Lab 3

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In [2]:
```
import numpy as np
```

1A)

In [11]:
```
A = np.array([[2, 3, 0],
              [1, 4, 3],
              [0, 0, 1]])
x1 = np.array([3, -1, 0])

Ax1 = np.dot(A, x1)


print("A * x1 =", Ax1)
```

```
A * x1 = [ 3 -1  0]
```

1B)

In [13]:
```
eigenvalue = Ax1[0] / x1[0]

is_eigenvector = np.allclose(Ax1, eigenvalue * x1)

print("Eigenvalue:", eigenvalue)
print("Is x1 an eigenvector of A?", is_eigenvector)
```

```
Eigenvalue: 1.0
Is x1 an eigenvector of A? True
```

2)

In [21]:
```
A = np.array([[4,2],[1,3]])

eigenvalues, eigenvectors = np.linalg.eig(A)

print(f'Eigenvalues = {eigenvalues}')
print(f'Eigenvectors =  \n{eigenvectors}')
```

```
Eigenvalues = [5. 2.]
Eigenvectors =
[[ 0.89442719 -0.70710678]
 [ 0.4472136   0.70710678]]
```

3)

In [27]:
```
A = np.array([[3, 2, 2],[2,3,2],[2,2,3]])
eigenvalues, eigenvectors = np.linalg.eig(A)

print("Eigenvalues:")
print(eigenvalues)

print("\nEigenvectors:")
print(eigenvectors)

for i, eigenvalue in enumerate(eigenvalues):
    print(f"Eigenspace for eigenvalue {eigenvalue}:")
    print(eigenvectors[:, i])
    print()
```

```
Eigenvalues:
[1. 7. 1.]

Eigenvectors:
[[-0.81649658  0.57735027 -0.09365858]
 [ 0.40824829  0.57735027 -0.65561007]
 [ 0.40824829  0.57735027  0.74926865]]
Eigenspace for eigenvalue 0.9999999999999987:
[-0.81649658  0.40824829  0.40824829]

Eigenspace for eigenvalue 6.999999999999998:
[0.57735027 0.57735027 0.57735027]

Eigenspace for eigenvalue 0.9999999999999998:
[-0.09365858 -0.65561007  0.74926865]
```

4)

In [32]:
```
A = np.array([[0, -1, 1, 1], [-1, 1, -2, 3], [2, -1, 0, 0], [1, -1, 1, 0]])
eigenvalues, eigenvectors = np.linalg.eig(A)

eigenvalues = np.real_if_close(eigenvalues, tol=1e-5)
eigenvectors = np.real_if_close(eigenvectors, tol=1e-5)

print(f'Eigenvalues = \n{eigenvalues}')
print(f'Eigenvectors =  \n{eigenvectors}')
```

```
Eigenvalues =
[ 2.  1. -1. -1.]
Eigenvectors =
[[ 5.77350269e-01  5.00000000e-01 -2.72247315e-16 -2.72247315e-16]
 [ 2.31970344e-16  5.00000000e-01 -7.07106781e-01 -7.07106781e-01]
 [ 5.77350269e-01  5.00000000e-01 -7.07106781e-01 -7.07106781e-01]
 [ 5.77350269e-01  5.00000000e-01  8.33283831e-16  8.33283831e-16]]
```

5)

In [36]:
```
A = np.array([[5,-6,-6],[-1,4,2],[3,-6,-4]])
eigenvalues, eigenvectors = np.linalg.eig(A)
print(f'Eigenvalues = \n{eigenvalues}')
print(f'Eigenvectors =  \n{eigenvectors}')
```

```
Eigenvalues =
[1. 2. 2.]
Eigenvectors =
[[-0.6882472  -0.68543457 -0.94146641]
 [ 0.22941573  0.31415751 -0.19764316]
 [-0.6882472  -0.6568748  -0.27309005]]
```

6)

In [45]:
```
A = np.array([[3, 2, 2], [2, 3, 2], [2, 2, 3]])
det = np.linalg.det(A)
trace = np.trace(A)

print(f"The Determinant is {det}")
print(f"The Trace is {trace}")
```

```
The Determinant is 7.000000000000001
The Trace is 9
```

In [ ]: