NETS 1500 – Homework 2

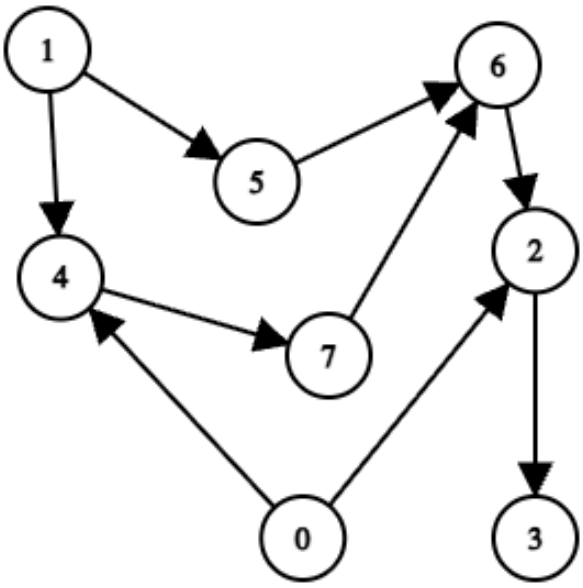
Due – February 26, 2026 at 12.00pm ET

Part 1 – Theory (50 points)

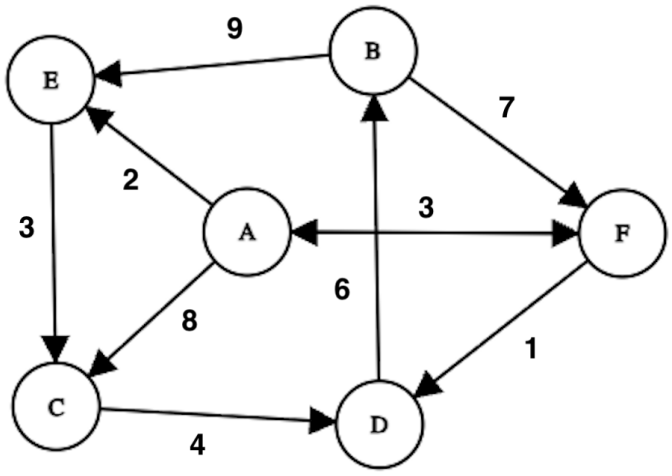
Please do the following problems:

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 produced 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 the lower number. Thus, if you could choose between nodes 1 and 7, node 1 would be visited before node 7. Please show your work. (10 points)



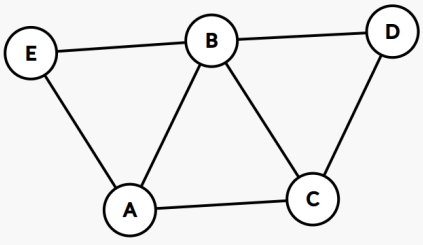
3. Using Dijkstra's algorithm, show the shortest path along with the path cost for each node starting at node A. Please show your work. (10 points)



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. (4 points)
    b. Give an example of a directed graph with negative weight edges for which Dijkstra's algorithm produces *correct* answers. (4 points)
    c. Explain why Dijkstra's works correctly in some cases and incorrectly in others. (4 points)

5. Exercise 3.7-4 from the class textbook. (Easley and Kleinberg) (4 points)

6. Answer the following questions about the graph below (4 points):
    a. What is the clustering coefficient for node B? (2 points)
    b. What is the neighborhood overlap of the A-B edge? (2 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) and state it clearly, in bold, in your write-up.
3. Modify the simulator to gather some data points to evaluate your hypothesis (and iterate on #2 until you have a hypothesis that can be validated/invalidated 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: Please make sure your hypotheses and conclusions are clearly defined and explained in your write-up.

Note 2: 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.

Note 3: If you make significant changes to the provided code, please mention that in your writeup. While grading, the TAs may reach out to you and ask you to share the code with them.

Note 4: For this part, the majority of the points will be objective (did you set up the experiment correctly, do you run and collect data correctly, do your conclusions follow from the data, does your data validate/invalidate the hypotheses, are your conclusions sound, etc.). There will be a small subjective part as well (is your experiment interesting/fun/cool).

Submission Instructions

Please submit a PDF file through Gradescope.

Please create a file called YOUR_PENNKEY_HW2.pdf. So, e.g., my homework submission would be Swapneel_HW2.pdf. Please submit this pdf file via Gradescope.