Due: Thursday, October 10th 4:30 p.m.

Problems for Math 408 and Math 708

1. In the previous assignment, you formed your *team multi-constrained knapsack problem*, and, the LP relaxation (question 2c.) of the team multi-constrained knapsack problem yielded a non-integer relaxed optimal solution. For this question, you will find a good integer solution to the problem (though perhaps not the optimal one) by doing part of a branch-and-bound expansion of the problem. In particular, you will implement a *depth-first* branch-and-bound until you reach an integer solution.

Beginning with the initial node corresponding to the IP and its LP relaxation, you will branch on a non-integer variable to give two subproblems. Solve the LP relaxation of each. If you get an integer solution, you are done. If you do not, take the branch that gives the higher upper bound (via its relaxed LP value) and repeat by expanding that node.

2. Another way to get a feasible solution to the team multi-constrained knapsack problem using the greedy procedure of homework 2 (question 1 a. on the individual homework): begin with the feasible point $\vec{x} = 0$. For each i from 1 to 9 in turn, see if the point remains feasible if x_i is set to 1. If it is, then set $x_i = 1$. Otherwise, reset to $x_i = 0$. Do this, and compare this feasible solution to the one found by depth-first search, as well as to the optimal solution obtained by AMPL in problem 1c. of the previous team homework.

3. Following the previous team homework, you have routing (distance) information on a set of locations of interest. For this assignment, we will look at heuristics solutions to a *symmetric travelling salesman problem* based on this data. The distances you will use for this exercise are the averages of the two directed distances between locations. This gives a *symmetrized* problem which is a good approximation of the original problem.

For this symmetrized problem, you should generate a good tour by applying each of the following heuristics:

a. Nearest Neighbour.

b. Nearest Insertion.

c. Double Minimum Spanning Tree.

d. Christofides.

In each case, summarize your computations in a table, and illustrate the tour you have found on a map containing your locations. For the heuristics that involve spanning trees and matchings, include these in your illustration. Note that these illustrations can be somewhat misleading since you are not using straight line distances between the points.

This assignment will be submitted directly to the instructor by e-mail. Please submit a single file named `team_hw2_name.pdf` (where `name` is your unique identifier from the first team homework) containing all your written work. You can also submit the written part by hand in class.