CSCE 411-502 Design and Analysis of Algorithms

Spring 2025

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Assignment # 6
(Due April 11)

1. It is clear that if a graph G is not connected then G has no spanning tree. (Slightly) modify Kruskal's algorithm so that on an input graph G, the algorithm either reports that G is not connected, or produces a minimum spanning tree for G. Your algorithm should *not* call a subroutine that tests the connectivity of G. Do not forget to give the complexity analysis of your algorithm.

2. A matching M is *maximal* if you cannot add edges to M to make a larger matching (note that it is different from a *maximum* matchine). Consider the bipartite graph $G = (U \cup V, E)$, where

$$U = \{u_1, u_2, u_3, u_4\}, \quad V = \{v_1, v_2, v_3, v_4\},$$

$$E = \{[u_1, v_1], [u_1, v_2], [u_1, v_4], [u_2, v_1], [u_2, v_3], [u_2, v_4], [u_3, v_1], [u_3, v_3], [u_4, v_1], [u_4, v_3]\}.$$

(a) Draw the graph G.
(b) Does G have a (non-maximum) maximal matching of size 1?, size 2? size 3?
(c) For each "yes" answer to the previous part, give a maximal matching of the given size, and show an augmenting path with respect to that matching.

3. Consider the following Job Completion problem:

> Given n workers and m jobs, such that each worker has a list of jobs that he can do. Decide if there is an assignment such that every job gets assigned to a worker who can do the job, assuming that each worker is given at most one job.

Design an efficient algorithm for the problem. Analyze your algorithm.