VISVESVARAYA TECHNOLOGICAL UNIVERSITY

BELAGAVI-590014

An Internship Report On

"IRIS FLOWER CLASSIFICATION"

Submitted in partial fulfillment of the requirements for the award of the degree of

Bachelor of EngineeringIn

Computer Science and Engineering

Submitted by

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(3LA19CS012)

Internship Carried Out

At

AiROBOSOFT PRODUCTS AND SERVICES LLP

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Our Vision, Your Future.

Department of Computer Science and Engineering,
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2022-2023

Lingaraj Appa Engineering College

Gornalli, Bidar-585403

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CERTIFICATE

This is to certify that the Internship project work entitled **"IRIS FLOWER CLASSIFICATION"** has been successfully carried out by **MD MISBAH MATEEN** a Bonafide work carried out by me at **Lingaraj Appa Engineering College** in partial fulfillment of the requirements for the award of degree in **Bachelor of Engineering in Computer Science and Engineering** of **Visvesvaraya Technological University, Belagavi** during academic year 2022-2023.

GUIDE	HOD	PRINCIPAL

EXTERNAL VIVA

Name of the Examiners	**Signature with Date**
1.	
2	

ACKNOWLEDGMENT

The satisfaction that I feel at the successful completion of, **"IRIS FLOWER CLSSIFICATION**" would be incomplete if I did not mention the people, whose able guidance and encouragement, crowned my efforts with success. It is my privilege to express my gratitude and respect to all those who inspired and helped me in the completion of my project. All the expertise belongs to those listed below.

I express my sincere thanks to our President **Poojya Dr. SharanbaswappaAppaji** and Secretary **Shri. Basavaraj Deshmukh** for providing all the required facilities for the completionof the report

I express my sincere thanks to our beloved Principal **Dr. Vinita . Patil**, LAEC, Bidar for giving me an opportunity to carry out my academic.

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I express my deepest gratitude and thanks to my guide Assistant **Prof. Basavaraj C** LAEC, Bidar for giving his valuable cooperation and excellent guidance in completing the report.

I express my sincere thanks to all the teaching & non-teaching staff of Computer Science and Engineering Department and our friends for their valuable cooperation during the developmentof my report.

Finally, I convey my sweet thanks to my beloved parents who supported me to pursue higher studies and providing me a pleasant environment at home to complete the mini project in time.

DATE:
PLACE:BIDAR

MD MISBAH MATEEN
(3LA19CS012)

DECLARATION

This is to declare that the Dissertation work entitled **"IRIS FLOWER CLASSIFICATION"** is a Bonafide work carried out by **MD MISBAH MATEEN** at **LAEC, Bidar** in the partial fulfillment of the requirements for the award of the degree of **BECHELOR OF ENGINEERING IN COMPUTER SCIENCE AND ENGINEERING OF UNIVERSITY, BELAGAVI,** under the guidance of **Prof. Baswaraj C**, Asst. Professor, LAEC further it is declared to the best of my knowledge that the work reported here in, does not form part of any other thesis or dissertation on the basis of whichany other candidate was conferred a degree or award on earlier occasion.

DATE:
PLACE: BIDAR

MD MISBAH MATEEN
(3LA19CS012)

ABSTRACT

Classification is a supervised machine learning technique which is used to predict group membership for data instances. Neural networks are being introduced to simplify the problem of classification. This model focuses on Iris flower classification using Neural Network. For simplification of classification we will use scikit learn tool kit. This project mainly focuses on the classification of dataset using scikit learn. The problem concerns that the recognition of Iris flower species (setosa, versicolor and verginica) on the basis of the measurements of length and width of sepal and petal of the flower. We can generate classification model by using various machine learning algorithms through training the iris flower dataset and can choose the model with highest accuracy to predict the species of iris flower more precisely. Classification of Iris data set would be detecting patterns from examining sepal and petal size of the Iris flower and how the prediction was made from analyzing the pattern to form the class of Iris flower. By using this pattern and classification, in future upcoming years the unseen data can be predicted more precisely. Artificial neural networks have been successfully applied to problems in pattern classification, function approximations, optimization, and associative memories. The goal here is to model the probabilities of class membership, conditioned on the flower features. In this project we will train our model with data using machine learning to predict the species of iris flower by input of the unseen data using what it has learnt from the trained data.

CONTENTS

LIST OF FIGURES

INTERNSHIP CERTIFICATE

AiRobosoft
Our Vision, Your Future.

Certificate of Internship

TO WHOM IT MAY CONCERN

We believe that our team is our biggest strength and we take pride in hiring the best and the brightest. We were confident that you would play a significant role in the overall success of the venture with AiROBOSOFT.

Upon the recommendation of the Academic Council, AiROBOSOFT Products And Services LLP Reg no: AAS-7147 hereby certify that **MD MISBAH MATEEN(3LA19CS012)** student of Lingaraj Appa Engineering college bidar, has successfully completed **Internship** in the field of **Full Stack Web Development** from 25th August 2022 to 25th September 2022.

At the time of internship, we found the candidate sincere, hardworking and fully devoted. We wish all the success in the future.

Director
(AiROBOSOFT Products and Services)

AiROBOSOFT Products and Services LLP

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CHAPTER 1

ABOUT THE COMPANY

Company Name: AiRobosoft Products and Services

Founder: Syed Asad Ahmed

Airobosoft Products and Services LLP is a Limited Liability Partnership firm incorporated on 28 June 2020. It is registered at the Registrar of Companies, Bangalore. Its total obligation of contribution is Rs. 20,000.

Designated Partners of Airobosoft Products and Services LLP are Syed Sultan Ahmed and Syed Asad Ahmed.

Airobosoft Products and Services LLP Identification Number is (LLPIN)AAS-7147. Its Email address is syedasadahmed44@icloud.com and its registered address is "No 1384, Arkavathy Layout 11th Block, Behind Manyata Tech Park Bangalore North Bangalore Karnataka 560045"

The current status of Airobosoft Products and Services LLP is - Active.

It is a community of Data Scientists, Robotics & Electronics Engineers, experts in Machine Learning, and more, collaborating together to work on fascinating futuristic technologies ensuring safety and ethics and empowering humans to overcome critical challenges.

Artificial intelligence could be one of humanity's most useful inventions. Company research and build safe AI systems that learn how to solve problems and advance scientific discovery for all.

The company's vision is to develop highly autonomous systems that outperform humans at the most economically valuable work that benefits all of humanity. The company attempts to directly build safe and beneficial AI, but will also consider our mission fulfilled if our work aids others to achieve this outcome.

1.1 Services

2.1.1 Airobot

2.1.2 Home Automation

2.1.3 ML & DL Experts

Airobot

AiROBOSOFT has the vision to revolutionize the easy use of robots in research and industry.

From pick and place process to environment sensing and organizing environmental behaviours.

Home Automation

The Home Automation system will control lighting, climate, entertainment systems, and appliances.

It also includes security such as access control and alarm system.

When connected to the internet, home devices inherit the properties of the Internet of Things(IoT).

ML & DL Experts

Getting together a community of aspiring data scientists, embedded, electronics, and machine learning engineers with full stack app developer company aim at solving business, human and environmental issues by supplicating problems with ideas of profitable solutions.

1.2 Courses

Certificate courses in

- Artificial intelligence, Data Science and Machine Learning.
- Robotics, Embedded Systems, and the Internet of things.
- Full Stack Software Development.
- BLOCKCHAIN, Hybrid iOS app development.

1.3 TASK PERFORMED

1.3.1 Overview

This report is a short description of our 4-week internship carried out as a part of the B.E program. The internship was carried out at AiRobosoft Product and Services LLP from 1st September 2022 to 1st October 2022. The project was carried out using python.

1.3.2 Software

Anaconda Navigator

Anaconda Navigator is a desktop graphical user interface (GUI) included in the Anaconda® distribution that allows you to launch applications and easily manage conda packages, environments, and channels without using command-line commands. Navigator can search for packages on Anaconda.org or in a local Anaconda Repository. It is available for Windows, macOS, and Linux.

Installing Anaconda Navigator

1. Download the Anaconda installer.
2. Double-click the installer to launch.
3. Click Next.
4. Read the licensing terms and click “I Agree”.
5. Select an install for “Just Me” unless you’re installing for all users (which requires Windows Administrator privileges) and click Next.
6. Select a destination folder to install Anaconda and click the Next button.
7. Choose whether to add Anaconda to your PATH environment variable. We recommend not adding Anaconda to the PATH environment variable, since this can interfere with other software. Instead, use Anaconda software by opening Anaconda Navigator or the Anaconda Prompt from the Start Menu.
8. Choose whether to register Anaconda as your default Python. Unless you plan on installing and running multiple versions of Anaconda or multiple versions of Python, accept the default and leave this box checked.
9. Click the Install button. If you want to watch the packages Anaconda is installing, click Show Details.

10. Click the Next button.
11. Optional: To install PyCharm for Anaconda, search on the link on a browser https://www.anaconda.com/pycharm. Or to install Anaconda without PyCharm, click the Next button.
12. After a successful installation you will see the "Thanks for installing Anaconda" dialog box
13. If you wish to read more about Anaconda.org and how to get started with Anaconda, check the boxes "Anaconda Individual Edition Tutorial" and "Learn more about Anaconda". Click the Finish button. And verify your installation

Python

What is Python?

Python is a popular programming language. It was created by Guido Van Rossum, and released in 1991.

It is used for:

- Artificial Intelligence
- Machine Learning
- Data Science
- Web Development (server-side)
- Software development, system scripting

What can Python do?

- Python can be used on a server to create web applications.
- Python can be used alongside software to create workflows.
- Python can connect to database systems. It can also read and modify files.
- Python can be used to handle big data and perform complex mathematics.
- Python can be used for rapid prototyping, or for production-ready software development.

Why Python?

- Python works on different platforms (Windows, Mac, Linux, Raspberry Pi, etc).

- Python has a simple syntax similar to the English language.
- Python has a syntax that allows developers to write programs with fewer lines than some other programming languages.
- Python runs on an interpreter system, meaning that code can be executed as soon as it is written. This means that prototyping can be very quick.
- Python can be treated in a procedural way, an object-orientated way, or a functional way.

