Written Problems

1. Order the following functions of \( n \) by their asymptotic growth rates:
   
   (a) \( 2^n \), (b) \( \log_2 n \), (c) \( \binom{n}{5} \), (d) \( n \), (e) \( 5n \), (f) \( 5.0 \), (g) \( n^2 \)

   
2. List the basic operations and behaviors for the following data structures:
   
   (a) lists, (b) queues, (c) stacks, (d) priority queues.

3. Consider the following tree:

   
   
   \[
   \begin{array}{c}
   a \\
   / \quad | \\
   b \\
   / \quad | \\
   e \\
   / \quad | \\
   f \\
   / \quad | \\
   g
   \end{array}
   \]

   (a) Starting from node \( a \) as a root, what is the level-order traversal of this tree?
   (b) Treating the tree as a graph, what is a breadth-first search order starting from node \( d \)?

4. Describe or name (if it has a famous name) an algorithm to solve the following problems in polynomial time, or indicate that it is NP-Hard. If it has a polynomial time algorithm, what is its asymptotic running time?

   (a) Finding the shortest path between any two nodes in a graph
   (b) Finding the shortest path between all pairs of nodes in a graph
   (c) Finding the shortest path through a graph that visits all nodes

Programming Problems

Go to http://courses.cs.vt.edu/cs4804/Fall16/hw0.html to try the python and autograder tutorial.