first name	last name		$\mathrm{id}\#$		
each page 8 marks	30 min	closed book	no devices	3 pages	page 1

1. Give the postorder traversal sequence of the transpose of this digraph, assuming that its node list and neighbor lists are stored in alphabetic order.

Write your answer here:



2. Using your answer to the previous question, list the strongly connected components of the digraph in the order that they are found by the algorithm from class.

Write your answer here:

3. Let D be a digraph with nodes x, y such that there is a directed path p_{xy} from x to y and a directed path p_{yx} from y to x. Prove/disprove: in the transpose D^T of D there is a directed path q_{xy} from x to y and a directed path q_{yx} from y to x.



4. (a) On the nodes below, draw the implication digraph for this 2-sat formula:

f = [1 -5] [-2 -4] [3 4] [-4 -5] [2 5] [-1 -5].



(b) Is the formula satisfiable? If yes, give a satisfying assignment; if no, explain.

5. A node is *simplicial* in a graph if its set of neighbors is a clique.(a) List all the simplicial nodes in this graph.Write your answer here:



(b) In a graph G, let v be a simplicial node, let M be the non-neighbors of v, and let I_M be an independent set in G[M]. Prove that $\{v\} \cup I_M$ is an independent set in G.



6. (a) Formulate the problem of finding a largest independent set in G as an integer program. Explain briefly.

(b) If you solve your answer to (a) using the mixed-integer-program solver at sagemath, will the solution be all integer, or might there be some non-integer (fractional) values in the solution? Explain.

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