Jupyter Notebook

What is Jupyter Notebook?

Jupyter Notebook is an open-source, web-based interactive environment, which allows you to create and share documents that contain live code, mathematical equations, graphics, maps, plots, visualizations, and narrative text. It integrates with many programming languages like Python, PHP, R, C#, etc.

Advantages of Jupyter Notebook

- **All in one place:** As you know, Jupyter Notebook is an open-source web-based interactive environment that combines code, text, images, videos, mathematical equations, plots, maps, graphical user interface and widgets to a single document.
- **Easy to convert:** Jupyter Notebook allows users to convert the notebooks into other formats such as HTML and PDF. It also uses online tools and nb viewer which allows you to render a publicly available notebook in the browser directly.
- **Easy to share:** Jupyter Notebooks are saved in the structured text files (JSON format).**Language independent:** Jupyter Notebook is platform-independent because it is represented as JSON (JavaScript Object Notation) format, which is a language-independent, text-based file format. Another reason is that the notebook can be processed by any programming language, and can be converted to any file formats such as Markdown, HTML, PDF, and others.
- **Interactive code:** Jupyter notebook uses **ipywidgets** packages, which provide many common user interfaces for exploring code and data interactivity.

1.3.3 Weekly Work Plan

- **Week 1:**
    1. Started with installing Anaconda Navigator and executed basic programs on Jupyter Notebook.
    2. Introduction to Python datatypes, variables, and Loop statements.
    3. Python String and various types of methods on strings.
    4. Built-in regular expression.
- **Week 2:**
    1. Python list and list comprehensions. And various list methods.
    2. Tuple construction and methods, sets and dictionary, functions, iterators, and generators in python.
    3. Built-in functions, and Object-Oriented programming concepts in python.
    4. Operation on Files, Modules and Packages. Error and exception handling and Database connectivity.
    5. Introduction to Numpy and Pandas. Array creation and avoiding loops using Numpy.
    6. Pandas object: series and dictionary. DataFrame operation and universal functions.
- **Week 3:**
    1. Pythonic missing data & how to handle it using Numpy and Pandas.
    2. Data Visualising in Python. Plotting lines, graphs, and histograms using Pandas.
    3. Introduction to Machine Learning. Procedure to develop projects in ML and its output types.
    4. Linear Regression and example project on Advertising data.
    5. Participated in the Entrepreneurship Meet on Emerging Business Plans & Ideas conducted by the company.

- **Week 4:**
    1. Logistic Regression and example project on Predict Candidate's Admission.
    2. Machine Learning Algorithm uses. An introduction to a Decision tree, Random Forest, and Neural Network algorithms.
    3. Long Short-Term Memory (LSTM) and example project on Stock Market Company future price prediction.
    4. Introduction to various neural networks.
    5. Convolutional Neural Networks and example project on handwritten text recognition.
    6. Feed Forward Neural Networks and example project on Boston housing price prediction.
- **Week 5:**
    1. Started with the Final Project. Project Topic: PyAudio module of Robotic Language Automation.
    2. Function definition to record the speaker's voice and store it as a .wav file.
    3. Function definition to play the recorded audio file if exist, else instruct the user to record voice before playing it.
    4. Created interactive buttons to record, and play the audio using the ipywidgets module.
    5. Integrated the features developed by all the member of group and completed project successfully.
    6. Submitted final project successfully and all members of the team received an internship certificate

CHAPTER 2

INTRODUCTION

2.1 Machine Learning

Machine learning is a process of feeding a machine enough data to train and predict a possibleoutcome using the algorithms. the more the processed or useful data is fed to the machine the more efficient the machine will become. When the data is complicated it learns the data and builds the prediction model. It is state that more the data, better the model, higher will be the accuracy. There are many ways for machine learning i.e. supervised learning, unsupervised learning and reinforcement learning.

2.2 Supervised Learning

In supervised learning machine learning model learns through the feature and labels of the object. Supervised learning uses labeled data to train the model here, the machine knew the features of the object and labels associated with those features or we can say that the supervised learning uses the set of data where the labels or the desired outcomes are already known. It is allowed to prediction about the unseen or future data.

2.3 Classification

Classification is one of the major data mining processes which maps data into predefined groups. It comes under supervised learning method as the classes are determined before examining the data. For applying all approaches to performing classification it is required to have some knowledge of the data. Usually, the knowledge of the data helps to find some unknown patterns. The aim of pattern classification is to building a function that provides output of two or more than two classes from the input feature.

The dataset for this project carried out from the UCI Machine Learning Repository. The Iris flower data set introduced by the British statistician and biologist Ronald Fisher that’s why it is also known by Fisher's Iris data set and it is a multivariate data set. The use of multiple measurements in taxonomic problems as an example of linear discriminant analysis.

CHAPTER 3

SYSTEM REQUIREMENT

3.1 HARDWARE REQUIREMENTS:

3.1.1 Processor – i3

3.1.22 GB RAM

3.1.3 Memory – 5 GB

3.2 SOFTWARE AND LIBRARIES REQUIREMENTS:

3.2.1python 3.7.2

3.2.2Jupyter Notebook

3.2.3sklearn

3.2.4csv

3.2.5numpy

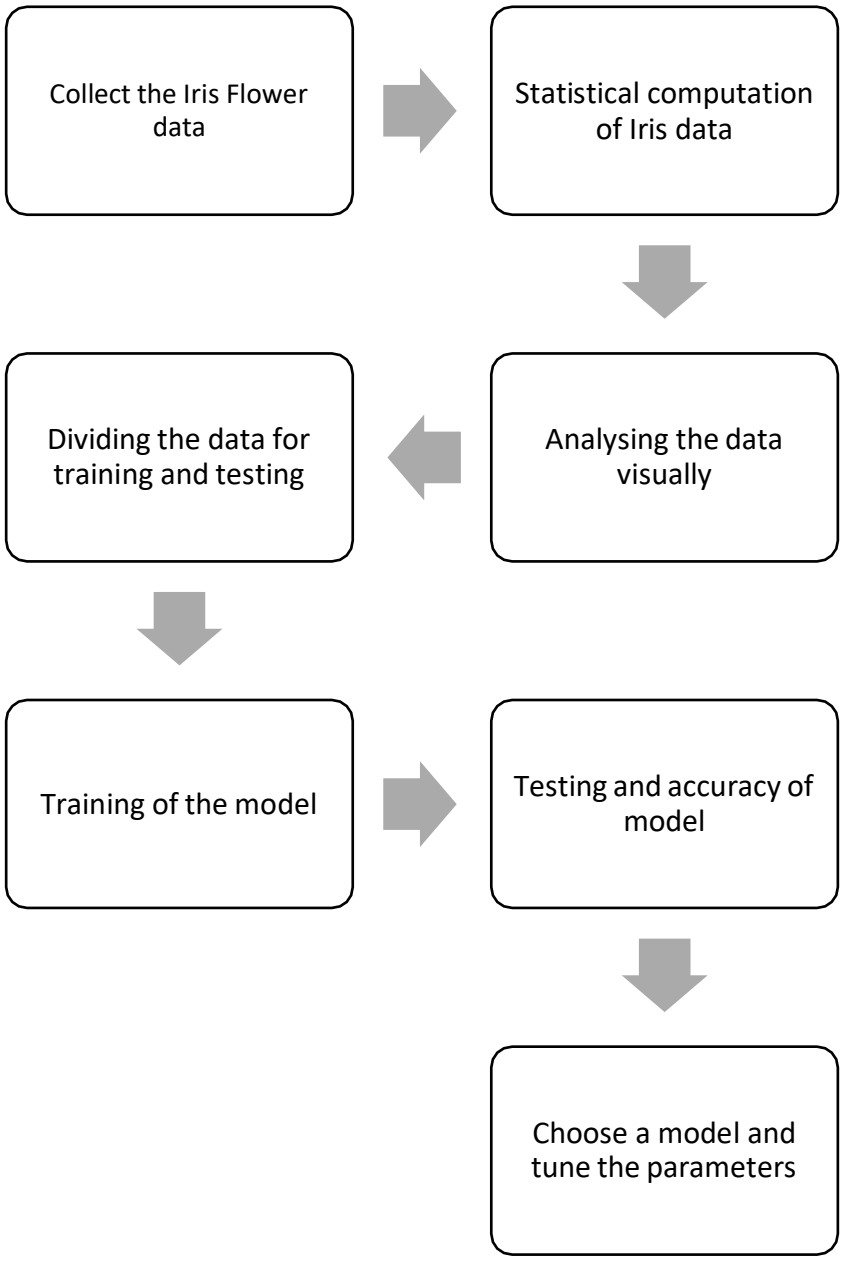
3.2.6pandas

3.2.7matplotlib

CHAPTER 4

PROPOSED MODEL

4.1 BLOCK DIAGRAM



Above block diagram is showing the step-by-step process to predict iris flower species.

Iris Data:

The dataset for this project originates from the UCI Machine Learning Repository. The Iris flower data set or Fisher's Iris data set is a multivariate data set. The data set consists of 50 samples from each of three species of Iris (Iris virginica, Iris versicolor and Iris setosa).

4.1.1 Four features were measured from each sample (in centimeters):

4.1.1.1 Length of the petals

4.1.1.2 Width of the petals

4.1.1.3 Length of the sepals

4.1.1.4 Width of the sepals

Understanding the data:

Iris flower data set contains the observation data with 150 samples. Since the dataframe has four features (Sepal width, sepal length, petal width and petal length) with 150 samples belonging to either of the three target classes. In this step we going into the mathematics of thedataset to find out the standard deviation, mean, minimum value and the four-quartile percentileof the data. Since the dataframe has four features (Sepal width, sepal length, petal width and petal length) with 150 samples belonging to either of the three target classes. In this step we going into the mathematics of the dataset to find out the standard deviation, mean, minimum value and the four-quartile percentile of the data.

Analysing the data visually:

It shows us the visual representation of how our data is scattered over the plane. This method is used in statistical analysis to understand various measures such as mean, median and deviation.

To understand how each feature accounts for classification of the data, we plot the graphs which shows us the correlation with respect to other features. This method helps just to figure out the important features which account the most for the classification in our model.

