ECE 3484 - Combinatorial Optimization - Project #4

ILP Analysis

The goal of this phase of your project is to use LP and ILP techniques to attempt to solve instances of your problem. Begin by developing an ILP formulation for your problem. Most problems have a natural formulation that works reasonably well. However, considerable work has been done to develop "tighter" formulations that are easier to solve. Do research to determine what ILP formulations have been developed.

Using the LP (or some other) relaxation of these models, compute a lower bound on the objective function for the instances in your benchmark. Evaluate your formulation's ability to successfully solve the relaxed optimization problem for large instances.

Find exact solutions using ILP formulations for as many instances as possible. Use the CPLEX options to limit the amount of CPU time consumed by any one instance. Again evaluate your formulation's ability to successfully solve the ILP optimization problem for large instances.

For instances for which greedy, LP lower bound, and exact solutions have all been found, evaluate the quality of the greedy solution relative to the optimal value, and evaluate the quality of the LP lower bound relative to the optimal value. How often is the greedy solution optimal? How often is the LP lower bound tight (close to the optimal value)?

For instances for which only greedy and LP lower bounds can be found, characterize the size of the gap between these values. Compute the average size of the gap (both absolute value and percentage), and the fraction of the instances for which the size of the gap is zero.

In summary:

1. Research and implement an ILP formulations for your optimization problem.
2. Compute LP lower bounds for as many instances in your benchmark as possible.
3. Compute an exact solution for as many instances in your benchmark as possible using ILP.
4. For instances for which exact solutions have been found, evaluate the gaps between the lower bound and exact solution, and the gaps between the exact solution and the greedy solution.
5. For instances for which no exact solution has been found, evaluate the gaps between the lower bound and the greedy solution.
6. Compare the effectiveness of your ILP formulation with your exhaustive algorithm. If possible, try to explain your findings.

The clear presentation of data is an important part of this writeup. Make good use of graphs and other figures where necessary. All project writeups must be typeset.

You should consider using shell scripts to automatically apply CPLEX to a large number of instances. You can call AMPL with a command line option giving a command file containing the commands to solve a particular instance. The AMPL output can be piped to an output file and automatically analyzed (with a selective use of "grep") to determine which instances were solved (and what the objective function was), which were infeasible, and which could not be solved in the time given. Applying CPLEX to a large benchmark can be done very efficiently in this way.