ಬೆಂಗಳೂರು
ನಗರ ವಿಶ್ವವಿದ್ಯಾಲಯ

BENGALURU
CITY UNIVERSITY

Bachelor Of Computer Applications
VI SEMESTER
2025

MACHINE LEARNING LAB MANUAL

PREPARED
BY

ASHWINI Y
DEPARTMENT OF COMPUTER SCIENCE
BENGALURU CITY UNIVERSITY

LIST OF PROGRAMS

1. **Install and set up Python and essential libraries like NumPy and pandas.**

2. **Introduce scikit-learn as a machine learning library.**

3. **Install and set up scikit-learn and other necessary tools.**

4. **Write a program to Load and explore the dataset of .CVS and excel files using pandas.**

5. **Write a program to Visualize the dataset to gain insights using Matplotlib or Seaborn by plotting scatter plots, bar charts.**

6. **Write a program to Handle missing data, encode categorical variables, and perform feature scaling.**

7. **Write a program to implement a k-Nearest Neighbours (k-NN) classifier using scikit- learn and Train the classifier on the dataset and evaluate its performance.**

8. **Write a program to implement a linear regression model for regression tasks and train the model on a dataset with continuous target variables.**

9. **Write a program to implement a decision tree classifier using scikit-learn and**
   visualize the decision tree and understand its splits.

10. **Write a program to Implement K-Means clustering and Visualize clusters.**

Labcycle 1. Install and set up Python and essential libraries like NumPy and pandas.

Installation of Python

Step 1: Search for Python

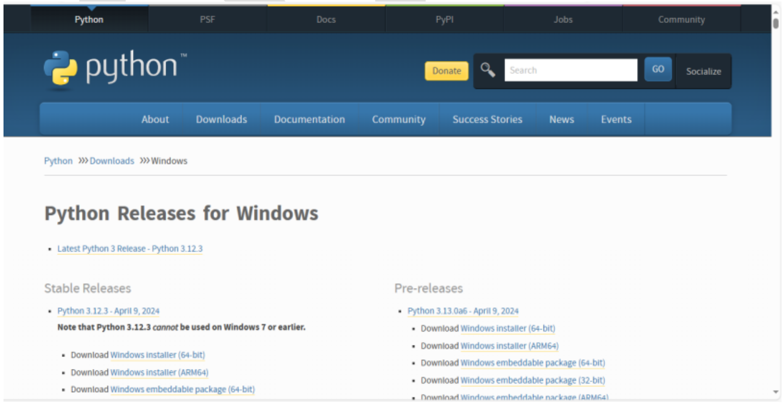
Type "Python download" in the Google search bar and press Enter key. In the list of links shown, select the

very link or click on the official website link: https://www.python.org/downloads/

Step 2: Select Version to Install Python

Choose the correct link for your device from the options provided: either Windows installer (64-bit) or

Windows installer (32-bit) and proceed to download the executable file.



Python Releases for Windows

- Latest Python 3 Release - Python 3.12.3

Stable Releases

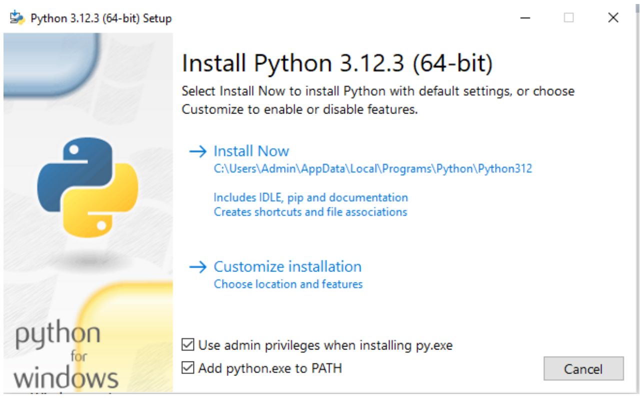
- Python 3.12.3 - April 9, 2024
  Note that Python 3.12.3 *cannot* be used on Windows 7 or earlier.
  - Download Windows installer (64-bit)
  - Download Windows installer (ARM64)
  - Download Windows embeddable package (64-bit)

Pre-releases

- Python 3.13.0a6 - April 9, 2024
  - Download Windows installer (64-bit)
  - Download Windows installer (ARM64)
  - Download Windows embeddable package (64-bit)
  - Download Windows embeddable package (32-bit)
  - Download Windows embeddable package (ARM64)

Step 3: Downloading the Python Installer

Once you have downloaded the installer, open the .exe file, such as python-3.12.3-amd64.exe, by double_clicking it to launch the Python installer. Choose the option to install the launcher for all users by checking the corresponding checkbox, so that all users of the computer can access the Python launcher application.


Python 3.12.3 (64-bit) Setup

Install Python 3.12.3 (64-bit)

Select Install Now to install Python with default settings, or choose Customize to enable or disable features.

