

# Finding Characteristic Polynomial, Eigenvalues and Eigenvectors of A Square Matrix in MATLAB

```
syms x  
A = sym([-13 6; 2 -2])
```

$$A = \begin{pmatrix} -13 & 6 \\ 2 & -2 \end{pmatrix}$$

## Finding Characteristic Polynomial

```
polyA = charpoly(A,x)
```

$$\text{polyA} = x^2 + 15x + 14$$

```
lambda = eig(A)
```

$$\text{lambda} = \begin{pmatrix} -14 \\ -1 \end{pmatrix}$$

**eig** returns vector of eigenvalues. The next command returns first a matrix whose columns are eigenvectors corresponding, in order, to the eigenvalues found. The second matrix shows the eigenvalues along a diagonal matrix

```
[Eigenvectors,DiagonalEigenvalues] = eig(A)
```

Eigenvectors =

$$\begin{pmatrix} -6 & \frac{1}{2} \\ 1 & 1 \end{pmatrix}$$

DiagonalEigenvalues =

$$\begin{pmatrix} -14 & 0 \\ 0 & -1 \end{pmatrix}$$

# Computing Eigenvalues and Eigenvectors Numerically

```
B = [1 2 3; 3 7 22; 7 8 10]
```

```
B = 3x3
     1     2     3
     3     7    22
     7     8    10
```

```
polyB = charpoly(B,x)
```

```
polyB = x3 - 18x2 - 116x - 67
```

```
Eigenvalues_of_B = eig(B)
```

```
Eigenvalues_of_B = 3x1
    23.1384
    -0.6443
    -4.4941
```

```
[Eigenvectors,DiagonalEigenvalues] = eig(B)
```

```
Eigenvectors = 3x3
    -0.1503   -0.6018    0.0755
    -0.8068    0.7763   -0.8880
    -0.5714   -0.1877    0.4536
DiagonalEigenvalues = 3x3
    23.1384     0     0
     0   -0.6443     0
     0     0   -4.4941
```

```
C = [1 2 3 4 5; 3 11 2 0 22; 0 5 7 5 3; 7 4 17 7 6; 12 21 19 6 6]
```

```
C = 5x5
     1     2     3     4     5
     3    11     2     0    22
     0     5     7     5     3
     7     4    17     7     6
    12    21    19     6     6
```

```
polyC = charpoly(C,x)
```

```
polyC = x5 - 32x4 - 360x3 + 5242x2 + 17350x - 57414
```

```
Eigenvalues_of_C = eig(C)
```

```
Eigenvalues_of_C = 5x1
    37.5700
   -13.7257
    -4.7912
```

2.1528  
10.7940

```
[Eigenvectors,DiagonalEigenvalues] = eig(C)
```

```
Eigenvectors = 5x5
```

```
-0.1812  -0.1516  -0.2204   0.6848   0.2382  
-0.5852  -0.6451   0.4297  -0.1898  -0.5630  
-0.2214   0.0721  -0.4287  -0.4078   0.2204  
-0.3711  -0.0975   0.7250   0.5731   0.7586  
-0.6619   0.7391  -0.2394   0.0200  -0.0472
```

```
DiagonalEigenvalues = 5x5
```

```
37.5700   0         0         0         0  
0  -13.7257   0         0         0  
0         0  -4.7912   0         0  
0         0         0   2.1528   0  
0         0         0         0  10.7940
```