```
Math 232, Jan 15, 2001:  Elimination/LU Decomposition

Augmented matrix  A b
A0 =
     2    -2     3     1
     6    -7    14     5
     4    -8    30    14

Proceed with elimination

A1=A0; A1(2,:)=A0(2,:)-3*A0(1,:),
A1 =
     2    -2     3     1
     0    -1     5     2
     4    -8    30    14
A2=A1; A2(3,:)=A1(3,:)-2*A1(1,:),
A2 =
     2    -2     3     1
     0    -1     5     2
     0    -4    24    12
A3=A2; A3(3,:)=A2(3,:)-4*A2(2,:),
A3 =
     2    -2     3     1
     0    -1     5     2
     0     0     4     4
E21=elemat(3,2,1,-3)
E21 =
     1     0     0
    -3     1     0
     0     0     1

E21: An elementary matrix.  It differs from the identity matrix
I   =
     1     0     0
     0     1     0
     0     0     1
only at one positio, namely position 2,1 (row 2, col 1).
The first elimination step can be expressed as a matrix-multiply:

B1=E21*A0
B1 =
     2    -2     3     1
     0    -1     5     2
     4    -8    30    14
```

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The same as our matrix A1

E31=elemat(3,3,1,-2)
E31 =
     1     0     0
     0     1     0
    -2     0     1
E32=elemat(3,3,2,-4)
E32 =
     1     0     0
     0     1     0
     0    -4     1
B2=E31*B1
B2 =
     2    -2     3     1
     0    -1     5     2
     0    -4    24    12
B3=E32*B2
B3 =
     2    -2     3     1
     0    -1     5     2
     0     0     4     4
C=E32*E31*E21*A0
C =
     2    -2     3     1
     0    -1     5     2
     0     0     4     4
M=E32*E31*E21
M =
     1     0     0
    -3     1     0
    10    -4     1
Ei21=inv(E21)
Inverse of a matrix G:  G*inv(G) = I;
in our example the intuitive meaning is just that inv(E21)
is undoing whatever E21 has done, i.e.,
    inv(E21)*E21*A0 = A0, i.e., inv(E21)*E21=I.
Ei21 =
     1     0     0
     3     1     0
     0     0     1
E21*Ei21
ans =
     1     0     0
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```
     0     1     0
     0     0     1
L=inv(E21)*inv(E31)*inv(E32)
L =
     1     0     0
     3     1     0
     2     4     1
```

The matrix L will get us from A3 back to the initial matrix A0 ! Note that its entries are precisely the multipliers used in the elimination steps. See also the supplementary Lecture Notes available from the Clandar Page at the 232 Web Site!

```
A3
A3 =
     2    -2     3     1
     0    -1     5     2
     0     0     4     4
L*A3
ans =
     2    -2     3     1
     6    -7    14     5
     4    -8    30    14
```

For Wednesday, Jan 17:

Formally introduce identity matrix I and inverse

Factorization of matrix only, A = L*U

knowing A=L*U, how do we solve Ax = b?