→ Install Now
C:\Users\Admin\AppData\Local\Programs\Python\Python312

Includes IDLE, pip and documentation
Creates shortcuts and file associations

→ Customize installation
Choose location and features

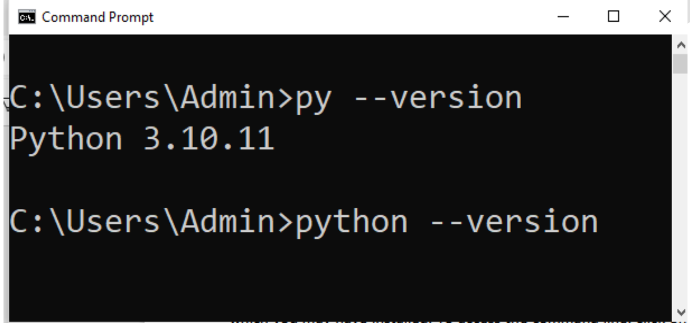
☑ Use admin privileges when installing py.exe
☑ Add python.exe to PATH

Enable users to run Python from the command line by checking the "Add python.exe to PATH" checkbox. After Clicking the "Install Now" Button the setup will start installing Python on your Windows system.

Step 4: Verify the Python Installation in Windows

After successful installation of Python, close the installation window. You can check if the installation of Python was successful by using either the command line or the Integrated Development Environment (IDLE), which you may have installed. To access the command line, click on the Start menu and type “cmd” in the search bar.

Then click on Command Prompt, type the command “python --V” or “python --version”. You can see installed version of Python on your system.



```
C:\Users\Admin>py --version
Python 3.10.11

C:\Users\Admin>python --version
```

Go to Python Integrated Development Environment (IDLE). In Windows search bar, type IDLE and you can see “IDLE (Python 3.12.3- bit)”. Open IDLE on the IDLE screen itself you can see version. This gives the conformation of successful installation of python.

Installation of essential packages Numpy and Pandas.

a) Install numpy package.

NumPy is an open-source Python library that facilitates efficient numerical operations on large quantities of data. There are a few functions that exist in NumPy that we use on pandas DataFrames. The most important part about NumPy is that pandas is built on top of it which means Numpy is required for operating the Pandas.

It is defined as a Python package used for performing the various numerical computations and processing of the multidimensional and single-dimensional array elements. The calculations using Numpy arrays are faster than the normal Python array. It is also capable of handling a vast amount of data and convenient with Matrix multiplication and data reshaping. Steps to install Numpy is,

Step 1: Open command prompt, CMD.

Step 2: Type the command,

```
C:\Users\Admin> py –m pip install numpy
```

Or

```
C:\Users\Admin>pip3 install numpy
```

Step 3: Upgrade the software by the command

```
C:\Users\Admin> py –m pip install - -upgrade pip
```

Or

```
C:\Users\Admin> pip3 install - -upgrade pip
```

b) Install pandas package.

Pandas is a very popular library for working with data (its goal is to be the most powerful and flexible open_source tool, and in our opinion, it has reached that goal). DataFrames are at the center of pandas. A DataFrame is structured like a table or spreadsheet. The rows and the columns both have indexes, and you can perform operations on rows or columns separately. It can perform five significant steps required for processing and analysis of data irrespective of the origin of the data, i.e., load, manipulate, prepare, model, and analyze.

Steps to install pandas is,

Step 1: Open command prompt, CMD.

Step 2: Type the command,

```
C:\Users\Admin> py –m pip install pandas
```

Or

```
C:\Users\Admin>pip3 install pandas
```

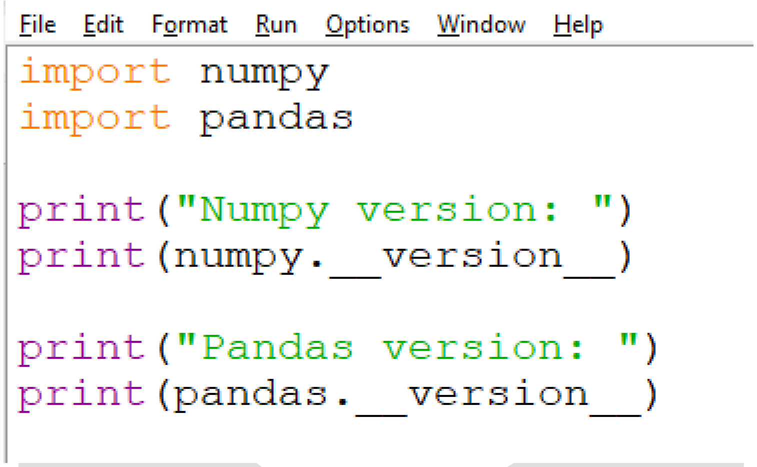
Step 3: Upgrade the software by the command

```
C:\Users\Admin> py –m pip install - -upgrade pip
```

Or

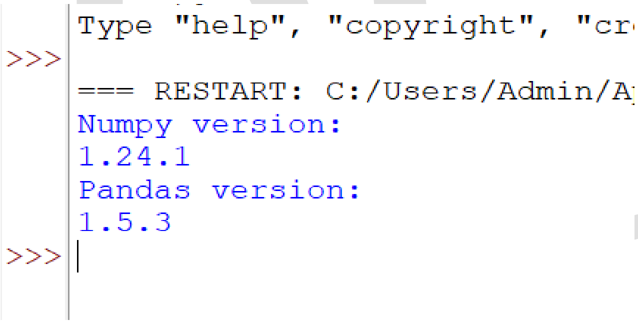
```
C:\Users\Admin> pip3 install - -upgrade pip
```

Upon successful installation, the version installed can be verified using the below program.



```
import numpy
import pandas

print("Numpy version: ")
print(numpy.__version__)

print("Pandas version: ")
print(pandas.__version__)
```

Output:



```
    Type "help", "copyright", "cr
>>>
    === RESTART: C:/Users/Admin/A
    Numpy version:
    1.24.1
    Pandas version:
    1.5.3
>>> 
```

Labcycle 2. Introduce scikit-learn as a machine learning library.

