CSE 3318-003 Lab Assignment 5

Due April 28, 5:00 p.m.

Goals:

1. Understanding of Warshall's algorithm.
2. Understanding of strongly connected components.

Requirements:

1. Write a program, based on Warshall's algorithm with successors, to find a ***leader*** for each strongly connected component of a directed graph. The leader of a strongly connected component is the ***smallest*** numbered vertex appearing in that SCC. The input will be formatted as follows:

   a. The first line will contain an integer `V` giving the number of vertices. `V` will not exceed 50.
   b. Tail and head for each edge, one edge per line. The tail and head will be in the range `0 ... V - 1`.
   c. A line with `-1 -1`.

2. Your program's output for each vertex *i* will be either 1) the fact that vertex *i* is a leader or 2) a path from vertex *i* to its leader and a path from the leader to vertex *i*. Your program must also output the intermediate matrices from your Warshall-based technique.

3. Submit your program source file on Canvas by 5:00 pm on Tuesday, April 28. One of the comment lines should include the compilation command used on OMEGA.

Getting Started:

1. Review Warshall's algorithm with successors. Also, consider the usual transitivity diagram (Notes 15, pp. 4-6) and how it relates to this problem.

2. Test files are available on the course web page. Other cases may be used when your submission is checked. Files with `.dat` extensions are the inputs, files with `.out` extensions are the outputs. Files with `.pdf` extensions are diagrams that make the SCCs and leaders obvious. The PDFs were created using the files with `.dot` extensions as input to the utilities available at `http://www.graphviz.org`

3. Since SCCs treat the graph as being reflexive (e.g. self-loops), each diagonal entry `A[i][i]` is initialized to `i`. If there is an edge from `i` to `j` (`i!=j`), then `A[i][j]` is initialized to `min(i,j)`. If there is no edge from `i` to `j`, then `A[i][j]` is initialized to a large "infinite" value.

4. Based on this initialization, Warshall's algorithm may be modified to terminate with the leader for the SCC of vertex `i` stored at `A[i][i]`.

5. Your code must execute in $O(V^3)$ time.

6. You may modify `http://ranger.uta.edu/~weems/NOTES3318/warshall.c` to do this assignment. Static allocation (i.e. no mallocs) is allowed.