Assignment One

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Question 1

Explore the various functions / methods that come under the following Python Libraries

Numpy

- np.array -> to create arrays
- random/rand() -> to work with random numbers
- shuffle() -> changing arrangements of elements in array
- random.normal() -> Normal distrubution
- random.binomial() -> Binomial distrubution
- random.poisson() -> Poisson distrubution
- random.uniform() -> Uniform distrubution

Pandas

- pandas.DataFrame() -> converts table to dataframe
- pd.read_csv() -> reads a csv file
- df.dropna() -> drops null values
- df.fillna() -> fills null values
- df.corr() -> shows relationship between columns
- df.plot() -> plotting

Scipy

- optimise.root -> finding roots for polynomials and linier equations

- scipy.optimize.minimize() -> function to minimize the function
- constants.pi -> constant pi and similar constants
- scipy.sparse.csgraph -> to work with graph data structure
- connected_components() -> to find the connected components in a graph
- savemat() -> to export data in Matlab format.

###Scikit-learn

- train_test_split -> Splits into training and testing data
- fit -> Trains a machine learning model on the given training data
- predict -> Generates predictions on new data using a trained model
- accuracy_score -> Computes the accuracy of the model's predictions
- cross_val_score -> Performs cross-validation to evaluate a model's performance

Matplotlib

- pyplot -> submodule used for plotting
- plot() -> used to draw points in a diagram
- subplot() -> to create subplots
- scatter() -> to create scatter plots
- bar() -> to create a bar graph
- hist() -> to create histograms

Question 2

Download the following dataset from UCI Machine Learning Repository and identify the type of ML model to be used (Supervised, Unsupervised, Semi-supervised, *Regression*, Classification).

Iris Dataset - Supervised Learning Classification: Target variables are provided and input vectors are classified into target classes

List down the features and class labels from the dataset. Explore the steps involved in the Learning process.

1. Loading the dataset.
2. Pre-Processing the data (Handling missing values, Normalization, Standardization).
3. Exploratory Data Analysis.
4. Feature Selection Techniques.
5. Split the data into training, testing and validation sets.

Iris

Step One: Loading Dataset

```
import numpy as np
import pandas as pd
import matplotlib as plt
import matplotlib.pyplot as plt
from sklearn.svm import SVR
from sklearn.svm import SVC
from sklearn.ensemble import RandomForestClassifier
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score
```

```
from google.colab import drive
drive.mount('/content/drive')
```

```
Mounted at /content/drive
```

```
file_path = '/content/drive/My Drive/Datasets/iris/Iris.csv'
data = pd.read_csv(file_path)
```

```
data
```

```
      Id  SepalLengthCm  SepalWidthCm  PetalLengthCm  PetalWidthCm  \
0      1            5.1           3.5            1.4           0.2
1      2            4.9           3.0            1.4           0.2
2      3            4.7           3.2            1.3           0.2
3      4            4.6           3.1            1.5           0.2
4      5            5.0           3.6            1.4           0.2
..   ...            ...           ...            ...           ...
145  146            6.7           3.0            5.2           2.3
146  147            6.3           2.5            5.0           1.9
147  148            6.5           3.0            5.2           2.0
148  149            6.2           3.4            5.4           2.3
149  150            5.9           3.0            5.1           1.8

            Species
0       Iris-setosa
1       Iris-setosa
2       Iris-setosa
3       Iris-setosa
4       Iris-setosa
..              ...
145  Iris-virginica
```

```
146  Iris-virginica
147  Iris-virginica
148  Iris-virginica
149  Iris-virginica

[150 rows x 6 columns]
```

Step Two: Preprocessing

Checking for null values

```
print(data[data.isnull().any(axis=1)])
```

```
Empty DataFrame
Columns: [Id, SepalLengthCm, SepalWidthCm, PetalLengthCm,
PetalWidthCm, Species]
Index: []
```

```
data = data.dropna(subset=['Id'])
data = data.dropna(subset=['Species'])
```

```
def g(data):
    data["SepalLengthCm"].fillna(data[data['Species'] == "Iris-
setosa"]["SepalLengthCm"].mean(), inplace=True)
    data["SepalLengthCm"].fillna(data[data['Species'] == "Iris-
virginica"]["SepalLengthCm"].mean(), inplace=True)
    data["SepalLengthCm"].fillna(data[data['Species'] == "Iris-
versicolor"]["SepalLengthCm"].mean(), inplace=True)

    data["SepalWidthCm"].fillna(data[data['Species'] == "Iris-setosa"]
["SepalWidthCm"].mean(), inplace=True)
    data["SepalWidthCm"].fillna(data[data['Species'] == "Iris-
virginica"]["SepalWidthCm"].mean(), inplace=True)
    data["SepalWidthCm"].fillna(data[data['Species'] == "Iris-
versicolor"]["SepalWidthCm"].mean(), inplace=True)

    data["PetalLengthCm"].fillna(data[data['Species'] == "Iris-
setosa"]["PetalLengthCm"].mean(), inplace=True)
    data["PetalLengthCm"].fillna(data[data['Species'] == "Iris-
virginica"]["PetalLengthCm"].mean(), inplace=True)
    data["PetalLengthCm"].fillna(data[data['Species'] == "Iris-
versicolor"]["PetalLengthCm"].mean(), inplace=True)

    data["PetalWidthCm"].fillna(data[data['Species'] == "Iris-setosa"]
["PetalWidthCm"].mean(), inplace=True)
    data["PetalWidthCm"].fillna(data[data['Species'] == "Iris-
virginica"]["PetalWidthCm"].mean(), inplace=True)
    data["PetalWidthCm"].fillna(data[data['Species'] == "Iris-
versicolor"]["PetalWidthCm"].mean(), inplace=True)
```

```
    return data
data = g(data)

data
```

```
      Id  SepalLengthCm  SepalWidthCm  PetalLengthCm  PetalWidthCm  \
0      1            5.1           3.5            1.4           0.2
1      2            4.9           3.0            1.4           0.2
2      3            4.7           3.2            1.3           0.2
3      4            4.6           3.1            1.5           0.2
4      5            5.0           3.6            1.4           0.2
..   ...            ...           ...            ...           ...
145  146            6.7           3.0            5.2           2.3
146  147            6.3           2.5            5.0           1.9
147  148            6.5           3.0            5.2           2.0
148  149            6.2           3.4            5.4           2.3
149  150            5.9           3.0            5.1           1.8

            Species
0       Iris-setosa
1       Iris-setosa
2       Iris-setosa
3       Iris-setosa
4       Iris-setosa
..              ...
145  Iris-virginica
146  Iris-virginica
147  Iris-virginica
148  Iris-virginica
149  Iris-virginica

[150 rows x 6 columns]
```

Step Three: Exploratory Data Analysis

```
len(data)
```

```
150
```

```
data.describe()
```

```
               Id  SepalLengthCm  SepalWidthCm  PetalLengthCm
PetalWidthCm
count  150.000000     150.000000    150.000000     150.000000
150.000000
mean    75.500000       5.843333      3.054000       3.758667
1.198667
std     43.445368       0.828066      0.433594       1.764420
0.763161
min      1.000000       4.300000      2.000000       1.000000
0.100000
```

```
25%     38.250000       5.100000      2.800000       1.600000
0.300000
50%     75.500000       5.800000      3.000000       4.350000
1.300000
75%    112.750000       6.400000      3.300000       5.100000
1.800000
max    150.000000       7.900000      4.400000       6.900000
2.500000
```

```
data.groupby('Species').describe()
```