Dividing the data for training and testing:

The data we use will split into training data and test data. The training set contains a known output and the model learns on this data in order to be generalized to other data later on. We have the test dataset (or subset) in order to test our model's prediction on this subset.

Train the model:

Using some of the commonly used algorithms, we will be training our model to check which algorithm is best suitable for our model. The algorithms that will be using are:

4.1.2Logistic Regression

4.1.3K – Nearest Neighbor (KNN)

4.1.4Random forest

4.1.5Support Vector Machine (SVM)

Choose a model and tune the parameters:

From the above models we will choose a model which will give us the best accuracy. After thatthe parameters will be tuned to get the class of the IRIS flower.

CHAPTER 5

IMPLEMENTATION

5.1 SETUP VIRTUAL ENVIRONMENT OR START JUPYTER NOTEBOOK

Virtual environment helps to keep dependencies between different projects. Its main purpose is to create an isolated environment for python projects. To setup virtual environment we have to follow some steps that are:

1. Open the terminal

2. Setup the pip package manager

3. Create the virtual environment

4. Activate the virtual environment

5. After that install the appropriate libraries (numpy, pandas, etc.) using pip

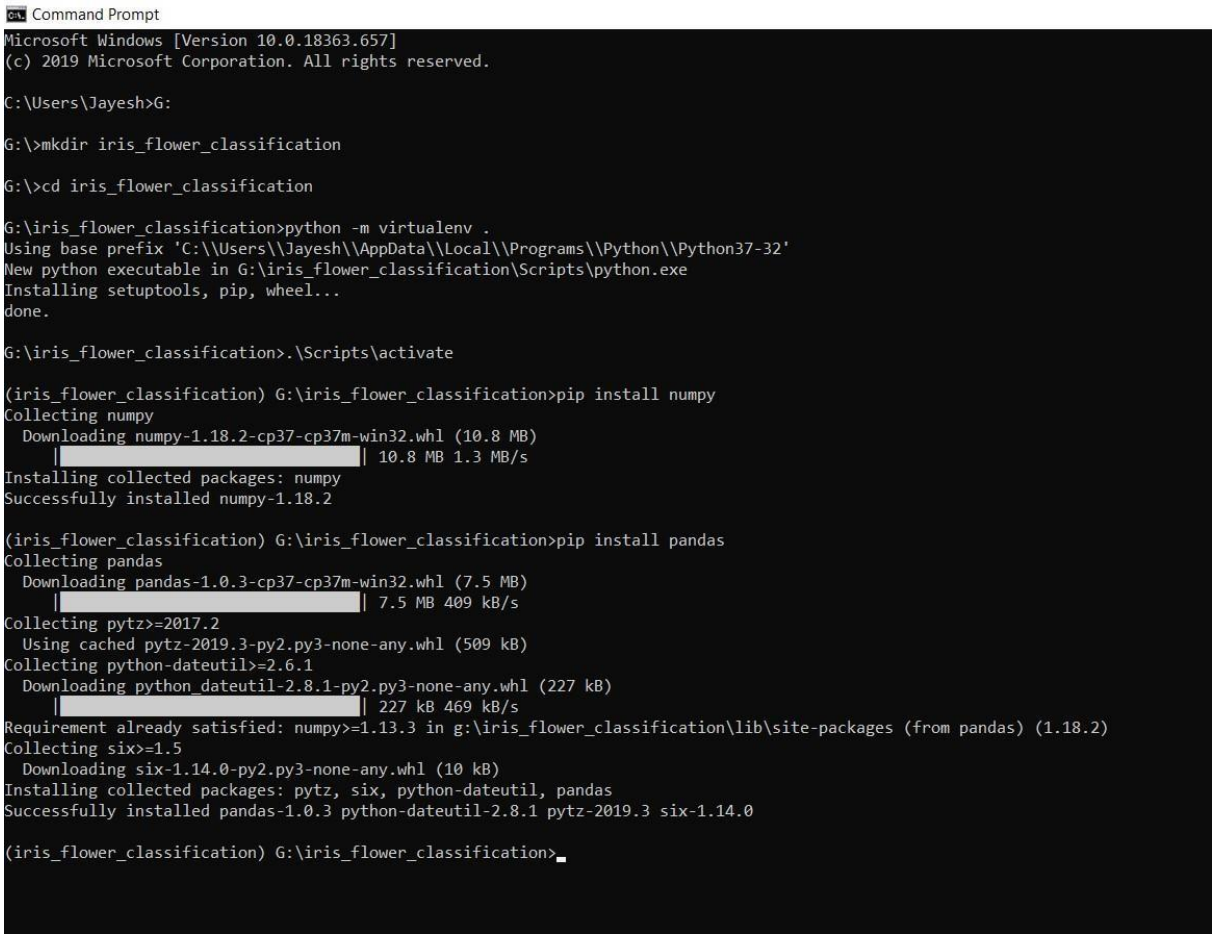


Fig. 5.1 Process for setup virtual environment

5.2 IMPORTING LIBRARIES AND DOWNLOAD THE DATA

The following libraries are required for this project:

```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
from sklearn.linear_model import LogisticRegression
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score
sns.set(color_codes=True)
%matplotlib inline
```

Fig 5.2 Imported Libraries

Here, we are importing numpy, pandas, seaborn, matplotlib and sklearn libraries. Where, numpy is an array processing package which is used in scientific computing with arrays. Pandas is built on the Numpy package and its key data structure is called the DataFrame. DataFrames allow us to store and manipulate tabular data in rows of observations and columns of variables. Seaborn is a library for statistical graphical representation and data visualization which is based on matplotlib. Matplotlib is a visualization library or plotting library used to generate plot, histogram, bar-chart, pie-chart, etc. Scikit-learn provides a range of machine learning algorithms which contains both unsupervised and supervised learning algorithms via a consistent interface in Python.

The iris dataset can be downloaded from the UCI Machine Learning Repository. Characteristics of data set is multivariate. This data set contain four attributes i.e. sepal length, sepal width, petal length, petal width in cm and it also contain three classes i.e. iris setosa, iris versicolour and iris virginica.

The dataset downloaded from the UCI Machine Learning Repository is in the form of CSV (Comma Separated Values) file and the file name is ‘iris.data’and save the file in the same directory as our project contains.

5.3 DATA EXPLORATION

Now we are going to move into data exploration as well as analysis using the iris data. Let’s import our data set using 'pandas' library, which will convert our data into the tabular format from the CSV format. The beauty of using pandas library is just that we can read the csv files. For converted our data into the understandable format we have to add column to the imported dataset which contain the attributes (sepal length, sepal width, petal length, petal
width), it gives heading for the imported data.

```
df=pd.read_csv("iris.data")
df=pd.read_csv("iris.data", header=-1)
column_name=["sepal length","sepal width","petal length","petal width","Iris Setosa"]
df.columns=column_name
df.head()
```

	sepal length	sepal width	petal length	petal width	Iris Setosa
0	5.1	3.5	1.4	0.2	Iris-setosa
1	4.9	3.0	1.4	0.2	Iris-setosa
2	4.7	3.2	1.3	0.2	Iris-setosa
3	4.6	3.1	1.5	0.2	Iris-setosa
4	5.0	3.6	1.4	0.2	Iris-setosa

Table 1: Showing Iris Dataset using pandas LibraryOr we can use seaborn instead of pandas as:

```
iris=sns.load_dataset("iris")
print(iris.head())
```

```
   sepal_length  sepal_width  petal_length  petal_width species
0           5.1          3.5           1.4          0.2  setosa
1           4.9          3.0           1.4          0.2  setosa
2           4.7          3.2           1.3          0.2  setosa
3           4.6          3.1           1.5          0.2  setosa
4           5.0          3.6           1.4          0.2  setosa
```

Table 2: Showing Iris Dataset using seaborn Library

5.4 DATA ANALYSIS

This dataset contains 150 samples Since the dataframe has four features (Petal length, petal width, sepal length and sepal width) with 150 samples belonging to either of the three target classes, and each class has distributed equally.

```
print(iris.groupby("species").size())
```

```
species
setosa        50
versicolor    50
virginica     50
dtype: int64
```

Table 3: Species in Iris Dataset

By using 'df.describe()' we can see the mathematics of the dataset, which helps to find out the standard deviation, mean, minimum value and the four quartile percentile of the data.

```
df.describe()
```

	sepal length	sepal width	petal length	petal width
count	150.000000	150.000000	150.000000	150.000000
mean	5.843333	3.054000	3.758667	1.198667
std	0.828066	0.433594	1.764420	0.763161
min	4.300000	2.000000	1.000000	0.100000
25%	5.100000	2.800000	1.600000	0.300000
50%	5.800000	3.000000	4.350000	1.300000
75%	6.400000	3.300000	5.100000	1.800000
max	7.900000	4.400000	6.900000	2.500000

Table 4: Statistical description of iris dataset

We can analyze some more information about our dataset, that it contains four non-nullcolumns and one object-based column. We can also see memory usage by the iris dataset.

```
print(iris.info())
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 150 entries, 0 to 149
Data columns (total 5 columns):
sepal_length    150 non-null float64
sepal_width     150 non-null float64
petal_length    150 non-null float64
petal_width     150 non-null float64
species         150 non-null object
dtypes: float64(4), object(1)
memory usage: 5.9+ KB
None
```

Fig 5.3 Information of iris dataset

5.5 DATA VISUALIZATION

In the previous section what we gone through is the exploration of all the data where we did some preliminary analysis of the data and get a few of it, but to progress further and to dive into the data a little bit more we are going to do some visualization. Visualization is a great way to develop a better understanding of your data and python and has a lot of great tools for specifically that purpose.

5.5.1 Pair-plot:

As we already import the seaborn so we just have to perform the pair-plot using the iris datasetwe have.To understand how each feature accounts for classification of the data, we can build a pair-plotwhich shows us the correlation with respect to other features.

