Matrices-Eigen-SystemOfEqns

December 9, 2021

[1]:
```
from sympy import *
```

[2]:
```
Matrix([[5,6,7]])
```

[2]:
$$\begin{bmatrix}5 & 6 & 7\end{bmatrix}$$

[3]:
```
Matrix([[1],[2],[3],[4]])
```

[3]:
$$\begin{bmatrix}1\\2\\3\\4\end{bmatrix}$$

[4]:
```
eye(5)
```

[4]:
$$\begin{bmatrix}1 & 0 & 0 & 0 & 0\\0 & 1 & 0 & 0 & 0\\0 & 0 & 1 & 0 & 0\\0 & 0 & 0 & 1 & 0\\0 & 0 & 0 & 0 & 1\end{bmatrix}$$

[5]:
```
zeros(5,6)
```

[5]:
$$\begin{bmatrix}0 & 0 & 0 & 0 & 0 & 0\\0 & 0 & 0 & 0 & 0 & 0\\0 & 0 & 0 & 0 & 0 & 0\\0 & 0 & 0 & 0 & 0 & 0\\0 & 0 & 0 & 0 & 0 & 0\end{bmatrix}$$

[6]:
```
ones(4,5)
```

[6]:
$$\begin{bmatrix}1 & 1 & 1 & 1 & 1\\1 & 1 & 1 & 1 & 1\\1 & 1 & 1 & 1 & 1\\1 & 1 & 1 & 1 & 1\end{bmatrix}$$

[7]:
```
diag(7,8,9)
```

[7]:
$$\begin{bmatrix}7 & 0 & 0\\0 & 8 & 0\\0 & 0 & 9\end{bmatrix}$$

[8]:
```
A=Matrix([[1,2],[3,4]])
B=Matrix([[5,6],[7,8]])
print(A)
print(B)
```

```
Matrix([[1, 2], [3, 4]])
Matrix([[5, 6], [7, 8]])
```

[9]:
```
A+B
```

[9]:
$$\begin{bmatrix} 6 & 8 \\ 10 & 12 \end{bmatrix}$$

[10]:
```
A-B
```

[10]:
$$\begin{bmatrix} -4 & -4 \\ -4 & -4 \end{bmatrix}$$

[12]:
```
A*B
```

[12]:
$$\begin{bmatrix} 19 & 22 \\ 43 & 50 \end{bmatrix}$$

[13]:
```
B**4+A**3
```

[13]:
$$\begin{bmatrix} 11624 & 13548 \\ 15824 & 18452 \end{bmatrix}$$

[14]:
```
A.inv()
```

[14]:
$$\begin{bmatrix} -2 & 1 \\ \frac{3}{2} & -\frac{1}{2} \end{bmatrix}$$

[15]:
```
A.row(1)
```

[15]:
$$\begin{bmatrix} 3 & 4 \end{bmatrix}$$

[16]:
```
B.col(-1)
```

[16]:
$$\begin{bmatrix} 6 \\ 8 \end{bmatrix}$$

Eigenvalues and Eigenvectors

[17]:
```
A=Matrix([[1,2],[3,4]])
```

[18]:
```
a
```

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
<ipython-input-18-3f786850e387> in <module>
----> 1 a
```

```
NameError: name 'a' is not defined
```

[19]:
```
A
```

[19]:
$$\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$$

[20]:
```
A.eigenvals()
```

[20]:
```
{5/2 - sqrt(33)/2: 1, 5/2 + sqrt(33)/2: 1}
```

[21]:
```
A.eigenvects()
```

[21]:
```
[(5/2 - sqrt(33)/2,
  1,
  [Matrix([
   [-2/(-3/2 + sqrt(33)/2)],
   [                     1]])]),
 (5/2 + sqrt(33)/2,
  1,
  [Matrix([
   [-2/(-sqrt(33)/2 - 3/2)],
   [                     1]])])]
```

[22]:
```
B=Matrix([[2,27,0],[0,4,40],[0,3,30]])
B
```

[22]:
$$\begin{bmatrix} 2 & 27 & 0 \\ 0 & 4 & 40 \\ 0 & 3 & 30 \end{bmatrix}$$

[23]:
```
B.eigenvals()
```

[23]:
```
{34: 1, 2: 1, 0: 1}
```

[24]:
```
B.eigenvects()
```

[24]:
```
[(0,
  1,
  [Matrix([
   [135],
   [-10],
   [  1]])]),
 (2,
  1,
  [Matrix([
   [1],
```

