



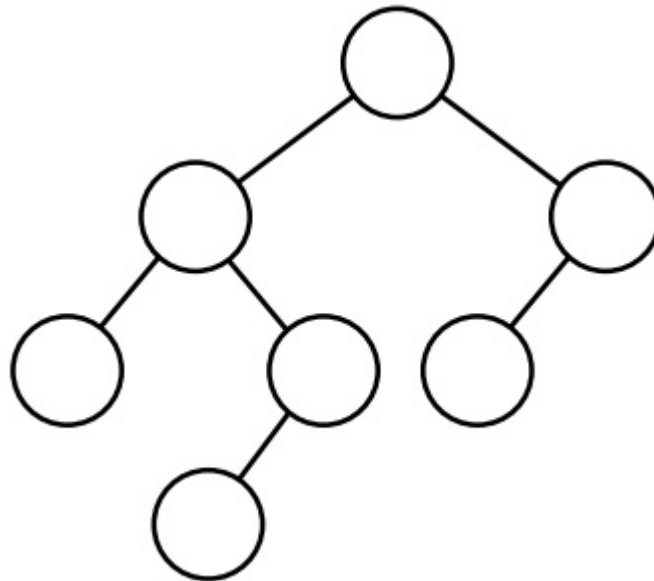
COS 226–Algorithms and Data Structures

Week 5: *Balanced Trees & Review (Algorithms §3.2)*

Version: March 6, 2018

Exercise 1 – Binary Search Trees and LLRBs

- A. Label each node in the following binary tree with numbers from the set $\{2, 26, 10, 27, 20, 15, 42\}$ so that it is a legal Binary Search Tree.



- B. Now label each edge in the figure with r or b, denoting RED and BLACK, so that the tree is a legal Left-Leaning Red-Black Tree.
- C. Argue that it is not possible to assign different red/black labels and still satisfy the LLRB-tree conditions.

Exercise 2

Algorithm Design Question

A. An array b is called a Circular Shift of array a , if b is obtained by rotating a sorted array a clockwise as shown below.

sorted array $a[]$

0	1	2	3	4	5	6	7	8	9
1	2	3	5	6	8	9	34	55	89

circular shift $b[]$

0	1	2	3	4	5	6	7	8	9
34	55	89	1	2	3	5	6	8	9

1. Assume that the array b consists of N comparable keys, no two of which are equal. Array a is not provided. Design an efficient algorithm to determine the minimum value of array a . Briefly describe your algorithm, using crisp and concise prose.

2. Design an efficient algorithm to find any given key in array b . You can use your algorithm in part (a) to help solve this problem. Briefly describe your algorithm, using crisp and concise prose.