

## 212 Lab #9 Key

My comments are in blue.

```
>> syms x y z t lambda L
```

1.

```
>> A=[1 6;2 5]
```

A =

```
 1  6
 2  5
```

```
>> [xi,R]=eig(sym(A))
```

xi =

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

R =

```
[-1, 0]
[ 0, 7]
```

$$\vec{x}(t) = c_1 \begin{pmatrix} -3 \\ 1 \end{pmatrix} e^{-t} + c_2 \begin{pmatrix} 1 \\ 1 \end{pmatrix} e^{7t}$$

2.

```
>> B=[2 9;1 10]
```

B =

```
 2  9
 1 10
```

```
>> [xi,R]=eig(sym(B))
```

xi =

```
[-9, 1]
[ 1, 1]
```

R =

```
[ 1, 0]
[ 0,11]
```

$$\vec{x}(t) = c_1 \begin{pmatrix} -9 \\ 1 \end{pmatrix} e^t + c_2 \begin{pmatrix} 1 \\ 1 \end{pmatrix} e^{11t}$$

3.

```
>> C=[3 4;0 2]
```

C =

```
 3  4  
 0  2
```

```
>> [xi,R]=eig(sym(C))
```

xi =

```
[-4, 1]  
[ 1, 0]
```

R =

```
[ 2, 0]  
[ 0, 3]
```

$$\vec{x}(t) = c_1 \begin{pmatrix} -4 \\ 1 \end{pmatrix} e^{2t} + c_2 \begin{pmatrix} 1 \\ 0 \end{pmatrix} e^{3t}$$

4.

```
>> D=[2 0;1 3]
```

D =

```
 2  0  
 1  3
```

```
>> [xi,R]=eig(sym(D))
```

xi =

```
[-1, 0]  
[ 1, 1]
```

R =

```
[ 2, 0]  
[ 0, 3]
```

$$\vec{x}(t) = c_1 \begin{pmatrix} -1 \\ 1 \end{pmatrix} e^{2t} + c_2 \begin{pmatrix} 0 \\ 1 \end{pmatrix} e^{3t}$$

5.

```
>> E=[4 5;6 11]
```

E =

```
 4  5  
 6 11
```

```
>> [xi,R]=eig(sym(E))
```

xi =

```
[-5/3, 1/2]  
[ 1, 1]
```

R =

```
[ 1, 0]  
[ 0, 14]
```

$$\vec{x}(t) = c_1 \begin{pmatrix} -5 \\ 3 \end{pmatrix} e^t + c_2 \begin{pmatrix} 1 \\ 2 \end{pmatrix} e^{14t}$$

6.

```
>> F=[0 1;8 2]
```

F =

```
 0  1  
 8  2
```

```
>> [xi,R]=eig(sym(F))
```

xi =

```
[-1/2, 1/4]  
[ 1, 1]
```

R =

```
[-2, 0]  
[ 0, 4]
```

$$\vec{x}(t) = c_1 \begin{pmatrix} -1 \\ 2 \end{pmatrix} e^{-2t} + c_2 \begin{pmatrix} 1 \\ 4 \end{pmatrix} e^{4t}$$

7.

```
>> G=[-1 1;3 1]
```

G =

```
-1 1  
3 1
```

```
>> [xi,R]=eig(sym(G))
```

xi =

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

R =

```
[ 2, 0]  
[ 0, -2]
```

$$\vec{x}(t) = c_1 \begin{pmatrix} 1 \\ 3 \end{pmatrix} e^{2t} + c_2 \begin{pmatrix} -1 \\ 1 \end{pmatrix} e^{-2t}$$

8.

```
>> H=[-2 5;7 0]
```

H =

```
-2 5  
7 0
```

```
>> [xi,R]=eig(sym(H))
```

xi =

```
[-1, 5/7]  
[ 1, 1]
```

R =

```
[-7, 0]  
[ 0, 5]
```

$$\vec{x}(t) = c_1 \begin{pmatrix} -1 \\ 1 \end{pmatrix} e^{-7t} + c_2 \begin{pmatrix} 5 \\ 7 \end{pmatrix} e^{5t}$$

