December 16, 2025, 17:00 (Room R1102)

Important Notice: You must print this take-home quiz and write your answers by hand with a pen.

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Q1 Figure	Q2 Figure
<pre> graph TD 0 --- 1 0 --- 2 0 --- 3 1 --- 4 1 --- 5 2 --- 6 3 --- 7 </pre>	<pre> graph TD - --- + - --- 3 + --- x + --- 3 + --- 4 + --- 10 3 --- 2 </pre>

Q1. (30 pts) Explain Breadth-First Search (BFS) on the graph and provide the BFS traversal order for the graph shown in Q1 Figure.

A1:

Explain: BFS 是一種「由近到遠、逐層走訪」的圖搜尋方法，從起始節點開始，先拜訪距離為1的節點，再拜訪距離為2的節點，依此類推，通常使用 Queue (併列) 來實作。從起始節點0出發，最少要走幾條邊才能到達

BFS traversal order: 0 → 1 → 2 → 3 → 4 → 6 → 5 → 7
距離: 0 1 1 1 1 2 2 2

* Nodes at the same level may be visited in different orders depending on the enqueue order.

Q2. (30 pts) In tree traversal, one common method is inorder traversal. Please use inorder traversal to print the arithmetic expression represented by the expression tree in Q2 Figure, and then evaluate it to compute the final result.

A2:

Inorder traversal: 左 → 根 → 右

$$\Rightarrow (3 \times 4) + (10 \div 2) - 3 = 14$$

→ final result: 14 *

Q3. (40 pts) A binary tree is a fascinating data structure with many variations, including binary search trees, AVL trees, red-black trees, complete binary trees, and max/min heaps. These variations can be classified as shape-based (structural constraints) or criteria-based (rules such as ordering). Choose one shape-based tree and one criteria-based tree, and provide a brief description of each.

A3:

Shape-based: Complete Binary Tree

1. 除了最後一層外，每一層都是滿的。
2. 最後一層的節點由左至右填滿。
3. 常用於 heap 的實作

Criteria-based: Binary Search Tree

1. 左子樹的所有節點 $<$ 根節點
2. 右子樹的所有節點 $>$ 根節點
3. Inorder (中序走訪) 會得到遞增排序結果