CS 163 — Winter 2024 — Midterm 2

Name:

UCInet id (your @uci.edu email address):

Use alternating seating.

Do not open this exam until told to start by the instructor.

This is a closed book, closed note exam. Calculators or other electronic devices are not allowed.

Please write your answers ONLY on the front side of each page.
Answers written elsewhere will not be scanned and will not graded.

Restroom breaks are not allowed: If you leave the classroom, you must turn in your exam first.

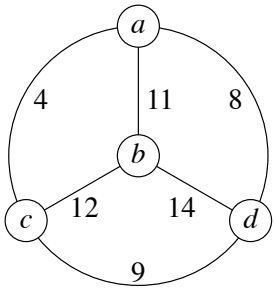
You may use the back sides of the pages as scratch paper.
Do not unstaple the pages.

1. (20 points) The first three presidents of the Association for Women in Mathematics were Mary Gray, Alice Schafer, and Lenore Blum. Suppose that, in an election between these three women, 65% of the voters prefer Gray to Schafer, 60% of the voters prefer Schafer to Blum, and 55% of the voters prefer Blum to Gray.

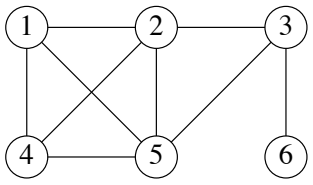
   (a) Who would win the election, according to the Schulze method?

   (b) Is there a Condorcet winner for this election? Explain why or why not.

2. (20 points) List in order the vertices of a tour that could be produced by the tree-doubling 2-approximation for the traveling salesperson problem on the graph below, starting from vertex a. (If a tour has repeated vertices or edges, leave them as they are. Do not remove the repetitions.)



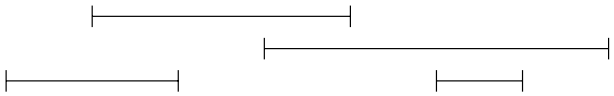
3. (20 points) What is the degeneracy of the following graph?



4. (20 points) List each maximal clique in the graph from question 3. You do not have to use the Bron-Kerbosch algorithm to find these cliques.

5. (20 points) We have seen that when the greedy coloring algorithm is used on an interval graph, in left-to-right order by the left endpoints of the intervals, it produces an optimal coloring.

   (a) When greedy coloring is used on the four intervals below, in left-to-right order by the *right* endpoints of the intervals, how many colors does it use?



   (b) Is this an optimal coloring? If yes, explain why fewer colors are impossible. If no, state how many colors are needed in an optimal coloring.

6. (20 points) Draw a four-vertex graph that is perfect but not chordal.