Scikit-learn is a widely-used Python library that provides a comprehensive suite of tools and functionalities for machine learning tasks.

1. Versatility: Scikit-learn offers a wide range of tools and functionalities for various machine learning tasks, including but not limited to:

• Supervised Learning: Classification, Regression. Almost all the popular supervised learning
algorithms, like Linear Regression, Support Vector Machine (SVM), Decision Tree etc., are the part of scikit-learn

• Unsupervised Learning: Clustering, Dimensionality Reduction. It supports all the popular unsupervised learning algorithms from clustering, factor analysis, PCA (Principal Component Analysis) to unsupervised neural networks

• Model Selection and Evaluation: Cross-validation, Hyperparameter Tuning

• Preprocessing: Data cleaning, Feature Engineering

2. Consistent Interface: It provides a consistent and user-friendly API, making it easy to experiment with different algorithms and techniques without needing to learn new syntax for each.

3. Integration with Other Libraries: Scikit-learn seamlessly integrates with other Python libraries like NumPy, pandas, and Matplotlib, allowing smooth data manipulation, preprocessing, and visualization.

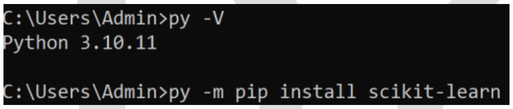
4. Ease of Learning: Its well-documented and straightforward interface makes it suitable for both beginners and experienced machine learning practitioners. It's often recommended for educational purposes due to its simplicity.

5. Performance and Scalability: While focusing on simplicity, scikit-learn also emphasizes performance. It's optimized for efficiency and scalability, making it suitable for handling large datasets and complex models.

6. Community and Development: As an open-source project, scikit-learn benefits from a vibrant community of developers and contributors. Regular updates, bug fixes, and enhancements ensure it stays relevant and up-to-date with the latest advancements in machine learning.

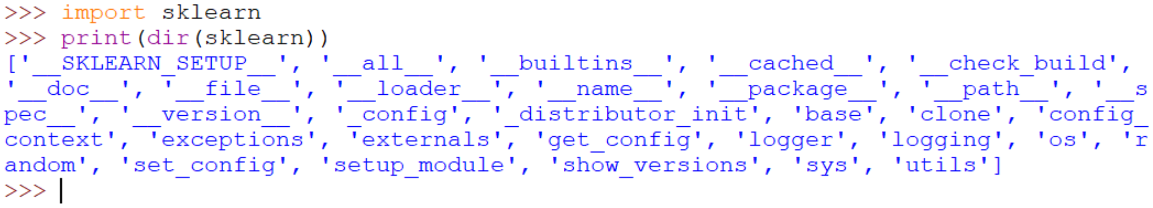
7. Application in Industry and Academia: Scikit-learn's robustness and ease of use have made it a go-to choose in various domains, including finance, healthcare, natural language processing, and more. It's widely used in research and production environments.

To access the command line, click on the Start menu and type “cmd” in the search bar. To install the scikit-learn module type the below command:



```
C:\Users\Admin>py -V
Python 3.10.11

C:\Users\Admin>py -m pip install scikit-learn
```

Output: dir command can be used to find out all the methods supported by sklearn



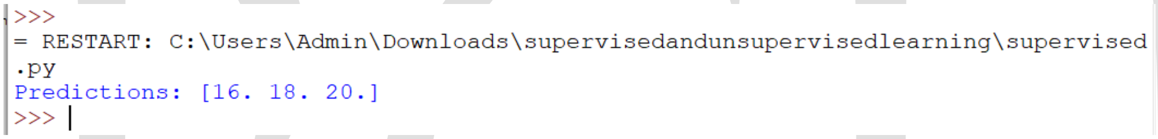
```
>>> import sklearn
>>> print(dir(sklearn))
['__SKLEARN_SETUP__', '__all__', '__builtins__', '__cached__', '__check_build',
'__doc__', '__file__', '__loader__', '__name__', '__package__', '__path__', '__s
pec__', '__version__', '_config', '_distributor_init', 'base', 'clone', 'config_
context', 'exceptions', 'externals', 'get_config', 'logger', 'logging', 'os', 'r
andom', 'set_config', 'setup_module', 'show_versions', 'sys', 'utils']
>>> |
```

Example: linear_example.py

```
from sklearn.linear_model import LinearRegression

# Sample dataset

X_train = [[1], [2], [3], [4], [5]]   # Features

y_train = [2,      4,     6,     8,    10]   # Labels

# Initialize the linear regression model

model = LinearRegression()

# Train the model on the training data
```

```
model.fit(X_train, y_train)

# Predict using the trained model

X_test = [[8], [9], [10]]   # New data to predict

predictions = model.predict(X_test)

# Print predictions

print("Predictions:", predictions)
```

<u>Output:</u>



```
>>>
= RESTART: C:\Users\Admin\Downloads\supervisedandunsupervisedlearning\supervised
.py
Predictions: [16. 18. 20.]
>>> 
```

Labcycle 3. Install and set up scikit-learn and other necessary tools.

