# COMP2014J: Data Structures and Algorithms 2
# Lab Worksheet 1 (Week 3 and 4): Trees

The goal of this worksheet is to get experience of how to write programs to deal with trees.

## Before you start:

1. You should already have a Java Development Kit (preferably version 17[1]) and the IntelliJ IDEA IDE installed.
2. Download the WS1-Trees.zip file from Brightspace.
3. Follow the instructions in the "Importing a Project into Intellij IDEA" document (on Brightspace) to import this project into Intellij IDEA. There is also a video, named "Import project into Eclipse and view Javadoc".
4. This project contains the following:
    a. In the "src" folder, you will find three Java files to get you started with the three questions below, named Q1.java, Q2.java and Q3.java.
    b. In the "doc" folder, you will find the API documentation for all the classes that are available to you. Open the file "index.html" to get the full list. There are some other data structures included in case they are helpful for you.

## Question 1

For this question, write your code in the Q1.java file. The first line in the main() method loads a tree that stores Character objects.

Write a program to explore this tree and print the results to the following questions. For an extra challenge, you should try to write your program **without** using the iterator() or positions() methods.

**Hint:** To answer these questions you will need to sometimes the same task many times. It might be useful to write a function to deal with this.

a) What is stored at the root of the tree?
b) What are stored in the children of the root position?
c) What is the depth of the position that stores "L"?
d) What is the height of the tree?
e) List the elements stored in any ancestors of the position that stores G.
f) List the elements stored in any descendants of the position that stores B.
g) List the elements that are stored at leaf (external) positions.
h) Is (N,L) an edge?
i) List the elements stored in the positions that are in the path from D to N.
j) Based on the code you have used to explore the tree contents and structure, can you draw a diagram to show the structure of the tree?

[1] You should not use any version of Java older than Java 11.

## Question 2

Write your code in the Q2.java file. The first line in the main() method loads a tree that stores Character objects.

a) What is the height of the tree?
b) What is the depth of the position that stores D?
c) List the elements stored in the children of the position that stores B.
d) List the elements stored in any siblings of the position that stores D.
e) List the elements that are stored at external positions.
f) What is the parent of the position that stores A?
g) List the ancestors of the position that stores E.
h) What is the size of the tree?
i) Based on the code you have used to explore the tree contents and structure, can you draw a diagram to show the structure of the tree?

## Question 3

Write your code in the Q3.java file. The first line in the main() method loads a tree that stores String objects.

a) Which is stored in the root position?
b) What are stored in the internal positions?
c) How many descendants does the position that stores “cs016/” have?
d) How many ancestors does the position that stores “cs016/” have?
e) What are the siblings of the position that stores “homeworks/”?
f) Which positions are in the subtree rooted at the position that stores “projects/”?
g) What is the depth of position that stores “papers/”?
h) What is the height of the tree?
i) Based on the code you have used to explore the tree contents and structure, can you draw a diagram to show the structure of the tree?