In the below picture if we look carefully, we can see that all the attributes are plotted against each other and the three different colours shows the distribution of three individual species (setosa, versicolor and verginica). It shows the distinctive relationships between the attributes.

```
sns.pairplot(iris, hue='species', height=3, aspect=1);
plt.show();
```

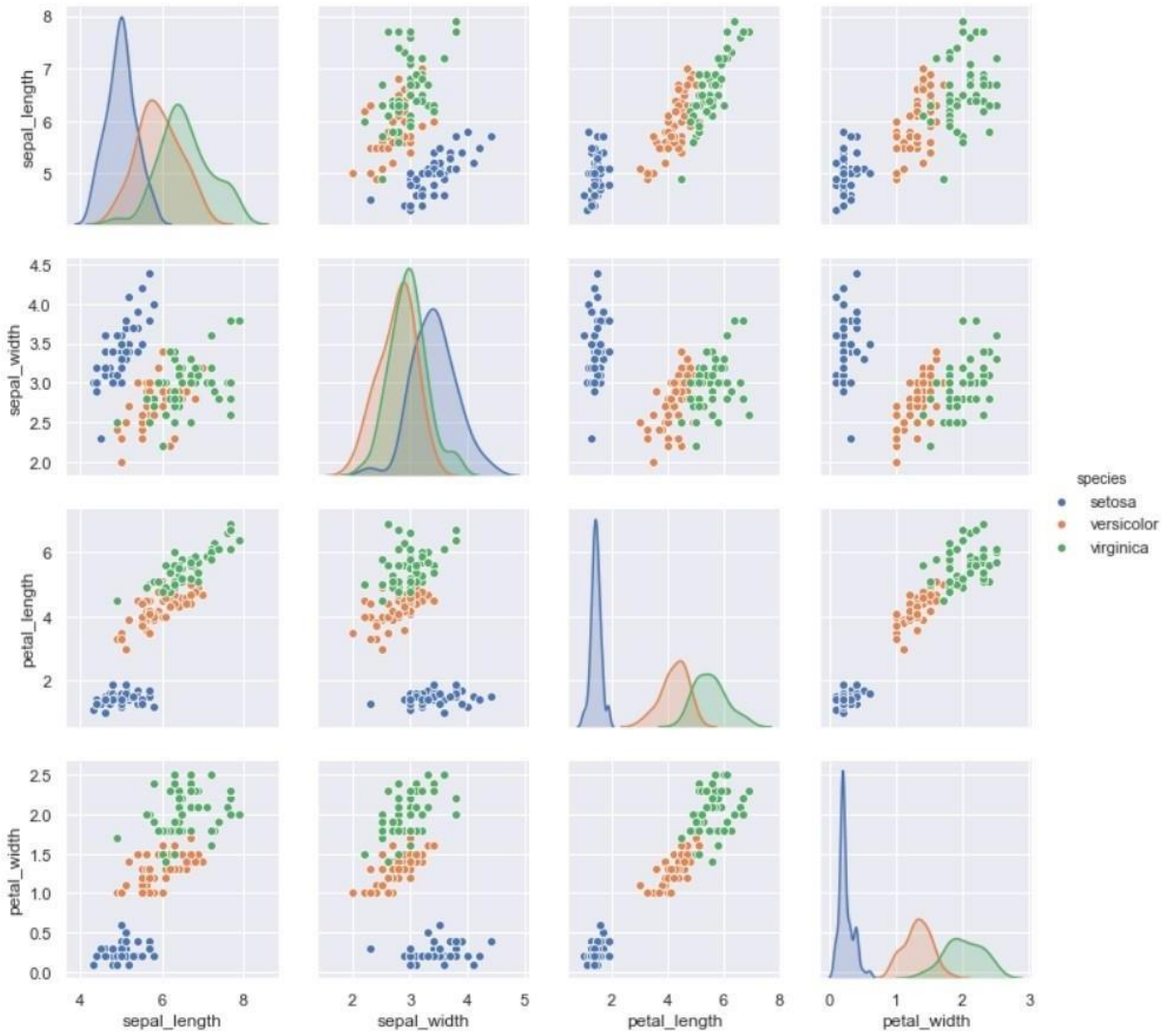


Fig.5.4 Pair-plot

5.5.2 Histogram

Historical representation is basically the pure distribution off all three combined species andfrom this it's not really all that informative because it just tells us overall distribution.

```
iris.hist(edgecolor='red', figsize=(12,8), linewidth=1.2)
plt.show()
```

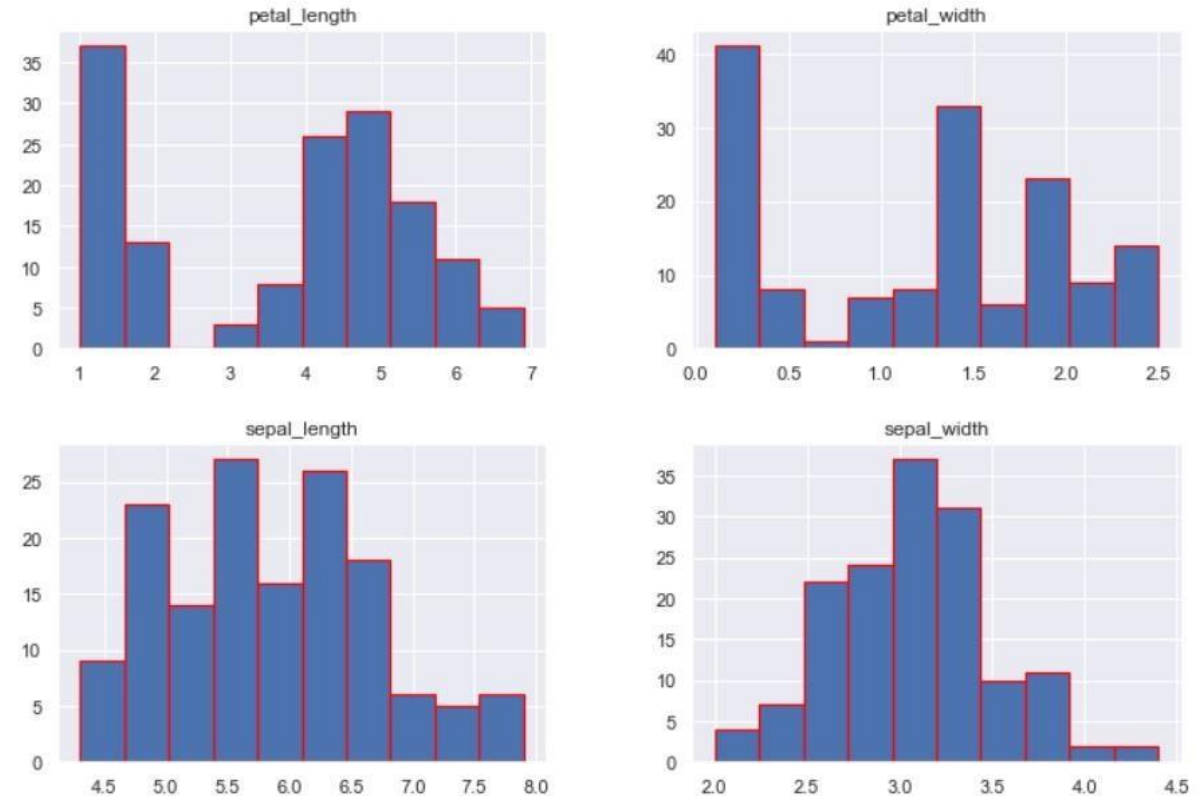


Fig.5.5 Histogram

5.5.3Violin-plot:

Let us look at the violin-plot which is as similar to the box-plot, Violin plot shows us the visualrepresentation of how our data is scattered over the plane. Here we can conclude from the below picture that in sepal length we can see this the distribution in setosa is much smaller

thanthe versicolor and verginica.

In sepal width we can examine that the distribution of setosa is widest and also the longest sepal width and longest petal length in comparisons to the otherattributes.

```
plt.figure(figsize=(12,8));
plt.subplot(2,2,1)
sns.violinplot(x='species', y='sepal_length', data=iris)
plt.subplot(2,2,2)
sns.violinplot(x='species', y='sepal_width', data=iris)
plt.subplot(2,2,3)
sns.violinplot(x='species', y='petal_length', data=iris)
plt.subplot(2,2,4)
sns.violinplot(x='species', y='petal_width', data=iris)
plt.show()
```

Output:

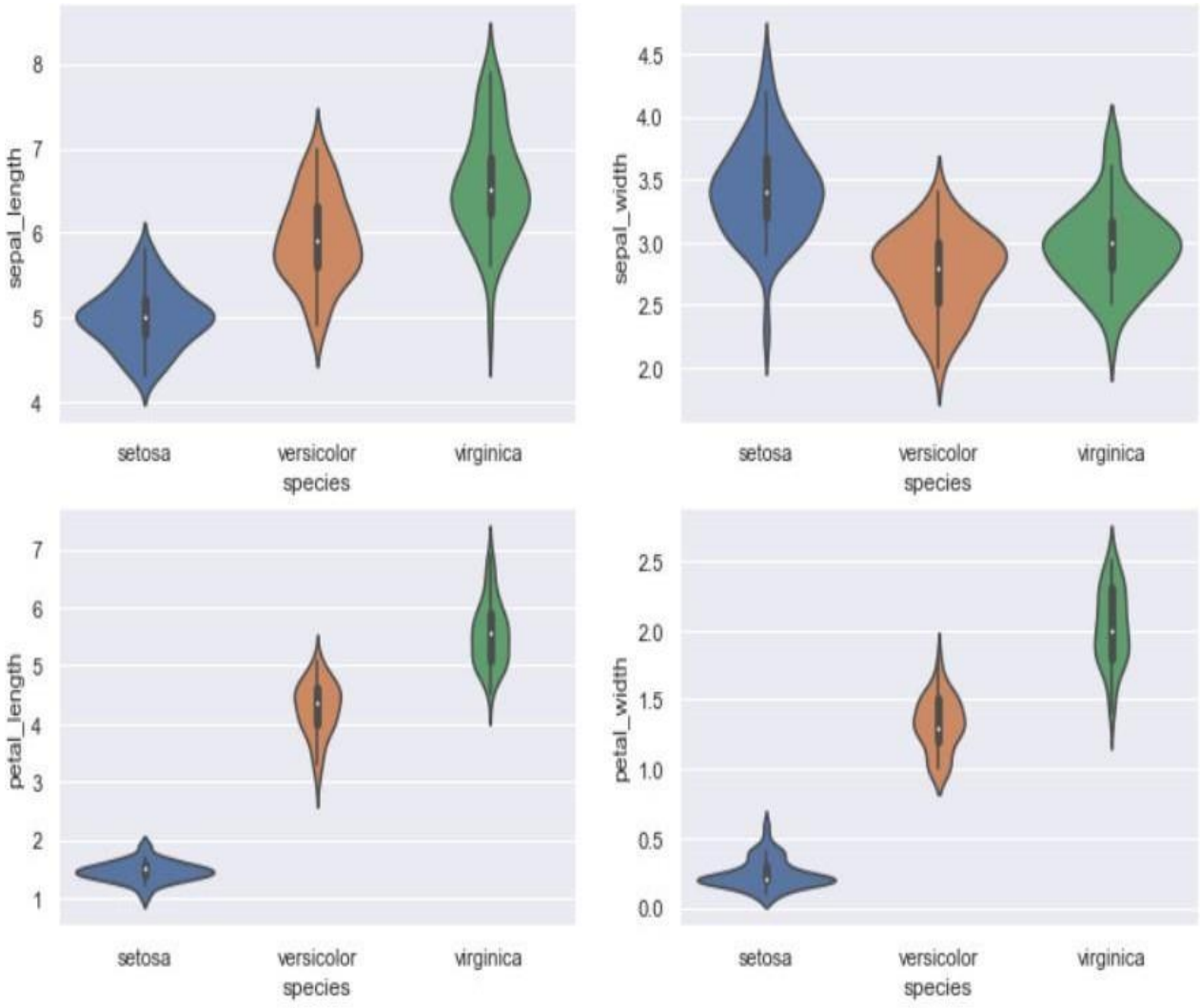


Fig.5.6 Violin-plot

5.5.4Box-plot:

Box plot is a graph which is based on percentile, which divides the data into four quartiles of 25% each. This method is numerously used in statistical analysis to understand various measures such as max, min, mean, median and deviation.

```
iris.boxplot(by='species', figsize=(12,8))
plt.show()
```

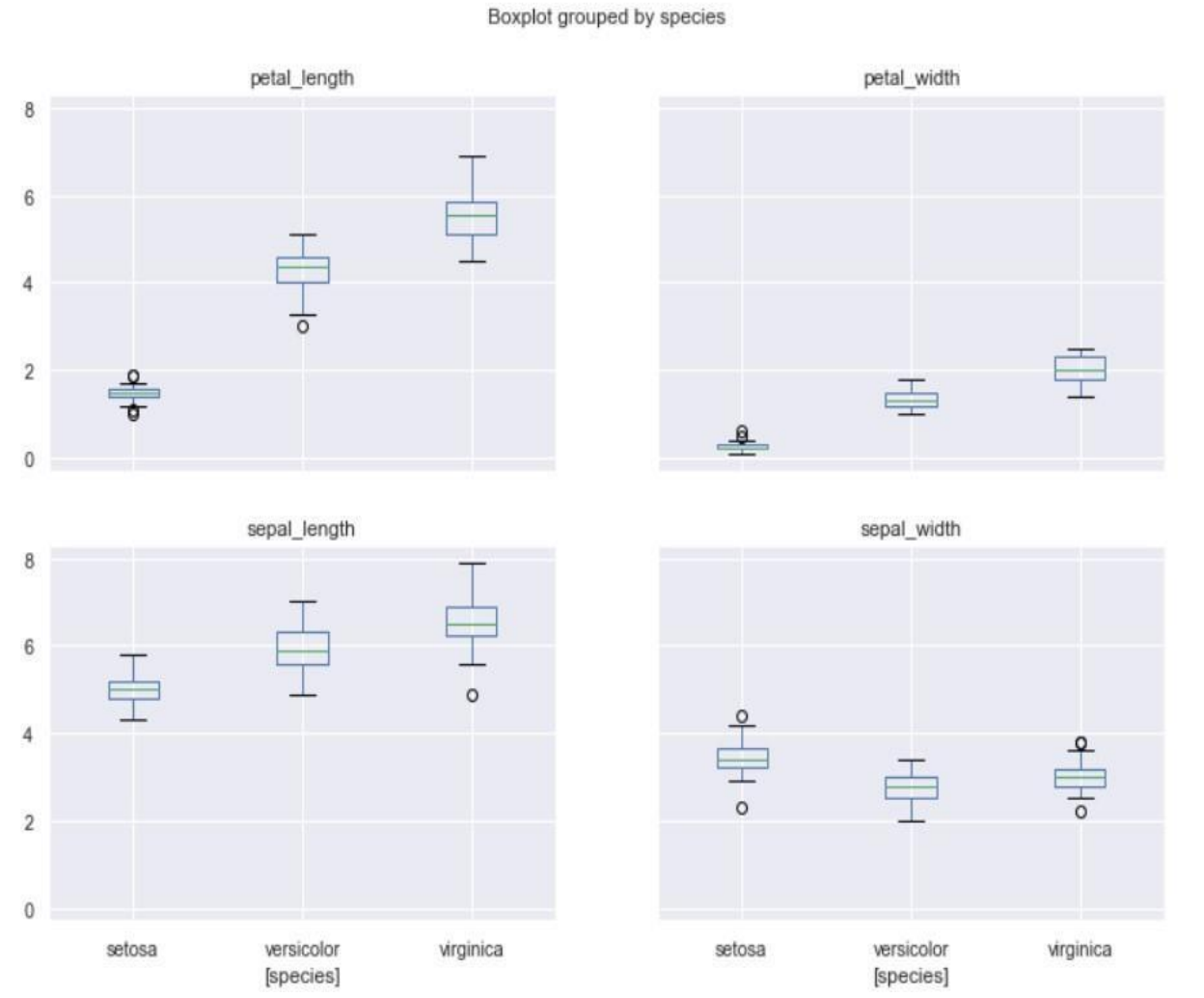


Fig.5.7 Box-plot

5.6 DIVIDING THE DATA FOR TRAINING AND TESTING

When we will understand what the dataset is about, we can start training our model based on the algorithms. First, we have to train our model with some of the samples. Here, we will be using scikit-learn library method called 'train_test_split' which divides our data set into a ratio of 80:20, in which 80% data will be using for training and 20% data will be using for testing. This process can be done by the following code:

```
X = df.iloc[:, :-1]
y = df.iloc[:, -1]
x_train, x_test, y_train, y_test = train_test_split(X, y, test_size=0.20, random_state=0)
```

Fig.5.8 Code for splitting dataset in training and testing dataset

Let's see our test data,

```
print(x_test.head())
```

	sepal length	sepal width	petal length	petal width
114	5.8	2.8	5.1	2.4
62	6.0	2.2	4.0	1.0
33	5.5	4.2	1.4	0.2
107	7.3	2.9	6.3	1.8
7	5.0	3.4	1.5	0.2

Table 5: Test Data

5.7 ALGORITHMS FOR TRAINING THE MODEL

5.7.1 LOGISTIC REGRESSION

Logistic Regression is a type of regression that predicts the probability of occurrence of an event by fitting the appropriate or cleaned data to a logistic function. Like several forms of regression analysis, it makes use of many predictor variables that will be either numerical or categorical.

For instance, the probability that a email received is spam or not might be predicted from knowledge of the type of data or the history of sender. This regression is quite used in several scenarios such as prediction of customer's propensity of purchasing a product or used in market analysis to improve the business and use to predict the unpredictable scenarios.

What is logistic regression?

Logistic Regression, also known as Logit Model or Logit Regression, is a mathematical modelused in statistics to estimate (guess) the probability of an event occurring having been given some previous data. Logistic Regression works with binary data, where either the event happens (True or 1) or the event does not happen (False or 0). So, by giving some feature x it tries to find out whether some event y happens or not. So, y can either be 0 or 1. In the case if the event happens, y is given the value 1. If the event does not happen, then y is given the value of 0. For example, if y represents whether a coin gives head, then y will be 1 if after tossing the coin we get head or y will be 0 if we get tail. This is known as Binomial Logistic Regression. Logistic Regression can also be used when there is use of multiple values for the variable y. This form of Logistic Regression is known as Multinomial Logistic Regression.

Logistic regression is named for the function used at the core of the method, the logistic function. The logistic function, also called the Sigmoid function was developed by statisticians it’s an S-shaped curve that can take any real-valued number and map it into a value between 0 and 1.

Eq. 1

$$\frac{1}{1 + e^{-x}}$$

Where,

e: base of the natural logarithms

x: value that you want to transform via the logistic function

The logistic regression equation has a very similar representation like linear regression. The difference is that the output value being modelled is binary in nature.

$$\hat{y} = \frac{e^{\beta_0+\beta_1 x_1}}{1 + \beta_0 + \beta_1 x_1}$$

or

$$\hat{y} = \frac{1.0}{1.0 + e^{-\beta_0-\beta_1 x_1}}$$

Eq. 2

$\beta 0$: intercept term

$\beta 1$: coefficient for $x1$

^y: predicted output with real value between 0 and 1

```
x = np.linspace(-6, 6, num = 1000)
plt.figure(figsize = (12,8))
plt.plot(x, 1 / (1 + np.exp(-x))); # Sigmoid Function
plt.title("Sigmoid Function");
```

