Kernel: SageMath 10.1

Experiment No: 3

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Aim: To find the solution of system of linear equation and finding 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

Q.1 =

In [3]:
```
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[3]:
```
[[x == (21/19), y == (-16/19), z == (-5/19)]]
```

In [4]:
```
A=matrix([[1,-2,3], [2,0,-3] ,[1,1,1]])
B=vector([2,3,0])
show('A= ', A , 'B= ', B.column())
```

Out[4]:

$$\text{A=}\begin{pmatrix} 1 & -2 & 3 \\ 2 & 0 & -3 \\ 1 & 1 & 1 \end{pmatrix} \text{B=}\begin{pmatrix} 2 \\ 3 \\ 0 \end{pmatrix}$$

In [5]:
```
C=A.augment(B)
show('C=',C)
```

Out[5]:

$$\text{C=}\begin{pmatrix} 1 & -2 & 3 & 2 \\ 2 & 0 & -3 & 3 \\ 1 & 1 & 1 & 0 \end{pmatrix}$$

In [6]:
```
rank(A)==rank(C)
```

Out[6]:
```
True
```

In [7]:
```
show(C.echelon_form())
```

Out[7]:

$$\begin{pmatrix} 1 & 0 & 8 & -1 \\ 0 & 1 & 12 & -4 \\ 0 & 0 & 19 & -5 \end{pmatrix}$$

Q.2 =

In [14]:
```
x, y, z = var('x, y, z')
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[14]: []

In [12]:
```
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[12]:

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

Q.3 =

In [15]:
```
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[15]: [[x == -1/2*r1 + 7/10, y == 1/2*r1 - 1/10, z == r1]]

In [16]:
```
A=matrix([[3, 1, 1], [1, -3, 2], [7, -1, 4]])
B=vector([2, 1, 5])
show('A= ', A , 'B= ', B.column())
```

Out[16]:

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

In [17]:
```
C=A.augment(B)
show('C=',C)
```

Out[17]:

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

In [18]:
```
rank(A)==rank(C)
```

Out[18]: True

In [19]:
```
show(C.echelon_form())
```

Out[19]:

