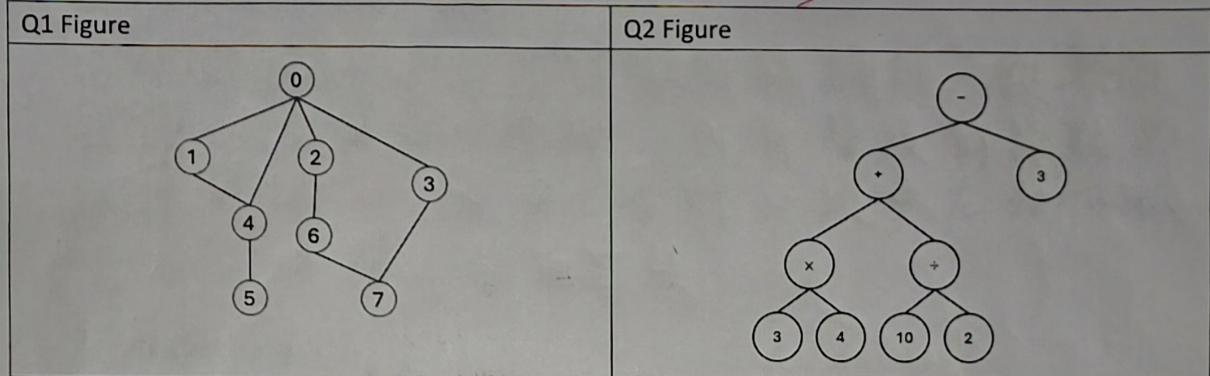


Due: December 16, 2025, 17:00 (Room R1102)

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

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

A1: BFS 會從起始點開始，走訪其直接鄰居的點，接著再走訪它們的鄰居...

$0 \rightarrow 1 \rightarrow 2 \rightarrow 3 \rightarrow 4 \rightarrow 6 \rightarrow 7 \rightarrow 5$

$$0 \Rightarrow [1, 2, 3, 4]$$

$$1 \Rightarrow [2, 3, 4]$$

$$2 \Rightarrow [3, 4, 6]$$

$$3 \Rightarrow [4, 6, 7]$$

$$4 \Rightarrow [6, 7, 5]$$

$$6 \Rightarrow [1, 5]$$

$$7 \Rightarrow [5]$$

$$5 \Rightarrow []$$

1. 使用 Queue

2. 從指定 node 開始

3. 一層一層走訪

4. 確定當前 node 的鄰居都走訪後，才會繼續

5. 走訪過的節點進行標記
避免再次訪問

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:

$$3 \times 4 = 12 \quad 10 \div 2 = 5$$

$$12 + 5 = 17$$

$$17 - 3 = 14$$

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:

1. Shape-based

Complete Binary Tree

它的定義取決於節點的結構排列，與數值無關。除最後一層外，所有層級的節點都必須被填滿，最後一層則必須由左向右依序填入。中間不得有空缺。

2. Criteria-based

Binary Search Tree

它的定義取決於節點數值大小，形狀不受限。其左子節點填入比父節點小之數值，而右子節點則反之。