Last class: The initial dictionary:

$X3 = 10 - 1\,X1 - 1\,X2$

$X4 = 4 + 2\,X1 - 1\,X2$

\---

$z = 0 + 1\,X1 + 2\,X2$

X1 enters. X3 leaves. z = 0

After 1 pivot:

$X1 = 10 - 1\,X2 - 1\,X3$

$X4 = 24 - 3\,X2 - 2\,X3$

\---

$z = 10 + 1\,X2 - 1\,X3$

Do the algebra to take the next pivot.

Formulate as an LP problem:

Toy company: produces planes and boats.
Selling price: Planes: $12, Boats $10.
Cost of raw materials: Planes $4, Boats $3.
A plane requires 3 hours to make and 1 hour to finish, while a boat requires 1 hour to make and 2 hours to finish.
The toy company knows it will not sell anymore than 30 planes per week.
The company cannot spend anymore than 120 hours per week making toys and 160 hours per week finishing toys.
The company wishes to maximize the profit it makes by choosing how many planes/boats to produce.

The plane/boat problem:

X1= number of planes

X2= number of boats

How would this be typed in for your program?

Maximize $z = 8 X1 + 7 X2$ // Profit

subject to

$1X1 + 0 X2 \leq 30$ //Number of planes at most 30

$3 X1 + 1 X2 \leq 120$ // Constraint on hours to make.

$1 X1 + 2 X2 \leq 160$ // Constraint on hours to finish.

$X1, X2 \geq 0$

What is the initial dictionary?

The solution (from my program):

X1= number of planes

X2= number of boats

After 3 pivots:

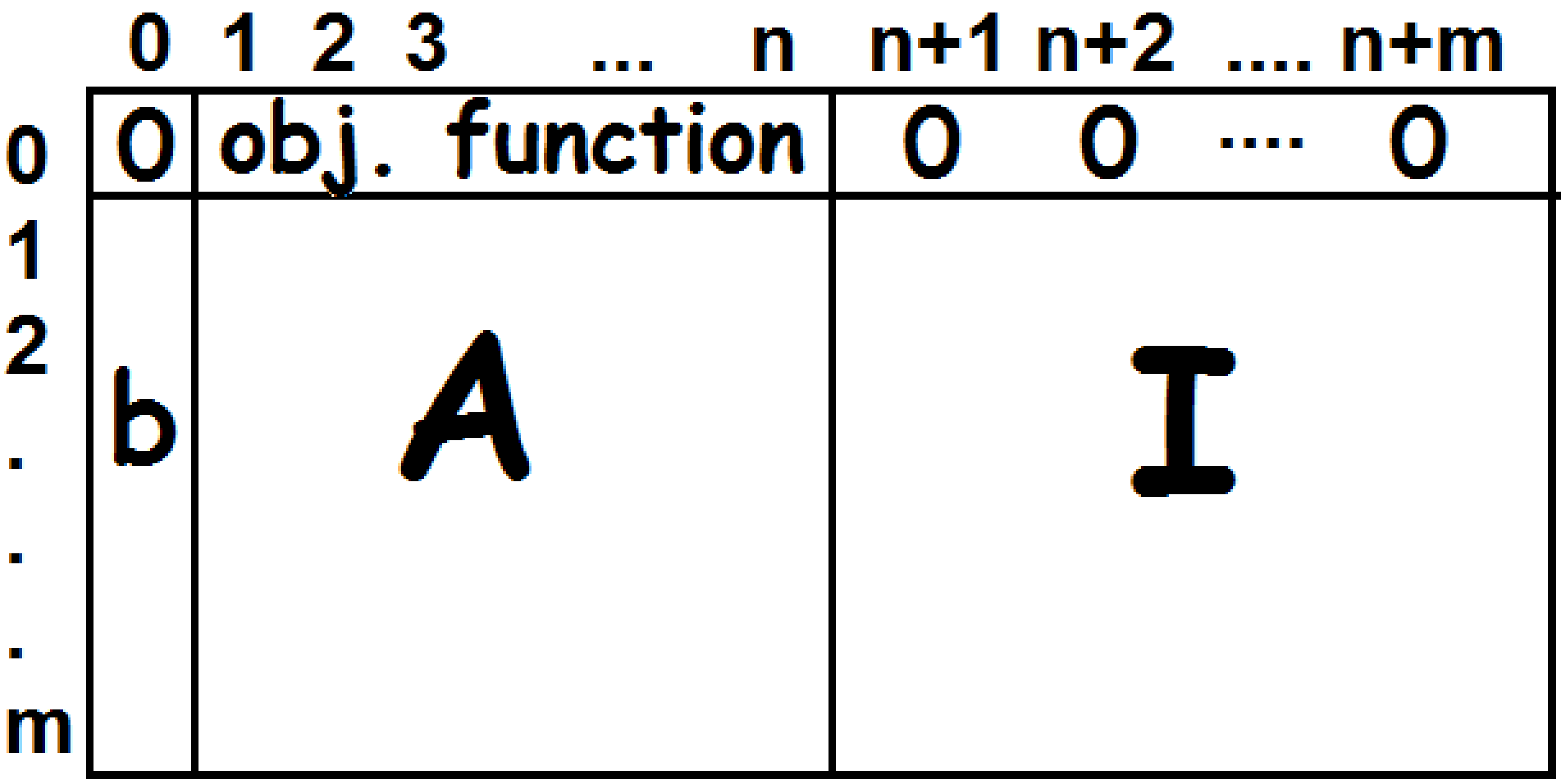
$$X1 = 16.00 - 0.40\, X4 + 0.20\, X5$$

$$X2 = 72.00 + 0.20\, X4 - 0.60\, X5$$

$$X3 = 14.00 + 0.40\, X4 - 0.20\, X5$$

$$z = 632.00 - 1.80\, X4 - 2.60\, X5$$

Because the b column is special and the z row is special, I chose to place them in column 0 and row 0 in my matrix for the Simplex algorithm. If you do this, the second phase of the project will probably be a little bit easier to implement.



Labor Shift Scheduling Problem

Unable to hire new police officers because of budget limitations, the Gotham City Police commissioner is trying to utilize the force better. The minimum requirements for police patrols for weekdays are noted below:

Time Period	Min
Midnight - 4:00 am	6
4:00 am - 8:00 am	4
8:00 am - noon	14
noon - 4:00 pm	8
4:00 pm - 8:00 pm	12
8:00 pm - Midnight	16

The police officers can start their shifts at the starting time of any of the above time periods. However they have to patrol for 8 hours. What is the minimum number of officers required to satisfy the requirements? Express this an LP problem.

June7/07 Raeside cartoon lampoons VPD, Times Colonist.

Announcements:

Assignment #1 has been posted: due Sept. 19 (or Sept. 23 with 10% late penalty)

Programming Project 1 has been posted: due Sept. 26 (or Sept. 30 with a 10% late penalty).

Another sample problem:

Maximize $5x_1 + 5x_2 + 3x_3$

subject to

$$
\begin{aligned}
x_1 + 3x_2 + x_3 &\le 3 \\
-x_1 + 3x_3 &\le 2 \\
2x_1 - x_2 + 2x_3 &\le 4 \\
2x_1 + 3x_2 - x_3 &\le 2
\end{aligned}
$$

$x_1, x_2, x_3 \ge 0$

How will we type in this problem as input?

Another sample problem: 3 4

Maximize $5x_1 + 5x_2 + 3x_3$ 5 5 3

subject to

$x_1 + 3x_2 + x_3 \le 3$		3 1 3 1
$-x_1 + 3x_3 \le 2$		2 -1 0 3
$2x_1 - x_2 + 2x_3 \le 4$		4 2 -1 2
$2x_1 + 3x_2 - x_3 \le 2$		2 2 3 -1