9.

```
>> I=[-3 7;5 -1]
```

I =

```
-3 7  
5 -1
```

```
>> [xi,R]=eig(sym(I))
```

xi =

```
[-7/5, 1]  
[ 1, 1]
```

R =

```
[-8, 0]  
[ 0, 4]
```

$$\vec{x}(t) = c_1 \begin{pmatrix} -7 \\ 5 \end{pmatrix} e^{-8t} + c_2 \begin{pmatrix} 1 \\ 1 \end{pmatrix} e^{4t}$$

10.

```
>> J=[-4 1;6 -5]
```

J =

```
-4 1  
6 -5
```

```
>> [xi,R]=eig(sym(J))
```

xi =

```
[-1/3, 1/2]  
[ 1, 1]
```

R =

```
[-7, 0]  
[ 0, -2]
```

$$\vec{x}(t) = c_1 \begin{pmatrix} -1 \\ 3 \end{pmatrix} e^{-7t} + c_2 \begin{pmatrix} 1 \\ 2 \end{pmatrix} e^{-2t}$$

11.

```
>> K=[3 -2;2 3]
```

K =

```
 3 -2
 2  3
```

```
>> [xi,R]=eig(sym(K))
```

xi =

```
[-i, i]
[ 1, 1]
```

R =

```
[ 3 - 2*i,  0]
[   0, 3 + 2*i]
```

optional

$$\vec{x}(t) = c_1 e^{3t} \begin{pmatrix} -\sin 2t \\ \cos 2t \end{pmatrix} + c_2 e^{3t} \begin{pmatrix} \cos 2t \\ \sin 2t \end{pmatrix}$$

12.

```
>> L=[-4 5;-5 -4]
```

L =

```
-4  5
-5 -4
```

```
>> [xi,R]=eig(sym(L))
```

xi =

```
[ i, -i]
[ 1, 1]
```

R =

```
[- 4 - 5*i,  0]
[   0, - 4 + 5*i]
```

optional

$$\vec{x}(t) = c_1 e^{-4t} \begin{pmatrix} \sin 5t \\ \cos 5t \end{pmatrix} + c_2 e^{-4t} \begin{pmatrix} -\cos 5t \\ \sin 5t \end{pmatrix}$$

13.

>> M=[-2 2;-5 6]

M =

```
-2  2
-5  6
```

>> [xi,R]=eig(sym(M))

xi =

```
[ 6^(1/2)/5 + 4/5, 4/5 - 6^(1/2)/5]
[      1,          1]
```

R =

```
[ 2 - 6^(1/2),    0]
[      0, 6^(1/2) + 2]
```

$$\vec{x}(t) = c_1 \begin{pmatrix} 4 + \sqrt{6} \\ 5 \end{pmatrix} e^{(2-\sqrt{6})t} + c_2 \begin{pmatrix} 4 - \sqrt{6} \\ 5 \end{pmatrix} e^{(2+\sqrt{6})t}$$

14.

>> N=[-2 5 3;0 2 -4;0 -1 2]

N =

```
-2  5  3
 0  2 -4
 0 -1  2
```

>> [xi,R]=eig(sym(N))

xi =

```
[ 13/2, 1, -7/6]
[  2, 0, -2]
[  1, 0,  1]
```

R =

[ 0, 0, 0]  
[ 0, -2, 0]  
[ 0, 0, 4]

$$\vec{x}(t) = c_1 \begin{pmatrix} 13 \\ 4 \\ 2 \end{pmatrix} + c_2 \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} e^{-2t} + c_3 \begin{pmatrix} -7 \\ -12 \\ 6 \end{pmatrix} e^{4t}$$

15.

>> O=[4 -2 0;0 0 -3;0 2 5]

O =

4 -2 0  
0 0 -3  
0 2 5

>> [xi,R]=eig(sym(O))

xi =

[-2, 1, -3/2]  
[-1, 0, -3/2]  
[ 1, 0, 1]

R =

[ 3, 0, 0]  
[ 0, 4, 0]  
[ 0, 0, 2]

>>

$$\vec{x}(t) = c_1 \begin{pmatrix} -2 \\ -1 \\ 1 \end{pmatrix} e^{3t} + c_2 \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} e^{4t} + c_3 \begin{pmatrix} -3 \\ -3 \\ 2 \end{pmatrix} e^{2t}$$