- Scikit-learn (Sklearn) is the most useful and robust library for machine learning in Python.
- It provides a selection of efficient tools for machine learning and statistical modeling including classification, regression, clustering and dimensionality reduction via a consistence interface in Python.
- This library, which is largely written in Python, is built upon NumPy, pandas,SciPy and Matplotlib.

<u>Pip upgrade:</u>

Using pip:

- Pip is Python's package manager.
- It usually comes installed with Python.
- Open a terminal/command prompt.

```
Py –m install pip - -upgrade pip
```

Procedure to install scikit-learn and other libraries:

a)Install NumPy :-

```
pip install numpy
```

press Enter. This command will download and install **NumPy**.

b)Install pandas:-

```
pip install pandas
```

press Enter. This command will download and install **pandas**.

c)Install matplotlib:-

```
pip install matplotlib
```

press Enter. This command will download and install **matplotlib**.

d)Install scipy:-

```
pip install scipy
```

press Enter. This command will download and install scipy

e)Install scikit-learn(sklearn):-

```
pip install scikit-learn
```

press Enter. This command will download and install scikit-learn

Verify installations:

Open a IDLE or JUPITER:

```
import numpy
import pandas
import scipy
import sklearn
import matplotlib
print("Numpy version: ")
print(numpy.__version__)
print("Numpy library is successfully installed ")
print("Pandas version: ")
print(pandas.__version__)
print("Pandas library is successfully installed ")
print("scipy version: ")
print(scipy.__version__)
print("scipy library is successfully installed ")
print("sklearn version: ")
print(sklearn.__version__)
print("sklearn library is successfully installed ")
print("matplotlib version: ")
print(matplotlib.__version__)
print("matplotlib library is successfully installed ")
```

Output:

```
Numpy version:
1.26.3
Numpy library is successfully installed
Pandas version:
2.2.0
Pandas library is successfully installed
scipy version:
1.12.0
scipy library is successfully installed
sklearn version:
1.4.0
sklearn library is successfully installed
matplotlib version:
3.8.2
matplotlib library is successfully installed
```

LABCYCLE4: Write a program to Load and explore the dataset of .CVS and excel files using pandas.

```
import pandas as pd
def explore_dataset(file_path):
    if file_path.endswith('.csv'):
        df = pd.read_csv(r"C:/BCA/Machine_Learning/iris.csv")
    elif file_path.endswith('.xlsx'):
        df = pd.read_excel("C:/BCA/Machine_Learning/iris.xlsx")
    else:
        print("Unsupported file format.")
        return
    print("Dataset information:")
    print(df.info())
    print("\n first few rows of the data are")
    print(df.head())
    print("Summary statistics:")
    print(df.describe())
    print("Unique values are: ")
    for column in df.select_dtypes(include='object').columns:
        print(f"{column}: {df[column].unique()}")

file_path = 'iris.csv'
explore_dataset("C:/BCA/Machine_Learning/iris.xlsx ")
```

Output:

```
Dataset information:

<class 'pandas.core.frame.DataFrame'>
RangeIndex: 150 entries, 0 to 149
Data columns (total 6 columns):
 #   Column            Non-Null Count   Dtype
```

