Experiment No.: 1

Aim: Create a numpy array and perform the following operations

1. Append values to the end of an array.
1. Insert values into an array at a specified position.
2. Delete elements from an array.
3. Find unique elements in an array.
4. Sort an array.
5. Save an array to a text file.
6. Load data from a text file into an array.

CO1: Use different python packages to perform numerical calculations, statistical computations and data visualization.

Procedure

```
import numpy as np
arr = np.array([3, 2, 1, 2])
print("Original array: ", arr)
print("Append (6,7,8): ", np.append(arr, [6, 7, 8]))
print("Insert Specific (10,11) at third second position: ", np.insert(arr, 2, [10, 11]))
print("Delete values (1,3): ", np.delete(arr, [0, 2]))
print("Unique element: ", np.unique(arr))
print("Sorted array: ", np.sort(arr))
np.savetxt('arr.txt', arr)
ld = np.loadtxt('arr.txt')
print("Loaded from arr.txt: ", ld)
```

Output Screenshot

```
C:\Users\ajcemca\PycharmProjects\pythonProject\venv\Scripts\python.exe C:\Users\ajcemca\PycharmProjects\pythonProject\qu1.py
Original array:  [3 2 1 2]
Append (6,7,8):  [3 2 1 2 6 7 8]
Insert Specific (10,11) at third second position:  [ 3  2 10 11  1  2]
Delete values (1,3):  [2 2]
Unique element:  [1 2 3]
Sorted array:  [1 2 2 3]
Loaded from arr.txt:  [3. 2. 1. 2.]
```

Result: The program was executed successfully and the output was obtained. Thus, CO1 has been attained.

Experiment No.: 2

Aim: You have two NumPy arrays, arr1 and arr2, containing the following data:

arr1 = np.array([1, 2, 3, 4, 5])

arr2 = np.array([6, 7, 8, 9, 10])
Write NumPy code to perform the following operations:

1. Add arr1 and arr2 to create a new array called result_add.
2. Multiply arr1 and arr2 to create a new array called result_multiply.
3. Calculate the mean of result_add.
4. Find the maximum value in result_multiply.

CO1: Use different python packages to perform numerical calculations, statistical computations and data visualization.

Procedure

```
import numpy as np
arr1 = np.array([1, 2, 3, 4, 5])
arr2 = np.array([6, 7, 8, 9, 10])
result_add = arr1 + arr2
print("Sum of array: ", result_add)
result_multiply = arr1 * arr2
print("Product of array: ", result_multiply)
print("Mean of array: ", np.mean(result_add))
print("Max value: ", np.max(result_multiply))
```

Output Screenshot

```
C:\Users\ajcemca\PycharmProjects\pythonProject\venv\Scripts\python.exe C:\Users\ajcemca\PycharmProjects\pythonProject\qu2.py
Sum of array:  [ 7  9 11 13 15]
Product of array:  [ 6 14 24 36 50]
Mean of array:  11.0
Max value:  50
```

Result: The program was executed successfully and the output was obtained. Thus, CO1 has been attained.

Experiment No.: 3

Aim: You have a NumPy array called grades that represents the scores of students in a class:
grades = np.array([85, 90, 78, 92, 88, 76, 95, 89, 84, 91])
Write NumPy code to answer the following questions:

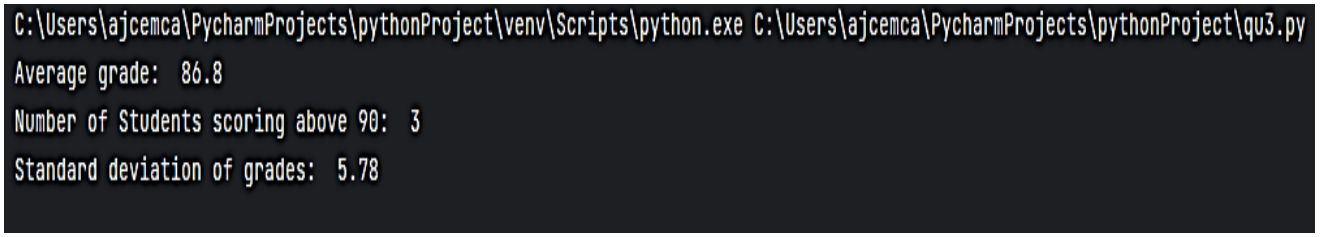
1. What is the average (mean) grade in the class?
2. How many students scored above 90?
3. Calculate the standard deviation of the grades.

CO1: Use different python packages to perform numerical calculations, statistical computations and data visualization.

Procedure

```
import numpy as np
grades = np.array([85, 90, 78, 92, 88, 76, 95, 89, 84, 91])
print("Average grade: ", np.mean(grades))
filter_grade = grades[grades > 90]
print("Number of Students scoring above 90: ", len(filter_grade))
std_grade = np.std(grades)
print("Standard deviation of grades: ", np.round(std_grade, decimals=2))
```

Output Screenshot



Result: The program was executed successfully and the output was obtained. Thus, CO1 has been attained.

Experiment No.: 4

Aim: Matrix Operations with NumPy

```
matrix_A = np.array([[1, 2, 3], [4, 5, 6], [7, 8, 9]])
matrix_B = np.array([[9, 8, 7], [6, 5, 4], [3, 2, 1]])
```

Perform the following matrix operations:

1. Add matrix_A and matrix_B element-wise to create a new matrix, matrix_sum.
2. Multiply matrix_A and matrix_B element-wise to create a new matrix, matrix_product.
3. Calculate the matrix product of matrix_A and matrix_B (dot product) and store it in matrix_dot.
4. Transpose matrix_A and store it in matrix_A_transpose.
5. Calculate the determinant of matrix_B and store it in determinant_B.
6. Find the eigenvalues and eigenvectors of matrix_A and store them in eigenvalues_A and eigenvectors_A.

7. Find SVD of a matrix

Print the results of each operation.

CO1: Use different python packages to perform numerical calculations, statistical computations and data visualization.

