Binary Trees: Practice Problems

Computer Science Department
University of Central Florida

COP 3502 – Computer Science I

Binary Trees: Practice Problems

- Warmup Problem 1:
  - Searching for a node in a BST

```
int find (struct tree_node *current_ptr, int val) {
        // Check if there are nodes in the tree.
        if (current_ptr != NULL) {
                // Found the value at the root.
                if (current_ptr->data == val)
                        return 1;
                // Search to the left.
                if (val < current_ptr->data)
                        return find(current_ptr->left, val);
                // Or...search to the right.
                else
                        return find(current_ptr->right, val);
        }
        else
                return 0;
}
```

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- Warmup Problem 2:
  - Searching for a node in an arbitrary tree
    - Not a BST
    - Doesn’t have the ordering property

```
int Find(struct tree_node *current_ptr, int val) {
        if (current_ptr != NULL)  {
                if (current_prt->data == val)
                        return 1;
                return (Find(current_ptr->left, val) ||
                        Find(current_ptr->right, val))
        }
        else
                return 0;
}
```

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- Warmup Problem 3:
  - Summing the values of nodes in a tree

```
int add(struct tree_node *current_ptr) {
        if (current_ptr != NULL)
                return current_ptr->data +
                add(current_ptr->left)+ add(current_ptr->right);
        else
                return 0;
}
```

Binary Trees: Practice Problems

- Count Nodes:
  - Write a function that counts (and returns) the number of nodes in a binary tree

```
int count(struct tree_node *root) {
        if (current_ptr != NULL)
                return 1 + count(root->left)+ add(root->right);
        else
                return 0;
}
```

  - Details:
    - If the “root” is not NULL, then the root increases our count
      - Shown by the return of 1
    - We then call count on the left and right subtrees of root

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- Count Leaf Nodes:
  - Write a function that counts (and returns) the number of leaf nodes in a binary tree

```
int numLeaves(struct tree_node *p) {
        if (p!= NULL) {
                if (p->left == NULL && p->right == NULL)
                        return 1;
                else
                        return numLeaves(p->left) + numLeaves(p->right);
        }
        else
                return 0;
}
```

Binary Trees: Practice Problems

- Print Even Nodes:
  - Write a function that prints out all **<u>even</u>** nodes in a binary search tree

```
int printEven(struct tree_node *current_ptr) {
        if (current_ptr != NULL) {
                if (current_ptr->data % 2 == 0)
                        printf("%d ", current_ptr->data);
                printEven(current_ptr->left);
                printEven(current_ptr->right);
        }
}
```

  - This is basically just a traversal
    - Except we added a condition (IF) statement before the print statement

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- Print Odd Nodes (in ascending order):
  - Write a function that prints out all **odd** nodes, in a binary search tree, in ascending order

```
int printOddAsc(struct tree_node *current_ptr) {
        if (current_ptr != NULL) {
                printOddAsc (current_ptr->left);
                if (current_ptr->data % 2 == 1)
                        printf("%d ", current_ptr->data);
                printOddAsc (current_ptr->right);
        }
}
```

  - The question requested **ascending** order
    - This requires an **inorder** traversal
    - So we simply changed the order of the statements

Brief Interlude: FAIL Picture

Binary Trees: Practice Problems

- Compute Height:
  - Write a recursive function to compute the height of a tree
    - Defined as the length of the longest path from the root to a leaf node
    - For the purposes of this problem,
      - a tree with only one node has height 1
      - and an empty tree has height 0
    - Your function should make use of the following struct:

```
struct tree_node {
        int data;
        struct tree_node* left;
        struct tree_node* right;
};
```

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- Compute Height:

```
int height(struct tree_node* root) {

        int leftHeight, rightHeight;

        if(root == NULL)
                return 0;

        leftHeight = height(root->left);
        rightHeight = height(root->right);

        if(leftHeight > rightHeight)
                return leftHeight + 1;

        return rightHeight + 1;
}
```

Binary Trees: Practice Problems

- Find Largest:
  - Write a recursive function that returns a pointer to the node containing the largest element in a BST
    - This one should be easy:
    - This is a BST, meaning it has the ordering property
    - So where is the largest node located
      - either the root or the greatest node in the right subtree
    - Your function should make use of the following struct:

```
struct tree_node {
        int data;
        struct tree_node* left;
        struct tree_node* right;
};
```

Binary Trees: Practice Problems

- Find Largest:

```
struct node* largest(struct tree_node *B) {

       // if B is NULL, there is no node
       if (B == NULL)
              return NULL;
       // If B’s right is NULL, that means B is the largest
       else if (B->right == NULL)
              return B;

       // SO if B’s right was NOT equal to NULL,
       // There is a right subtree of B.
       // Which means that the largest value is in this
       // subtree.  So recursively call B’s right.
       else
              return largest(B->right);
}
```