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

Q.2= a-

In [51]:
```
A = Matrix([[1,-3],[-3,1]])
```

```
show(A)
```

Out[51]: $\begin{pmatrix} 1 & -3 \\ -3 & 1 \end{pmatrix}$

q.2 a - 2x2

In [65]:
```
A=Matrix(QQ,2,2,[1,-3,-3,1])
A.charpoly()
```

Out[65]:
```
x^2 - 2*x - 8
```

In [66]:
```
solve(x^2-2*x-8==0,x)
```

Out[66]:
```
[x == -2, x == 4]
```

In [69]:
```
A.eigenvalues()
```

Out[69]:
```
[4, -2]
```

In [68]:
```
(-2*identity_matrix(2)-A).echelon_form()
```

Out[68]:
```
[ 1 -1]
[ 0  0]
```

q.2 b - 3x3

In [71]:
```
B=Matrix(QQ,3,3,[4,1,3,-1,0,-1,3,-1,4])
B.charpoly()
```

Out[71]:
```
x^3 - 8*x^2 + 7*x
```

In [72]:
```
solve(x^3 - 8*x^2 + 7*x==0,x)
```

Out[72]:
```
[x == 1, x == 7, x == 0]
```

In [73]:
```
B.eigenvalues()
```

Out[73]:
```
[7, 1, 0]
```

In [74]:
```
(1*identity_matrix(3)-B).echelon_form()
```

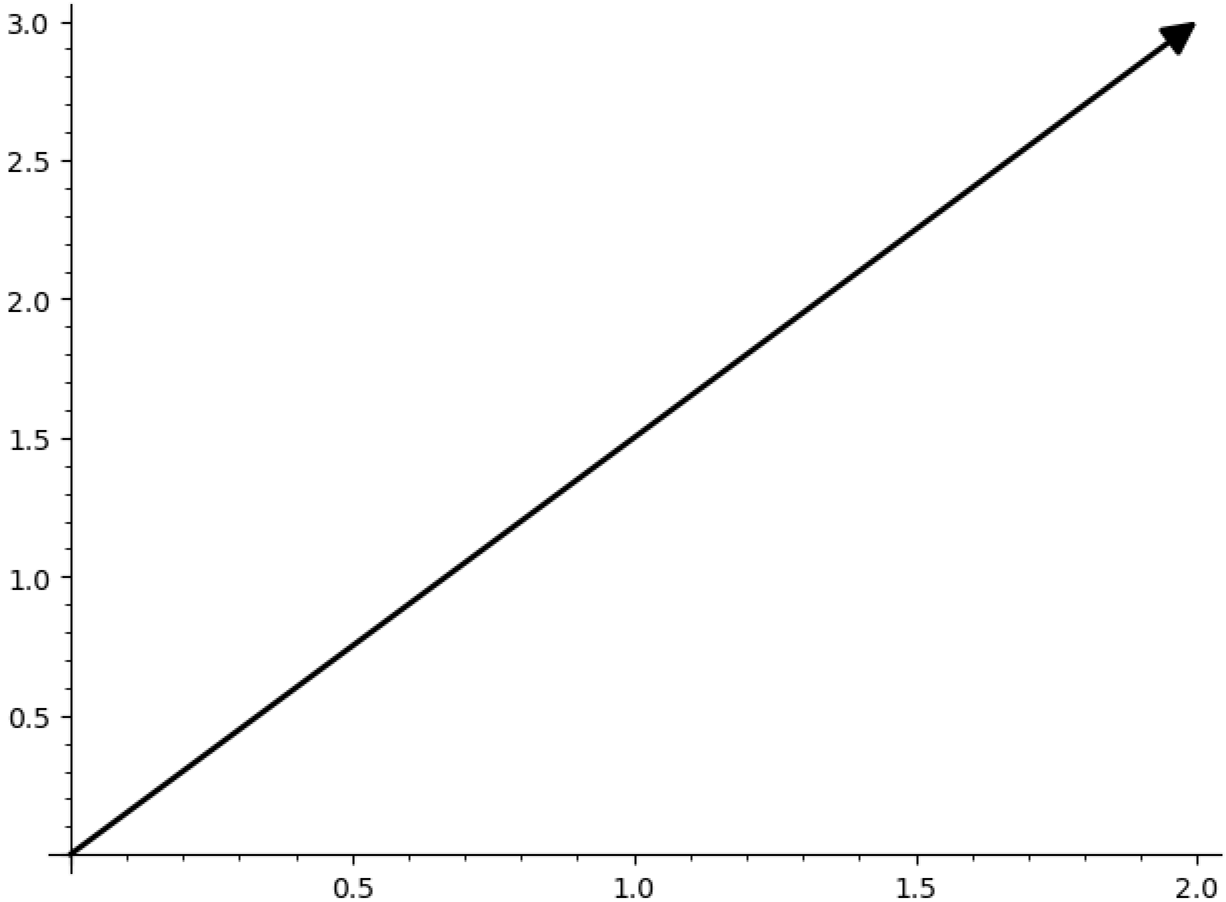
Out[74]:
```
[1 0 1]
[0 1 0]
[0 0 0]
```

eigen vector =

Q.1=

In [25]:
```
a=vector([2,3])
plot(a,color="black")
```

Out[25]:



In [26]:

```
A=matrix([[2,0],[0,2]])
c=A*a
```

In [27]:

