CSCI-2725 Homework 3

Yitao Tian

March 17, 2023

Extra credit: There is 5 percentage extra credit if you don't submit hand-written homework (including the diagrams). You can use LaTeX or any other tool to write your homework.

1. (4 points each) **State** the following as true or false.

   (a) Recursive functions often have fewer local variables than the equivalent iterative functions.

   (b) Recursive functions must contain a path that does not contain recursive call.

   (c) Recursive functions are always less efficient than the corresponding iterative functions in terms of Big-O complexity.

2. (6 points each)

```
int fun(int num) {
    if (num < 2) {
        return 1;
    }
    else if (num % 2 == 0) {
        return fun(num / 2);
    }
    else {
        return fun(3 * num + 1);
    }
}
```

(a) How many recursive calls will be made for function call `fun(7)`? Show your work on how you got the number of recursive calls.

(b) How many recursive calls will be made for function call `fun(8)`? Show your work on how you got the number of recursive call.

(c) Do you see any problem in the above function? If so, give justification to your answer.

3. (6 points each) What are the outputs of the following function calls? Show your work to justify your answer.

```
int fun(int k, int n)
{
    if (n == k) { return k; }
    else {
        if (n > k) { return fun(k, n - k); }
        else { return fun(k - n, n); }
    }
}
```

(a) `System.out.print(fun(10,6));`

(b) `System.out.print(fun(7,13));`

4. (6 points) What is the output of the following function call? Show your work to justify your answer.

```
1       void Quiz( int n ) {
2           if (n > 0) {
3               System.out.print("0");
4               Quiz(n - 1);
5               System.out.print("1");
6               Quiz(n - 1);
7           }
8       }
```

`System.out.print(Quiz(2));`

5. (4 points each) **Consider** the binary search tree below (the numbers inside the nodes are not the actual data; they are just numbers labeling the nodes).

   (a) If node 1 is deleted, what node or nodes can replace node 1 in the tree?

   (b) 4 2 7 5 1 6 8 3 is a traversal of the tree in which order?

   (c) 1 2 4 5 7 3 6 8 is a traversal of the tree in which order?

6. (4 points each) **Consider** the following set of input data:

50 72 96 94 107 26 13 11 9 2 10 14 25 51 33 16 95 12

(a) **Draw** a binary search tree using the above input (in the order given).

(b) What nodes are in level 3 of the tree?

(c) **List** all the leaf nodes in the tree.

(d) What is the height of the binary search tree containing this input?

(e) **Give** the output of post-order traversal function called on the above tree.

(f) What is the maximum height of the binary serach tree containing this input?

(g) What is the minimum height of a binary search tree containing this input?

(h) **Draw** the tree after deleting the node containing 94.

(i) **Use** the above tree (from part (h)) and draw the tree after deleting the node containing 13.

(j) **Use** the above tree (from part (i)) and draw the tree after deleting the node containing 50.