

University of Waterloo

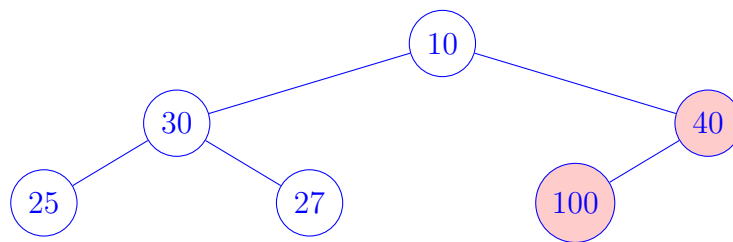
CS240E, Spring 2026

Programming Question 1 **Post-Mortem**

Note that the "hand-marking" in secret test 5's output does not constitute marks - it is a relic from an old version of this programming question. The secret test cases themselves will not be released, but you are welcome to ask more details about the failing tests at office hours.

There were quite a few off-by-one errors, or small errors where some checking loops exit too early. Note that a lot of you test insertion a very large amount, but there's less tests with mass deletion.

One of the most common mistakes is not realizing fix-up requires checking both levels (at least initially when inserting), not just checking grandparents. For example, in the following tree when you insert 100, if you only checked the grandparent condition, $100 > 10$ and it's fine. But $100 > 40$ violates the condition between it and its parent.



Similarly, when fixing down, you can't only go down and check the grandchildren, because the node swapped into the new root can be very large / the node swapped into the child of root can be very small.