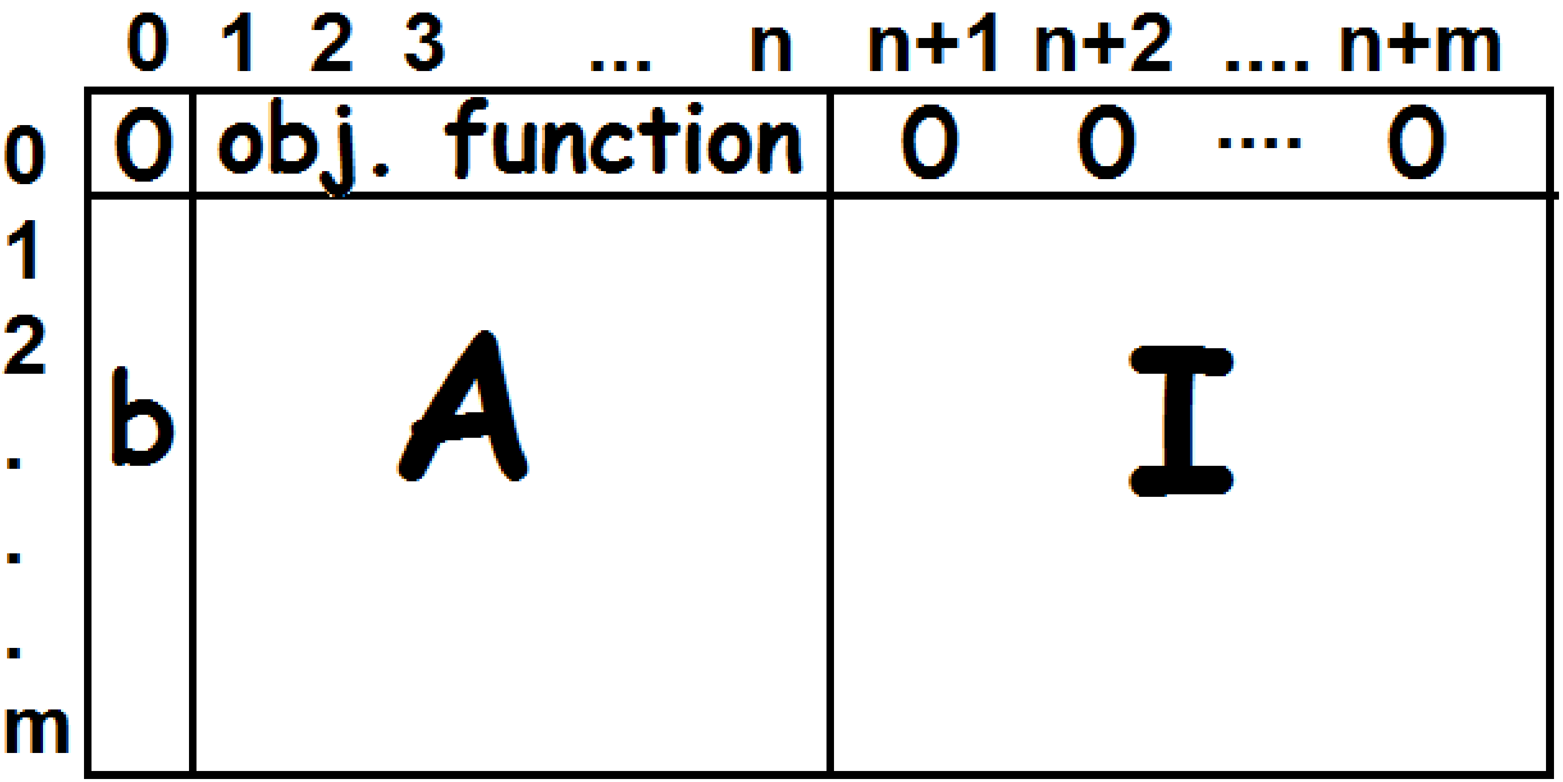
$x_1, x_2, x_3 \ge 0$

The initial dictionary:

```
X4 =  3.00-  1.00 X1 -  3.00 X2 -  1.00 X3
X5 =  2.00+  1.00 X1 +  0.00 X2 -  3.00 X3
X6 =  4.00-  2.00 X1 +  1.00 X2 -  2.00 X3
X7 =  2.00-  2.00 X1 -  3.00 X2 +  1.00 X3
------------------------------------------
z  = -0.00+  5.00 X1 +  5.00 X2 +  3.00 X3
```

How should we represent this in a tableau/array for our computer program?

Because the b column is special and the z row is special, I chose to place them in column 0 and row 0 in my matrix for the Simplex algorithm. If you do this, the second phase of the project will probably be a little bit easier to implement.



```
X1  enters.   X7  leaves.  z = -0.000000

After   1 pivot:

X4 =  2.00-  1.50 X2 -  1.50 X3 +  0.50 X7
X5 =  3.00-  1.50 X2 -  2.50 X3 -  0.50 X7
X6 =  2.00+  4.00 X2 -  3.00 X3 +  1.00 X7
X1 =  1.00-  1.50 X2 +  0.50 X3 -  0.50 X7
------------------------------------------
z  =  5.00-  2.50 X2 +  5.50 X3 -  2.50 X7
```

```
X3  enters.   X6  leaves.  z = 5.000000

After   2 pivots:
X4 =  1.00-  3.50 X2 +  0.50 X6 +  0.00 X7
X5 =  1.33-  4.83 X2 +  0.83 X6 -  1.33 X7
X3 =  0.67+  1.33 X2 -  0.33 X6 +  0.33 X7
X1 =  1.33-  0.83 X2 -  0.17 X6 -  0.33 X7
------------------------------------------
z  =  8.67+  4.83 X2 -  1.83 X6 -  0.67 X7
```

```
X2  enters.   X5  leaves.  z = 8.666667

After   3 pivots:
X4 =  0.03+  0.72 X5 -  0.10 X6 +  0.97 X7
X2 =  0.28-  0.21 X5 +  0.17 X6 -  0.28 X7
X3 =  1.03-  0.28 X5 -  0.10 X6 -  0.03 X7
X1 =  1.10+  0.17 X5 -  0.31 X6 -  0.10 X7
-------------------------------------------
z  = 10.00-  1.00 X5 -  1.00 X6 -  2.00 X7
```

How could we argue that this must be the optimal solution?