Due: Thursday, November 14th 11:59 p.m.

Problems for Math 408 and Math 708

1. On your individual Homework 4, each of you developed 3 cover inequalities from your personal knapsack inequality. Explain why these inequalities are also valid for your team multi-constrained knapsack problem.

2. Add all of these new cover inequalities to get a tighter formulation of your team multi-constrained knapsack problem. Solve this relaxation with `AMPL`. Is your solution optimal for the integer program? How does the new bound compare to the original relaxation containing only the four knapsack constraints?

For this and subsequent questions, you are only required to use the cover inequalities of students who submitted the individual homework 4. You do not have to find additional cover inequalities for phantom students. You should, however, retain their knapsack inequalities.

3. Let S be the the set of integer solutions to your team multi-constrained knapsack problem. Find the dimension as a face of $\text{conv}(S)$ of each of the knapsack inequalities and one cover inequality per student from the previous question.

4. Each student in the group should find one of their cover inequalities that can be lifted to a stronger valid inequality for $\text{conv}(S)$. Lift this inequality maxmizing the value of the lifted coefficient α. Add the lifted inequalities to your formulation and resolve.

5. In class you have seen how to formulate a relaxation of the travelling salesman problem using **only** (asymmetric) degree constraints at the vertices, along with non-negativity constraints on the variables. Do this for your team routing problem and solve it in `AMPL`. Is your solution integral? If not, re-solve it with integrality constraints added. Illustrate the solution.

This assignment will be submitted directly to the instructor by e-mail. Please submit a single file named `team_hw4_name.pdf` containing all your written work, with your group identifier substituted in place of `name`.