Procedure

```
import numpy as np
from scipy.linalg import svd
matrix_A = np.array([[1, 2, 3], [4, 5, 6], [7, 8, 9]])
matrix_B = np.array([[9, 8, 7], [6, 5, 4], [3, 2, 1]])
matrix_sum = matrix_A + matrix_B
print("Sum of matrices: \n", matrix_sum)
matrix_product = matrix_A * matrix_B
print("Product of matrices: \n", matrix_product)
matrix_dot = np.dot(matrix_A, matrix_B)
print("Dot Product of matrices: \n", matrix_dot)
matrix_A_transpose = np.transpose(matrix_A)
print("Transpose of matrix A: \n", matrix_A_transpose)
determinant_B = np.linalg.det(matrix_B)
print("Determinant of matrix B: ", determinant_B)
eigenvalues_A, eigenvectors_A = np.linalg.eig(matrix_A)
print("Eigenvalues of matrix A: \n", eigenvalues_A)
print("Eigenvectors of matrix A: \n", eigenvectors_A)
U, s, VT = svd(matrix_A)
print("SVD of Martrix A: ")
print("U: ", U)
print("s: ", s)
print("VT: ", VT)
```

Output Screenshot

```
C:\Users\ajcemca\PycharmProjects\pythonProject\venv\Scripts\python.exe C:\Users\ajcemca\PycharmProjects\pythonProject\qu4.py
Sum of matrices:
 [[10 10 10]
 [10 10 10]
 [10 10 10]]
Product of matrices:
 [[ 9 16 21]
 [24 25 24]
 [21 16  9]]
Dot Product of matrices:
 [[ 30  24  18]
 [ 84  69  54]
 [138 114  90]]
Transpose of matrix A:
 [[1 4 7]
 [2 5 8]
 [3 6 9]]
Determinant of matrix B:  0.0
Eigenvalues of matrix A:
 [ 1.61168440e+01 -1.11684397e+00 -1.30367773e-15]
Eigenvectors of matrix A:
 [[-0.23197069 -0.78583024  0.40824829]
 [-0.52532209 -0.08675134 -0.81649658]
 [-0.8186735   0.61232756  0.40824829]]
```

```
SVD of Martrix A:
U:  [[-0.21483724  0.88723069  0.40824829]
 [-0.52058739  0.24964395 -0.81649658]
 [-0.82633754 -0.38794278  0.40824829]]
s:  [1.68481034e+01 1.06836951e+00 4.41842475e-16]
VT:  [[-0.47967118 -0.57236779 -0.66506441]
 [-0.77669099 -0.07568647  0.62531805]
 [-0.40824829  0.81649658 -0.40824829]]
```

Result: The program was executed successfully and the output was obtained. Thus, CO1 has been attained.

Experiment No.: 5

Aim: You have a CSV file named "sales_data.csv" containing sales data with columns for "Date," "Product", "Quantity", and "Revenue". Load this data using Pandas and answer the following questions:

1. How many rows and columns are there in the dataset?
2. What is the total revenue for all the sales?

CO1: Use different python packages to perform numerical calculations, statistical computations and data visualization.

Procedure

```
import pandas as pd
df = pd.read_csv("sales_data.csv")
print(df.head())
print("Number of rows: ", len(df))
print("Number of columns: ", len(df.columns))
print("Total Revenue: ", sum(df['Revenue']))
```

Output Screenshot

```
C:\Users\ajcemca\PycharmProjects\pythonProject\venv\Scripts\python.exe C:\Users\ajcemca\PycharmProjects\pythonProject\qu5.py
       Date Product  Quantity  Revenue
0  1/5/2023     pen         2       40
1  2/6/2023    book         3      150
2  4/7/2023  pencil         5       20
3  5/6/2023  eraser         2       15
Number of rows:  4
Number of columns:  4
Total Revenue:  225
```

Result: The program was executed successfully and the output was obtained. Thus, CO1 has been attained.

Experiment No.: 6

Aim: You have a DataFrame called "student_data" with columns "Student_ID" "Name" "Age" and "GPA". Perform the following operations using Pandas:

1. Filter and display the rows of students who are 20 years old or older.
2. Calculate the average GPA of the students in the DataFrame.
3. Sort the DataFrame in descending order of GPA and display the top 5 students with the highest GPAs.
4. Group the students by their ages and calculate the average GPA for each age group.

CO1: Use different python packages to perform numerical calculations, statistical computations and data visualization.

Procedure

```
import pandas as pd
df = pd.read_csv("student_data.csv")
print(df.head(), "\n")
age = df[df['Age'] > 19]
print("Students who are 20 years old or older: \n", age)
print("\nAverage GPA of all students:",df['GPA'].mean().round(2))
data1 = df.sort_values(by='GPA', ascending =  False)
print("\nTop 5 students with hightest GPA: \n", data1.head(5))
data2 = df.groupby('Age')['GPA'].mean().reset_index()
print("\nAverage GPA by age group: \n", data2)
```

Output Screenshot

```
C:\Users\ajcemca\PycharmProjects\DataScience&ML\venv\Scripts\python.exe
  Student_ID     Name  Age  GPA
0       A101    Robin   15  8.9
1       A102    Akhil   22  7.8
2       A103     Arun   23  8.7
3       A104    Donna    9  9.6
4       A105   Gopika   22  8.5

Students who are 20 years old or older:
   Student_ID     Name  Age  GPA
1       A102    Akhil   22  7.8
2       A103     Arun   23  8.7
4       A105   Gopika   22  8.5
5       A106    Shine   26  9.4
6       A107    Priya   20  9.3

Average GPA of all students: 8.89

Top 5 students with hightest GPA:
   Student_ID    Name  Age  GPA
3       A104   Donna    9  9.6
5       A106   Shine   26  9.4
6       A107   Priya   20  9.3
0       A101   Robin   15  8.9
2       A103    Arun   23  8.7
```

```
Average GPA by age group:
    Age   GPA
0    9  9.60
1   15  8.90
2   20  9.30
3   22  8.15
4   23  8.70
5   26  9.40
```

Result: The program was executed successfully and the output was obtained. Thus, CO1 has been attained.

Experiment No.: 7

Aim: Histogram and Quartile Plot:

a. **Question**: Use a dataset of your choice (e.g., exam scores of students, employee salaries, or any other numerical data). Create a histogram to visualize the data's distribution. Afterward, plot quartiles (e.g., Q1, Q2, Q3) on the same graph. Answer the following questions:
   i. What does the histogram reveal about the data's distribution?
   ii. How do the quartiles relate to the histogram?
   iii. Are there any outliers in the data, and if so, how do they affect the quartiles?

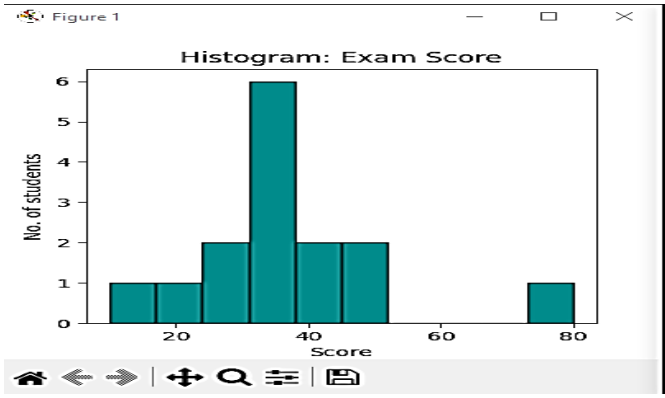
b. **Output:** Provide the histogram and quartile plot along with a written analysis.

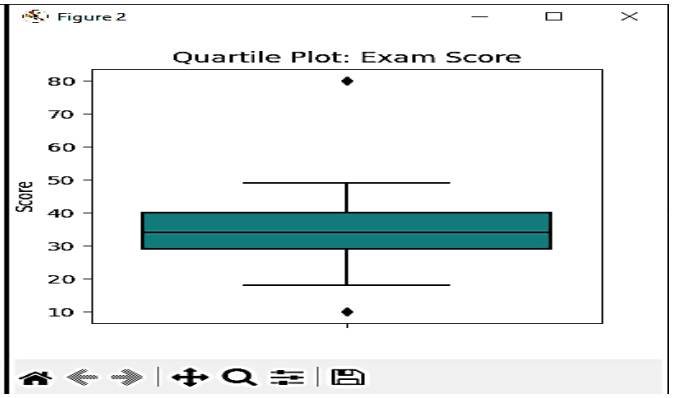
CO1: Use different python packages to perform numerical calculations, statistical computations and data visualization.

Procedure

```
import matplotlib.pyplot as plt
import seaborn as sns
import numpy as np
marks = np.array([10,18,34,
            37, 33, 38,
            34, 24, 80,
            45, 49, 27,
            31, 35, 42])
fig, ax = plt.subplots(figsize = (4, 4))
ax.hist(marks, color = "darkcyan", ec = "black", lw = 1)
plt.title('Histogram: Exam Score')
plt.ylabel('No. of students')
plt.xlabel('Score')
plt.figure(figsize = (4, 4))
sns.boxplot(y = marks, color = 'darkcyan')
plt.title('Quartile Plot: Exam Score')
plt.ylabel('Score')
plt.show()
```

Output Screenshot





a. The histogram reveals that the largest distribution of score is between 30 and 38 with 6 students. The distribution between 10-24 and 73-80 is the same with 1 student.

b. The Quartile plot shows that the distribution in lower quartile is less than the upper quartile which reveals a higher score among the students.The InterQuartile range(IQR) between 28 and 40 reveals where the majority scores are distributed. We also obtain a median of 34 for the data.

c. It is revealed that two outliers at 10 and 80 exist which are translated better in Quartile plot than histogram. These outliers remain clearly out of the minimum and maximum of the plot thereby signifying an unusual difference from the usual distribution.

Result: The program was executed successfully and the output was obtained. Thus, CO1 has been attained.

Experiment No.: 8

Aim: Distribution Chart and Scatter Plot:

a. **Question:** Choose a dataset that contains two numerical variables (e.g., income vs. education level, temperature vs. ice cream sales). Create a distribution chart for each variable and a scatter plot to visualize their relationship. Answer the following questions:
   i. What do the distribution charts reveal about each variable?
   ii. Is there a correlation between the two variables based on the scatter plot?
   iii. Can you identify any patterns or trends in the data?

Output: Present the distribution charts, scatter plot, and your observations in a report.

CO1: Use different python packages to perform numerical calculations, statistical computations and data visualization.

Procedure

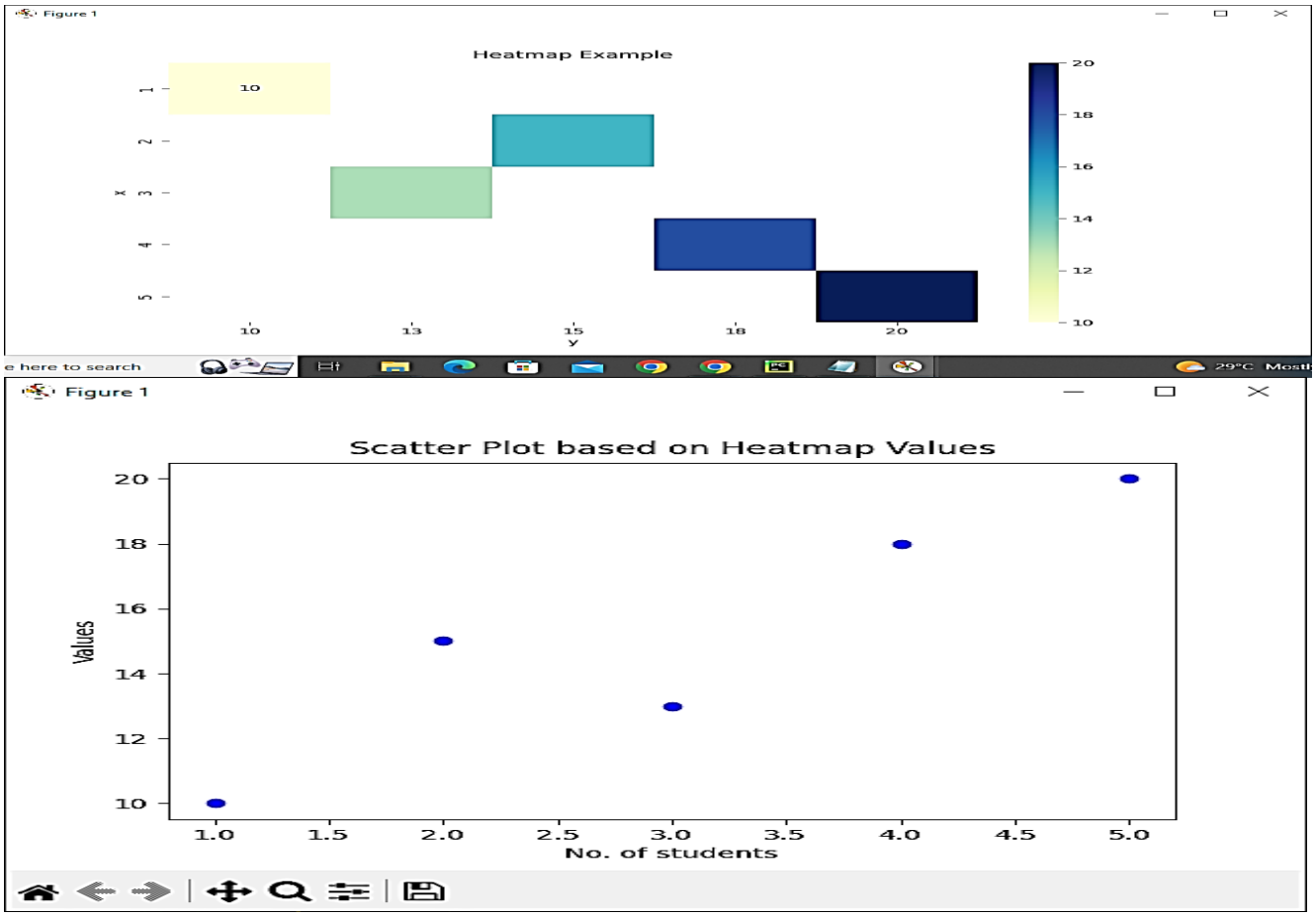
Heat Map charts:-

```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns

x_values = [1, 2, 3, 4, 5]
y_values = [10, 15, 13, 18, 20]
data_values = [10, 15, 13, 18, 20]
df = pd.DataFrame({'x': x_values, 'y': y_values, 'value': data_values})
heatmap_data = df.pivot_table(index = 'x', columns = 'y', values = 'value')
fig, ax = plt.subplots(figsize = (10, 6))
sns.heatmap(heatmap_data, annot = True, cmap = 'YlGnBu', cbar = True)
plt.title('Heatmap Example')
plt.show()
```

