Mixed Integer Programming Exercises
ADFOCS 2003
September 12, 2003

1. Propose a simple algorithm for generating feasible integer solutions from relaxation solutions. You can use relaxation values, cost coefficients, reduced costs, strong branching, etc. as input to your algorithm. The fewer LP re-solutions your algorithm requires, the better (so the algorithm remains quick on large models). Try your algorithm on a few model (using *change problem relaxed_milp* to change the model to an LP, *optimize* to solve a relaxation, *display solution ...* to look at results, and *change bound ...* to modify the model). Does your approach find feasible solutions? Near-optimal solutions? Try to trace difficulties back to constraints in the model to gain a better understanding of why your approach runs into trouble. p0033_p and p0040_p are nice, small models that are good places to start, since near-optimal solutions are surprisingly difficult to find. If you are feeling confident after trying these, try air02_p or arki001_p.

2. Open models p0040.lp and p0040_p.lp (the presolved version) in a text editor. Construct arguments to justify each change that presolve made.

3. Open models p0033.lp and p0033_p.lp (the presolved version) in a text editor. Construct an argument to justify fixing variable C173 to zero. Also, construct an argument for the transformation on constraint R127.

4. Read model knap.lp into CPLEX (*read knap.lp*):

```
Maximize x1 + x2 + x3 + x4
Subject To
 c1: x1 + 9 x2 + 10 x3 + 11 x4 <= 19
Binaries
 x1 x2 x3 x4
End
```

Solve the relaxed model (*change problem relaxed; optimize*). Examine the solution (*display solution variables* -) and find a violated (unlifted) cover cut. Add it to the model (by editing *knap.lp* or using the *add* command). Re-solve the model. Repeat until you can't find any more unlifted cover cuts. What is the relaxation objective? Now try lifting one of your cover cuts. What is the relaxation objective?

Can you derive the same cut using Gomory rounding? (Hint: you'll need the use a coefficient reduction argument to increase the coefficient on x1 first.)

4. Read model *agg.lp* into CPLEX:

```
Maximize y1 + y2
Subject To
 c1: y1 + y3 - 2 x1 <= 0
 c2: y2 + y3 - 2 x2 <= 0
 c3: x1 + x2 <= 1
Bounds
 0 <= y1 <= 1
 0 <= y2 <= 1
 0 <= y3 <= 1
Binaries
 x1 x2
End
```

Add a set of implied bound cuts that tighten the model so the relaxation is integral.