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Exercise 4.1

a)

```
>> B = [1.2 2.5; 4 0.7]

B =

    1.2000    2.5000
    4.0000    0.7000
```

b)

```
>> [eigvec, eigval] = eig(B)

eigvec =

    0.6501   -0.5899
    0.7599    0.8075


eigval =

    4.1221         0
         0   -2.2221
```

Exercise 4.2

a & b)

```
>> A = [3 4; -1 -2]

A =

     3     4
    -1    -2

>> [eigvec, eigval] = eig(A)

eigvec =

    0.9701   -0.7071
   -0.2425    0.7071


eigval =

     2     0
     0    -1
```

c) As t gets large, the solutions diverge because there is only one negative eigenvalue.

d)

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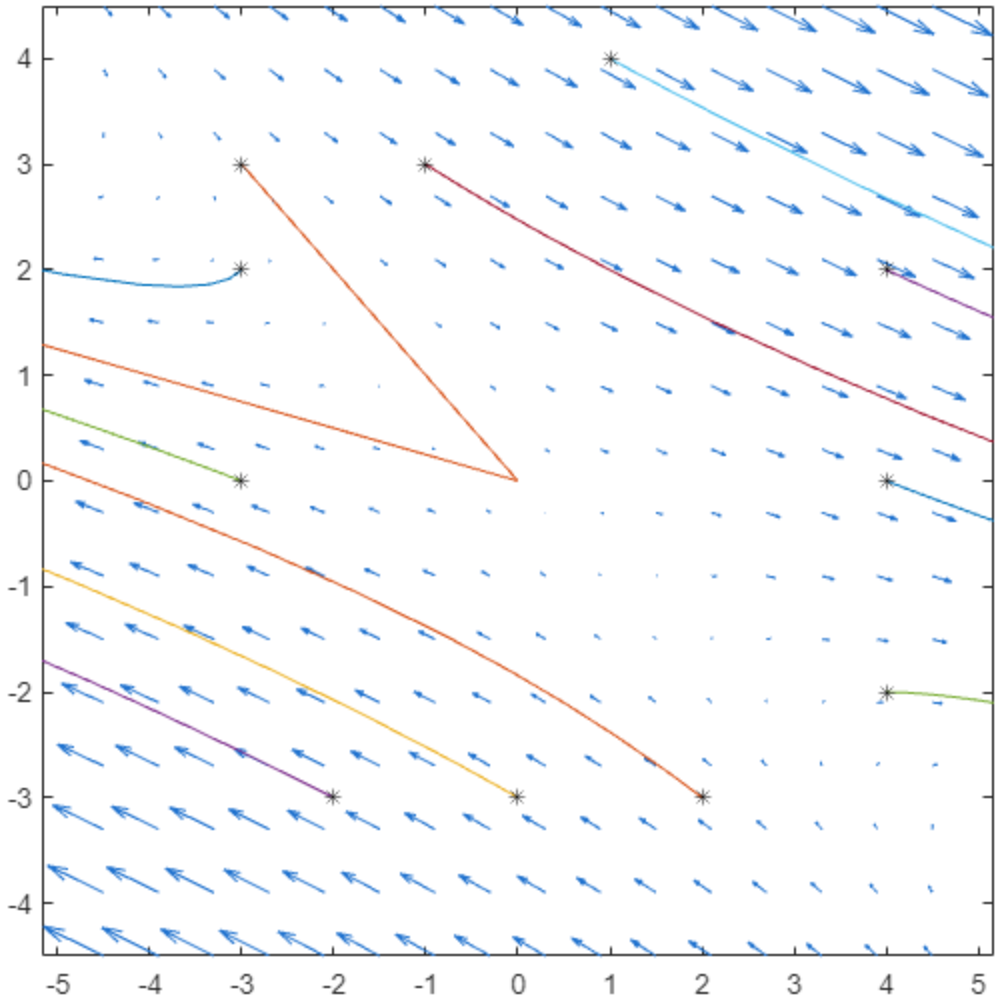

Yes. As t increases or decreases, the solutions diverge.

