CS 275 Sections 001 and 002 Exam 4 April 19, 2007

You may use the class notes from the course web site, your own notes, and the textbook only for references during the exam. You have approximately 70 minutes.

Write your name and the page number on each piece of paper you use. If you use the back, label that, too. If you split a problem's solution, please note this fact. Show your work. *There are 7 problems on two sides/page.*

No electronic devices are to be used. Turn off your cell phone now. Answering one means you are done with your exam on the spot.

1. Apply an algorithm from the textbook or class notes to determine a minimal spanning tree for the simple connected graph in Figure 1.
   (a) Show all steps of the algorithm.
   (b) State which algorithm you used.
   (c) Is your minimal spanning tree unique? Why or why not?

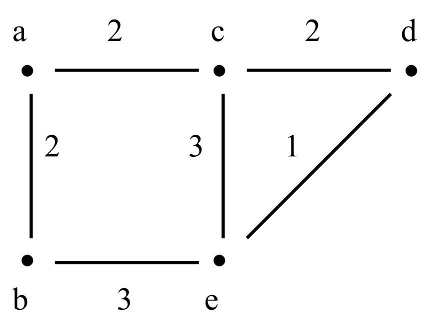

Figure 1

2. Consider the ordered rooted tree in Figure 2.
   (a) Number the tree using the universal address system.
   Using (a), list the transversal orders of the tree in
   (b) preorder,
   (c) inorder, and
   (d) postorder

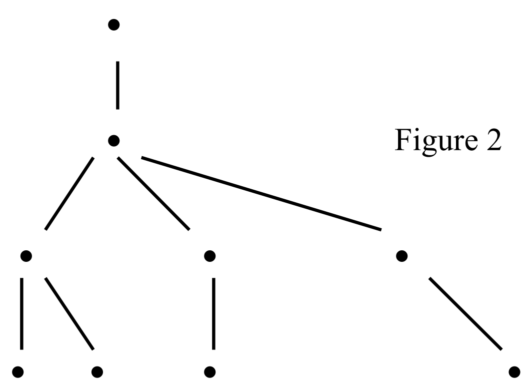

Figure 2

3. A zoo receives a shipment of animals, some pairs of which will eat the other species. These pairs must be kept separated from each other in different compounds to keep all of the animals alive. Use some element of graph theory to model the smallest number of compounds needed.
(a) Which element of graph theory should you use?
(b) Describe how to determine the minimum number of compounds needed to keep all of the animals alive.
(c) What is the minimum number of compounds needed?
Note: Base your answer just on the need to keep the species from eating the other species, not some new constraint that you add.

4. How many simple paths are there from a to b in the graph in Figure 3? List the unique ones to prove your case.

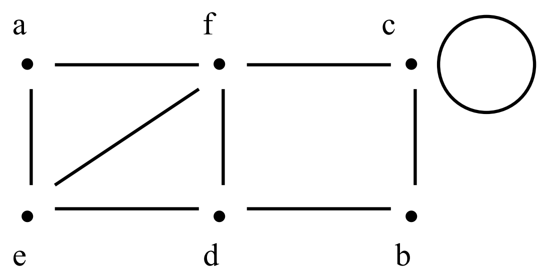

Figure 3

5. Given a set R = { 1, 2, 3, 4 } and the following relations on R:
(a) R1 = { (1,1), (1,2), (2,2), (3,3), (4,4) }
(b) R2 = { (1,2), (2,1), (1,3), (3,1) }
(c) R3 = { (1,1), (1,2), (2,3), (3,2), (4,1) }
(d) R4 = { (1,1), (1,2), (1,3), (2,1), (2,2), (2,4), (3,1), (3,3), (4,2), (4,4) }
Categorize each relation as reflexive, symmetric, antisymmetric, and/or transitive.

6. (a) Construct a nontrivial equivalence relation using a 4×4 adjacency matrix.
(b) Draw its digraph representation.

7. Prove or disprove: Let A = **R** and for each $i \in \mathbf{Z}$ let $A_i = [i, i+1)$. Then $\{A_i\}_{i \in \mathbf{Z}}$ is a partition of A.