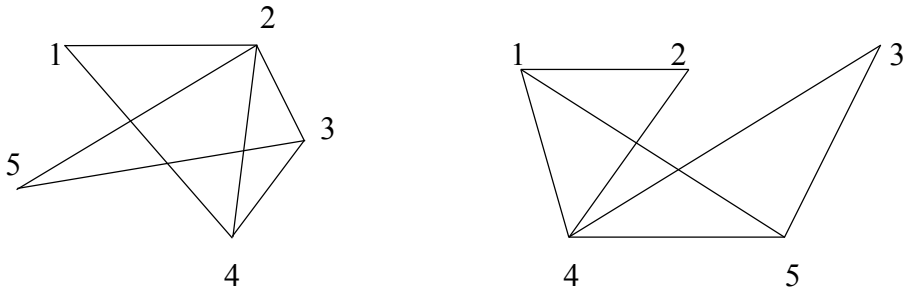
INFSCI 2591: Algorithm Design
Project 3
Due: November 1, 2016

1. Two graphs $G_1$and G_2 are called isomorphic when orderings of their vertices produce equal adjacency matrices. In other words, if $v_1,\ldots v_n$ is the set of vertices in $G_1$and $u_1,\ldots,u_n$is the set of vertices in G_2, then adjacent vertices v_i and v_j in G_1have corresponding vertices u_k and u_l that are also adjacent in G_2. See below for an example of two graphs that are isomorphic. Ordering for the graph on left: 1, 2, 3, 4, 5; ordering for the graph on right: 3, 4, 1, 5, 2.



   a. Write and implement a backtracking algorithm that checks to see if two undirected simple graphs are isomorphic. The algorithm should print "not isomorphic", if the two graphs are not isomorphic. The algorithm should print "isomorphic" and the orderings of their vertices for which their adjacency matrices are equal, if the graphs are isomorphic. Use the test cases provided in courseweb to test your algorithm [pseudocode and results of the test cases: 80 points]

   b. Show the time complexity of the algorithm. [20 points]

2. The shortest cycle in a graph G is called the girth of G.

   a. Write a breadth-first search algorithm that finds the girth of a graph G. Use the test cases provided in courseweb to test your algorithm [pseudocode and results of the test cases: 60 points]

   b. Show the time complexity of the algorithm where m is the number of edges and n is the number of vertices. [15 points]

   c. Implement the algorithm and on run it on connected undirected graphs of various sizes. Plot the time performance of the algorithm. [25 points]

Total points: 200