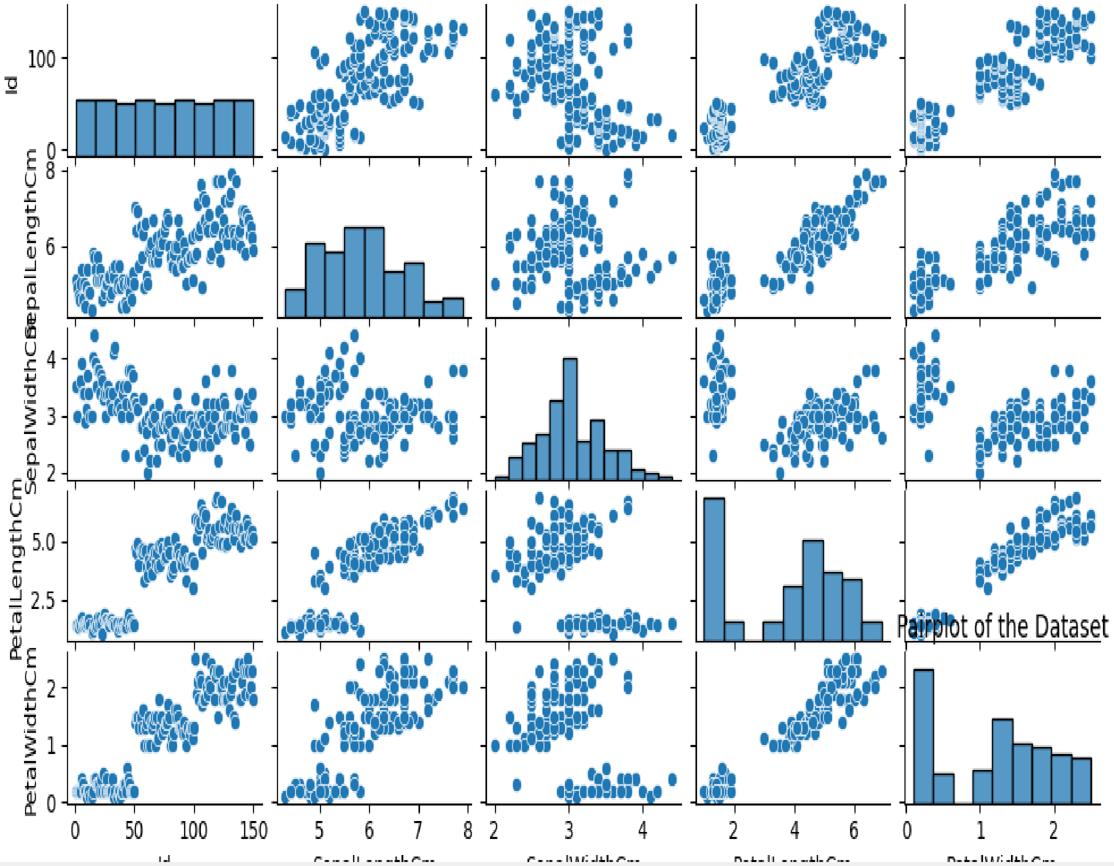
```
---   ------            --------------   -----
 0    Id                              150 non-null      int64
 1    SepalLengthCm   150 non-null      float64
 2    SepalWidthCm    150 non-null      float64
 3    PetalLengthCm   150 non-null      float64
 4    PetalWidthCm    150 non-null      float64
 5    Species            150 non-null      object
dtypes: float64(4), int64(1), object(1)
memory usage: 7.2+ KB
None

 first few rows of the data are
    Id   SepalLengthCm   SepalWidthCm   PetalLengthCm
PetalWidthCm         Species
0     1                5.1                3.5                1.4                0.2
Iris-setosa
1     2                4.9                3.0                1.4                0.2
Iris-setosa
2     3                4.7                3.2                1.3                0.2
Iris-setosa
3     4                4.6                3.1                1.5                0.2
Iris-setosa
4     5                5.0                3.6                1.4                0.2
Iris-setosa

Summary statistics:
                         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

Unique values are:
Species: ['Iris-setosa' 'Iris-versicolor' 'Iris-virginica']
```

LABCYCLE5:
Write a program to Visualize the dataset to gain insights using Matplotlib or Seaborn by plotting scatter plots, bar charts.

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

def visualize_dataset(file_path):
    df = pd.read_csv(r"C:BCA/Machine Learning/ML_LAB/iris.csv")
    sns.pairplot(df)
    plt.title("Pairplot of the Dataset")
    plt.show()
    if df.iloc[:, 0].dtype =='object':
        sns.countplot(x=df.columns[0], data=df)
        plt.title("Bar chart of categorical column")
        plt.xlabel(df.columns[0])
        plt.ylabel("count")
        plt.show()
    else:
        print("No categorical column found to plot bar chart")

file_path = 'iris.csv'
visualize_dataset(r"C:BCA/Machine Learning/ML_LAB/iris.csv")
```

Output:

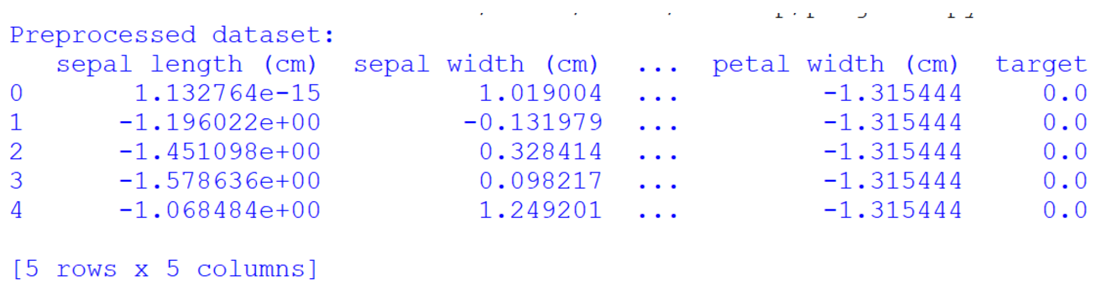

Id
SepalLengthCm
SepalWidthCm
PetalLengthCm
PetalWidthCm
100
0
8
6
4
3
2
5.0
2.5
2
1
0
0
50
100
150
5
6
7
8
2
3
4
2
4
6
0
1
2
Pairplot of the Dataset

LABCYCLE6:

Write a program to Handle missing data, encode categorical variables, and perform feature scaling.

```
import pandas as pd
from sklearn.datasets import load_iris
from sklearn.impute import SimpleImputer
from sklearn.preprocessing import OneHotEncoder, StandardScaler

# Load Iris dataset
iris = load_iris()
iris_df = pd.DataFrame(data=iris.data, columns=iris.feature_names)
iris_df['target'] = iris.target

def preprocess_dataset(df):
  df.iloc[::10, 0] = float('NaN')
  imputer = SimpleImputer(strategy='mean')
  df[df.columns] = imputer.fit_transform(df[df.columns])
  scaler = StandardScaler()
  df[df.columns[:-1]] = scaler.fit_transform(df[df.columns[:-1]])
  return df

preprocessed_df = preprocess_dataset(iris_df)
print("Preprocessed dataset:")
print(preprocessed_df.head())
```

Output:



```
Preprocessed dataset:
   sepal length (cm)  sepal width (cm)  ...  petal width (cm)  target
0       1.132764e-15          1.019004  ...         -1.315444     0.0
1      -1.196022e+00         -0.131979  ...         -1.315444     0.0
2      -1.451098e+00          0.328414  ...         -1.315444     0.0
3      -1.578636e+00          0.098217  ...         -1.315444     0.0
4      -1.068484e+00          1.249201  ...         -1.315444     0.0

[5 rows x 5 columns]
```

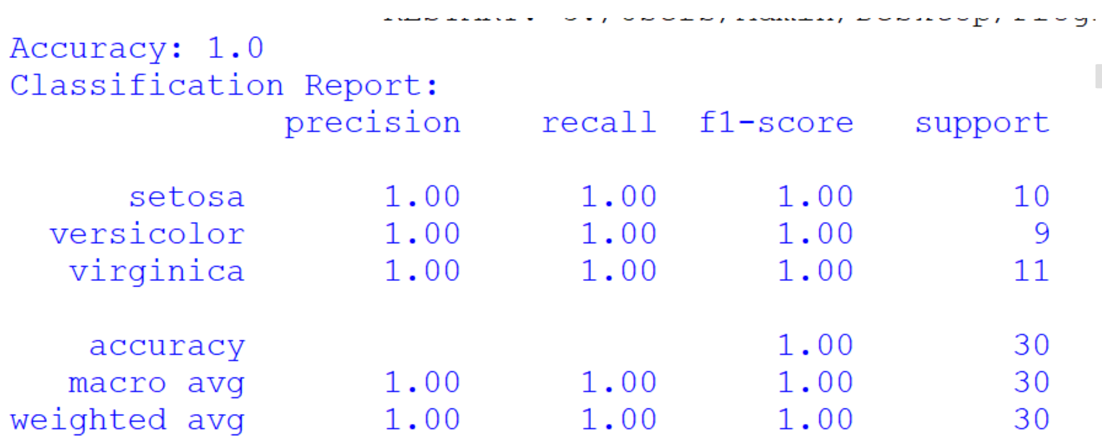
LABCYCLE7:

Write a program to implement a k-Nearest Neighbours (k-NN) classifier using scikit-learn and Train the classifier on the dataset and evaluate its performance.

```
import numpy as np
import pandas as pd
from sklearn.datasets import load_iris
from sklearn.model_selection import train_test_split
from sklearn.neighbors import KNeighborsClassifier
from sklearn.metrics import accuracy_score, classification_report

# Load 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)
# Initialize the k-NN classifier
k = 3 # Number of neighbors
knn_classifier = KNeighborsClassifier(n_neighbors=k)

# Train the classifier
knn_classifier.fit(X_train, y_train)
# Make predictions on the testing set
y_pred = knn_classifier.predict(X_test)
# Evaluate the classifier's performance
accuracy = accuracy_score(y_test, y_pred)
```

```
print("Accuracy:", accuracy)
# Display classification report
print("Classification Report:")
print(classification_report(y_test, y_pred,
target_names=iris.target_names))
```

Output:



```
Accuracy: 1.0
Classification Report:
              precision    recall  f1-score   support

      setosa       1.00      1.00      1.00        10
  versicolor       1.00      1.00      1.00         9
   virginica       1.00      1.00      1.00        11

    accuracy                           1.00        30
   macro avg       1.00      1.00      1.00        30
weighted avg       1.00      1.00      1.00        30
```

LABCYCLE8:

Write a program to implement a linear regression model for regression tasks and Train the model on a dataset with continuous target variables.

```
import numpy as np
import pandas as pd
from sklearn.datasets import fetch_california_housing
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.metrics import mean_squared_error, r2_score

# Load California Housing dataset
california = fetch_california_housing()
X = california.data
y = california.target

# Convert the data to a pandas DataFrame for easier manipulation
california_df = pd.DataFrame(data=X,
columns=california.feature_names)
california_df['target'] = y

# 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)

# Initialize Linear Regression model
linear_regression = LinearRegression()

# Train the model
```

```
linear_regression.fit(X_train, y_train)

# Make predictions on the testing set
y_pred = linear_regression.predict(X_test)

# Evaluate the model's performance
mse = mean_squared_error(y_test, y_pred)
r2 = r2_score(y_test, y_pred)
print("Mean Squared Error:", mse)
print("R-squared Score:", r2)
```

Output:

