MAT 343 MATLAB LAB 3 **NAME: _Hieu Pham____**

```
%Exercise 1
A = floor(10*rand(4,3))

A =

   9   8   8
   2   7   4
   6   4   6
   4   0   7

E1 = eye(4);
E1([1,3],:)=E1([3,1],:)

E1 =

   0   0   1   0
   0   1   0   0
   1   0   0   0
   0   0   0   1

E2 = eye(4);
E2(2,2)=5

E2 =

   1   0   0   0
   0   5   0   0
   0   0   1   0
   0   0   0   1

E3 = eye(4);
E3(4,1)=7

E3 =

   1   0   0   0
   0   1   0   0
   0   0   1   0
   7   0   0   1
```

MAT 343 MATLAB LAB 3 **NAME: _Hieu Pham____**

```
E1*A

ans =

    6    4    6
    2    7    4
    9    8    8
    4    0    7

E2*A

ans =

    9    8    8
   10   35   20
    6    4    6
    4    0    7

E3*A

ans =

    9    8    8
    2    7    4
    6    4    6
   67   56   63

%For E1*A, the rows were swapped/exchanged.
%For E2*A, the second row was multiplied by 5.
%For E3*A, Row 4 was the original row 4 plus 7*row1
%Exercise 2
%Part A
A = [1,-2,3;2,-6,5;-1,-4,0];
E1 = eye(3);
E1(2,1) = -2

E1 =

    1    0    0
   -2    1    0
    0    0    1
```

MAT 343 MATLAB LAB 3 **NAME: _Hieu Pham____**

```
E1*A

ans =

    1    -2     3
    0    -2    -1
   -1    -4     0

E2 = eye(3);
E2(3,1) = 1

E2 =

    1     0     0
    0     1     0
    1     0     1

E2*E1*A

ans =

    1    -2     3
    0    -2    -1
    0    -6     3

E3 = eye(3);
E3(3,2) = -3

E3 =

    1     0     0
    0     1     0
    0    -3     1

U = E3*E2*E1*A

U =

    1    -2     3
    0    -2    -1
    0     0     6
```

MAT 343 MATLAB LAB 3 **NAME: _Hieu Pham____**

```
%U is the upper triangular matrix.
%Part B
L = inv(E1)*inv(E2)*inv(E3)

L =

    1    0    0
    2    1    0
   -1    3    1

%L is the lower triangular matrix.
A=L*U

A =

    1   -2    3
    2   -6    5
   -1   -4    0

%L*U produced matrix A.
%Exercise 3
%Part A
p = [3,1,2,5,4];
E = eye(length(p));
E = E(p,:)

E =

    0    0    1    0    0
    1    0    0    0    0
    0    1    0    0    0
    0    0    0    0    1
    0    0    0    1    0

A = floor(10*rand(5))

A =

    9    9    8    6    4
    7    4    0    2    9
    1    8    1    1    4
    4    0    2    0    4
```

MAT 343 MATLAB LAB 3 **NAME: _Hieu Pham____**

```
   9   3   1   7   8

E*A

ans =

   1   8   1   1   4
   9   9   8   6   4
   7   4   0   2   9
   9   3   1   7   8
   4   0   2   0   4

A*E

ans =

   9   8   9   4   6
   4   0   7   9   2
   8   1   1   4   1
   0   2   4   4   0
   3   1   9   8   7

%For E*A operation, the rows were swapped in the same order as E matrix.
%For A*E operation, the columns were swapped in matrix A.
%Part B
inv(E)

ans =

   0   1   0   0   0
   0   0   1   0   0
   1   0   0   0   0
   0   0   0   0   1
   0   0   0   1   0

E'

ans =

   0   1   0   0   0
   0   0   1   0   0
   1   0   0   0   0
```

```
    0    0    0    0    1
    0    0    0    1    0

%E and E' produced the same results.
%Exercise 4
%Part A
A = [2,2,4,6;1,2,1,4;-4,-3,-7,-8;2,1,3,3];
b = [6;8;-11;3];
[L,U,P] = lu(A)

L =

    1.0000         0         0         0
   -0.2500    1.0000         0         0
   -0.5000    0.4000    1.0000         0
   -0.5000   -0.4000   -1.0000    1.0000


U =

   -4.0000   -3.0000   -7.0000   -8.0000
         0    1.2500   -0.7500    2.0000
         0         0    0.8000    1.2000
         0         0         0    1.0000


P =

    0    0    1    0
    0    1    0    0
    1    0    0    0
    0    0    0    1

L*U

ans =

   -4   -3   -7   -8
    1    2    1    4
    2    2    4    6
    2    1    3    3
```

MAT 343 MATLAB LAB 3 **NAME: _Hieu Pham____**

P*A-L*U (If PA = LU, their differences evaluate to 0)

```
ans =

     0     0     0     0
     0     0     0     0
     0     0     0     0
     0     0     0     0
```

```
%Part B
y = L\(P*b);
x = U\y

x =

   -1.0000
    8.0000
    1.0000
   -2.0000

P*b

ans =

   -11
     8
     6
     3

P*A*x

ans =

   -11
     8
     6
     3

%Part C
z = [-1;8;1;-2];
norm (x-z)
```

```
ans =

  2.2204e-016

%Exercise 5
%Part A
A = rand(500);
x = ones(500,1);
b = A*x;
tic; R = rref([A,b]); x_rref = R(:,end); toc

elapsed_time =

   20.7520

%Part B
tic; [L,U,P] = lu(A); y = L\(P*b); x_lu = U\y; toc

elapsed_time =

    0.0370

%The LU decomposition produced faster result than Part A.
%Part C
norm(x_rref - x)

ans =

  1.5236e-011

norm(x_lu - x)

ans =

  1.9308e-011

%The solutions are different. The LU decomposition likely the most accurate.
diary off
```