Course: Data Structures (CSE CS203A, 114-1)
Take-Home Quiz IV: Tree/Heap/Graph

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

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

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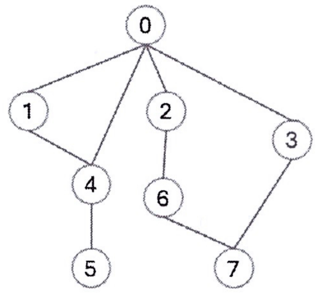
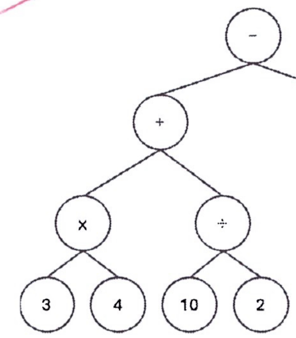
Q1 Figure	Q2 Figure
	

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: Breadth-First Search (BFS) 廣度優先搜尋是一種圖的走訪方式

※特點：1. 先拜訪離起點最近的所有節點 2. 再一層一層向外擴展（用 Queue）

① 起點：0 ② 第一層：1、2、3、4 ③ 第二層：2→6，3→7、4→5

※ BFS Traversal Order： revisiting

18 0（起點）→ 1 → 2 → 3 → 4 → 6 → 7 → 5 ※

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（中序走訪）：Left subtree（左子樹）→ Root（節點）→ Right subtree（右子樹）

※ 內部節點：運算子（+、−、×、÷），葉節點：數字 ∴ 中序走訪可以把 tree → 中序運算式

Root：−

Left subtree：+ { left：×（3，4） right：÷（10，2）

Right subtree：3

⇒ （3×4）+（10÷2）− 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 tree (形狀導向) : Complete Binary Tree 完全二元樹

⇒ 重點在於「樹長得怎樣」，不管數值大小順序

⇒ 除了最後一層，其他都滿，最後一層節點要由左到右填

⇒ 常見於 "Heap" 也是 criteria-based.

(2) Criteria-based tree (規則導向) : Binary Search Tree (BST) 二元搜尋樹

⇒ 重點在「節點之間必須遵守某些規則 (例如大小關係)」

⇒ 有明確大小規則 (左<根<右)

⇒ 搜尋效率較高 (Average $O(\log n)$)