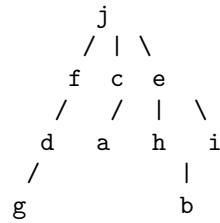# Solutions to Assignment 4 - Part III: Working with Trees

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1 Problem 1: Pre-order and Post-order Traversal

Given Tree:

```
      j
     / | \
    f  c  e
   /  /  | \
  d  a   h  i
 /         |
g          b
```

Pre-order Traversal (Root → Left → Right):

$$j, f, d, g, c, a, e, h, b, i$$

Post-order Traversal (Left → Right → Root):

$$g, d, f, a, c, b, h, i, e, j$$

—

2 Problem 2: Expression Tree for Polynomial

Given polynomial:

$$5y^2 - 3y + 2$$
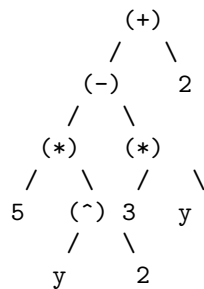
2.1 (a) Prefix Expression (Pre-order)

$$+ - *5^y 2 * 3y 2$$

2.2 (b) Postfix Expression (Post-order)
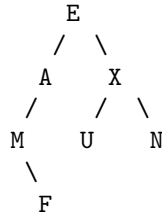
$$5y2^*3y * -2+$$

Expression Tree:

```
        (+)
       /   \
     (-)    2
     / \
   (*)   (*)
  / \   / \
 5  (^) 3  y
    / \
   y   2
```

—

3   Problem 3: Constructing a Binary Tree

Given Traversals: - Preorder: `EXAMFUN` - Inorder: `MAFXUEN`
  Constructed Tree:

```
    E
   / \
  A   X
 /   / \
M   U   N
 \
  F
```

—

4   Problem 4: Binary Search Tree Traversals

Given BST:

```
    100
    / \
  20   200
 / \   / \
10 30 150 300
```
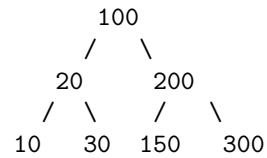
Pre-order Traversal:

$$100, 20, 10, 30, 200, 150, 300$$

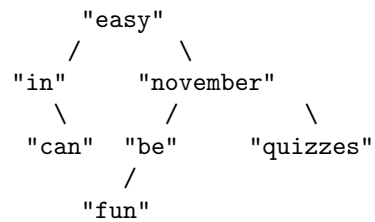**In-order Traversal (Sorted Order):**

$$10, 20, 30, 100, 150, 200, 300$$

Post-order Traversal:

$$10, 30, 20, 150, 300, 200, 100$$

—

5   Problem 5: Transforming a Tree into a BST

Given Tree:

```
    "easy"
   /      \
"in"     "november"
  \       /        \
 "can" "be"      "quizzes"
         /
      "fun"
```
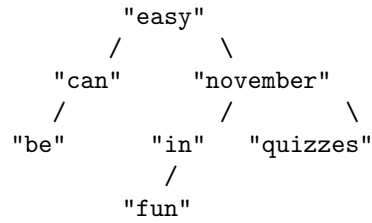
(a) **Pre-order Traversal:**

"easy", "in", "can", "november", "be", "fun", "quizzes"

(b) **Post-order Traversal:**

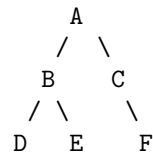"can", "in", "fun", "be", "quizzes", "november", "easy"

(c) **Balanced BST:**

```
       "easy"
      /      \
  "can"      "november"
  /          /         \
"be"      "in"     "quizzes"
           /
        "fun"
```

—

6 Problem 6: Constructing a Binary Tree from Traversals

Given Traversals: - In-order: `DBEAFC` - Pre-order: `ABDECF`

Constructed Tree:
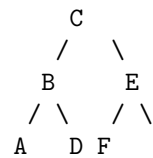
```
    A
   / \
  B   C
 / \   \
D   E   F
```

Post-order Traversal:

$$D, E, B, F, C, A$$
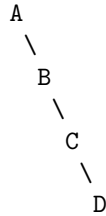
Possible BSTs of Height 2:

```
    C
   /  \
  B    E
 / \  / \
A   D F
```

—

7 Problem 7: Preorder vs. Postorder Relationship

Can preorder and postorder be the same? No, unless it is a single-node tree.

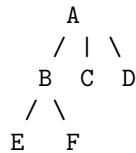**Can preorder be the reverse of postorder?** Yes, in a completely linear tree:

```
   A
    \
      B
       \
         C
          \
            D
```

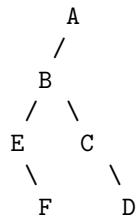where **Preorder** = 'A B C D' and **Postorder** = 'D C B A'.

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8 Problem 8: General Tree Representation as a Binary Tree

Given General Tree T and Converted Binary Tree T':

```
(a) General Tree T:
        A
      / | \
     B  C  D
    / \
   E   F
```

```
(b) Binary Tree T':
        A
       /
      B
     / \
    E    C
     \    \
      F    D
```

8.1 (a) Is a preorder traversal of T' equivalent to a preorder traversal of T?

Yes.

8.2 **(b) Is a postorder traversal of T' equivalent to a postorder traversal of T?**

Yes.

8.3 **(c) Is an inorder traversal of T' equivalent to a standard traversal of T?**

No.