```
Mean Squared Error: 0.5558915986952425
R-squared Score: 0.5757877060324521
```

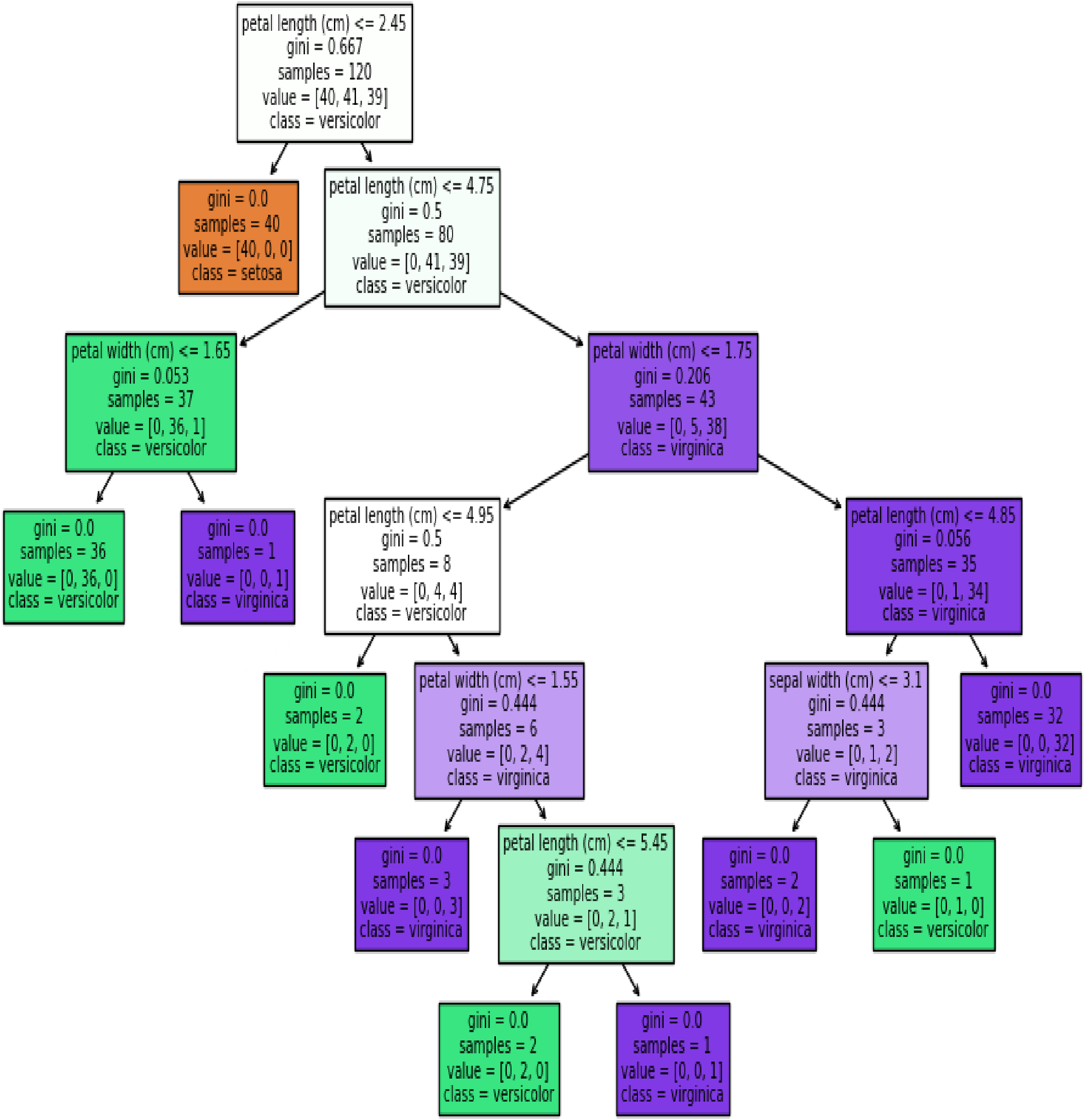
LABCYCLE9:

Write a program to implement a decision tree classifier using scikit-learn and visualize the decision tree and understand its splits.

```
import numpy as np
import pandas as pd
from sklearn.datasets import load_iris
from sklearn.model_selection import train_test_split
from sklearn.tree import DecisionTreeClassifier, plot_tree
import matplotlib.pyplot as plt