Scatter Plot:-

```
x_values = [1, 2, 3, 4, 5]
data_values = [10, 15, 13, 18, 20]

df = pd.DataFrame({'x': x_values, 'value': data_values})

plt.scatter(df['x'], df['value'], marker = 'o', color = 'blue', label = 'Data Points')
plt.xlabel('No. of students')
plt.ylabel('Values')
plt.title('Scatter Plot based on Heatmap Values')
plt.show()
```

Output Screenshot



a. In the heatmap, the values are symmetrically distributed along the x and y axes, forming a diagonal pattern from the bottom-left to the top-right. This indicates that there might be some correlation or relationship between 'x' and 'y' values.
In the scatter plot, there is a clear upward trend in the data points as 'x' increases. This suggests a positive correlation between 'x' and 'value'. As the number of students (x-values) increases, the 'values' tend to increase as well.
The data points are relatively closely clustered around the trendline, indicating a strong correlation. There doesn't appear to be any outliers or significant deviations from the trendline.

b. Based on the scatter plot and the observed trend, it is evident that there is a positive correlation between the two variables ('x' and 'value'). As 'x' increases, 'value' tends to increase as well.

c. The primary pattern or trend identified in the data is a positive linear relationship. As the number of students (x-values) increases, the 'values' also increase, suggesting that there might be a positive impact of increasing the number of students on the 'values'. In summary, the distribution charts and scatter plot reveal that there is a positive correlation between the two variables ('x' and 'value'), and the data follows a clear upward trend. Increasing the number of students is associated with higher 'values'.

Result: The program was executed successfully and the output was obtained. Thus, CO1 has been attained.

Experiment No.: 9

Aim: Bubble Chart and Density Chart:

a. **Question:** Select a dataset with at least three numerical variables (e.g., population, income,

and education level by city). Create a bubble chart that represents the data by using bubble sizes and colors to encode information. Additionally, create a density chart (e.g., a 2D density plot) to show the concentration of data points. Answer the following questions:

i. How does the bubble chart help in visualizing multivariate data?
ii. What insights can you gain from the density chart in terms of data concentration?
iii. Are there any interesting patterns or outliers in the data?

CO1: Use different python packages to perform numerical calculations, statistical computations and data visualization.

Procedure

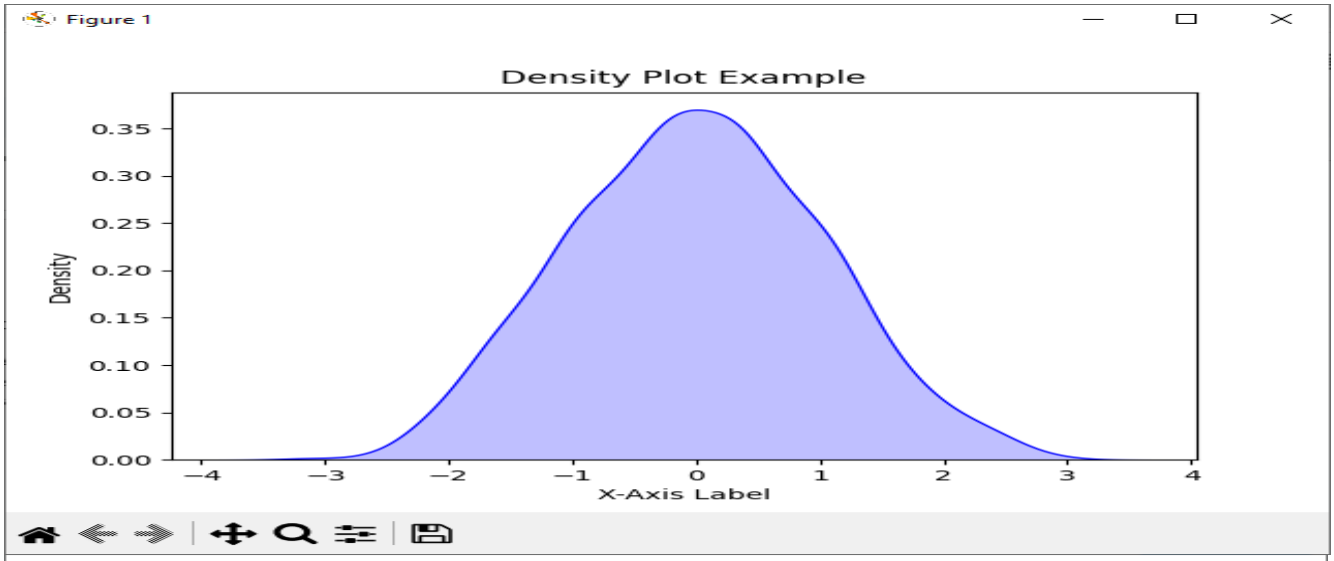
Density Chart:-

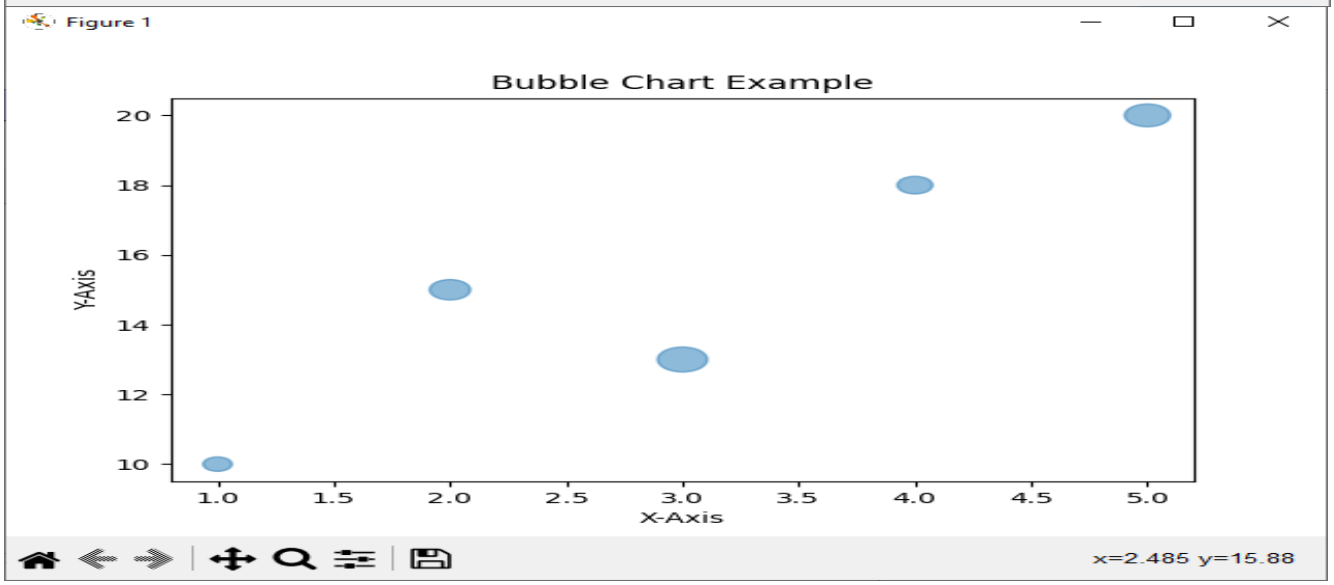
```
import seaborn as sns
import matplotlib.pyplot as plt
import numpy as np

data = np.random.randn(1000)

sns.kdeplot(data, fill=True, color='blue', label='Density Plot')

plt.xlabel('X-Axis Label')
plt.ylabel('Density')
plt.title('Density Plot Example')

plt.show()
```

