Communications Network Design
Class Exercise 3: Due before lecture, Wed May 20th, 2009

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1. Solve the following problem using the branch and bound algorithm. For convenience, always select x_1 as the branching variable when both x_1 and x_2 are fractional. Show your working (you may use Matlab, or some other tool to solve relaxations, but show the solutions for each branch, and the order of examining them, and explain your reasoning at each step)!

$$
\begin{aligned}
\text{Maximize} \quad & z = x_1 + x_2 \\
\text{subject to} \quad & 2x_1 + 5x_2 && \leq && 16 \\
& 6x_1 + 5x_2 && \leq && 30 \\
& x_1, x_2 \geq 0, \text{ and integer}
\end{aligned}
$$

Hint: In the branch and bound examples in lectures, I used a linear program solver from MATLAB called linprog. To use, for example to solve

$$
\begin{aligned}
\max \quad & c^t x \\
\text{subject to} \quad & Ax \leq b \\
\text{and} \quad & x \geq 0
\end{aligned}
$$

you would (in matlab) create the matrices and vectors A, b and c, and then use the command

```
linprog(c, A, b, [], [], zeros(size(c)))
```

Use matlab's help utility to get more information.

You may use another linear program solver you have access to, or solve by hand.

2. Solve the following integer knapsack problem using branch and bound. We have 6 possible items to put into a knapsack and we want to find the combination that fits into its finite volume as effectively as possible. The backpack has volume 10, and the volumes and values of the 6 possible items are given in the following table

	Item					
	1	2	3	4	5	6
volume	9	4	3	7	1	2
value	6	2	9	3	9	6

Find the indicator vector z that takes value 1 when an item is included in the pack, and zero otherwise.

3. Find the best solution you can to the following integer knapsack problem with 12 objects with backpack volume $B = 15$.

	Item											
	1	2	3	4	5	6	7	8	9	10	11	12
volume	5	9	7	7	9	10	5	9	5	1	9	3
value	6	2	2	6	5	5	6	3	7	4	10	6

I will give a prize to the student who gets the best (maximum value) solution.