58131 Data structures (Spring 2007)
Exercise 4 (12–16 February)

There are only two problems, for two reasons:

- to give you some time to catch up with TRAKLA2 exercises
- because the lectures did not get as far as intended.

1. Consider the following red-black tree (where Nil nodes have not been drawn):

   ![Red-black tree diagram]

   (a) Show the end result and main steps when the key 9 is deleted (or to be precise, when one performs RB-DELETE(T, z) where z is a pointer to the node with key 9).

   (b) Same task, but now the key 8 is to be deleted. (Use the original tree as the initial stage, not the result from previous part.)

   (c) Same task again, but with the key 3.

2. Show that any binary search tree can be transformed to any other binary search tree with the same keys by performing $O(n)$ rotations.

   Hint: First show that any tree can be converted to a right-linear one, i.e., a tree where no node has a left child. Notice that this is about generic binary search trees, not red-black trees.