1. Numpy:

a. Using NumPy create random vector of size 15 having only Integers in the range 1-20.

1. Reshape the array to 3 by 5
2. Print array shape.
3. Replace the max in each row by 0

Create a 2-dimensional array of size 4 x 3 (composed of 4-byte integer elements), also print the shape, type and data type of the array.

```
import numpy as np
        rand = np.random.randint(1,20,15) #create random vector of size 15 having only
Integers in the range 1-20.
    print("Original array:")
    print(rand)
    rand=np.reshape(rand,(3,5),order='c') #Reshape the array to 3 by 5
    print(rand)
    print(np.shape(rand)) #Print array shape
            maxNum = np.amax(rand, axis=1)
    rand=np.where(np.isin(rand,maxNum), 0, rand) #Replace the max in each row by 0
    print("Maximum value of each row replaced by 0:")
    print(rand)
}
```

```
Original array:
[ 2  3 14  9  8 11  2  3 19  5  5 12 14 11  6]
[[ 2  3 14  9  8]
 [11  2  3 19  5]
 [ 5 12 14 11  6]]
(3, 5)
Maximum value of each row replaced by 0:
[[ 2  3  0  9  8]
 [11  2  3  0  5]
 [ 5 12  0 11  6]]
```

b. Write a program to compute the eigenvalues and right eigenvectors of a given square array given below:

[[3 -2]

[1 0]]

```
import numpy as np
        A = np.array([[3, -2],
        [1, 0]])
        eigenvalues, eigenvectors = np.linalg.eig(A)
        print("Eigenvalues:")
        for eigenvalue in eigenvalues:
        print(eigenvalue)
        print("\nRight Eigenvectors:")
        for i in range(len(eigenvectors)):
        print(f"Eigenvector {i+1}: {eigenvectors[:, i]}")
        print(result)
```

Original matrix:
[[3 -2]
[1 0]]
Eigenvalues of the said matrix [2. 1.]
Eigenvectors of the said matrix [[0.89442719 0.70710678]
[0.4472136   0.70710678]]

c. Compute the sum of the diagonal element of a given array.

[[0 1 2]

[3 4 5]]

```
import numpy as np
        A = np.array([[0, 1, 2],
        [3, 4, 5]])
        diagonal_sum = np.trace(A)
        print("Sum of diagonal elements:", diagonal_sum)
        print(result)
```

Original matrix:
[[0 1 2]
[3 4 5]]
Condition number of the said matrix: 4

d. Write a NumPy program to create a new shape to an array without changing its data.

Reshape 3x2:

[[1 2]

[3 4]

[5 6]]

Reshape 2x3:

[[1 2 3]

[4 5 6]]

```
import numpy as np
        A = np.array([[1, 2],
        [3, 4],
        [5, 6]])
        reshape_3x2 = A.reshape(3, 2)
        print("Reshape 3x2:")
        print(reshape_3x2)
        reshape_2x3 = A.reshape(2, 3)
        print("\nReshape 2x3:")
        print(reshape_2x3)
```

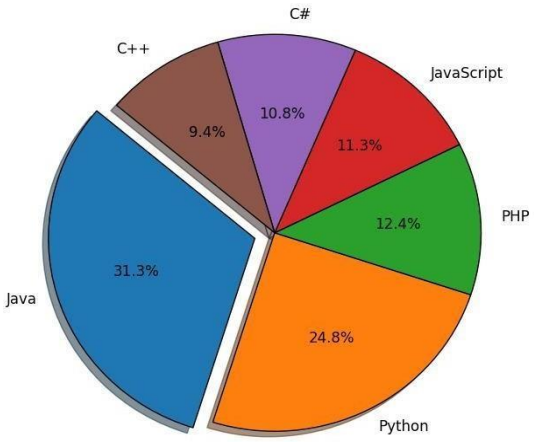
output the reshaped arrays:
Reshape 3x2:
[[1 2]
[3 4]
[5 6]]
Reshape 2x3:
[[1 2 3]
[4 5 6]]

2. Matplotlib

1. Write a Python programming to create a below chart of the popularity of programming Languages.
2. Sample data:
   Programming languages: Java, Python, PHP, JavaScript, C#, C++
   Popularity: 22.2, 17.6, 8.8, 8, 7.7, 6.7

```
import matplotlib.pyplot as plt
        # Data to plot
        languages = 'Java', 'Python', 'PHP', 'JavaScript', 'C#', 'C++'
        popuratity = [22.2, 17.6, 8.8, 8, 7.7, 6.7]
        colors = ["#1f77b4", "#ff7f0e", "#2ca02c", "#d62728", "#9467bd", "#8c564b"]
        # explode 1st slice
        explode = (0.1, 0, 0, 0,0,0)
        # Plot
        plt.pie(popuratity, explode=explode, labels=languages, colors=colors,
        autopct='%1.1f%%', shadow=True, startangle=140)

        plt.axis('equal')
        plt.show()
```


C#
C++
JavaScript
10.8%
9.4%
11.3%
PHP
12.4%
31.3%
Java
24.8%
Python