Binary Trees: Practice Problems

- Number of Single Children:
  - In a binary tree, each node can have zero, one, or two children
  - Write a recursive function that returns the number of nodes with a single child

  - Your function should make use of the following struct:

```
struct tree_node {
        int data;
        struct tree_node* left;
        struct tree_node* right;
};
```

Binary Trees: Practice Problems

- Number of Single Children:

```
int one (struct tree_node *p) {
        if (p != NULL) {
                if (p->left == NULL)
                        if (p->right != NULL)
                                return 1 + one(p->right);
                else if (p->right == NULL)
                         if (p->left != NULL)
                                return 1 + one(p->left);
                else
                                return one(p->left) + one(p->right);
        }
}
```

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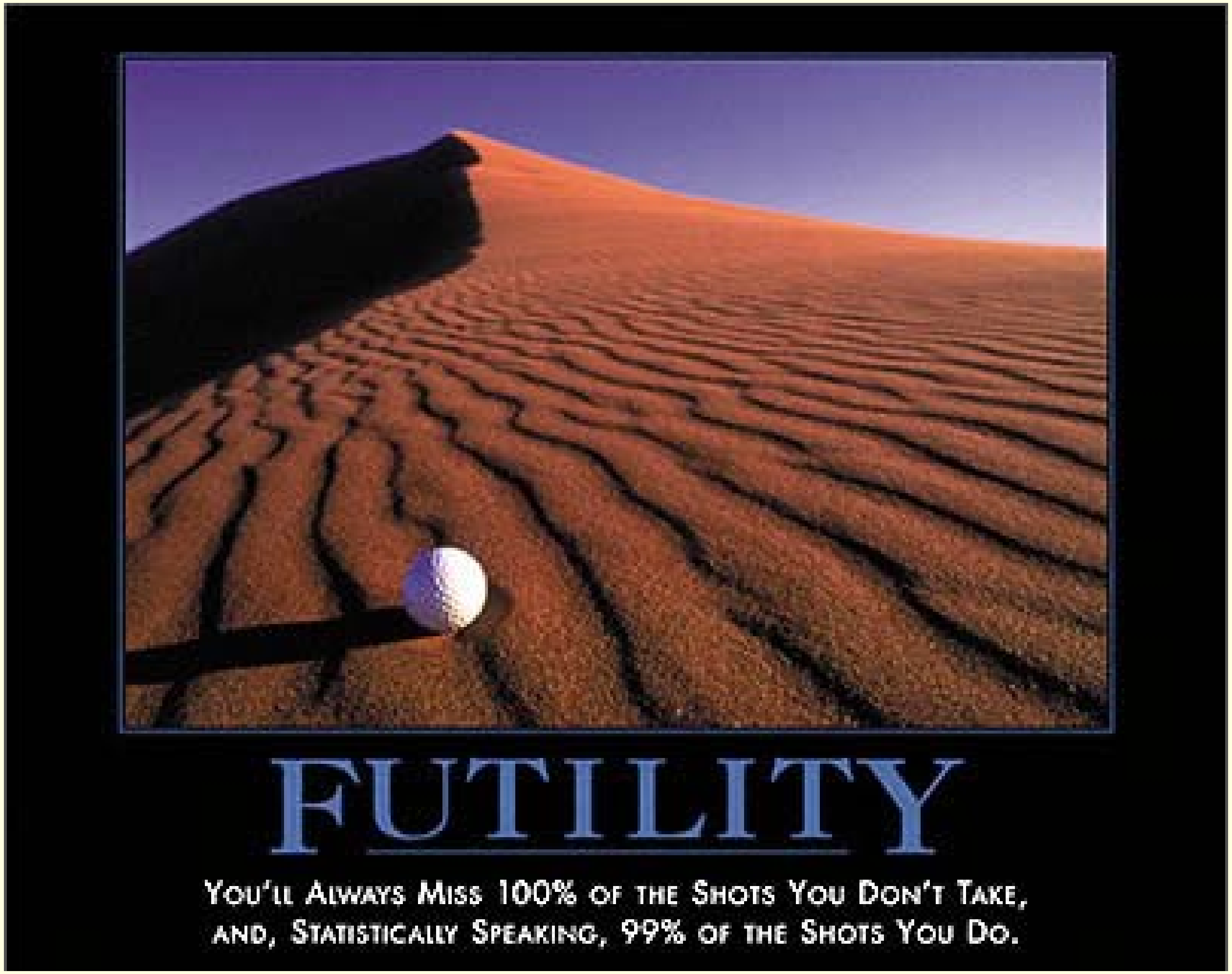
SPICY!

Daily Demotivator



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