Bubble Diagram

```
import matplotlib.pyplot as plt

x = [1, 2, 3, 4, 5]
y = [10, 15, 13, 18, 20]
sizes = [100, 200, 300, 150, 250]
plt.scatter(x, y, s=sizes, alpha=0.5)

plt.xlabel('X-Axis')
plt.ylabel('Y-Axis')

plt.title('Bubble Chart Example')
plt.show()
```

Output Screenshot





i. Bubble Chart for Multivariate Data Visualization:
A bubble chart is effective for visualizing multivariate data as it incorporates three variables in a two-dimensional space. In this case:
X-Axis: Represents one variable.
Y-Axis: Represents another variable.
Bubble Size: Represents a third variable.
The size of each bubble indicates the magnitude of the third variable. This allows you to quickly identify patterns and relationships between three different aspects of the data. For example, in the given code, you can observe how the size of the bubbles varies, providing insights into the relationship between 'x,' 'y,' and 'sizes.'

ii. Density Chart Insights:
The density chart (Kernel Density Estimate - KDE) is used to visualize the distribution of a univariate data set. In the provided code:

X-Axis: Represents the data points.
Y-Axis: Represents the estimated density of those data points.
Insights from the density chart:
Data Concentration: The peaks in the density plot indicate regions where the data is concentrated. In areas with higher density, you can infer that there are more data points.

iii. Patterns and Outliers:

Density Chart (KDE): The density chart may reveal peaks and troughs, suggesting where the data is concentrated or sparse. In this example, since the data is generated randomly, you may not observe specific patterns or outliers.
Bubble Chart: Patterns in the bubble chart can be observed by examining the distribution and size of bubbles. If there are clusters of large or small bubbles, it indicates patterns or trends in the multivariate data. In this specific example, the data is manually set, and no distinct patterns or outliers are apparent.
It's important to note that for more meaningful insights, real-world data with specific patterns or characteristics is often required. The provided code uses random data, limiting the ability to make specific observations about patterns or outliers.

Result: The program was executed successfully and the output was obtained. Thus, CO1 has been attained.

Experiment No.: 10

Aim: Program to implement K-Nearest Neighbour Classification and find the accuracy of algorithm.

CO2: Use different packages and frameworks to implement regression and classification algorithms.

Procedure

```
from sklearn.neighbors import KNeighborsClassifier
from sklearn.model_selection import train_test_split
from sklearn.datasets import load_iris
```

```
from sklearn.metrics import accuracy_score
iris = load_iris()
x = iris.data
y = iris.target
x_train, x_test, y_train, y_test = train_test_split(x, y, test_size = 0.2, random_state = 42)
knn = KNeighborsClassifier(n_neighbors = 7)
knn.fit(x_train, y_train)
print(knn.predict(x_test))
V = knn.predict(x_test)
result = accuracy_score(y_test, V)
print("Accuracy= ", result)
```

Output Screenshot

```
C:\Users\ajcemca\PycharmProjects\DSML\venv\Scripts\python.exe C:\Users\ajcemca\PycharmProjects\DSML\Exp4.py
[1 0 2 1 1 0 1 2 2 1 2 0 0 0 0 1 2 1 1 2 0 2 0 2 2 2 2 2 0 0]
accuracy: 0.9666666666666667

Process finished with exit code 0
```

Result: The program was executed successfully and the output was obtained. Thus, CO2 has been attained.

Experiment No.: 11

Aim: Program to implement Simple Linear Regression and find r2 score.

CO2: Use different packages and frameworks to implement regression and classification algorithms.

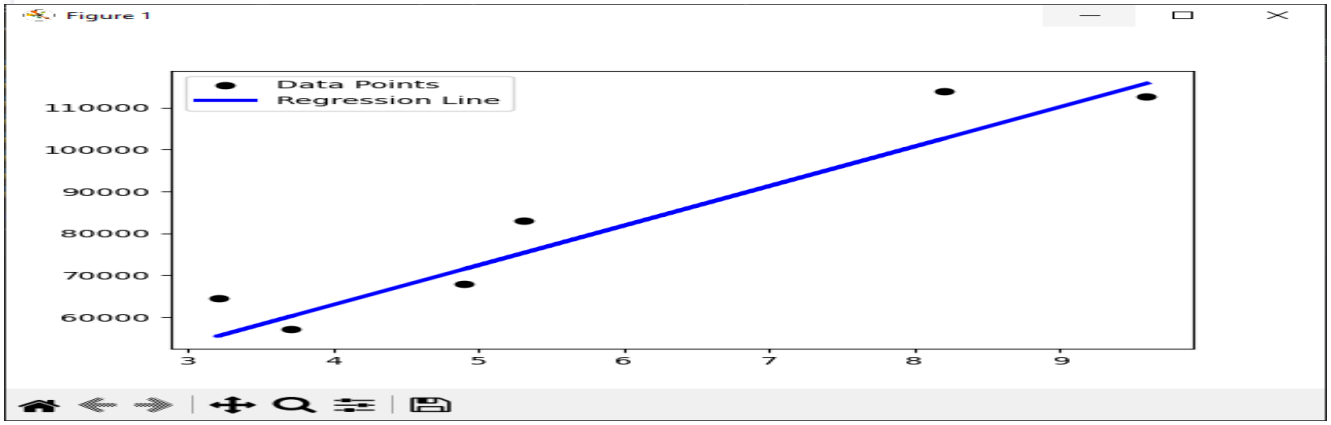
Procedure

```
import pandas as pd
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.metrics import r2_score
data = pd.read_csv('Salary_Data.csv')
x = data['YearsExperience'].values.reshape(-1, 1)
y = data['Salary'].values
x_train, x_test, y_train, y_test = train_test_split(x, y, test_size = 0.2, random_state = 42)
```

```
LR = LinearRegression()
LR.fit(x_train, y_train)
D = LR.predict(x_test)
r2 = r2_score(y_test, D)
print("R2 Score: ", r2)
plt.scatter(x_test, y_test, color = 'black', label = 'Data Points')
plt.plot(x_test, D, color = 'blue', linewidth = 3, label = 'Regression Line')
plt.xlabel = 'YearsExperience'
plt.ylabel = 'Salary'
plt.legend() plt.show()
```

Output Screenshot

```
C:\Users\ajcemca\PycharmProjects\pythonProject\venv\Scripts\python
[115790.21011287  71498.27809463 102596.86866063  75267.80422384
  55477.79204548  60189.69970699]
r2 score: 0.9024461774180497
```



Result: The program was executed successfully and the output was obtained. Thus, CO2 has been attained.

