COM S 783 / OR&IE 634 Approximation Algorithms **Fall Semester, 2003**

Assignment 1: 9/8/03

Lecturer: Yuval Rabani *Due date: 9/29/03*

1. Show an infinite sequence of increasingly large instances where the algorithm of Christofides outputs solutions with approximation factor approaching $\frac{3}{2}$.

2. Find a polynomial time $\frac{4}{3}$-approximation algorithm for instances of METRIC TSP where the distances are either 1 or 2.
hint: The 2-matching problem (find a minimum weight subset of edges M such that each node is adjacent to *exactly* 2 edges in M) can be solved in polynomial time.

3. Give an infinite sequence of increasingly large instances for which the greedy set cover algorithm performs poorly. Try to get a lower bound matching the upper bound we proved in class. (You may use weighted or unweighted instances.)

4. Consider the following algorithm for (unweighted) VERTEX COVER: In each connected component of the input graph execute a depth first search (DFS). Output the nodes that are not leaves in the DFS tree. Show that the output is indeed a vertex cover, and that it approximates the minimum vertex cover within a factor of 2.

5. Consider the following two algorithms for the knapsack problem: (i) The greedy algorithm, as defined in class; (ii) The algorithm that packs the maximum profit item. Prove that the algorithm that picks the best of these two solutions is a 2-approximation for the knapsack problem.