Study Questions for Midterm 1, Data Structures & Algorithms

You are welcome to discuss questions and solutions with your classmates or others. I have no solutions to provide but can answer questions you may have.

1. Arrange the following expressions by growth rate from slowest to fastest.

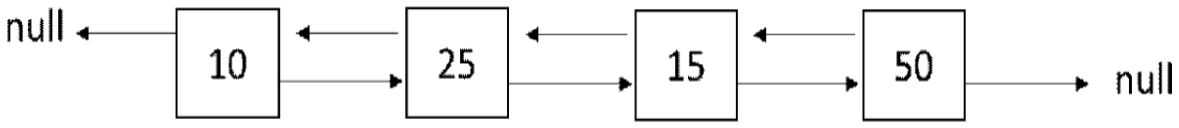
   $4n^2$
   $\log_3 n$
   $n!$
   3^n
   $20n$
   2
   $\log_2 n$
   $n^{2/3}$

2. Using the definition of Big-O and Ω, find the upper and lower bounds for the following expressions.
   a. $37n$
   b. $23n^3 + 88$
   c. $2n\lg n + 10000n$
   d. $0.5*2^n + 10000n^6$

3. Determine the Big-O runtime for this recursive function

```
int foo(int n)
{
   if (n > 1)
   {
         return n + foo(n-1);
   }
   return 1;
}
```

4. Given the doubly linked list below, where `head` points to the node with 10 and `tail` points to the node with 50:



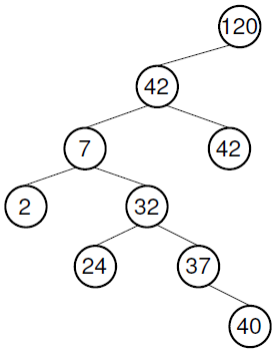
   a. If p is a pointer to the node with the value of 15, give the code that deletes that node from the doubly-linked list.

b. If p is a pointer to the node with the value of 10 and q is a pointer to the node with 25, give the code that swaps those two nodes in the linked list by swapping next/previous pointers (not just copying the value from one node to the other).

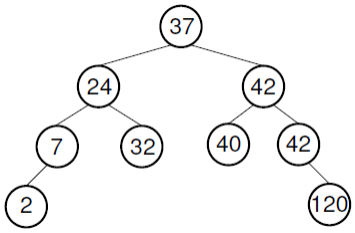
5. Write a recursive function that takes as input a pointer to the root node of a binary tree (pseudocode is fine). The function should return the height of the tree (the height of an empty tree is 0, the height of a tree with one node is 1, etc.)

6. Write a recursive function that takes as input a pointer to the root node of a binary tree (pseudocode is fine). The function should return the number of total leaves in the tree.

7. Given the binary search tree below:



a. List the order the nodes are visited if we use the pre-order traversal algorithm
b. Show the resulting tree if we insert the values 45, 41, and 35
c. Show (using the original tree) how the tree would be reorganized if we delete the node with value 7
d. Given this tree, show how the tree would be reorganized if we delete the root node.



8. Describe a set of characters and frequencies for which the worst case scenario of the Huffman compression scheme that results in the worst/least amount of compression.