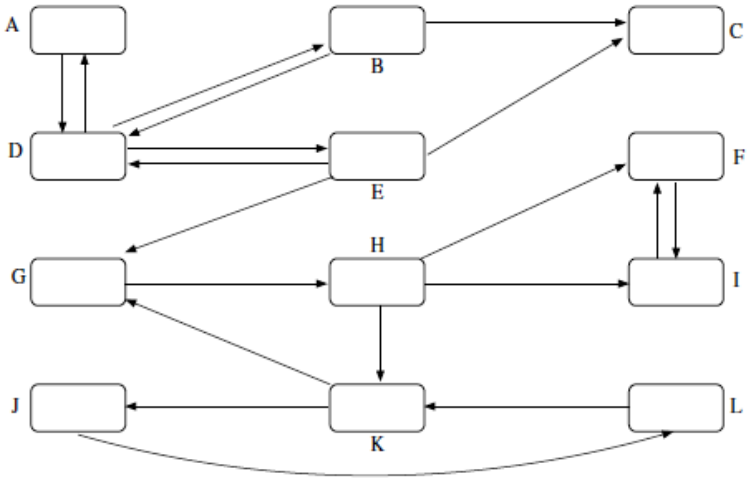
CS590 homework 6 – Graphs exploration (BFS, DFS)

The due date for this assignment is Sunday, Nov 25th, at 11.59pm. This assignment is worth 10% of your final grade.

Any sign of collaboration will result in a 0 and being reported to the Graduate Academic Integrity Board. Late submission policy described in the syllabus will be applied.

(100 points)

1. You are give the following graph $G = (V, E)$:



(a) Perform a DFS (depth-first search) on the given graph. You will visit the nodes in increasing order starting with **A** (increasing from **A** to **L**). Give the discovery $u.d$ and finishing times $u.f$ for every vertex u in the graph. Classify all edges (tree, back, forward, and cross edges).

(b) Perform a DFS (depth-first search) on the given graph. You will visit the nodes in decreasing order starting with **L** (decreasing from **L** to **A**). Give the discovery $u.d$ and finishing times $u.f$ for every vertex u in the graph. Classify all edges (tree, back, forward, and cross edges).

(c) Determine the strongly connected components (SCC) of the given graph $G = (V, E)$. Use your output of (a) as a starting point for the remainder of the SCC algorithm. Give the discovery and finishing times for the second run of DFS. Give the sets of vertices that form an SCC and draw the corresponding SCC graph.

(d) Determine the strongly connected components (SCC) of the given graph $G = (V, E)$. Use your output of (b) as a starting point for the remainder of the SCC algorithm. Give the discovery and finishing times for the second run of DFS. Give the sets of vertices that form an SCC and draw the corresponding SCC graph.

(40 points)

2. Provide an implementation in C++ of the DFS, and BFS algorithms. You are given a class declaration in the header file *graph.h*, which you should implement in *graph.cpp*. You should also implement a test case for each algorithm in *main.cpp.* For both algorithms, whenever you visit a node of the graph, print the node ID using a *cout* instruction to show the sequence that the nodes are visited.

(60 points)

Remarks:

- You are not allowed to use code from online resources. Your submission will be tested against that, and will receive a 0, and a report to the Graduate Academic Integrity Board if it is detected.
- You can use containers from the C++ Std library.
- A Makefile is provided to build the code in LinuxLab.
- The programming, and testing will take some time. Start early.
- Feel free to use the provided source code for your implementation. You have to document your code.