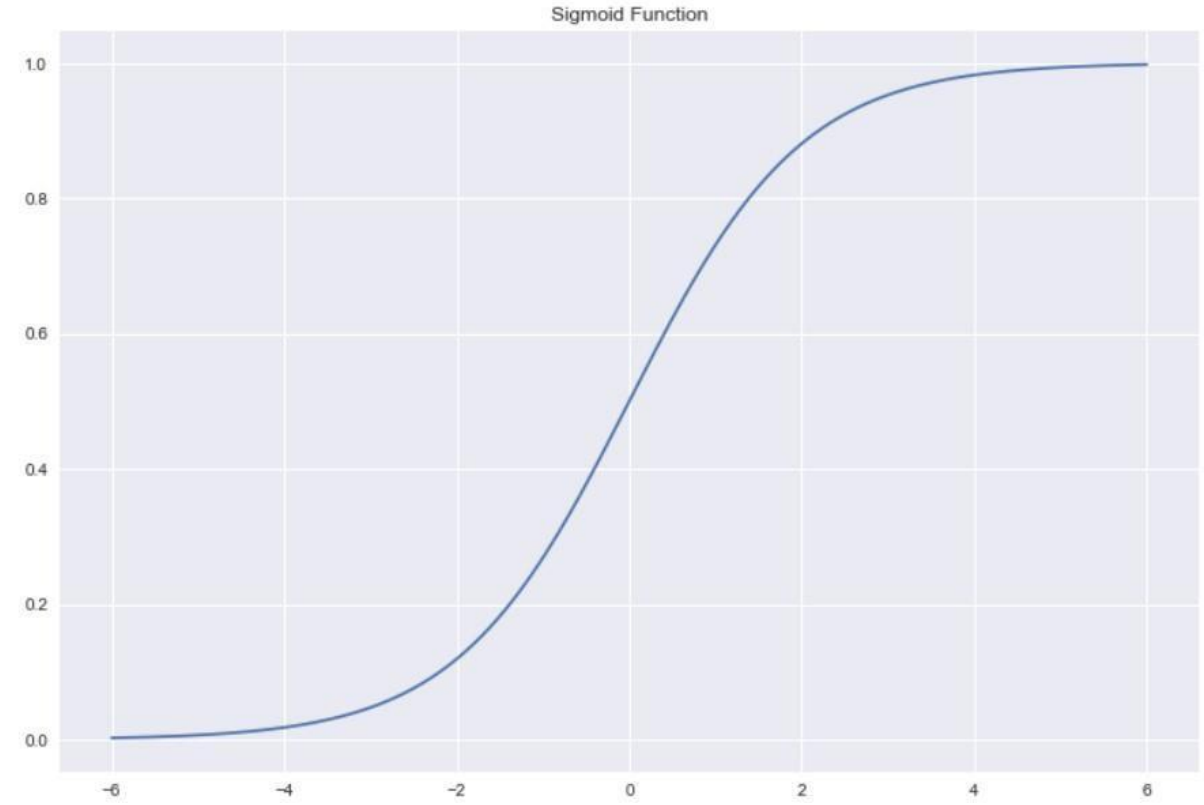


Fig.5.9 Graph of Sigmoid Function

5.7.2K-NEAREST NEIGHBOR ALGORITHM

K-Nearest Neighbor (KNN) is one of the simplest supervised machine learning algorithms mostly used for classification which uses an entire dataset in extreme phase. When prediction is required for unknown data it searches through the entire training dataset for k more similar instances and the data with the most similar instance is finally returned as the prediction.

What is KNN Algorithm?

K-Nearest Neighbor is an algorithm which stores every accessible case and characterizes the new cases dependent on the component similarity measure or similarity features. We can say that if we are similar to our neighbors then we are one of them. For example, if apple looks most similar to banana, orange or melon rather than a monkey, rat or a cat then most

likely apple belongs to the group of fruits.

But in-general KNN is using such application where you're looking for similar items i.e. when the task is some form of fine items similar to this one then you call the search as a KNN search.

Let's see the example of scenarios that is used in the industry:

So let's see the industrial application of KNN algorithm starting with recommender system, thebiggest use case of KNN search is a recommender system, this recommender system is like anautomated form of a shop counter person, today when you're asking for a product not only shows you the product but also suggest you or displays you relevance set of products which are related to the item you're already interested in buying this KNN algorithm is applied to recommending products like an Amazon or a recommending media like in case of Netflix or Today's almost all of us must have used Amazon for shopping so just for a knowledge, more than thirty five percent of Amazon dot com's revenue is generated by its recommendation engine and so what's the strategy the Amazon uses recommendation as a targeted marketing tool in both the email campaigns and on most of its website pages. Amazon will recommend many products from different categories based on what we are browsing and it will pull those products in front of us which are likely to buy like the frequently bought together option that comes at the bottom of the product page to tempt us into buying the combo well this recommendation has just one main goal that is increase average order value by providing product suggestions based on items in the shopping cart well based on the product they're currently looking out on site.

What is K in KNN Algorithm?

In K-Nearest Neighbor, K denotes the number of nearest neighbors which are voting for the class of the new data or the testing data. For example, if K=1 then the testing data are given thesame label as a close to this example in the training set, similarly if K=3 or more the labels of the three closest classes are checked and most common label are assigned to the testing data.

As we can see in figure the value of K increases decision region gets smoother. If K=1 then there will be the case of overfitting as it takes only one neighbor. Most of the value of K lies between 3-10 to generate accurate result.

K = Number of Nearest Neighbors

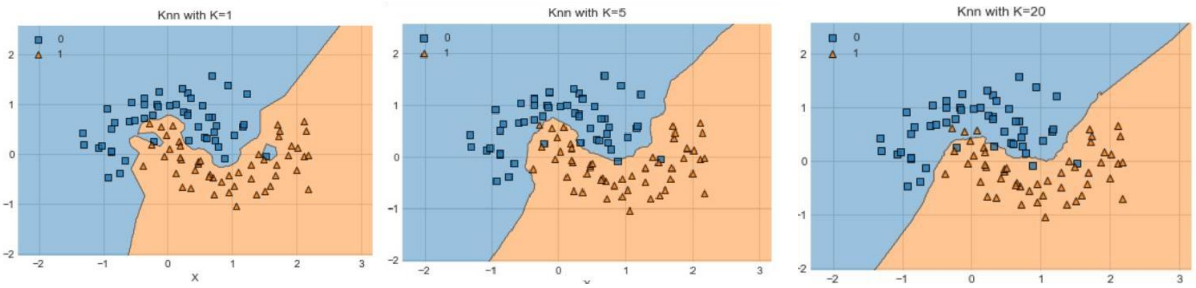


Fig.5.10 Decision Region graph

KNN algorithm is based on feature similarity choosing the right value of K is a process called parameter tuning and is important for better accuracy. There is no particular method for findingthe value of K but for finding k we could keep some points in our mind like K shouldn't be too big, if it's too big then it's going to take forever to process so this going to run into processing issues and resources issues. To prevent from these issues there are some methods to choose a value of K:

5.7.2.1 Sqrt(n), where n is the total number of data points,

5.7.2.2 Odd value of K is selected to avoid confusion between two classes of data,

5.7.2.3 There is another way to choose the value of K i.e. cross-validation, in this way take the small portion of training dataset and call it a validation dataset and then use the different values of K to choose the best performance on the validation set and then choose that value of K to minimizing the validation error.

How does KNN algorithm Work?

In the given below fig. there is blue and orange point on a graph so these blue points belong to class A and orange ones belong to class B. Now we can see a new point in the form of star andour task is to predict whether this new point belongs to class A or it belongs to class B. So to start the prediction the very first thing that we have to do is to select the value of K, as we know K in KNN algorithm refers to the number of nearest neighbors that you want to set, for examplein this case take K equal to three.

KNN uses least distance measures, So when we calculate the distance we'll get one blue and two orange points which are closest to the star now since in this case as we have a majority of orange points so we can say that for K equal to three the star belongs to class B. all we can see that the star is more similar to the orange points.

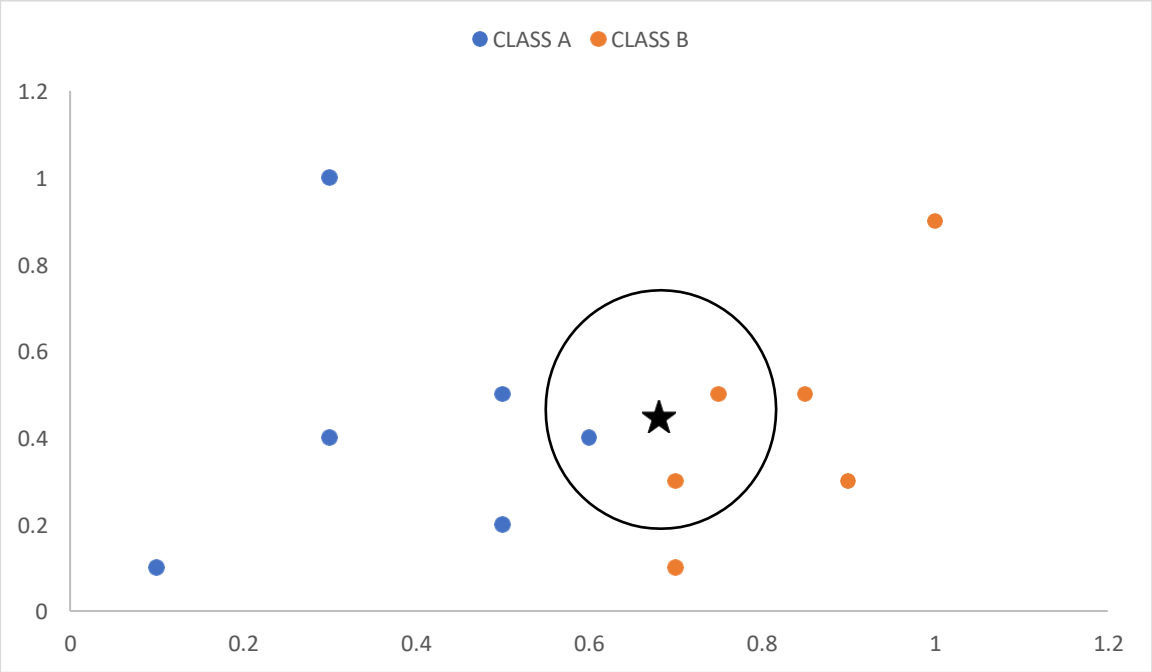


Fig 5.11 Graph of 3- Nearest Neighbor

Mathematics of KNN algorithm

There are different types of data and similarity measures are dependent on that. The Euclidean distance can be used for real-valued data. Hamming distance can be used for other types of data such as binary or categorical data. The average of the predicted attribute may be returned in the case of regression problems. The most prevalent class may be returned in the case of classification.

Euclidean Distance

Euclidean distance is defined as the square root of the sum of difference between the new point x and existing point y. KNN algorithm use the Euclidean Distance to find the K number of nearest neighbors.