Exercise 4.3

a)

```
>> A = [2.7 -1; 4.1 3.7];
[eigvec, eigval] = eig(A)

eigvec =

  -0.1093 + 0.4291i  -0.1093 - 0.4291i
   0.8966 + 0.0000i   0.8966 + 0.0000i


eigval =

   3.2000 + 1.9621i   0.0000 + 0.0000i
   0.0000 + 0.0000i   3.2000 - 1.9621i
```

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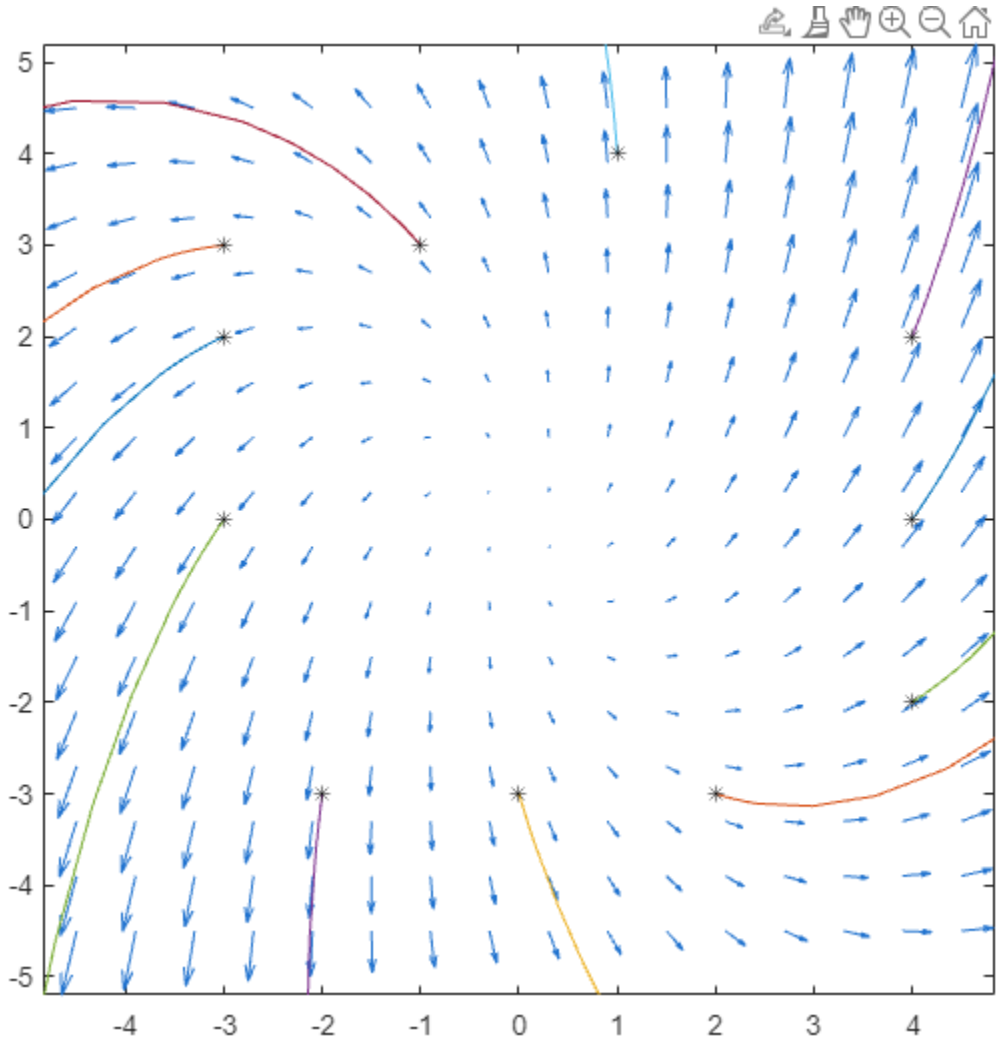
b)

$$v(t) = c_1 e^{(3.2 + 1.9621i)t}[-0.1093 + 0.4291i;\ 0.8966] + c_2 e^{(3.2 + 1.9621i)t}[-0.1093 - 0.4291i;\ 0.8966]$$

c)



As t grows large, the solutions approach infinity.

Exercise 4.4

a)

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```
>> A = [1.25, -0.97, 4.6; -2.6, -5.2, -0.31; 1.18, -10.3, 1.12];
[eigvec, eigval] = eig(A)

eigvec =

   0.7351 + 0.0000i   0.4490 + 0.2591i   0.4490 - 0.2591i
  -0.1961 + 0.0000i  -0.3375 + 0.2242i  -0.3375 - 0.2242i
   0.6490 + 0.0000i  -0.7530 + 0.0000i  -0.7530 + 0.0000i


eigval =

   5.5698 + 0.0000i   0.0000 + 0.0000i   0.0000 + 0.0000i
   0.0000 + 0.0000i  -4.1999 + 2.6606i   0.0000 + 0.0000i
   0.0000 + 0.0000i   0.0000 + 0.0000i  -4.1999 - 2.6606i

>>
```

b) No. It is not stable because the eigenvalue is greater than 0.

Exercise 4.5

a)

```
>> [eigvec, eigval] = eig(A)

eigvec =

   0.1994 - 0.1063i   0.1994 + 0.1063i  -0.0172 + 0.0000i   0.0067 + 0.0000i
  -0.0780 - 0.1333i  -0.0780 + 0.1333i  -0.0118 + 0.0000i   0.0404 + 0.0000i
  -0.0165 + 0.6668i  -0.0165 - 0.6668i  -0.4895 + 0.0000i  -0.0105 + 0.0000i
   0.6930 + 0.0000i   0.6930 + 0.0000i   0.8717 + 0.0000i   0.9991 + 0.0000i


eigval =

  -0.0329 + 0.9467i   0.0000 + 0.0000i   0.0000 + 0.0000i   0.0000 + 0.0000i
   0.0000 + 0.0000i  -0.0329 - 0.9467i   0.0000 + 0.0000i   0.0000 + 0.0000i
   0.0000 + 0.0000i   0.0000 + 0.0000i  -0.5627 + 0.0000i   0.0000 + 0.0000i
   0.0000 + 0.0000i   0.0000 + 0.0000i   0.0000 + 0.0000i  -0.0073 + 0.0000i
```

b) asymptotically stable since the real portions of the eigenvalues are < 0

c) The 4th eigenvector is biggest; most related to pitch.

Exercise 4.6

a)

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```
>> B = [0.01; -0.175; 0.153; 0];
F = [0 7 0 -1];
B*F

ans =

         0    0.0700         0   -0.0100
         0   -1.2250         0    0.1750
         0    1.0710         0   -0.1530
         0         0         0         0
```

b)

```
>> F = [0 5 0 -0.1]

F =

         0    5.0000         0   -0.1000

>> B*F

ans =

         0    0.0500         0   -0.0010
         0   -0.8750         0    0.0175
         0    0.7650         0   -0.0153
         0         0         0         0

>>
```

c)

```
>> C = A+B*F

C =

   -0.0558   -0.9468    0.0802    0.0405
    0.5980   -0.9900   -0.0318    0.0175
   -3.0500    1.1530   -0.4650   -0.0153
         0    0.0805    1.0000         0
```

d)

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```
>> F = [0 2 0 -0.09];
eig(A + B*F)

ans =

  -0.1751 + 0.9370i
  -0.1751 - 0.9370i
  -0.0001 + 0.0000i
  -0.6354 + 0.0000i
```