```
  [0],
  [0]])]),
 (34,
  1,
  [Matrix([
   [9/8],
   [4/3],
   [  1]])])]
```

[25]:
```
P,D=A.diagonalize()
P
```

[25]:
$$\begin{bmatrix} -\frac{\sqrt{33}}{6} - \frac{1}{2} & -\frac{1}{2} + \frac{\sqrt{33}}{6} \\ 1 & 1 \end{bmatrix}$$

[26]:
```
D
```

[26]:
$$\begin{bmatrix} \frac{5}{2} - \frac{\sqrt{33}}{2} & 0 \\ 0 & \frac{5}{2} + \frac{\sqrt{33}}{2} \end{bmatrix}$$

[27]:
```
C=Matrix([[1,1,1],[0,1,1],[0,0,1]])
C
```

[27]:
$$\begin{bmatrix} 1 & 1 & 1 \\ 0 & 1 & 1 \\ 0 & 0 & 1 \end{bmatrix}$$

[28]:
```
C.is_diagonalizable()
```

[28]:
```
False
```

[29]:
```
C.eigenvals()
```

[29]:
```
{1: 3}
```

[30]:
```
P,D=C.diagonalize()
P
```

```
---------------------------------------------------------------------------
MatrixError                               Traceback (most recent call last)
<ipython-input-30-2e47a176d9ae> in <module>
----> 1 P,D=C.diagonalize()
      2 P

~\anaconda3\lib\site-packages\sympy\matrices\matrices.py in diagonalize(self,␣
 ↪reals_only, sort, normalize)
    375
    376     def diagonalize(self, reals_only=False, sort=False, normalize=False):
```

```
--> 377         return _diagonalize(self, reals_only=reals_only, sort=sort,
    378                 normalize=normalize)
    379

~\anaconda3\lib\site-packages\sympy\matrices\eigen.py in _diagonalize(M,␣
↪reals_only, sort, normalize)
    603
    604     if not is_diagonalizable:
--> 605         raise MatrixError("Matrix is not diagonalizable")
    606
    607     if sort:

MatrixError: Matrix is not diagonalizable
```

[31]:
```
N=Matrix([[0,-6,-4],[5,-11,-6],[-6,9,4]])
N
```

[31]:
$$\begin{bmatrix} 0 & -6 & -4 \\ 5 & -11 & -6 \\ -6 & 9 & 4 \end{bmatrix}$$

[32]:
```
N.eigenvals()
```

[32]:
```
{-3: 1, -2: 2}
```

[33]:
```
N.eigenvects()
```

[33]:
```
[(-3,
  1,
  [Matrix([
   [ 2/3],
   [-1/3],
   [   1]])]),
 (-2,
  2,
  [Matrix([
   [   0],
   [-2/3],
   [   1]])])]
```

[34]:
```
N.is_diagonalizable()
```

[34]:
```
False
```

[35]:
```
# Matrix and System of linear equation #
```

[36]:
```
A=Matrix([[1,2,4],[1,5,2],[1,1,0]])
A
```

[36]:
$$\begin{bmatrix} 1 & 2 & 4 \\ 1 & 5 & 2 \\ 1 & 1 & 0 \end{bmatrix}$$

[37]:
```
A.det()
```

[37]:
$$-14$$

[38]:
```
B=Matrix([[1,2],[3,4]])
B
```

[38]:
$$\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$$

[39]:
```
B.T
```

[39]:
$$\begin{bmatrix} 1 & 3 \\ 2 & 4 \end{bmatrix}$$

[40]:
```
B.det()
```

[40]:
$$-2$$

[41]:
```
C=Matrix([[7,8],[9,10]])
C
```

[41]:
$$\begin{bmatrix} 7 & 8 \\ 9 & 10 \end{bmatrix}$$

[42]:
```
C.rref()
```

[42]:
```
(Matrix([
 [1, 0],
 [0, 1]]),
 (0, 1))
```

[43]:
```
C.rank()
```

[43]:
```
2
```

[44]:
```
D=Matrix([[1,2,3],[4,5,6],[7,8,9]])
D
```

[44]:
$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$$

[45]:
```
D.nullspace()
```

[45]:
```
[Matrix([
 [ 1],
 [-2],
 [ 1]])]
```

[46]:
```
D.columnspace()
```

[46]:
```
[Matrix([
 [1],
 [4],
 [7]]),
 Matrix([
 [2],
 [5],
 [8]])]
```

[47]:
```
# x+y+z=3, x-y+z=1, x-y-z=-1#
x,y,z=symbols("x,y,z")
A=Matrix([[1,1,1],[1,-1,1],[1,-1,-1]])
B=Matrix([[3],[1],[-1]])
linsolve((A,B),[x,y,z])
```

[47]:
$$\{(1,\ 1,\ 1)\}$$

[48]:
```
# x+y=3, x-y=1 #
A=Matrix([[1,1],[1,-1]])
B=Matrix([[3],[1]])
sol,params=A.gauss_jordan_solve(B)
```

[49]:
```
sol
```

[49]:
$$\begin{bmatrix}2\\1\end{bmatrix}$$

[ ]:
```

```