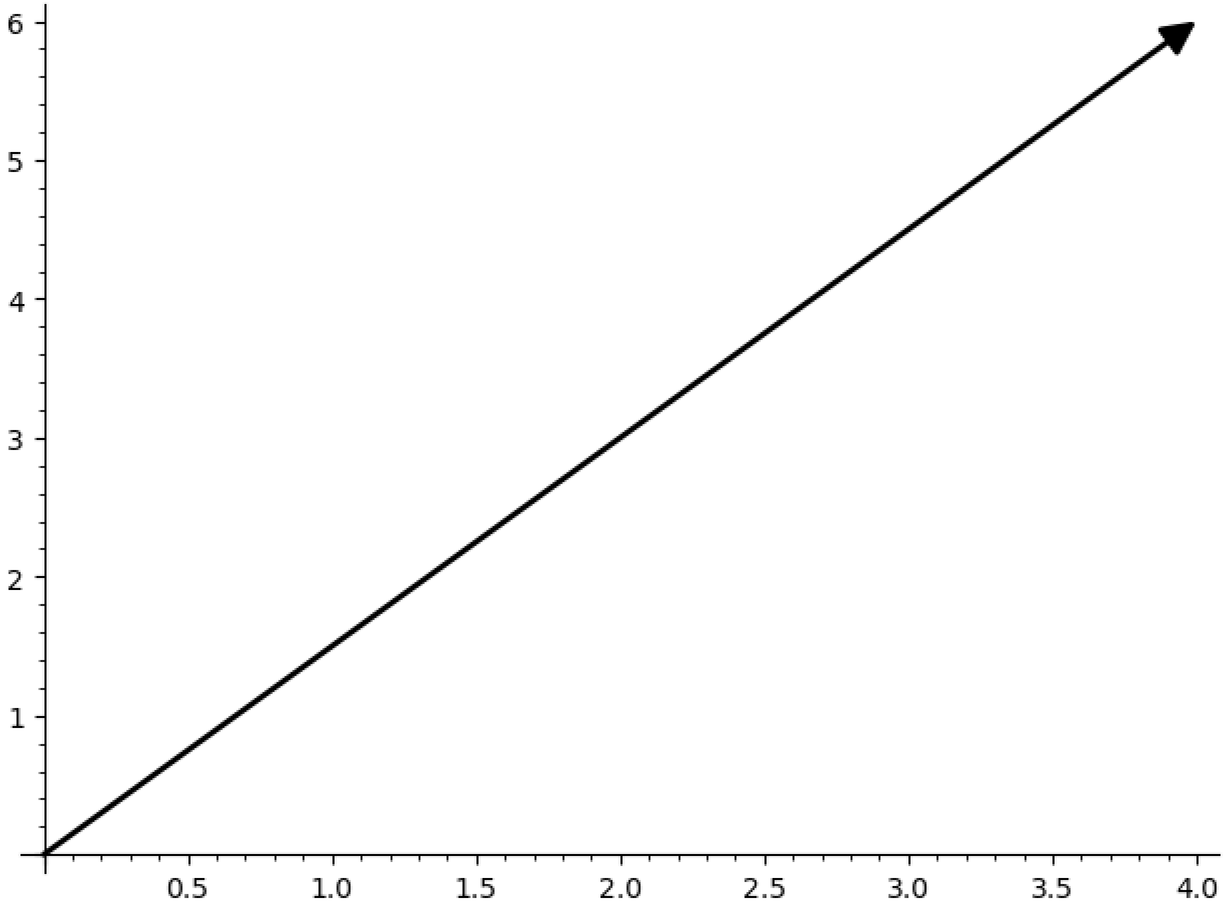
```
c
```

Out[27]: (4, 6)