Eq.3

$$\text{Euclidean distance} = \sqrt{\sum_{i=1}^{k}(x_i - y_i)^2}$$

Manhattan Distance

Manhattan distance has used to calculate the distance between real vector using sum of their absolute difference.

$$\text{Manhattan distance} = \sqrt{\sum_{i=1}^{k} |x_i - y_i|}$$

Eq. 4

KNN is called as a lazy learner. KNN as a classification is a very simple algorithm but that's not the reason why it is called lazy learner. KNN is a lazy learner because it doesn't have a discriminative function from the training data but what it does, it memorizes the training data.There is no learning phase of the model and all of the work happens at the time of prediction is requested that's why KNN is referred as a lazy learner algorithm.

5.7.3RANDOM FOREST ALGORITHM

Random forest or random decision forest is an ensemble classifier that operates by constructing multiple decision trees models during the training phase. Ensemble models combines the decision from multiple models to choose the result as the final decision.

What is Random Forest?

Random forest is a supervised machine learning algorithm used for classification. In this the trees are trained on subsets which are being selected as random therefore this is called randomforest. So, random forest is the collection or an ensemble of decision trees. The whole dataset is used in the decision tress with considering all features but in random forest only the subset of dataset is selected at random and the particular number of features are selected at random, that is how the random forest is built upon. Number of decision trees will be grown and each

decision tree will result into certain final outcome and random forest just collect results of all the decision trees and the decision of the majority of the trees will be the final result.

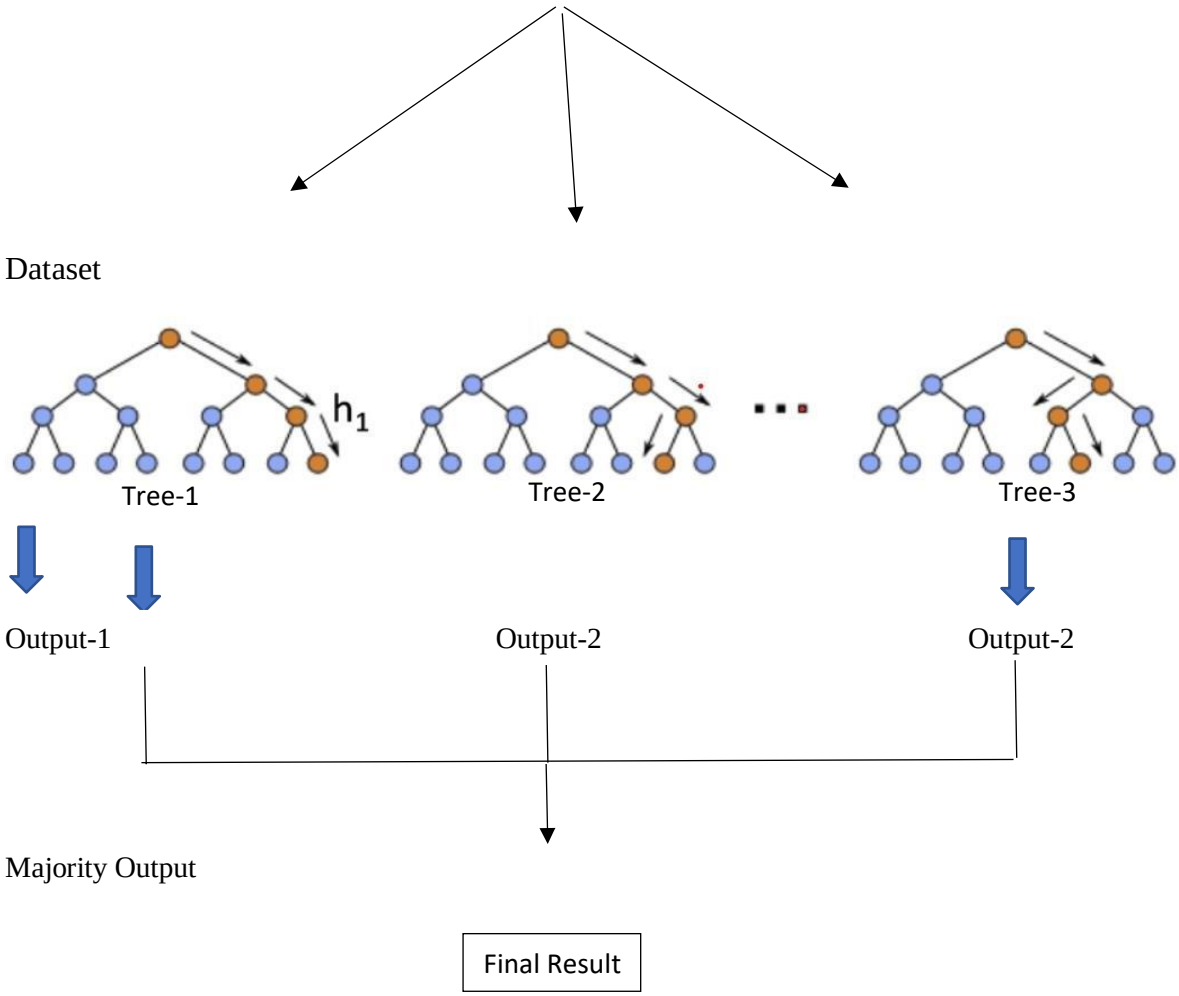


Fig 5.12 Working Diagram of Random Forest

Random Forest is a versatile algorithm capable of performing both regression and classification. Random Forest has many benefits like

- It uses the multiple trees which reduce the risk of overfitting
- Random Forest has high accuracy that runs efficiently on large database.
- Random Forest algorithm can also estimate missing data. Random Forest can maintain accuracy when a large proportion of data is missing.

What is decision tree?

Decision tree builds classification models in the form of a tree structure. Decision tree splits the entire dataset in the structure of a tree and it makes decision at every node hence called decision tree. Decision Tree has some important terms which are:

Entropy: Entropy is a measure of randomness or unpredictability in the data set.

Entropy for one attribute-

$$(T) = \sum_{i=1}^{c} -p_i \log_2 p_i$$

Eq.5

Entropy for two attributes-

$$E(T, X) = \sum_{c \in X} P(c) E(c)$$

Eq.6

Information gain: Information gain is the measure of the decrease in entropy after a dataset is split.

$$Gain(T, X) = Entropy(T) - Entropy(T, X)$$

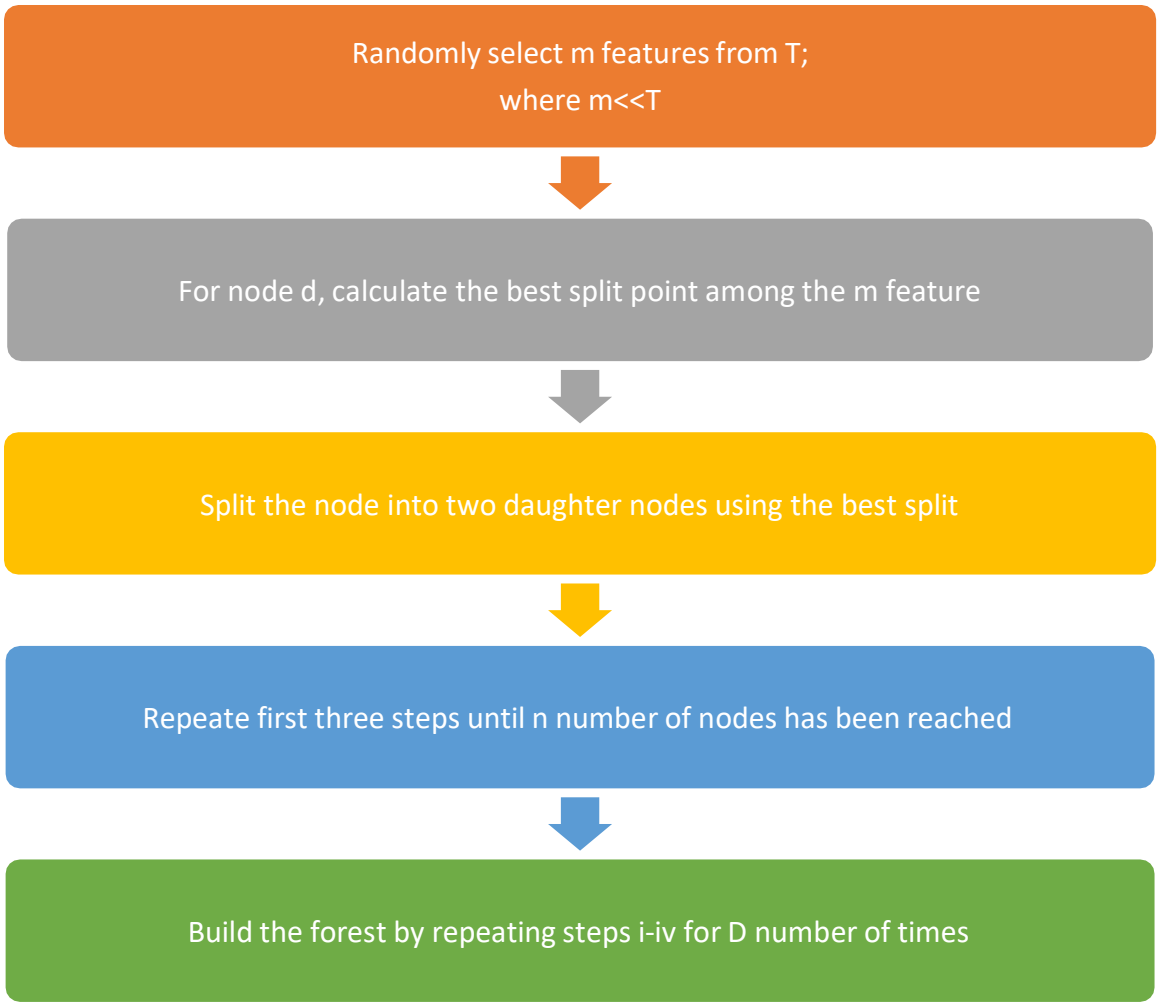
Eq.7

Leaf Node: Final decisions or classification results of a tree are known as leaf node.

Decision Node: Node which has two or more branches in decision tree.

Root Node: The top most node in decision tree is the root node.

How Random Forest Algorithm works?