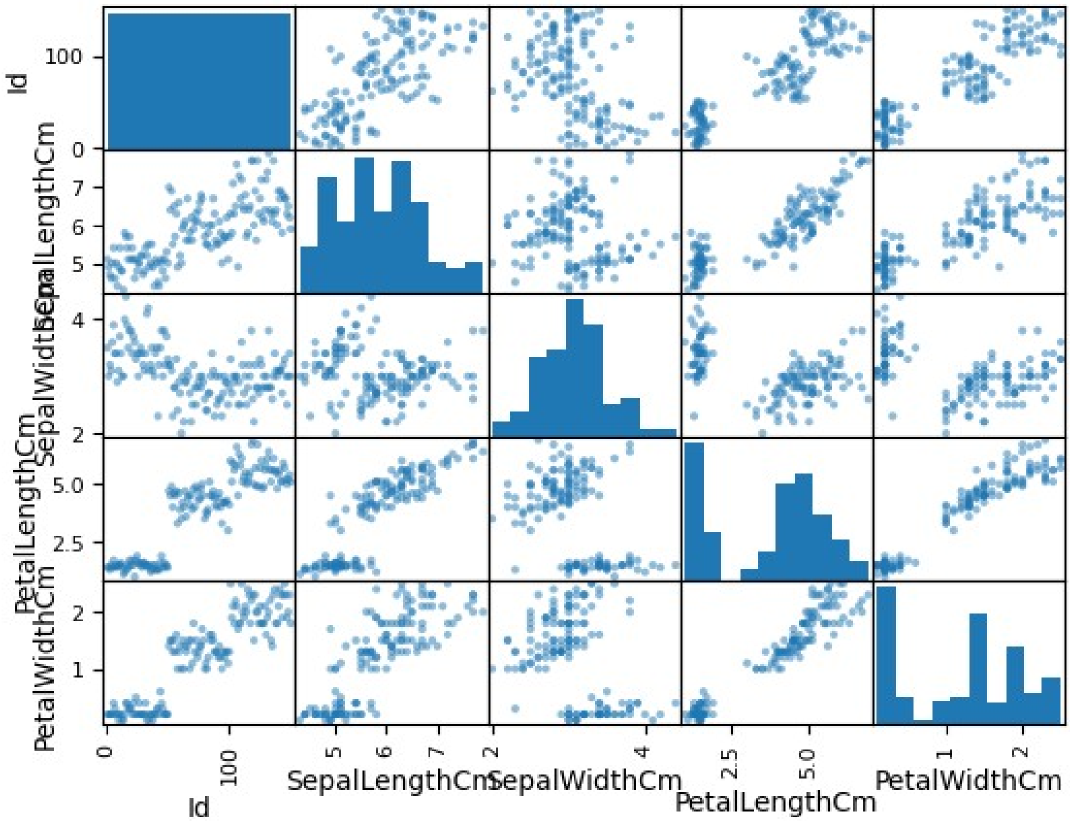
```
                   Id
\
                count   mean        std    min     25%    50%     75%
max
Species

Iris-setosa      50.0   25.5  14.57738    1.0   13.25   25.5   37.75
50.0
Iris-versicolor  50.0   75.5  14.57738   51.0   63.25   75.5   87.75
100.0
Iris-virginica   50.0  125.5  14.57738  101.0  113.25  125.5  137.75
150.0

                SepalLengthCm         ... PetalLengthCm
PetalWidthCm  \
                        count   mean  ...           75%  max
count
Species                               ...

Iris-setosa             50.0  5.006  ...         1.575  1.9
50.0
Iris-versicolor         50.0  5.936  ...         4.600  5.1
50.0
Iris-virginica          50.0  6.588  ...         5.875  6.9
50.0


                  mean       std  min  25%  50%  75%  max
Species
Iris-setosa      0.244  0.107210  0.1  0.2  0.2  0.3  0.6
Iris-versicolor  1.326  0.197753  1.0  1.2  1.3  1.5  1.8
Iris-virginica   2.026  0.274650  1.4  1.8  2.0  2.3  2.5

[3 rows x 40 columns]
```

```
data['Species'].value_counts()
```