Experiment No.: 12

Aim: Program to implement Multiple Linear Regression and evaluate its performance.

CO2: Use different packages and frameworks to implement regression and classification algorithms.

Procedure

```
import pandas as pd
from sklearn.datasets import fetch_california_housing
from sklearn.metrics import mean_squared_error
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
california_housing = fetch_california_housing()
df = pd.DataFrame(data = california_housing.data, columns = california_housing.feature_names)
df['Target'] = california_housing.target
x = df.drop('Target', axis = 1)
y = df['Target']
x_train, x_test, y_train, y_test = train_test_split(x, y, test_size = 0.2, random_state = 42)
model = LinearRegression()
model.fit(x_train, y_train)
```

```
predictions = model.predict(x_test)
mse = mean_squared_error(y_test, predictions)
print(f "Mean Squared Error: {mse}")
```

Output Screenshot

```
C:\Users\ajcemca\PycharmProjects\pythonProject'
Mean Squared Error: 0.555891598695244

Process finished with exit code 0
```

Result: The program was executed successfully and the output was obtained. Thus, CO2 has been attained.

Experiment No.: 13

Aim: Program to implement Decision Tree Classification.

CO3: Use different packages and frameworks to implement text classification using SVM and clustering using K-means.

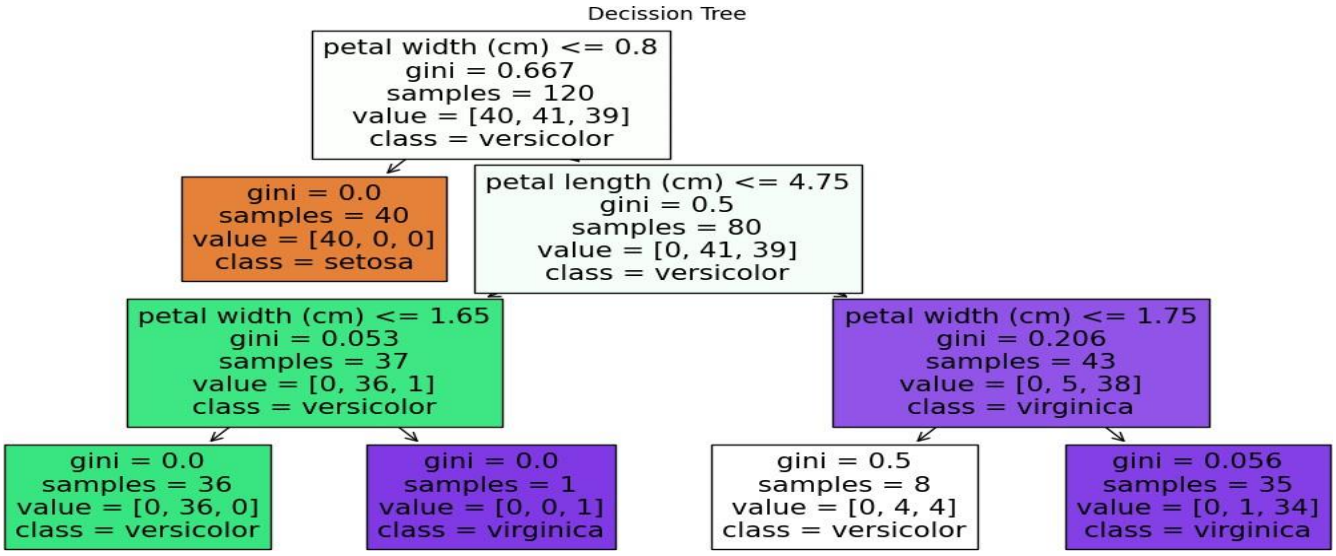
Procedure

```
from sklearn.datasets import load_iris
from sklearn.model_selection import train_test_split
from sklearn.tree import DecisionTreeClassifier, plot_tree
from sklearn.metrics import accuracy_score, classification_report
from matplotlib import pyplot as plt
iris = load_iris()
x = iris.data
y = iris.target
x_train, x_test, y_train, y_test = train_test_split(x, y, test_size=0.2, random_state = 42)
dt = DecisionTreeClassifier(max_depth = 3)
dt.fit(x_train, y_train)
print(dt.predict(x_test))
D = dt.predict(x_test)
result = accuracy_score(y_test, D)
print("Accuracy = ", result)
cr = classification_report(y_test, D)
print("Classification Report: ", cr)
```

```
plt.figure(figsize = (15, 20))
plot_tree(dt, filled = True, feature_names = iris.feature_names, class_names = iris.target_names)
plt.title("Decision Tree")
plt.show()
```

Output Screenshot

```
C:\Users\ajcemca\PycharmProjects\pythonProject\venv\Scripts\python.exe C:\Users\ajcemca\PycharmProjects\pythonProject
[1 0 2 1 2 0 1 2 1 1 2 0 0 0 0 1 2 1 1 2 0 2 0 2 2 2 2 2 0 0]
accuracy: 0.9666666666666667
classification_report:               precision    recall  f1-score   support

           0       1.00      1.00      1.00        10
           1       1.00      0.89      0.94         9
           2       0.92      1.00      0.96        11

    accuracy                           0.97        30
   macro avg       0.97      0.96      0.97        30
weighted avg       0.97      0.97      0.97        30
```



Result: The program was executed successfully and the output was obtained. Thus, CO3 has been attained.

Experiment No.: 14

Aim: Program to implement K-Means Classification.

