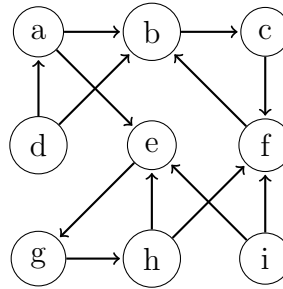# Problem Set 5

CS 331

Due Wednesday, March 11

1. Consider running DFSALL on the following graph, where every itera-
   tion (the outer one over all vertices, and the inner ones over edges) is
   in alphabetical order by vertex name:

   (a) What is the preorder of the vertices? What is the postorder?

   (b) Shade in the "tree" edges.

   (c) Circle the strongly connected components.

   (d) Give a topological ordering of the strong component graph.

2. (Problem 21 of the book) Kris is a professional rock climber who is
   competing in the U.S. climbing nationals. The competition requires
   Kris to use as many holds on the climbing wall as possible, using only
   transitions that have been explicitly allowed by the route-setter. The
   climbing wall has n holds. Kris is given a list of m pairs (x, y) of holds,
   each indicating that moving directly from hold x to hold y is allowed;
   however, moving directly from y to x is not allowed unless the list also
   includes the pair (y, x). Kris needs to figure out a sequence of allowed
   transitions that uses as many holds as possible, since each new hold
   increases his score by one point. The rules allow Kris to choose the
   first and last hold in his climbing route. The rules also allow him to
   use each hold as many times as he likes; however, only the first use of
   each hold increases Kris's score.

   (a) Define the natural graph representing the input. Describe and
       analyze an algorithm to solve Kris's climbing problem if you are
       guaranteed that the input graph is a dag.

(b) Describe and analyze an algorithm to solve Kris's climbing problem with no restrictions on the input graph. Both of your algorithms should output the maximum possible score that Kris can earn.