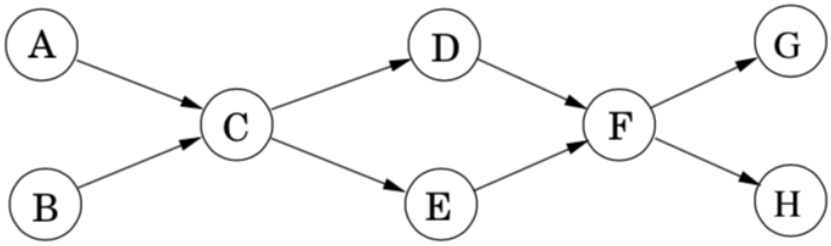
NETS 150 – Homework 2

Due – Feb 21, 2019 at 12.00pm

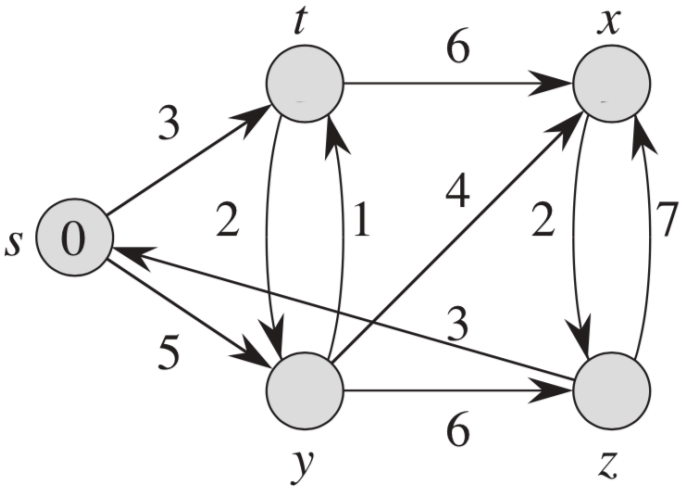
Part 1 – Theory (50 points)

Please do the following problems:

1. Consider the following conjecture: In a directed graph G, if there is a path from node A to node B, then in any DFS on G, the start time of B must be less than the finish time of A. Is this true or false? If true, explain why. If false, show a counterexample. (10 points)
2. Show the ordering of vertices produces by Topological Sort for the graph below. Use the algorithm shown in class with the following modification: If you have a choice of more than one valid node in your algorithm, choose them alphabetically. Thus, if you could choose between nodes A and B, node A would be picked before node B. (10 points)



3. Using Dijkstra's algorithm, show the shortest path along with the path cost for each node starting at node s. Please show your work. (10 points)



4. Negative edge weights and Dijkstra's algorithm:
    a. Give an example of a directed graph with negative weight edges for which Dijkstra's algorithm produces *incorrect* answers. (5 points)
    b. Give an example of a directed graph with negative weight edges for which Dijkstra's algorithm produces *correct* answers. (5 points)
    c. Explain why Dijkstra's works correctly in certain cases and incorrectly in others. (5 points)
5. Exercise 3.7-3 from the class textbook. (Easley and Kleinberg) (5 points)

Part 2 – Experimentation (50 points)

You saw Schelling's Model of Segregation in class, which suggested that even seemingly small preferences for "similar" neighbors (3 out of 8) would result in a segregated population. A number of you had questions about variants of this model.

Your task is to take the Schelling simulator, available online in Java source, and look at how it works.

The Simulator is divided into two classes: `SchellingSimulator` (which includes the main logic) and `SchellingVisualizer` (which runs the simulator and visualizes the results using a nicer graphical grid). You may run either class to see the results of an experiment, but you'll have nicer results with the `SchellingVisualizer`.

Modify the simulator to do the following:

1. Decide on a sociological question that can be studied within the context of the model, which requires you to expand the set of parameters (E.g., consider larger populations, different movement policies, more groups, etc.).
2. Formulate a hypothesis (e.g., consider a particular set of parameters that you think affects the outcome).
3. Modify the simulator to gather some data points to evaluate your hypothesis (and iterate on #2 until you have a hypothesis that is validated by the data).
4. Write a brief (perhaps 1-3 paragraphs) explanation of your hypothesis, your experimental methods, and your conclusions. Accompany them **with a graph (line, chart, bar, pie, …) supporting your case**.

Note that in general you should be careful not to make the population too high relative to the number of cells to the grid – otherwise people will spend a long time trying to find a place to move.

Submission Instructions

We recommend submitting the theory part electronically also. However, you can turn in a physical copy at the start of class, if you prefer. The code should be submitted electronically. Please **do not** print it out.

Please create a folder called YOUR_PENNKEY. Places all your files inside this – theory writeup and the writeup for the experimentation part. It will thus be called YOUR_PENNKEY.zip. So, e.g., my homework submission would be swapneel.zip. Please submit this zip file via canvas.