**Practical: 1**

**Aim: To study various machine learning libraries like - Scipy, Sklearn, Keras, Tensorflow with their usage.**

**What is NumPy?**

NumPy is a general-purpose array-processing package. It provides a high-performance multidimensional array object, and tools for working with these arrays.

It is the fundamental package for scientific computing with Python. It contains various features including these important ones:

* A powerful N-dimensional array object
* Sophisticated (broadcasting) functions
* Tools for integrating C/C++ and Fortran code
* Useful linear algebra, Fourier transform, and random number capabilities

Besides its obvious scientific uses, NumPy can also be used as an efficient multi-dimensional container of generic data.

Arbitrary data-types can be defined using Numpy which allows NumPy to seamlessly and speedily integrate with a wide variety of databases.

1. Arrays in NumPy: NumPy’s main object is the homogeneous multidimensional array.
2. Array creation: There are various ways to create arrays in NumPy.
3. Array Indexing: Knowing the basics of array indexing is important for analysing and manipulating the array object. NumPy offers many ways to do array indexing.
4. Basic operations: Plethora of built-in arithmetic functions are provided in NumPy.
5. Sorting array: There is a simple np.sort method for sorting NumPy arrays.

**# Scipy:**

- SciPy is a python library that is useful in solving many mathematical equations and algorithms. It is designed on the top of Numpy library that gives more extension of finding scientific mathematical formulae like Matrix Rank, Inverse, polynomial equations, LU Decomposition, etc. Using its high level functions will significantly reduce the complexity of the code and helps in better analyzing the data. SciPy is an interactive Python session used as a data-processing library that is made to compete with its rivalries such as MATLAB, Octave, R-Lab,etc. It has many user-friendly, efficient and easy-to-use functions that helps to solve problems like numerical integration, interpolation, optimization, linear algebra and statistics.

The benefit of using SciPy library in Python while making ML models is that it also makes a strong programming language available for use in developing less complex programs and applications.

1. Linear Algebra
2. Compute pivoted LU decomposition of a matrix
3. Eigen values and eigen vectors of this matrix
4. Solving systems of linear equations can also be done

**# Pandas:**

- Pandas is an open-source Python Library providing high-performance data manipulation and analysis tool using its powerful data structures. The name Pandas is derived from the word Panel Data – an Econometrics from Multidimensional data.

- Python with Pandas is used in a wide range of fields including academic and commercial domains including finance, economics, Statistics, analytics, etc.

- **## Key Features of Pandas:**

- Fast and efficient DataFrame object with default and customized indexing.

- Tools for loading data into in-memory data objects from different file formats.

- Data alignment and integrated handling of missing data.

- Reshaping and pivoting of date sets.

- Label-based slicing, indexing and subsetting of large data sets.

- Columns from a data structure can be deleted or inserted.

- Group by data for aggregation and transformations.

- High performance merging and joining of data.

- Time Series functionality.

**# Sci-Kit learn (sklearn):**

- Sklearn or Scikit-learn is an open source machine learning library that supports supervised and unsupervised learning.

- It also provides various tools for model fitting, data preprocessing, model selection and evaluation, and many other utilities.

- **## Features:**

- Rather than focusing on loading, manipulating and summarising data, Scikit-learn library is focused on modeling the data. Some of the most popular groups of models provided by Sklearn are as follows −

- Supervised Learning algorithms − 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 algorithms − On the other hand, it also has all the popular unsupervised learning algorithms from clustering, factor analysis, PCA (Principal Component Analysis) to unsupervised neural networks.

- Clustering − This model is used for grouping unlabeled data.

- Cross Validation − It is used to check the accuracy of supervised models on unseen data.

- Dimensionality Reduction − It is used for reducing the number of attributes in data which can be further used for summarisation, visualisation and feature selection.

- Ensemble methods − As name suggest, it is used for combining the predictions of multiple supervised models.

- Feature extraction − It is used to extract the features from data to define the attributes in image and text data.

- Feature selection − It is used to identify useful attributes to create supervised models.

- Open Source − It is open source library and also commercially usable under BSD license

**# TensorFlow:**

- TensorFlow makes it easy for beginners and experts to create machine learning models for desktop, mobile, web, and cloud.

- It is used for implementing machine learning and deep learning applications.

- To develop and research on fascinating ideas on artificial intelligence, Google team created TensorFlow.

- TensorFlow is designed in Python programming language, hence it is considered an easy to understand framework.

- **## Features:**

- It includes a feature of that defines, optimizes and calculates mathematical expressions easily with the help of multi-dimensional arrays called tensors.

- It includes a programming support of deep neural networks and machine learning techniques.

- It includes a high scalable feature of computation with various data sets.

- TensorFlow uses GPU computing, automating management. It also includes a unique feature of optimization of same memory and the data used.

**# Keras:**

- Keras is an open source deep learning framework for python.

- It has been developed by an artificial intelligence researcher at Google named Francois Chollet.

- Leading organizations like Google, Square, Netflix, Huawei and Uber are currently using Keras.

- **## Features**

- Keras leverages various optimization techniques to make high level neural network API easier and more performant. It supports the following features −

- Consistent, simple and extensible API.

- Minimal structure - easy to achieve the result without any frills.

- It supports multiple platforms and backends.

- It is user friendly framework which runs on both CPU and GPU.

- Highly scalability of computation.