# CSC 212 Homework # 5
# AVL Trees & B-Trees & Hash Tables
# **Due date: 01/01/2017**

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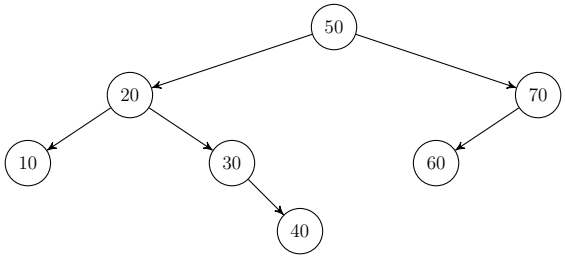
|---|---|
| Guidelines: | This is an individual assignment.<br>The homework must be **submitted electronically through LMS**.<br>**Hard copy submissions are not accepted**. |

## Problem 1

Perform the following operations on the AVL tree below: **Insert 55**, **Insert 35**, **Insert 65**, **Insert 45**, **Delete 10**, **Delete 30**, **Delete 50**. Mention the rotation type: none, single, or double. Each operation is independent, and must be performed on the original tree.




## Problem 2

Complete the table below by computing the resulting balance for each of the specified rotations made on the trees shown in Figure 1.

| Case | Initial balance | Rotation | Resulting balance |
|---|---|---|---|
| (a) | $Bal_0$(A)=-2, $Bal_0$(B)=-1 | R(A) | $Bal_1$(A)=0, $Bal_1$(B)=0 |
| (a) | $Bal_0$(A)=-2, $Bal_0$(B)=0 | R(A) | $Bal_1$(A)=?, $Bal_1$(B)=? |
| (b) | $Bal_0$(A)=2, $Bal_0$(B)=1 | L(A) | $Bal_1$(A)=?, $Bal_1$(B)=? |
| (c) | $Bal_0$(A)=-2, $Bal_0$(B)=1, $Bal_0$(c)=-1 | L(B), R(A) | $Bal_1$(A)=?, $Bal_1$(B)=?, $Bal_1$(C)=? |
| (d) | $Bal_0$(A)=2, $Bal_0$(B)=-1, $Bal_0$(c)=0 | R(B), L(A) | $Bal_1$(A)=?, $Bal_1$(B)=?, $Bal_1$(C)=? |

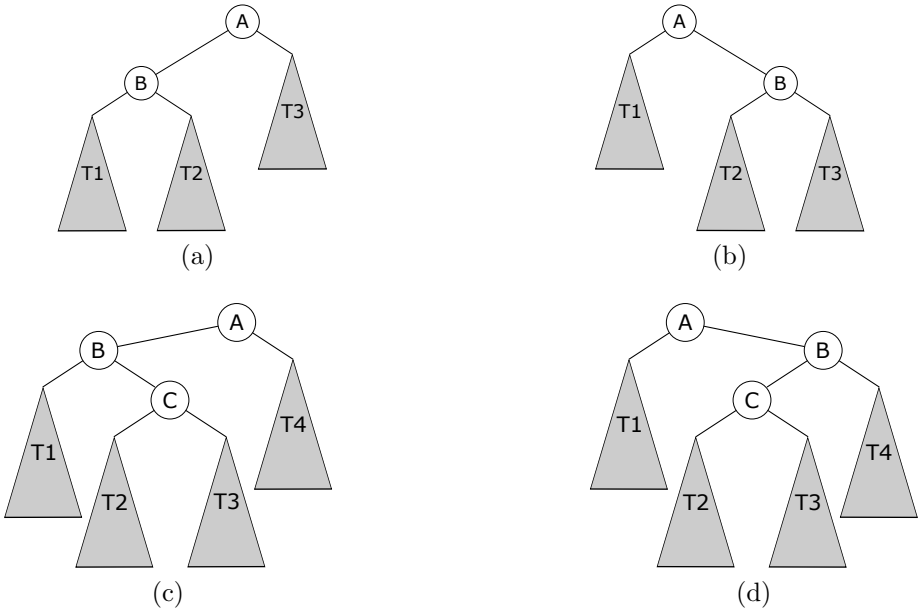
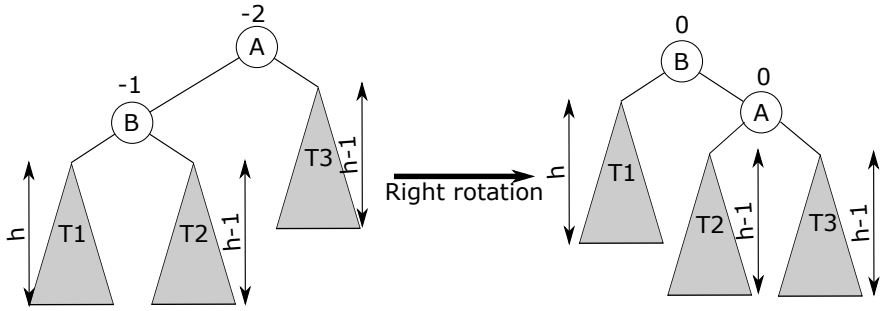



Figure 1: Trees.

**Example 2.1.** *For the first line:*




## Problem 3

Given the B+ Tree of order 3 in Figure 2, do the following operations, **each on the original tree**, and draw the tree at each step: Insert 30, Insert 48, Insert 20, Delete 11, Delete 25, Delete 19.

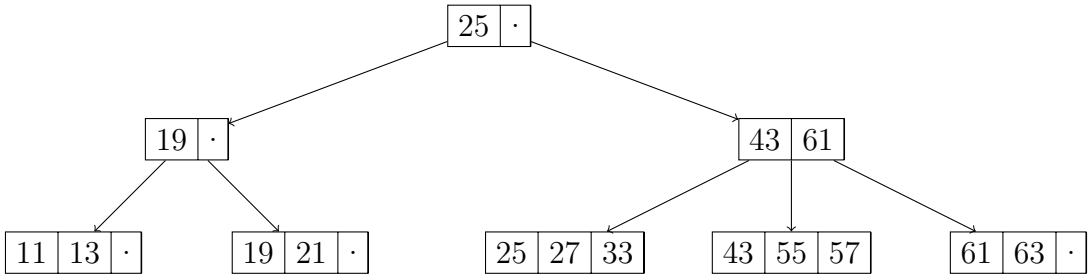



Figure 2: B+ Tree.

## Problem 4

We want to store the following sequence of keys in a hash table: 407, 801, 815, 704, 814, 721, 935. Draw the result of inserting these keys for each of the following tables:

1. Hash function: Select the last two digits then use division by 7: $h(k) = (k\%100)\%7$. Collision resolution strategy: Linear rehashing with $c = 2$ (Show the number of probes).

2. Hash function: Folding on a single digit then use division by 7. Collision resolution strategy: External chaining.

3. Hash function: $h(k) = (3\times(k\%100))\%7$. Collision resolution strategy: coalesced chaining with a cellar size of 2 (Show clearly the links and the final location of epla).

## Problem 5

Given the following hash table of size 9 to store integer keys:

- Hash function: $h(k) = k\%9$.
- Collision resolution strategy: Linear probing with $c = 1$.

If we insert the following keys in the order 1, 6, 11, 14, 3, 12, 5, 28, 9, what is the aggregate (overall) number of collisions? (i.e how many times will an element try to move to location that is already occupied?)