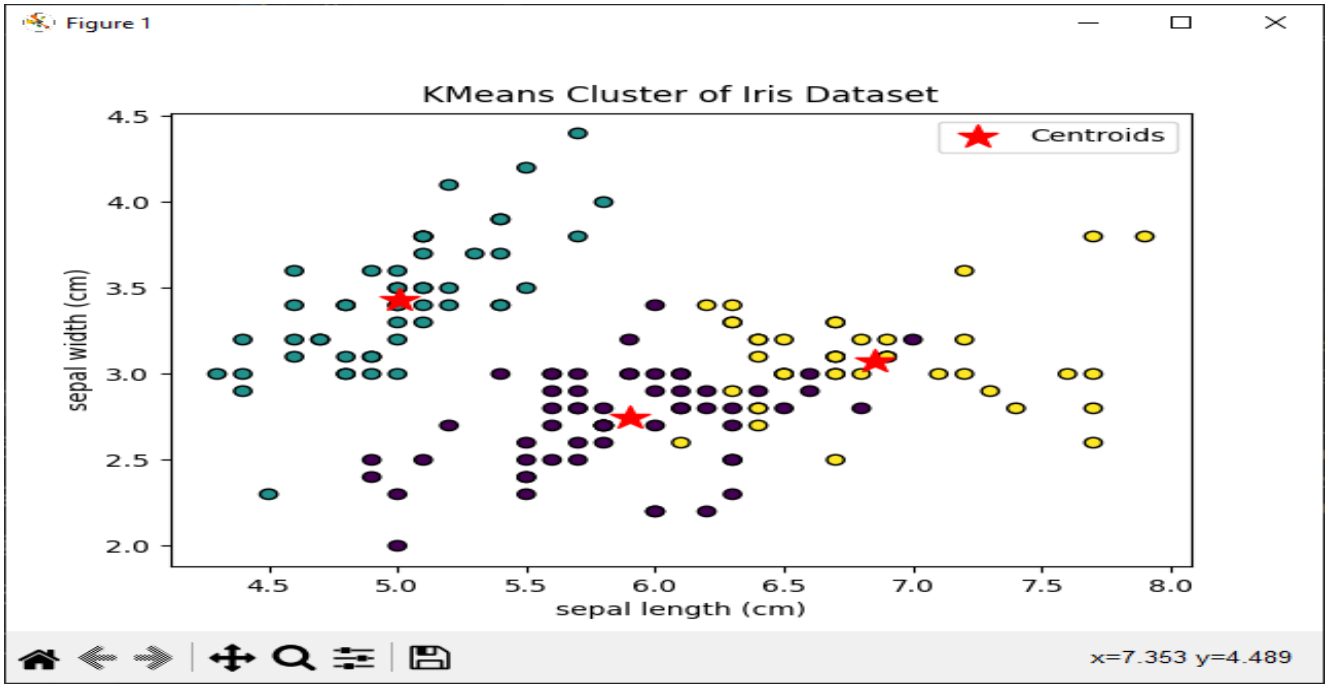
CO3: Use different packages and frameworks to implement text classification using SVM and clustering using K-means.

Procedure

```
from sklearn.datasets import  load_iris
from sklearn.cluster import KMeans
import matplotlib.pyplot as plt
iris = load_iris()
x = iris.data
y = iris.target
kmeans = KMeans(n_clusters = 3,  random_state = 42)
kmeans.fit(x)
cluster_labels = kmeans.labels_
print(cluster_labels)
centroids = kmeans.cluster_centers_
print(centroids)
plt.scatter(x[:, 0], x[:, 1], c = cluster_labels, cmap = 'viridis', marker = 'o', edgecolors = 'black')
plt.scatter(centroids[:, 0], centroids[:, 1], marker = "*", s = 200, c = 'red', label = 'Centroids')
plt.xlabel(iris.feature_names[0])
plt.ylabel(iris.feature_names[1])
plt.title('KMeans Cluster of Iris Dataset')
plt.legend()
plt.show()
```

Output Screenshot

```
[1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
 1 1 1 1 1 1 1 1 1 1 1 1 1 0 0 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
 0 0 0 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 2 0 2 2 2 2 0 2 2 2 2
 2 2 0 0 2 2 2 2 2 0 2 0 2 0 2 2 0 0 2 2 2 2 2 0 2 2 2 2 0 2 2 2 0 2 2 2 0 2
 2 0]
[[5.9016129  2.7483871  4.39354839 1.43387097]
 [5.006      3.428      1.462      0.246     ]
 [6.85       3.07368421 5.74210526 2.07105263]]
```



Result: The program was executed successfully and the output was obtained. Thus, CO3 has been attained.

Experiment No.: 15

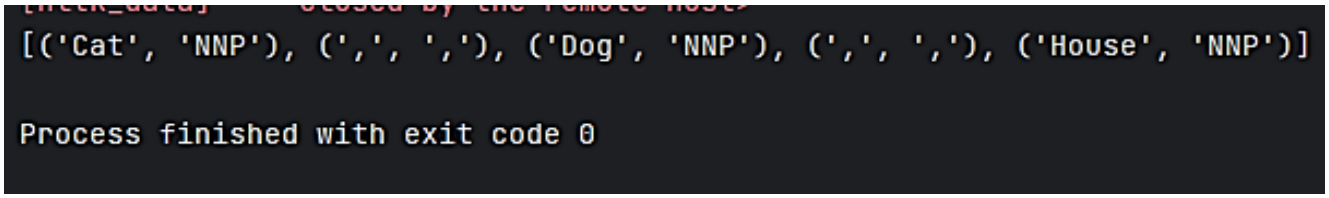
Aim: Program to implement Part-Of-Speech (POST) Tagging.

CO5: Implement programs for web data mining and natural language processing using NLTK.

Procedure

```
import nltk
from nltk import pos_tag
from nltk.tokenize import word_tokenize

# Download necessary NLTK resources
nltk.download('punkt')
nltk.download('averaged_perceptron_tagger')

# Sample sentence
sentence = "Cat, Dog, House"

# Tokenize the sentence
words = word_tokenize(sentence)

# Perform POS tagging
pos_tags = pos_tag(words)

# Display the result
print(pos_tags)
```

Output Screenshot



Result: The program was executed successfully and the output was obtained. Thus, CO5 has been attained.

Experiment No.: 16

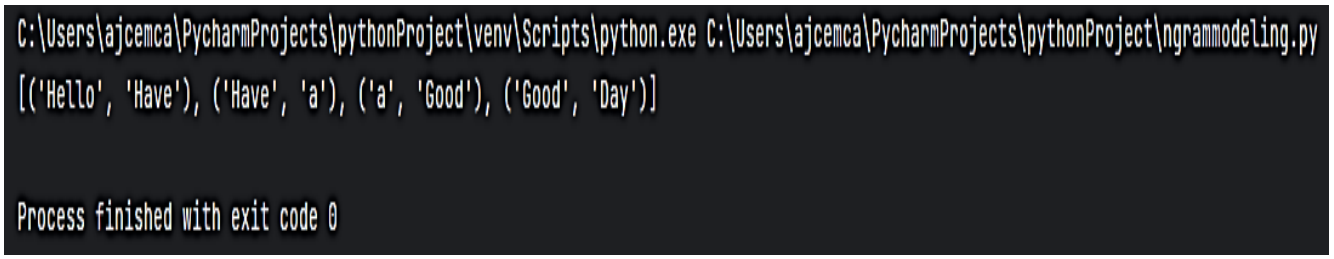
Aim: Program to implement N-Gram Modeling.

