Quadratic form to Canonical Form

1)

```
clc
clear all
syms x1 x2 x3 y1 y2 y3 real
Q=input('Enter the quadratic form x1,x2 and x3  ')
a11=(1/2)*diff(diff(Q,x1),x1);
a22=(1/2)*diff(diff(Q,x2),x2);
a33=(1/2)*diff(diff(Q,x3),x3);
a12=(1/2)*diff(diff(Q,x1),x2);
a21=a12;
a13=(1/2)*diff(diff(Q,x1),x3);
a31=a13;
a23=(1/2)*diff(diff(Q,x2),x3);
a32=a23;
A=[a11 a12 a13; a21 a22 a23;a31 a32 a33];
A=double(A)
[N,D]=eig(A);
D1=N'*A*N
Y=[y1;y2;y3]
disp('The Canonical Form')
cf=vpa(Y'*D*Y,5)
```

Problem 1 :-

Enter the quadratic form x1,x2 and x33*x1^2+3*x2^2+3*x3^2-2*x2*x3+2*x1*x2+2*x1*x3

Q =

3*x1^2 + 2*x1*x2 + 2*x1*x3 + 3*x2^2 - 2*x2*x3 + 3*x3^2

A =

```
[ 3,  1,  1]
[ 1,  3, -1]
[ 1, -1,  3]
```

A =

```
     3     1     1
     1     3    -1
     1    -1     3
```

N =

```
   -0.5774    0.1870    0.7948
    0.5774    0.7818    0.2354
    0.5774   -0.5948    0.5594
```

D =

```
    1.0000         0         0
         0    4.0000         0
         0         0    4.0000
```

D1 =

```
    1.0000    0.0000   -0.0000
    0.0000    4.0000   -0.0000
   -0.0000   -0.0000    4.0000
```

Y =

```
 y1
 y2
 y3
```

The Canonical Form

cf =

```
y1^2 + 4.0*y2^2 + 4.0*y3^2
```

Problem 2 :-

Enter the quadratic form x1,x2 and x3 x1^2+3*x2^2+6*x3^2+2*x2*x3+4*x1*x3+2*x1*x2

Q =

```
x1^2 + 2*x1*x2 + 4*x1*x3 + 3*x2^2 + 2*x2*x3 + 6*x3^2
```

A =

```
     1     1     2
     1     3     1
     2     1     6
```

D1 =

```
    0.1540    0.0000   -0.0000
    0.0000    2.7431    0.0000
   -0.0000    0.0000    7.1029
```

Y =

```
 y1
 y2
 y3
```

The Canonical Form

cf =

0.15397*y1^2 + 2.7431*y2^2 + 7.1029*y3^2

Problem 3 :-

Enter the quadratic form x1,x2 and x3 3*x1^2+5*x2^2+3*x3^2-2*x2*x3+2*x1*x3-2*x1*x2

Q =

3*x1^2 - 2*x1*x2 + 2*x1*x3 + 5*x2^2 - 2*x2*x3 + 3*x3^2

A =

```
     3    -1     1
    -1     5    -1
     1    -1     3
```

D1 =

```
    2.0000   -0.0000    0.0000
   -0.0000    3.0000    0.0000
    0.0000    0.0000    6.0000
```

Y =

```
 y1
 y2
 y3
```

The Canonical Form

cf =

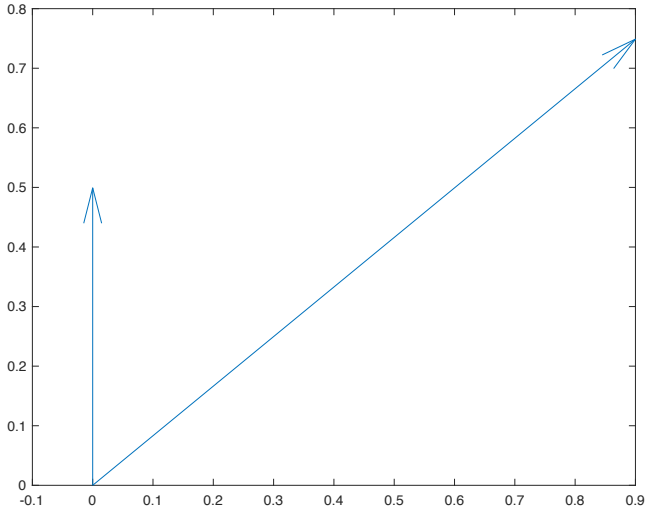
2.0*y1^2 + 3.0*y2^2 + 6.0*y3^2

Visualisation of Eigen Vectors

1)

```
clc
clear all
A=input('Enter a 2*2 matrix:')
[P,D]=eig(A);
O=zeros(2);
quiver(O(:,1),O(:,2),P(:,1),P(:,2))
pause
hold on
ev=diag(D)
AP=A*P
quiver(O(:,1),O(:,2),AP(:,1),AP(:,2))
```

```
Output :-

Enter a 2*2 matrix:[2 3;0 4]


A =


     2     3

     0     4
```

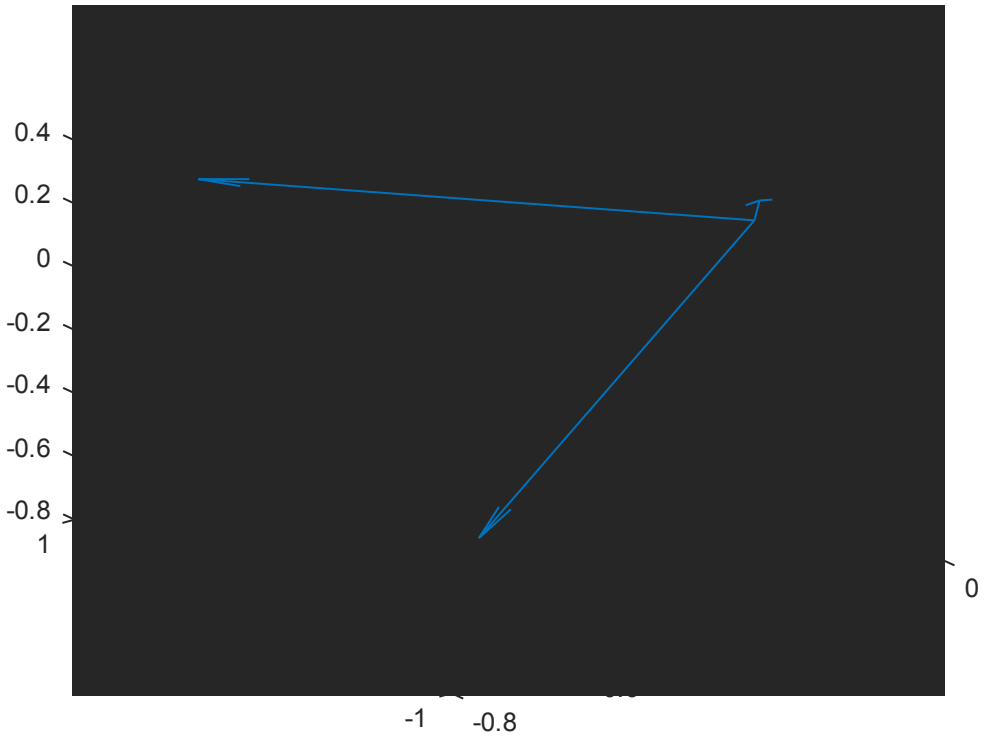


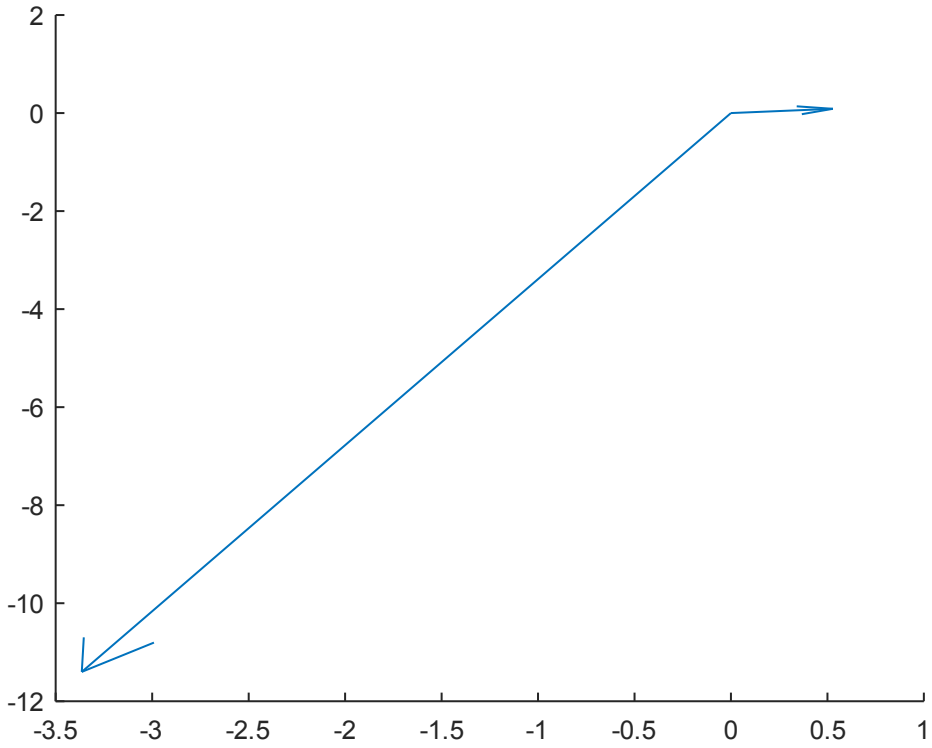
2)

```
clc
clear all
A=input('Enter a 2*2 or 3*3matrix:')
[P,D]=eig(A);
n=size(A);
O=zeros(n);
AP=D*P'
if n==2
    quiver(O(:,1),O(:,2),P(:,1),P(:,2))
    pause
    hold on
    quiver(O(:,1),O(:,2),AP(:,1),AP(:,2))
else
    quiver3(O(:,1),O(:,2),O(:,3),P(:,1),P(:,2),P(:,3))
    pause
    hold on
    quiver3(O(:,1),O(:,2),O(:,3),AP(:,1),AP(:,2),AP(:,3))
end
```

Output :-

```
Enter a 2*2 or 3*3matrix:[1 2 3;4 5 6;7 8 9]

A =

     1     2     3

     4     5     6

     7     8     9

AP =

   -3.7386  -12.6651    6.5797

    0.5867    0.0969    0.9119

    0.0000   -0.0000   -0.0000
```


0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
1
0
-1
-0.8


2
0
-2
-4
-6
-8
-10
-12
-3.5
-3
-2.5
-2
-1.5
-1
-0.5
0
0.5
1