

## Diagonalization in MATLAB

*Generate  $6 \times 6$  matrix with 2 prs complex eigenvalues*

```
>> P = randint(6,6,4)    % arg's are #rows, #cols,  
                        % and range 0:(4-1) for matrix entries  
3   1   3   1   0   0  
0   0   2   3   0   2  
2   3   0   0   0   1  
1   1   1   1   2   3  
3   2   3   3   1   1  
3   3   3   0   0   1    %% turns out invertible  
  
>> D = diag([0 0 0 0 .5 4]'); %% diagonal matrix  
  
>> D(1:2,1:2) = [2 -1; 1 2]; D(3:4,3:4) = [1 5; -5 1]  
2.0   -1.0     0     0     0     0  
1.0    2.0     0     0     0     0  
0      0      1.0   5.0     0     0  
0      0     -5.0   1.0     0     0  
0      0      0      0     0.5     0  
0      0      0      0     0      4.0
```

```
>> A = P*D*inv(P)
    6.519    1.968    6.468   -0.715    1.430   -9.690
    6.304    3.994   10.494    1.057   -2.114  -11.538
    5.063    0.728    4.228    1.449   -2.899   -3.133
    7.240    3.766    7.266    3.108   -5.215   -6.905
   10.234    2.943   12.943    0.513   -0.525  -15.842
    5.582    2.696    5.696   -0.266    0.532   -6.823
```

```
>> [ real(eig(A))' ; imag(eig(A))' ]
    1.0    1.0    4.0    2.0    2.0    0.5
    5.0   -5.0    0     1.0   -1.0    0
```

*Generally: command  $[V, G] = \text{eig}(A)$  gives*  
 *$V =$  matrix with eigenvector columns*  
 *$G =$  diagonal matrix of eigenvalues*

```
>> Q = [real(V(:,1)), imag(V(:,1)), real(V(:,4)), ...
        imag(V(:,4)), V(:,[3 6])];
>> inv(Q) * A * Q
    1.0    5.0    0.0    0.0    0.0   -0.0
   -5.0    1.0    0.0   -0.0    0   -0.0
    0.0   -0.0    2.0    1.0    0.0    0.0
   -0.0   -0.0   -1.0    2.0    0.0   -0.0
   -0.0    0.0    0.0    0.0    4.0   -0.0
   -0.0    0.0    0.0    0.0    0.0    0.5
```

```
>> B = eye(6) + [ zeros(5,1) eye(5); zeros(1,6) ]
    1     1     0     0     0     0
    0     1     1     0     0     0
    0     0     1     1     0     0
    0     0     0     1     1     0
    0     0     0     0     1     1
    0     0     0     0     0     1
```

*has only **one** eigenvec, 6-times multiple e.v. 1*

```
>> [V G] = eig(B + rand(6,6)*.01);
```

```
>> diag(G)
    1.5062
    1.0883 + 0.4064i
    1.0883 - 0.4064i
    0.6779 + 0.1960i
    0.6779 - 0.1960i
    0.9956
```

```
>> eig(diag(1:6)+ rand(6,6)*.01)
    1.0013    2.0004    6.0056    3.0003    4.0006    5.0044
```