**Kernel:** SageMath 10.1

Experiment No: 3

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Aim: To find the eigen values and eigen vectors for the given matrix.

Solve the following system of equations

1. $x-2y+3z=2; 2x-3z=3; x+y+z=0$
2. $2x-y+z=4; 3x-y+z=6; 4x-y+2z=7; -x+y-z=9$
3. $3x+y+z=2; x-3y+2z=1; 7x-y+4z=5$

Q1

In [2]:
```
x, y, z = var('x, y, z')
solve([x-2*y + 3*z == 2, 2*x - 3*z == 3, x+y+z==0], x, y, z)
```

Out[2]:
```
[[x == (21/19), y == (-16/19), z == (-5/19)]]
```

In [3]:
```
A=matrix([[1,-2,3], [2,0,-3] ,[1,1,1]])
B=vector([2,3,0])
show('A= ', A , 'B= ', B.column())
```

Out[3]:
$$A= \begin{pmatrix} 1 & -2 & 3 \\ 2 & 0 & -3 \\ 1 & 1 & 1 \end{pmatrix} B= \begin{pmatrix} 2 \\ 3 \\ 0 \end{pmatrix}$$

In [4]:
```
C=A.augment(B)
show('C=',C)
```

Out[4]:
$$C= \begin{pmatrix} 1 & -2 & 3 & 2 \\ 2 & 0 & -3 & 3 \\ 1 & 1 & 1 & 0 \end{pmatrix}$$

In [5]:
```
rank(A)==rank(C)
```

Out[5]:
```
True
```

In [6]:
```
show(C.echelon_form())
```

Out[6]:
$$\begin{pmatrix} 1 & 0 & 8 & -1 \\ 0 & 1 & 12 & -4 \\ 0 & 0 & 19 & -5 \end{pmatrix}$$

Q2

In [11]:
```
solve([2*x-y+z == 4, 3*x-y+z == 6,4*x-y+2*z == 7, -x+y-z==9], x, y, z)
```

Out[11]:
```
[]
```

In [15]:
```
A=matrix([[2, -1, 1], [3, -1, 1], [1, -1, 2], [-1, 1, -1]])
B=vector([4,6,7,9])
show('A= ', A , 'B= ', B.column())
```

Out[15]:
$$A= \begin{pmatrix} 2 & -1 & 1 \\ 3 & -1 & 1 \\ 1 & -1 & 2 \\ -1 & 1 & -1 \end{pmatrix} B= \begin{pmatrix} 4 \\ 6 \\ 7 \\ 9 \end{pmatrix}$$

In [16]:
```
C=A.augment(B)
```

```
show('C=',C)
```

Out[16]:

$$C=\begin{pmatrix} 2 & -1 & 1 & 4 \\ 3 & -1 & 1 & 6 \\ 1 & -1 & 2 & 7 \\ -1 & 1 & -1 & 9 \end{pmatrix}$$

In [17]:
```
rank(A)==rank(C)
```

Out[17]: False

In [18]:
```
show(C.echelon_form())
```

Out[18]:

$$\begin{pmatrix} 1 & 0 & 0 & 2 \\ 0 & 1 & 0 & 5 \\ 0 & 0 & 1 & 5 \\ 0 & 0 & 0 & 11 \end{pmatrix}$$

Q3

In [20]:
```
x, y, z = var('x, y, z')
solve([3*x+y+z == 2, x-3*y+2*z == 1,7*x-y+4*z == 5], x, y, z)
```

Out[20]: [[x == -1/2*r4 + 7/10, y == 1/2*r4 - 1/10, z == r4]]

In [21]:
```
A=matrix([[3, 1, 1], [1, -3, 2], [7, -1, 4]])
B=vector([2, 1, 5])
show('A= ', A , 'B= ', B.column())
```

Out[21]:

$$A=\begin{pmatrix} 3 & 1 & 1 \\ 1 & -3 & 2 \\ 7 & -1 & 4 \end{pmatrix} B=\begin{pmatrix} 2 \\ 1 \\ 5 \end{pmatrix}$$

In [22]:
```
C=A.augment(B)
show('C=',C)
```

Out[22]:

$$C=\begin{pmatrix} 3 & 1 & 1 & 2 \\ 1 & -3 & 2 & 1 \\ 7 & -1 & 4 & 5 \end{pmatrix}$$

In [23]:
```
rank(A)==rank(C)
```

Out[23]: True

In [25]:
```
show(C.echelon_form())
```

Out[25]:

$$\begin{pmatrix} 1 & 7 & -3 & 0 \\ 0 & 10 & -5 & -1 \\ 0 & 0 & 0 & 0 \end{pmatrix}$$

Conclusion:

In [0]: Eigen values and the eigen vectors of various matrices were obtained with graphical representation.