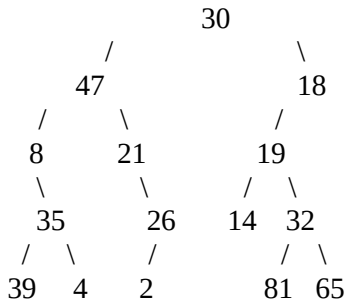
COP 3502 Section 1 Exam 2B – Binary Trees, AVL Trees, Binary Heaps Solution
(Friday 11/17/2023)

1) (10 pts) Write a **recursive** function that counts the number of nodes in a binary search tree that store values in between low and high, inclusive. **For full credit, you must avoid recursively calling the function on any subtree where the answer is guaranteed to be 0 based on simple logic.**

```
typedef struct treenode {
    int data;
    struct treenode *left;
    struct treenode *right;
} treenode;

int numbetween(treenode* root, int low, int high) {

    if (root == NULL) return 0;                                  // 1 pt

    int res = 0;                                                 // 1/2 pt
    if (root->data >= low && root->data <= high) res++;          // 2 pts

    if (low <= root->data)                                       // 1 pt
        res += numbetween(root->left, low, high);                // 2 pts
    if (high >= root->data)                                      // 1 pt
        res += numbetween(root->right, low, high);               // 2 pts

    return res;                                                  // 1/2 pt

}
```

Note: Solution above assumes that repeated values are possible. If they are not, then we can adjust things by 1…grade both assumptions (either repeats are possible or not possible) as valid, so multiple if conditions are acceptable. **Also, just award an integer number of pts. Res initialization and return must both be included to earn that point.**

2) (5 pts) Write out the post order traversal of the binary tree depicted below.



39 , 4 , 35 , 8 , 2 , 26 , 21 , 47 , 14 , 81 , 65 , 32 , 19 , 18 , 30

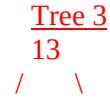
Grading: 1/3 pt per slot, do the floor function (15 correct = 5, 12-14 = 4, 9-11 = 3, etc.)

3) (10 pts) Insert the following values into an initially empty AVL tree. Draw a box around the final tree after each insertion: 2, 13, 27, 22, 26, 40, and 33.

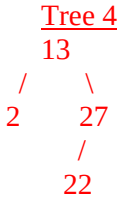
Tree 1

Tree 2

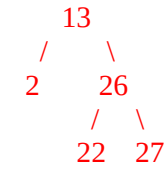
Tree 3



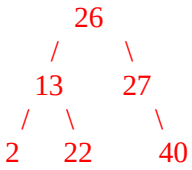
Tree 4



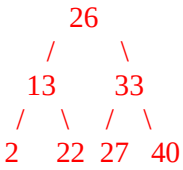
Tree 5



Tree 6



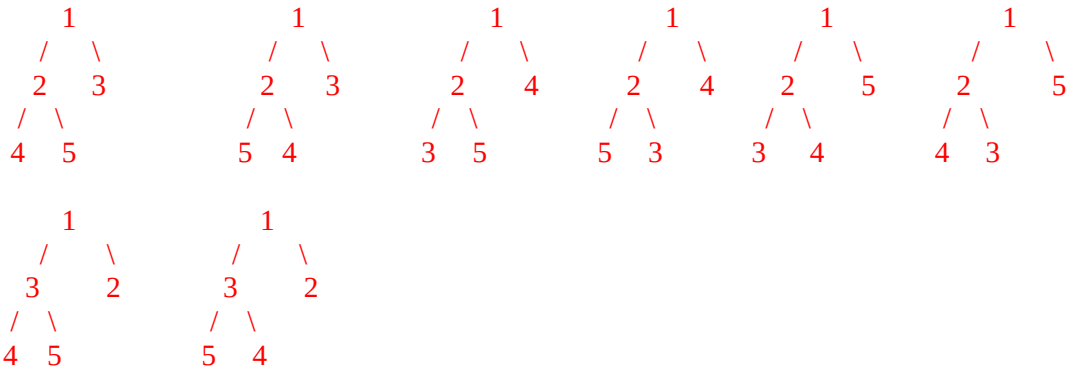
Tree 7



Grading: 1 pt for tree 1
1 pt for tree 2
2 pts for tree 3
1 pt for tree 4
2 pts for tree 5
2 pts for tree 6
1 pt for tree 7

Only give the points for a tree if the tree is exactly correct. (So cascading errors will lose lots of points.)

4) (9 pts) There are eight possible valid binary (minimum) heaps storing the integers 1, 2, 3, 4 and 5. Draw all eight of these possible heaps in a tree form, drawing a box around each of your answers.



Grading: 1 pt per heap, 1 pt bonus pt for getting all 8
-1 pt for each invalid answer, cap score at 0.

5) (1 pt) The Nicholson School of Communication is the first program of building named after a person/couple. What's the last name of that couple?

Nicholson (Give to all)