# Load 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)

# Initialize Decision Tree classifier
decision_tree = DecisionTreeClassifier()

# Train the classifier
decision_tree.fit(X_train, y_train)
```

```
# Visualize the decision tree
plt.figure(figsize=(12, 8))
plot_tree(decision_tree, feature_names=iris.feature_names,
class_names=iris.target_names, filled=True)
plt.show()
```

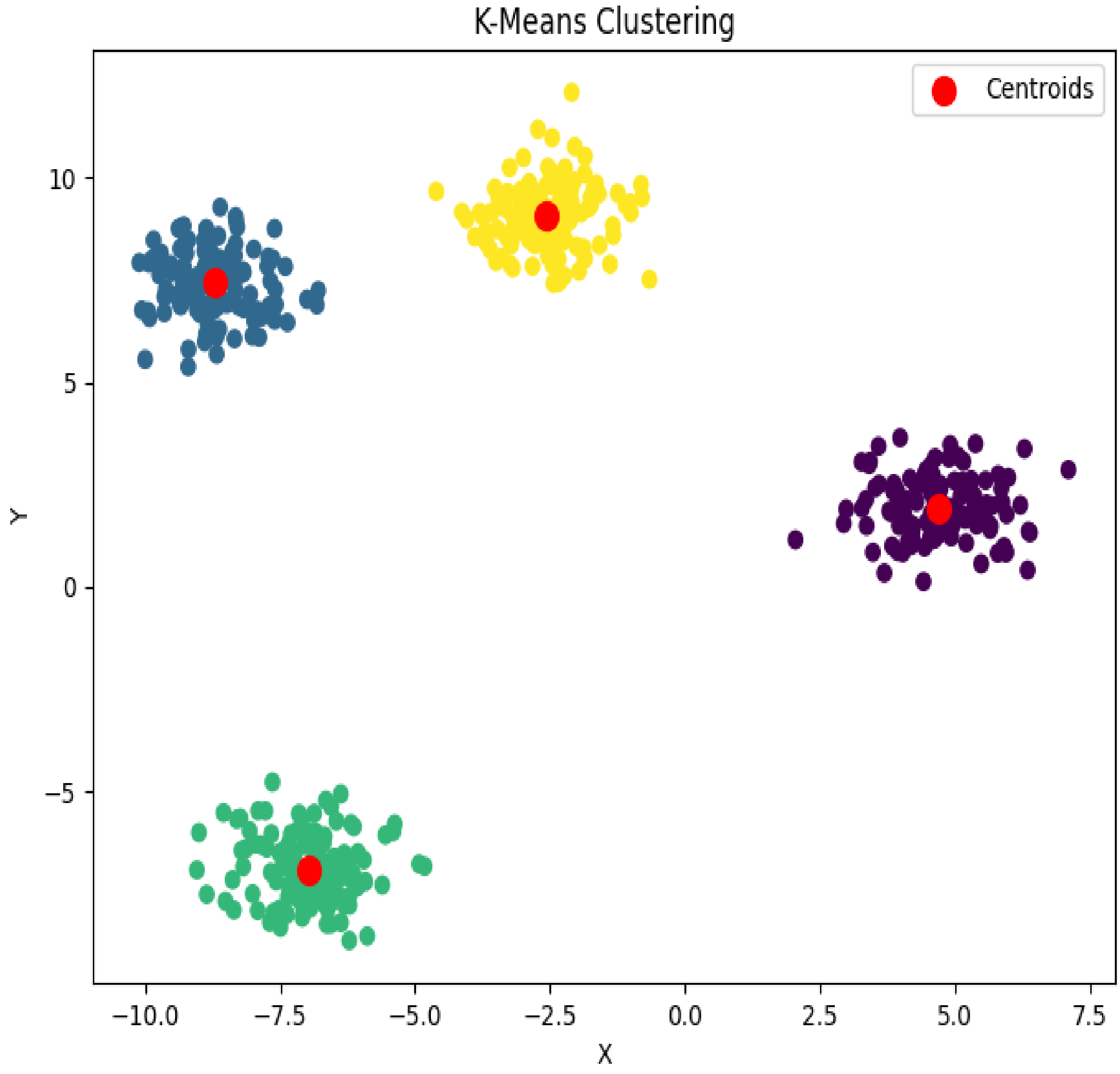
Output:


petal length (cm) <= 2.45
gini = 0.667
samples = 120
value = [40, 41, 39]
class = versicolor
gini = 0.0
samples = 40
value = [40, 0, 0]
class = setosa
petal length (cm) <= 4.75
gini = 0.5
samples = 80
value = [0, 41, 39]
class = versicolor
petal width (cm) <= 1.65
gini = 0.053
samples = 37
value = [0, 36, 1]
class = versicolor
petal width (cm) <= 1.75
gini = 0.206
samples = 43
value = [0, 5, 38]
class = virginica
gini = 0.0
samples = 36
value = [0, 36, 0]
class = versicolor
gini = 0.0
samples = 1
value = [0, 0, 1]
class = virginica
petal length (cm) <= 4.95
gini = 0.5
samples = 8
value = [0, 4, 4]
class = versicolor
petal length (cm) <= 4.85
gini = 0.056
samples = 35
value = [0, 1, 34]
class = virginica
gini = 0.0
samples = 2
value = [0, 2, 0]
class = versicolor
petal width (cm) <= 1.55
gini = 0.444
samples = 6
value = [0, 2, 4]
class = virginica
sepal width (cm) <= 3.1
gini = 0.444
samples = 3
value = [0, 1, 2]
class = virginica
gini = 0.0
samples = 32
value = [0, 0, 32]
class = virginica
gini = 0.0
samples = 3
value = [0, 0, 3]
class = virginica
petal length (cm) <= 5.45
gini = 0.444
samples = 3
value = [0, 2, 1]
class = versicolor
gini = 0.0
samples = 2
value = [0, 0, 2]
class = virginica
gini = 0.0
samples = 1
value = [0, 1, 0]
class = versicolor
gini = 0.0
samples = 2
value = [0, 2, 0]
class = versicolor
gini = 0.0
samples = 1
value = [0, 0, 1]
class = virginica

LABCYCLE10. Write a program to Implement K-Means clustering and Visualize clusters.

```
import numpy as np
import matplotlib.pyplot as plt
from sklearn.datasets import make_blobs
from sklearn.cluster import KMeans

# Generate sample data
X, y = make_blobs(n_samples=500, centers=4, cluster_std=0.8,
random_state=42)

# Create a K-Means clusterer with 4 clusters
kmeans = KMeans(n_clusters=4, random_state=42)

# Fit the data
kmeans.fit(X)

# Get cluster labels
labels = kmeans.labels_

# Plot the data with cluster labels
plt.figure(figsize=(8, 6))
plt.scatter(X[:, 0], X[:, 1], c=labels, cmap='viridis')
plt.scatter(kmeans.cluster_centers_[:, 0], kmeans.cluster_centers_[:, 1],
s=100,
c='red', label='Centroids')
plt.title('K-Means Clustering')
plt.xlabel('X')
plt.ylabel('Y')
plt.legend()
plt.show()
```

Output:


K-Means Clustering
● Centroids
Y
X