Exercise 1;

```
>> E1 = eye (4);
>> E1 ([3 ,2] ,:)= E1 ([2 ,3] ,:);

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

>> E3 = eye (4);
>> E3 (1 ,3)=5;

>> A = floor(10*rand(4,3))
A =

     8     6     9
     9     0     9
     1     2     1
     9     5     9

>> E1*A

ans =

     8     6     9
     1     2     1
     9     0     9
     9     5     9

>> E2*A

ans =

     8     6     9
    36     0    36
     1     2     1
     9     5     9

>> E3*A

ans =

    13    16    14
     9     0     9
     1     2     1
     9     5     9
```

describe specifically how the rows of A have changed. What general pattern do you see? That is, what effect does multiplying a matrix A on the left by an elementary matrix have on the matrix A?

The matrix seems to have a pretty constant changes throughout. Apparat from multiplication of different numbers the parts which had same rows got multiplied in the same fashion and the parts which were multiplied had the multiplied values.

The observation was so that if we multiplied the identity matrix with a and do all the manipulations for E1, E2 and E3 will will end up with same matrix as now.

Exercise 2
Part a)

```
>> E1 =[1,0,0;0,1,0;0,4/3,1];
>> E2 = [1,0,0;0,1,0;8/3,0,1];
>> E3 = [1,0,0;5,1,0;0,0,1];
>> U = E3*E2*E1*A

U =

    -2     4    -4
     0   -15    15
     0     0     4

>> L = inv(E1)*inv(E2)*inv(E3)

L =

       1           0           0
      -5           1           0
       4         -4/3          1
```

Part B)

```
>> format short
>> A-L*U

ans =

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

This Proves A= LU

Exercise 3)
Part A)

```
>> p = [5 ,3 ,4 ,2 ,1];
>> E = eye ( length ( p ) ) ;
>> E = E (p ,:)

E =

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

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

>> A = floor(10*rand(5))
A =

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

>> E*A

ans =

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

E*A is a rearranged matrice A. It has same rows just in different order.

```
>> A*E

ans =

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

A*E is very similar to A as A*E has same columns as rows in A. Just in jumble order.

Part B)

```
>> inv(E)
```

ans =

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

>> E'

ans =

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

E^{-1} and E^{T} are the same matrices.

Exercise 4)
Part A:
>> A =[-7, 6, 7, 4;9,-4, 9, -7;4, -7, -9, -8;8, 5, -3,-5]

A =

```
    -7     6     7     4
     9    -4     9    -7
     4    -7    -9    -8
     8     5    -3    -5
```

>> b = [-12;139;9;-28]

b =

```
   -12
   139
     9
   -28
```

>> [L,U,P] = lu(A)

L =

```
    1.0000         0         0         0
    0.8889    1.0000         0         0
    0.4444   -0.6104    1.0000         0
   -0.7778    0.3377   -0.8986    1.0000


U =

    9.0000   -4.0000    9.0000   -7.0000
         0    8.5556  -11.0000    1.2222
         0         0  -19.7143   -4.1429
         0         0         0   -5.5797


P =

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


>> (P*A)-(L*U)

ans =

   1.0e-14 * = 0

         0         0         0         0
         0         0         0         0
         0         0         0         0
   -0.0888         0   -0.1776    0.0888
```

The answer is equal to 0 so it proves PA=LU

Part B)

```
>> y = L\(P*b)

y =

  139.0000
 -151.5556
 -145.2857
   16.7391
```

```
>> x_lu = U\y
```

x_lu =

2
-7
8
-3

Part C)

```
x_lu =

     2
    -7
     8
    -3

>> x = [2,-7,8,-3]'

x =

     2
    -7
     8
    -3

>> x_lu-x
```

ans =

0
0
0
0

This proves x_lu = x;

Exercise 5)

```
>> A = rand(800);
>> x = ones(800,1);
>> b=A*x;
```

Part A)

```
>> tic; R = rref([A, b]); x_rref = R(:,end); toc
Elapsed time is 7.087166 seconds.
```

Part B)

```
>> tic; [L,U,P] = lu(A);y = L\(P*b);x = U\y; toc
Elapsed time is 0.022390 seconds.
```

The LU factorization method is way faster

Part C)

```
>> norm(x_rref - x)

ans =

   1.5299e-11

>> norm(x_lu - x)

ans =

   1.4332e-11
```

Part B **LU factorization is a more accurate.**