



# DATA STRUCTURES & ALGORITHMS

## Lab session 4

### AVL and HEAP

#### 1. OBJECTIVE

The objectives of Lab 4 are (1) to introduce an implementation of AVL tree in C++ and (2) to practice algorithms to handle a heap

#### 2. EXPERIMENTS and EXERCISES

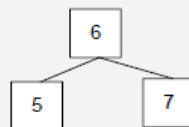
##### *a. AVL Tree*

Please observe the initial code in the files *AVL.h* and *AVL.cpp*. Accomplish the following tasks:

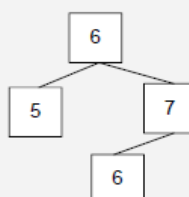
2.1. Use the pre-written method *insert* to sequentially build an AVL tree by inserting numbers in the following list one-by-one from an empty AVL: {71, 1, 4, 13, 87, 91, 72, 33, 19, 60, 59, 21, 17}. After each insertion done, call the method *printLNR* to print out the on-going tree generated.

2.2. Currently, the method *avl\_insert* will raise an error when inserting a duplicated data. Modify the method such that it accepts duplicated new data. Once duplicated, the new data will be inserted to the right subtree of the corresponding node.

**Example 1.** Suppose we have a current tree as follows:



When we try to insert a new data of 6, the new data will be inserted to the right subtree of the duplicated node, resulting in the new tree as follows:





2.3. Consider the method *avl\_remove*, which is uncompleted. Accomplish this method by replacing the commented statement “*Please fill your code here*” with appropriate code.

*b. Heap*

Please observe the initial code in the files *MaxHeap.h* and *MaxHeap.cpp*. Accomplish the following tasks:

2.4. Use the pre-written method *insertHeap* to sequentially build a heap by inserting numbers in the following list one-by-one: {71, 1, 4, 13, 87, 91, 72, 33, 19, 60, 59, 21, 17}. After each insertion done, call the method *prinHeap* to print out the on-going heap generated.

2.5. Do the following tasks:

- Let user input from keyboard a list of integers, ended by 0.
- Use the method *buildHeap* to build a heap from the inputted array.
- Print out the heap.

2.6. Based on the *MaxHeap* class, develop the *MinHeap* class and resolve the exercises 2.4 and 2.5 with the developed *MinHeap*.

2.7. Accomplish the uncompleted methods *ReheapDown* and *deleteHeap*.

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