CSC 270: Assignment 1

Due: at beginning of tutorial, Fri. Oct. 3, 1997.

1. **Linear Systems.** Write a C program to solve a set of linear equations, $A\vec{x} = \vec{b}$ using Gaussian elimination with partial pivoting (row interchanges). Your program should first read in N, the number of equations. Then it should read in the N rows of A, each followed by the corresponding row of the right hand side, $\vec{b}$. For example, the input data

```
2
1  2  3
4  5  6
```

corresponds to the set of equations

$$1x_1 + 2x_2 = 3,$$
$$4x_1 + 5x_2 = 6.$$

After reading and printing the input, your program should then solve the problem using Gaussian elimination with row interchanges. Next, it should print the solution, $\vec{x}$, it obtained. Finally it should compute and print the residual, $\vec{r}$, where

$$\vec{r} = A\vec{x} - \vec{b}.$$

You can assume $N \leq 5$, so that you can declare A, x and b as simple variables:

```
float A[MAX_DIM][MAX_DIM], x[MAX_DIM], b[MAX_DIM];
```

Here `MAX_DIM` should be set using the C preprocessor's `#define` statement.

Run your program on these sets of input data:

a) This 3×3 problem:

$$x_1 + 2x_2 + 3x_3 = 14,$$
$$x_1 + 2x_2 + 2x_3 = 11,$$
$$x_1 + x_2 + x_3 = 6,$$

which has the solution $\vec{x} = (1, 2, 3)^T$.

b) This 1×1 problem:

$$2x_1 = 12.3456$$

Over...

c) A 2×2 problem that is nearly singular, so that the "solution" printed by your program is easily seen to be wrong (say at least in the third digit of x_1 or x_2, when compared to the true solution $\vec{x}$).

d) Test your program with $N = 6$. This is too big for your arrays, so your program should stop with an error message.

Watch the course web page for a description of the programming style that we expect, and a note on what to hand in.