CO5: Implement programs for web data mining and natural language processing using NLTK.

Procedure

```
from nltk import bigrams,word_tokenize
sentence = "Hello Have a Good Day"
words = word_tokenize(sentence)
bigrams_list = list(bigrams(words))
print(bigrams_list)
```

Output Screenshot



Result: The program was executed successfully and the output was obtained. Thus, CO5 has been attained.

Experiment No.: 17

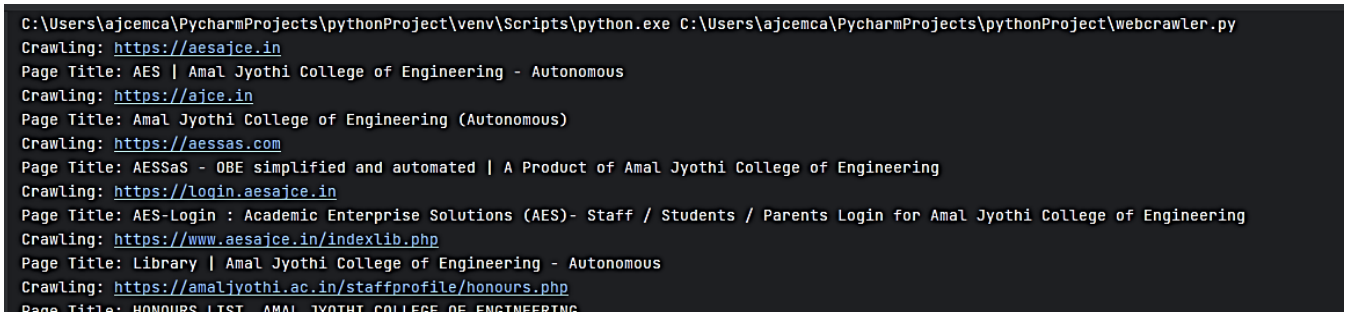
Aim: Program to implement a simple web crawler.

CO5: Implement programs for web data mining and natural language processing using NLTK.

Procedure

```
import requests
from bs4 import BeautifulSoup
def simple_web_crawler(url, max_depth = 2):
  visited_urls = set()
 def crawl(url, depth)
 if depth > max_depth or url in visited_urls:
                return
 print(f "Crawling: {url}")
          try:
                response = requests.get(url)
                visited_urls.add(url)
                if response.status_code == 200:
                   soup = BeautifulSoup(response.text, 'html.parser')
                   title = soup.title.string.strip() if soup.title else 'No title found'
                   print(f"Page Title: {title}")
                   for link in soup.find_all('a', href = True):
                      next_url = link['href']
                      crawl(next_url, depth + 1)
             except Exception as e:
                print(f "Error crawling {url}: {e}")
          crawl(url, depth = 1)
       if __name__ == "__main__":
          start_url = "https://aesajce.in"
          simple_web_crawler(start_url)
```

Output Screenshot



Result: The program was executed successfully and the output was obtained. Thus, CO5 has been attained.

Experiment No.: 18

Aim: Program to implement a Feed Forward Network using Iris Data Set.

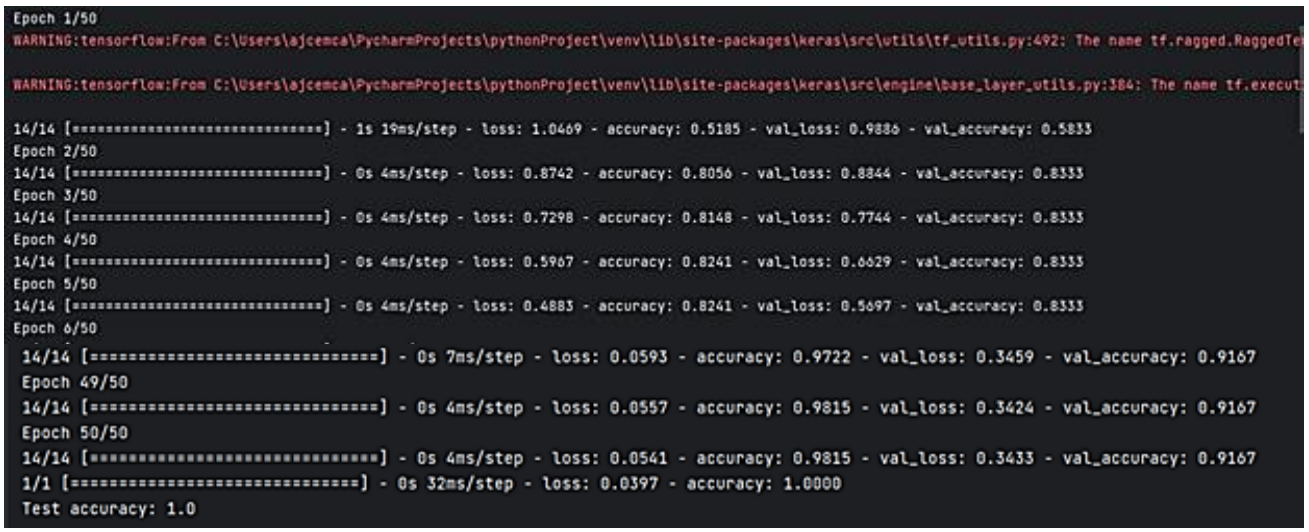
CO4: Implement programs for web data mining and natural language processing using NLTK.

Procedure

```
import numpy as np
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler, LabelEncoder
```

```
from sklearn.datasets import load_iris
from tensorflow.keras import models, layers
        # Load the Iris dataset
        iris = load_iris()
        X = iris.data
        y = iris.target
        # Split the dataset into training and testing sets
        X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)
        # Standardize the features
        scaler = StandardScaler()
        X_train = scaler.fit_transform(X_train)
        X_test = scaler.transform(X_test)
        # One-hot encode the target variable
        label_encoder = LabelEncoder()
        y_train = label_encoder.fit_transform(y_train)
        y_test = label_encoder.transform(y_test)
        # Create a simple feedforward neural network model
        model = models.Sequential()
        model.add(layers.Dense(64, activation='relu', input_shape=(4,)))
        model.add(layers.Dense(32, activation='relu'))
        model.add(layers.Dense(3, activation='softmax'))  # Output layer with 3 classes
        # Compile the model
        model.compile(optimizer='adam',
                loss='sparse_categorical_crossentropy',  # Use 'categorical_crossentropy' if y is one-
        hot encoded
                metrics=['accuracy'])
        # Train the model
        model.fit(X_train, y_train, epochs=50, batch_size=8, validation_split=0.1)
        # Evaluate the model on the test set
        test_loss, test_acc = model.evaluate(X_test, y_test)
        print(f 'Test accuracy: {test_acc}')
```

Output Screenshot



Result: The program was executed successfully and the output was obtained. Thus, CO4 has been attained.