In [28]:

```
plot(c,color="black")
```

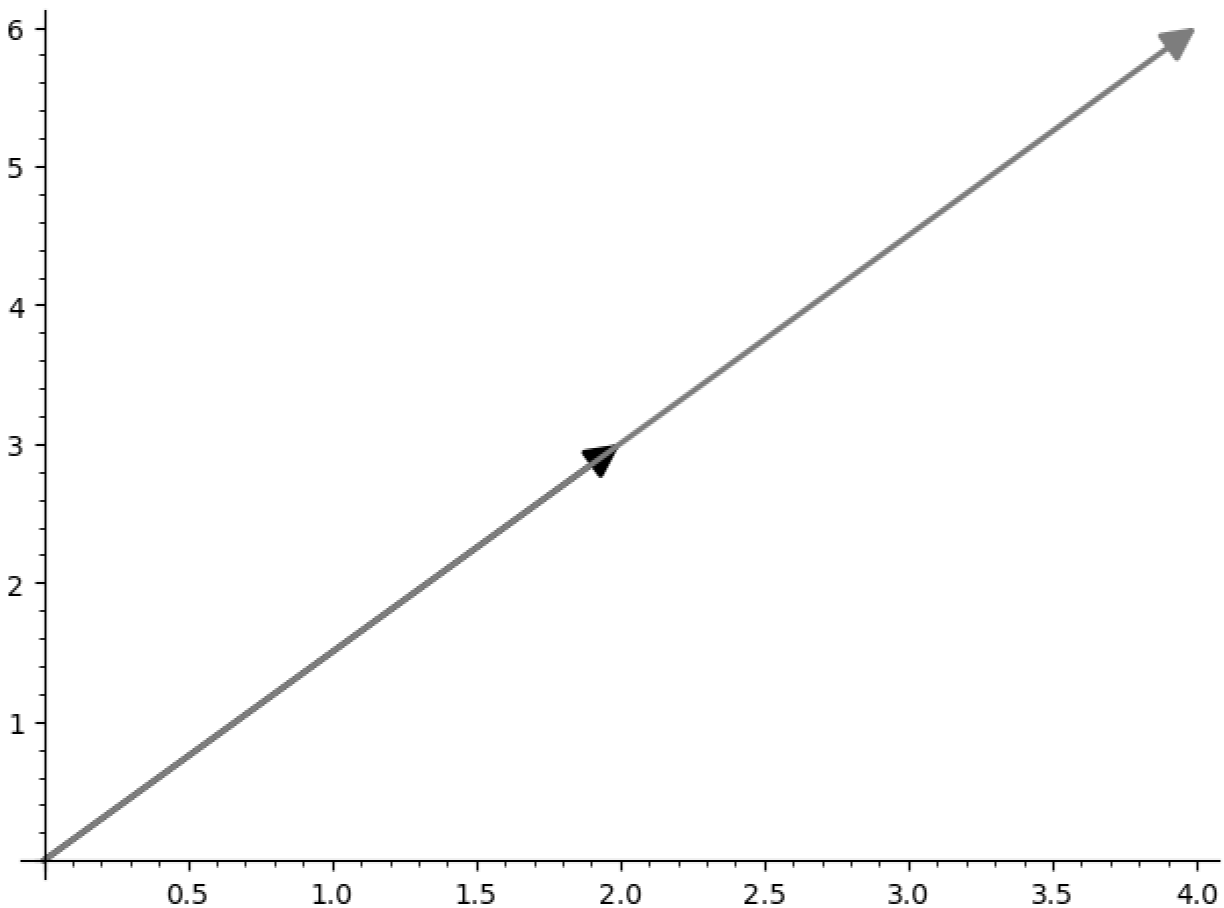
Out[28]:



In [30]:

```
plot(a,color="black")+plot(c,color="grey")
```

Out[30]:

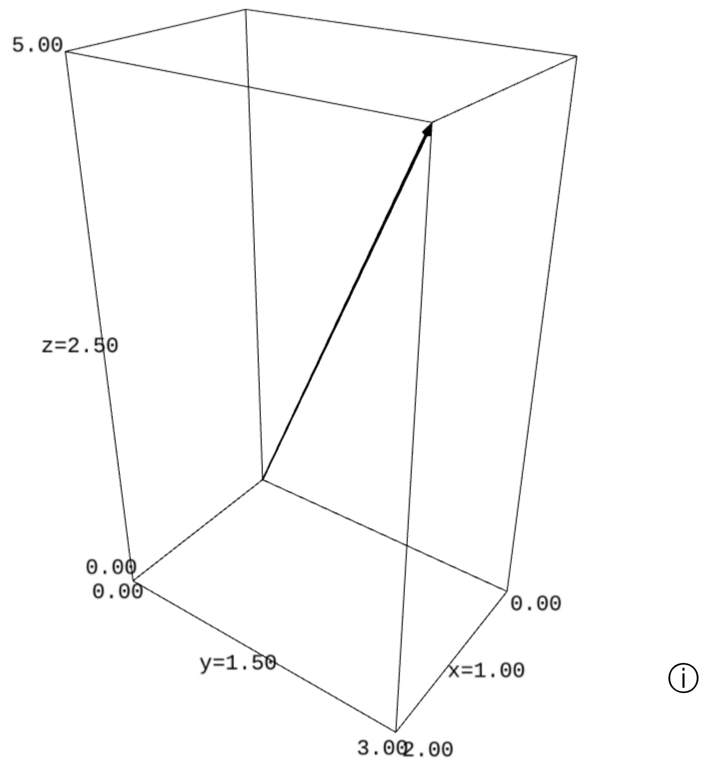


Q.2 =

In [45]:

```
a=vector([2,3,5])
plot(a,color="black")
```

Out[45]:



In [32]:

```
A=matrix([[2,0,1],[1,0,2],[2,1,4]])
c=A*a
```

In [33]:

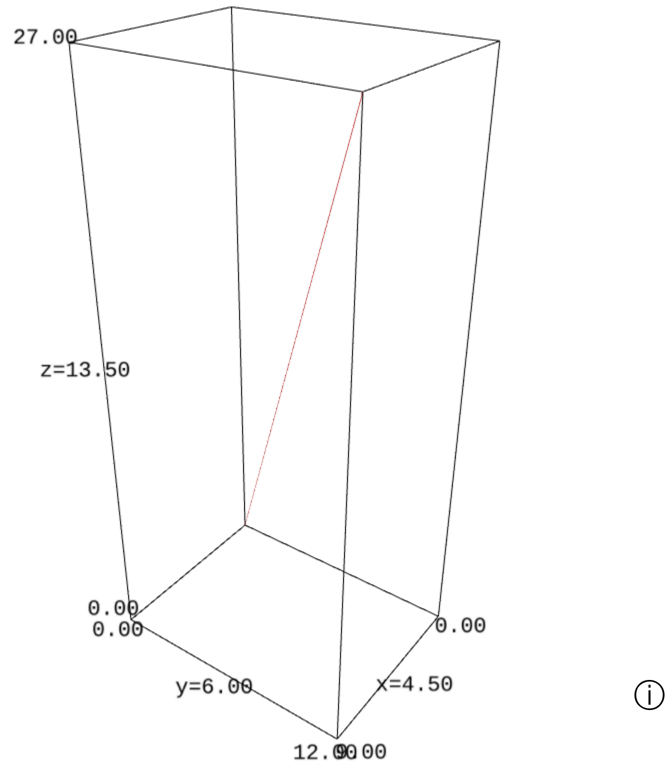
```
c
```

Out[33]: (9, 12, 27)

In [34]:

```
plot(c,color="red")
```

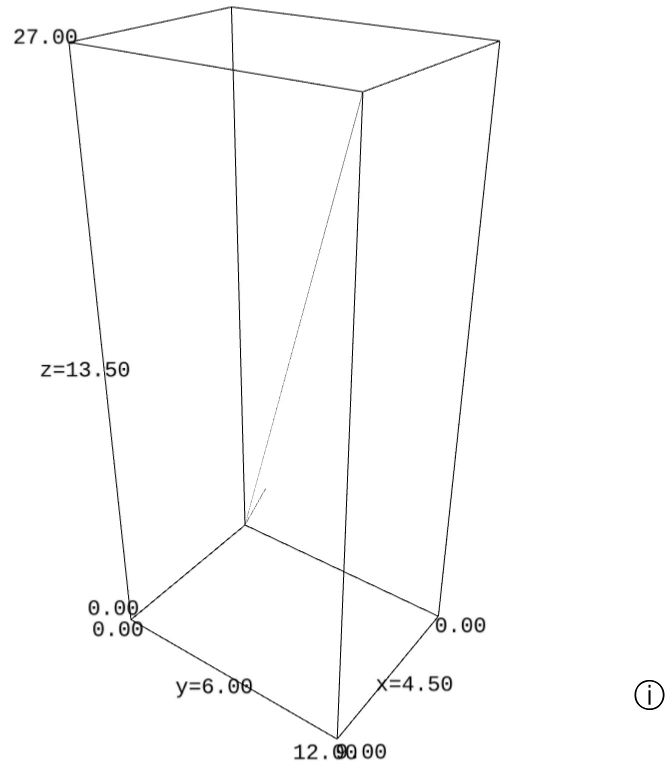
Out[34]:



In [37]:

```
plot(a,color="black")+plot(c,color="grey")
```

Out[37]:

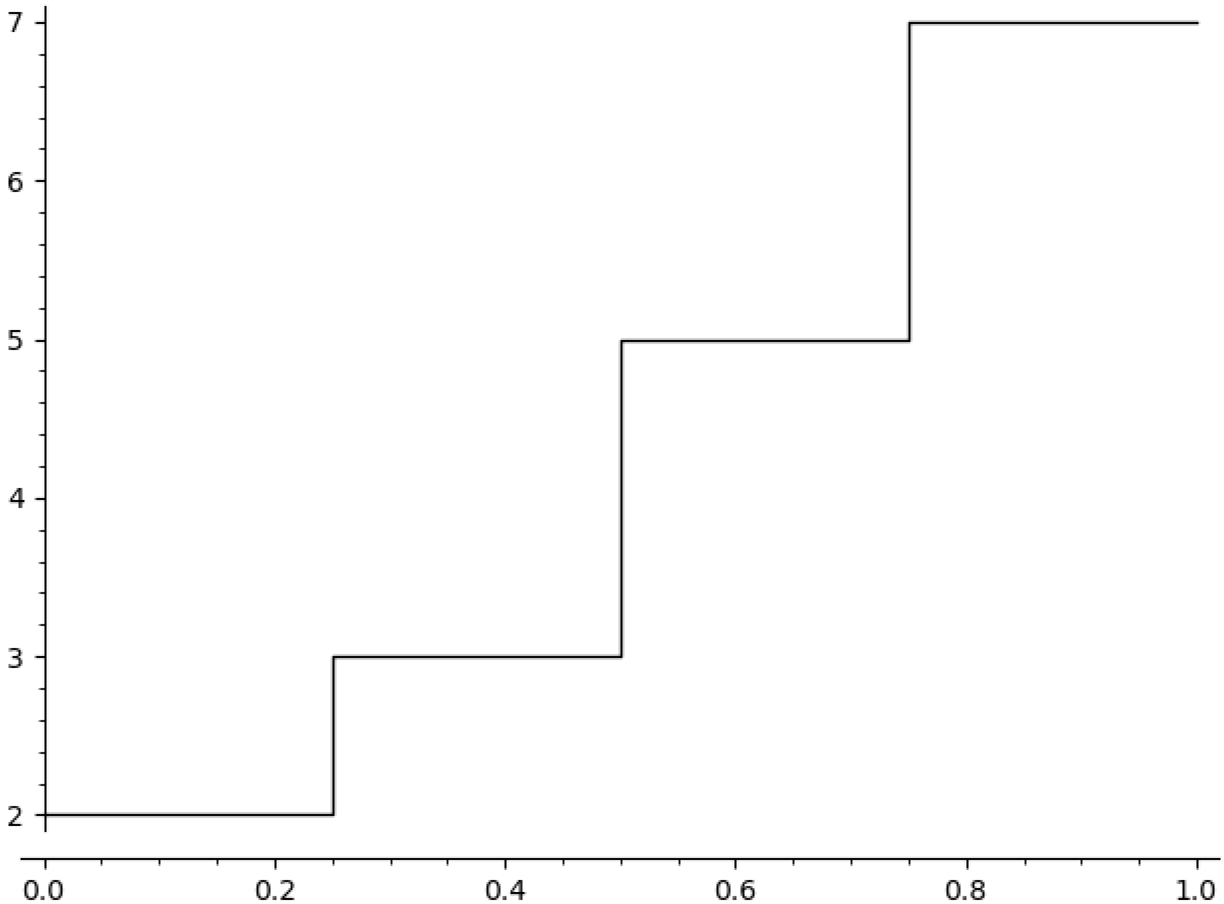


Q.3 =

In [44]:

```
a=vector([2,3,5,7])
plot(a,color="black")
```

Out[44]:



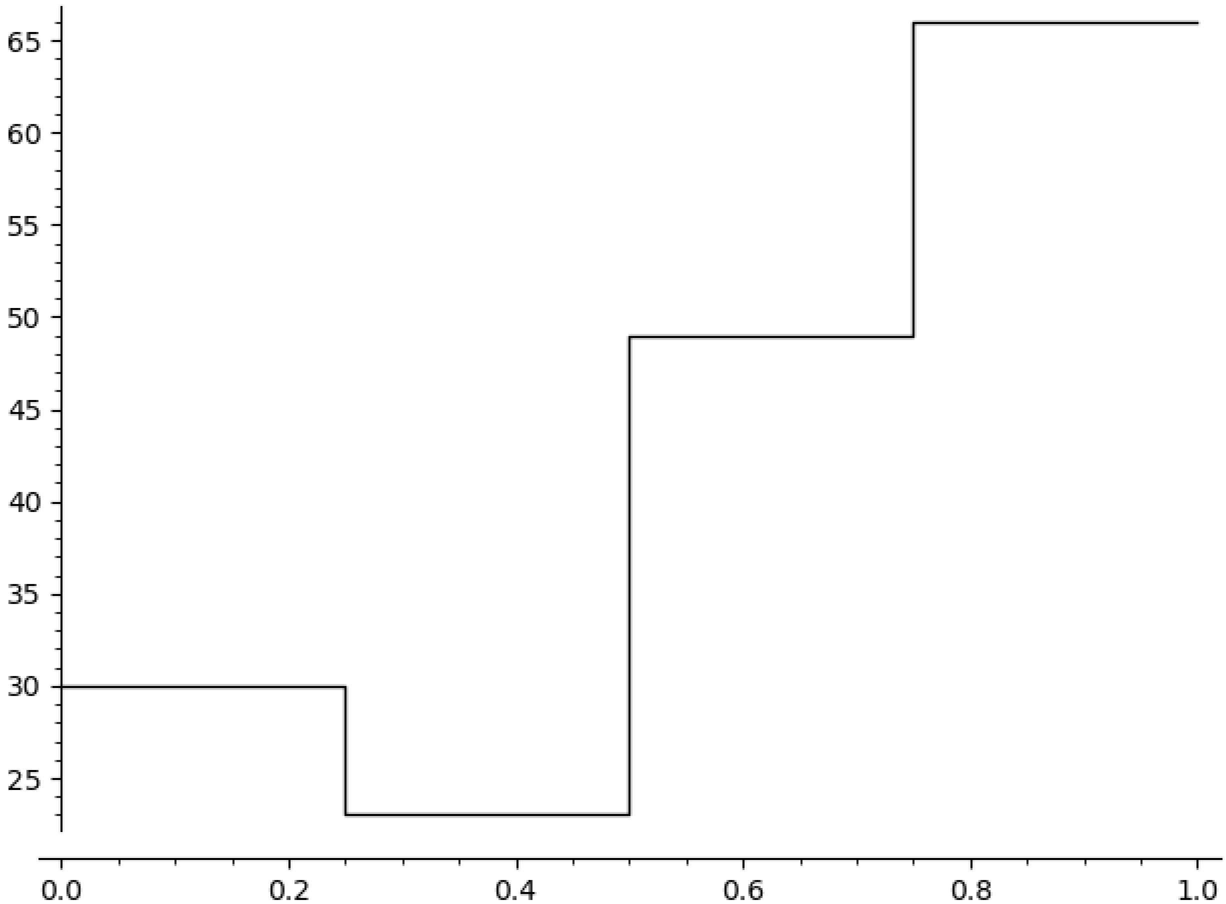
In [39]:
```
A=matrix([[2,0,1,3],[3,1,0,2],[5,2,1,4],[2,4,3,5]])
c=A*a
```

In [40]:
```
c
```

Out[40]: (30, 23, 49, 66)

In [43]:
```
plot(c,color="black")
```

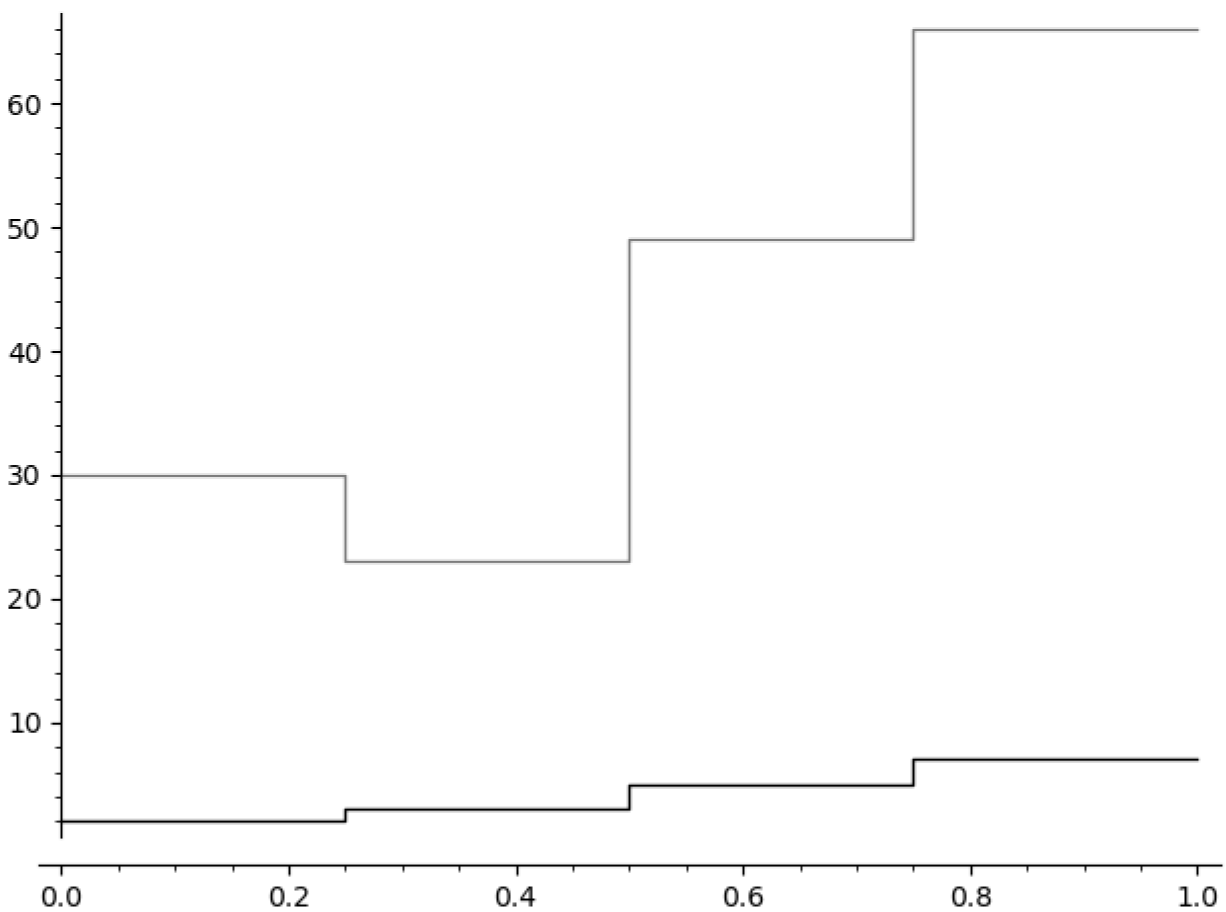
Out[43]:



In [42]:

```
plot(a,color="black")+plot(c,color="grey")
```

Out[42]:



Conclusion : The Solution Of System Of Linear Equation And EigenValues, Eigen Vector For A Matrix Is Generated Successfully.