CMPT 307-08-2 Assignment 10

(From lecture on July 15, 2008)

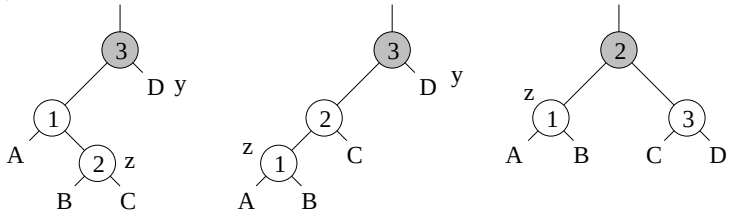
Deadline: July 22, 5:30pm

Problem 10.1. What is the largest possible number of internal nodes in a red-black tree with black-height k? What is the smallest possible number?

Problem 10.2. Prove that at most $n-1$ right rotations suffice to transform any n-node binary search tree into a right-going chain.
Argue that this implies that any n-node binary search tree can be transformed into any other n-node binary search tree using $\mathcal{O}(n)$ rotations (left and right).

Problem 10.3. Consider a red-black tree formed by inserting n nodes with **RB-Insert** into an initially empty tree. Argue that if $n > 1$, the tree has at least one red node. What is the minimal number of red nodes of a red-black tree with 5 elements? What is the minimal number of red nodes of a red-black tree with 5 elements obtained by calling 5 times **RB-Insert** on an empty tree?

Problem 10.4. Suppose that the black-height of the root of each of the subtrees A, B, C, D in the left most tree in the figure bellow is k. Label each node in each tree with its black-height to verify that property **(RB5)** is preserved by the transformations.



Case 2 Case 3

Problem 10.5. Consider all 4 cases of the algorihtm **RB-Delete-Fixup** (see also Figure 13.7 in the textbook). Verify that all 4 transformation preserve property **(RB5)**.