# Assignment 11: Depth-first search (DFS)

**Allocated time: 2 hours**

## Implementation

You are required to correctly and efficiently implement the depth first search algorithm (DFS) (*Chapter 22.3*[1]). For graph representation, you should use adjacency lists. You also have to:

- Implement the Tarjan algorithm for detecting strongly connected components
- Implement topological sorting (*Chapter 22.4*[1])

## Requirements

### 1. DFS (5p)

Exemplify the correctness of your algorithm/implementation by running it on a smaller graph:

- print the initial graph (the adjacency lists)
- print the tree resulted from DFS

### 2. Topological sort (1p)

Exemplify the correctness of your algorithm/implementation by running it on a smaller graph:

- print the initial graph (the adjacency lists)
- print a list of nodes sorted topologically (should this list be nonempty/if it is why so?)

### 3. Tarjan (2p)

Exemplify the correctness of your algorithm/implementation by running it on a smaller graph:

- print the initial graph (the adjacency lists)
- print all strongly connected components of the graph

### 4. Analysis of the DFS performance (2p)

**!** Before you start to work on the algorithm evaluation code, make sure you have a correct algorithm!

Since, for a graph, both |V| and |E| may vary, and the running time of DFS depends on both, we will make each analysis in turn:

1. Set |V| = 100 and vary |E| between 1000 and 4500, using a 100 increment. Generate the input graphs randomly – make sure you don't generate the same edge twice for the same graph. Run the DFS algorithm for each graph and count the number of operations performed; generate the corresponding chart (i.e. the variation of the number of operations with |E|).
2. Set |E| = 4500 and vary |V| between 100 and 200, using an increment equal to 10. Repeat the procedure above to generate the chart which gives the variation of the number of operations with |V|.

[1] Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein. *Introduction to Algorithms*