

CSE 3318-003 Lab Assignment 5

Due May 4, 2021, 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 $0 \dots V - 1$.
 - 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, May 4. 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 16, pp. 4-5) 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 ($i \neq j$), 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 -1 (or some other value depending on your code).
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. Static allocation (i.e. no mallocs) is allowed.
7. You may modify <http://ranger.uta.edu/~weems/NOTES3318/warshall.c> to do this assignment.