1 AVL Trees

1. Draw two different AVL trees which contain the same values (1-15) but have different shapes. Label each node with its height, and make sure that both trees are valid AVL trees.

2 2-3-4 Trees

2. Draw a valid 2-3-4 tree that includes the values A-Z.

3 Splay Trees

3. Imagine that we touch the value G in the following tree. Show how the node is splayed to the root; redraw the tree at every step, and list each step as a Zig, Zig-Zig, or Zig-Zag transform.

```
H
/\        \
/  \       /\   \\
/    \     /  \  \\
D L    B F J N
/ \   / \   / \
/  \ /  \ /  \\
A C E G I K M O
```

4 Description Questions

4. (a) Explain why all of the leaves in a B-Tree are always the same distance from the root.

(b) Explain what “amortized time” means. You do not have to prove any particular amortized time claim; instead, explain what exactly it means when we claim that a given algorithm takes $O(lg\ n)$ amortized time. Be sure to make it clear how this is different than ordinary time that we have used in the rest of this course.

(c) Describe how B-Trees and 2-3-4 trees are related to each other. (This should take only a single sentence.)