T: number of features

D: number of trees to be constructed V: output; the class with highest vote

5.7.4SUPPORT VECTOR MACHINE ALGORITHM

A support vector machine abbreviated as SVM was first introduced in the 1960's and late an improvised in the 1990's. SVM is supervised learning machine learning classification algorithm that has become extremely popular nowadays owing to its extremely efficient results so SVM is implemented in a slightly differently than other machine learning algorithms it is capable of performing classification and regression and outlier detection as well.

What is Support Vector Machine?

Support vector machine is a discriminative classifier that is formally designed by a separativehyperplane. It is a representation of examples as points in space that are mapped so that the points of different categories are separated by a gap as wide as possible. SVM does not directly provide probability estimates these are calculated using five-fold cross validation. Five-fold cross validation means the dataset will divided randomly into 5 subsets and then take a subsetfor use as a test set and use remaining subgroups as a training set, then fit a model on the training set and evaluate the score, this will happen until each subset one-by-one considered asa test-set.

The main objective of support vector machine is to separate the given data of different classesby a line (hyperplane) in the best possible way. The nearest points of classes from the hyperplane is known by support vectors. There can be many hyperplanes that will separate the classes, so to choose the appropriate hyperplane SVM algorithm find the nearest points to the hyperplane of both the classes and check the distance between the hyperplane and support vectors. Here, this distance is known by margin. SVM algorithm selects the hyperplane which gives the maximum margin.

In the below figure in Graph-A we can see that there are two lines blue and green. It is clearlyseen that blue is placed in the space in which the support vectors give maximum margin fromthe blue line therefor blue line will selected as a hyperplane.

Graph A

Graph B

Fig 5.13 Select hyperplane

The distribution of the data can be critical means data will not always be separated in linear form; it can be inseparable in linear plane. So, to separate this type of data there is a trick in SVM i.e. kernel. Kernel is used to transform the input in higher dimensional space so, the separation between the classes can be easy.

What is SVM kernel?

SVM Kernels is basically used to add more dimensions to a lower dimensional space to make it is easier to separate the data. It converts the linearly inseparable problem in linearly separable problem by adding more dimensions using the kernel. a support vector machine is implementedin practice by kernel, the kernel helps to make a more accurate classifier. In the below figure itis shown that to separate the classes it is mandatory to add one more dimension. So, the z-axisis added to the graph to separate the classes.

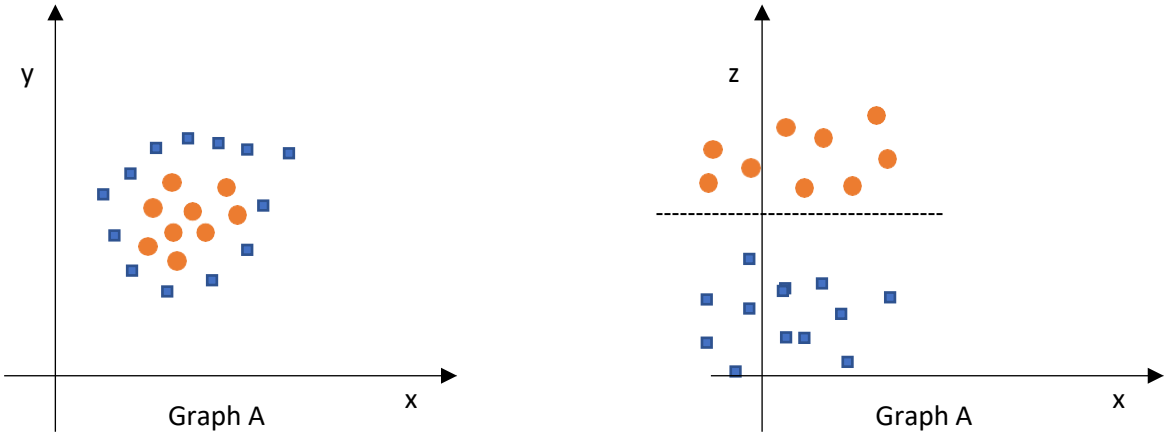


Fig 5.14 Add dimension to separate the classes

There are three types of kernels:

1. Linear Kernels: A linear kernel can be used as a normal dot product between any two given observations.
2. Polynomial Kernels: It is a generalized form of linear kernels. It can distinguish curved and non-linear input space as well.
3. Radial Basis Function Kernel: It is commonly used in SVM classification, it can map the space in infinite dimensions.

5.8 TRAINING OF THE MODEL

For training of the data fit the 80% trained data into the model. By the below codes we can train our data.

By Logistic regression

```
model = LogisticRegression()
model.fit(x_train, y_train)
```

By K-Nearest Neighbor Algorithm

```
from sklearn.neighbors import KNeighborsClassifier
model_1 = KNeighborsClassifier(n_neighbors=5)
model_1.fit(x_train, y_train)
```

By Random Forest Algorithm

```
from sklearn.ensemble import RandomForestClassifier
model_2 = RandomForestClassifier(n_estimators=5)
model_2.fit(x_train, y_train)
```

By Support Vector Machine Algorithm

```
from sklearn.svm import SVC
model_3 = SVC(kernel='linear')
model_3.fit(x_train, y_train)
```

Fig 5.15 Code for train the model

5.9 PREDICT THE DATA AND ACCURACY OF THE MODELS

In this step we will predict iris species of our test data and also find the iris species of unknowndata i.e. data out of the box or can say that, data outside the taken dataset based on what it haslearnt in previous step and get the result.

For test data:

```
predictions = model.predict(x_test)
print(predictions)
```

```
['Iris-virginica' 'Iris-versicolor' 'Iris-setosa' 'Iris-virginica'
 'Iris-setosa' 'Iris-virginica' 'Iris-setosa' 'Iris-versicolor'
 'Iris-versicolor' 'Iris-versicolor' 'Iris-virginica' 'Iris-versicolor'
 'Iris-versicolor' 'Iris-versicolor' 'Iris-versicolor' 'Iris-setosa'
 'Iris-versicolor' 'Iris-versicolor' 'Iris-setosa' 'Iris-setosa'
 'Iris-virginica' 'Iris-virginica' 'Iris-setosa' 'Iris-setosa'
 'Iris-virginica' 'Iris-setosa' 'Iris-setosa' 'Iris-versicolor'
 'Iris-versicolor' 'Iris-setosa']
```

```
KNN_predictions = model_1.predict(x_test)
print(KNN_predictions)
```

```
['Iris-virginica' 'Iris-versicolor' 'Iris-setosa' 'Iris-virginica'
 'Iris-setosa' 'Iris-virginica' 'Iris-setosa' 'Iris-versicolor'
 'Iris-versicolor' 'Iris-versicolor' 'Iris-virginica' 'Iris-versicolor'
 'Iris-versicolor' 'Iris-versicolor' 'Iris-virginica' 'Iris-setosa'
 'Iris-versicolor' 'Iris-versicolor' 'Iris-setosa' 'Iris-setosa'
 'Iris-virginica' 'Iris-versicolor' 'Iris-setosa' 'Iris-setosa'
 'Iris-virginica' 'Iris-setosa' 'Iris-setosa' 'Iris-versicolor'
 'Iris-versicolor' 'Iris-setosa']
```

Fig 5.16 Code for predictions of test data

```
SVM_predictions = model_3.predict(x_test)
print(SVM_predictions)
```

```
['Iris-virginica' 'Iris-versicolor' 'Iris-setosa' 'Iris-virginica'
 'Iris-setosa' 'Iris-virginica' 'Iris-setosa' 'Iris-versicolor'
 'Iris-versicolor' 'Iris-versicolor' 'Iris-virginica' 'Iris-versicolor'
 'Iris-versicolor' 'Iris-versicolor' 'Iris-versicolor' 'Iris-setosa'
 'Iris-versicolor' 'Iris-versicolor' 'Iris-setosa' 'Iris-setosa'
 'Iris-virginica' 'Iris-versicolor' 'Iris-setosa' 'Iris-setosa'
 'Iris-virginica' 'Iris-setosa' 'Iris-setosa' 'Iris-versicolor'
 'Iris-versicolor' 'Iris-setosa']
```

```
RF_predictions = model_2.predict(x_test)
print(RF_predictions)
```

```
['Iris-virginica' 'Iris-versicolor' 'Iris-setosa' 'Iris-virginica'
 'Iris-setosa' 'Iris-virginica' 'Iris-setosa' 'Iris-versicolor'
 'Iris-versicolor' 'Iris-versicolor' 'Iris-virginica' 'Iris-versicolor'
 'Iris-versicolor' 'Iris-versicolor' 'Iris-versicolor' 'Iris-setosa'
 'Iris-versicolor' 'Iris-versicolor' 'Iris-setosa' 'Iris-setosa'
 'Iris-virginica' 'Iris-versicolor' 'Iris-setosa' 'Iris-setosa'
 'Iris-virginica' 'Iris-setosa' 'Iris-setosa' 'Iris-versicolor'
 'Iris-versicolor' 'Iris-setosa']
```

For unknown data:

```
p = pd. DataFrame([[1,3,5.1,2.4]], columns = ["a", "b","c","d"])
predictions = model.predict(p)
print(predictions)
```

```
['Iris-virginica']
```

Fig 5.17 Prediction of unseen data

Now, for finding accuracy of the model we will use 20% test data predictions and y_test. The code for the following is:

```
print("Accuracy of logistic regression algorithm:", accuracy_score(y_test, predictions))
print("Accuracy of KNN algorithm:", accuracy_score(y_test, KNN_predictions))
print("Accuracy of Random Forest algorithm:", accuracy_score(y_test, RF_predictions))
print("Accuracy of SVM algorithm:", accuracy_score(y_test, SVM_predictions))
```

```
Accuracy of logistic regression algorithm: 0.9666666666666667
Accuracy of KNN algorithm: 0.9666666666666667
Accuracy of Random Forest algorithm: 1.0
Accuracy of SVM algorithm: 1.0
```

Fig 5.18 Accuracy of trained models

There are two models which shows the highest accuracy i.e. Random Forest and SVM with accuracy score 1.0.

CONCLUSION

In this project, we used the various powerful algorithms to train our data. Processing of data is also important to acquire the best result and as we can see the above results, they are very satisfactory. The accuracy score of above four models are very good and they can be used to predict the species of iris flower and in four of the above models two models shows the 100%accuracy. As we can conclude that in future with appropriate data of features of any flower it is possible to classify the species of any flower.

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