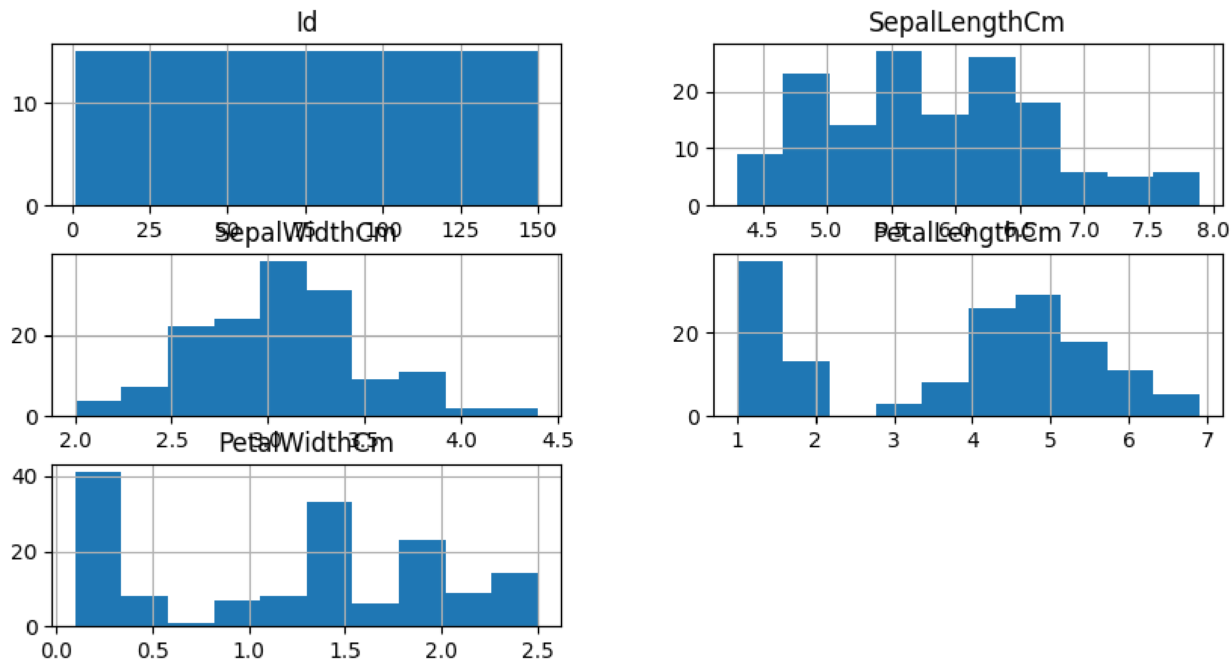
```
Iris-setosa        50
Iris-versicolor    50
```

```
Iris-virginica     50
Name: Species, dtype: int64
```

```
from matplotlib import pyplot as plt
pd.plotting.scatter_matrix(data)
plt.show()
```




```
data.hist(bins=10, figsize=(10, 5))
plt.show()
```



Step Four: Feature Selection Techniques

The features here chosen are labeled in the data itself: Sepal Length, Sepal Width, Petal Length, and Petal Width. Thus, further feature selection techniques may not be required.

Step Five: Split into Training data and Testing Data

```
data

      Id  SepalLengthCm  SepalWidthCm  PetalLengthCm  PetalWidthCm  \
0      1            5.1           3.5            1.4           0.2
1      2            4.9           3.0            1.4           0.2
2      3            4.7           3.2            1.3           0.2
3      4            4.6           3.1            1.5           0.2
4      5            5.0           3.6            1.4           0.2
..   ...            ...           ...            ...           ...
145  146            6.7           3.0            5.2           2.3
146  147            6.3           2.5            5.0           1.9
147  148            6.5           3.0            5.2           2.0
148  149            6.2           3.4            5.4           2.3
149  150            5.9           3.0            5.1           1.8

            Species
0       Iris-setosa
1       Iris-setosa
2       Iris-setosa
3       Iris-setosa
4       Iris-setosa
..              ...
145  Iris-virginica
```

```
146   Iris-virginica
147   Iris-virginica
148   Iris-virginica
149   Iris-virginica

[150 rows x 6 columns]

y = data['Species']
X = data[['SepalLengthCm', 'SepalWidthCm', 'PetalLengthCm',
'PetalWidthCm']]
print(X)
print(y)

     SepalLengthCm  SepalWidthCm  PetalLengthCm  PetalWidthCm
0              5.1           3.5            1.4           0.2
1              4.9           3.0            1.4           0.2
2              4.7           3.2            1.3           0.2
3              4.6           3.1            1.5           0.2
4              5.0           3.6            1.4           0.2
..             ...           ...            ...           ...
145            6.7           3.0            5.2           2.3
146            6.3           2.5            5.0           1.9
147            6.5           3.0            5.2           2.0
148            6.2           3.4            5.4           2.3
149            5.9           3.0            5.1           1.8

[150 rows x 4 columns]
0         Iris-setosa
1         Iris-setosa
2         Iris-setosa
3         Iris-setosa
4         Iris-setosa
            ...
145    Iris-virginica
146    Iris-virginica
147    Iris-virginica
148    Iris-virginica
149    Iris-virginica
Name: Species, Length: 150, dtype: object

X_train, X_test, y_train, y_test = train_test_split(X, y,
test_size=0.2, random_state=42)

print(f"Number of samples in training set: {len(X_train)}")
print(f"Number of samples in testing set: {len(X_test)}")

Number of samples in training set: 120
Number of samples in testing set: 30
```

```python
model = RandomForestClassifier(random_state=42)
model.fit(X_train, y_train)
y_pred = model.predict(X_test)

accuracy = accuracy_score(y_test, y_pred)
print(f"Model Accuracy on Testing Set: {accuracy}")
```

```
Model Accuracy on Testing Set: 1.0
```