

Name: \_\_\_\_\_

1. (1 pt.)

- **Read all material carefully.**
- You may refer to your books, papers, and notes during this test.
- No computer or network access of any kind is allowed (or needed).
- Write, and draw, carefully. Ambiguous or cryptic answers receive zero credit.
- Use the conventions used in class and the textbook for notation, algorithmic options, etc.

Write your name in the space provided above.

2. (9 pts.) What is the number of distinct (nonisomorphic) binary min-heaps that hold the five keys: 1, 2, 3, 4, 5? Depict each heap in the usual graphical manner and explain clearly why there are no others. (If the number of heaps too large, you may abbreviate the depiction of the heaps with suitable comments to ensure the result is clear.)

[additional space for answering the earlier question]

3. (10 pts.) Depict the result of inserting the following keys, in the order listed, into an initially empty *bottom-up splay tree*:

3, 5, 7, 1, 4, 2, 8, 9, 0, 6

Depict the state of the tree after each insertion, as well as before and after each rotation. Identify each rotation by annotating the root of the rotated subtree with an asterisk (\*).

[additional space for answering the earlier question]

3, 5, 7, 1, 4, 2, 8, 9, 0, 6

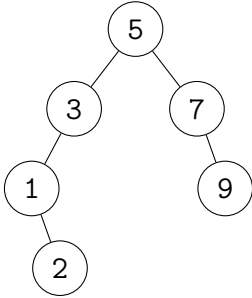
4. (10 pts.) Repeat Question 3 for a *top-down splay tree*. [Reminder: depict the three structures very clearly for each step.]

3, 5, 7, 1, 4, 2, 8, 9, 0, 6

[additional space for answering the earlier question]

3, 5, 7, 1, 4, 2, 8, 9, 0, 6

5. (10 ★ pts.) Is the following tree a valid *bottom-up splay tree*? If not, explain why, and provide a valid bottom-up splay tree that is as similar to it as possible. Otherwise, provide a sequence of operations that generates the given tree starting with an empty tree, and depict the state of the tree after each operation, listing the rotations used.



[additional space for answering the earlier question]