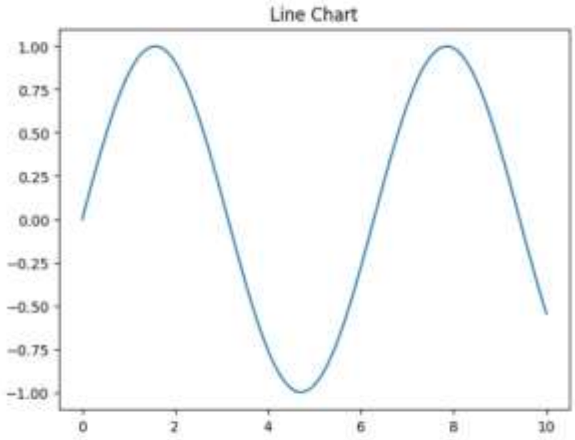
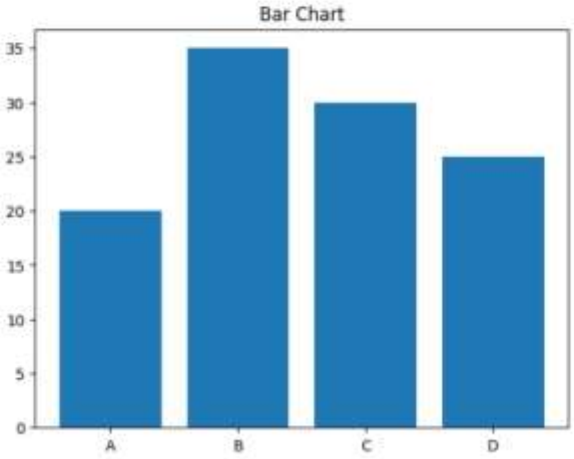
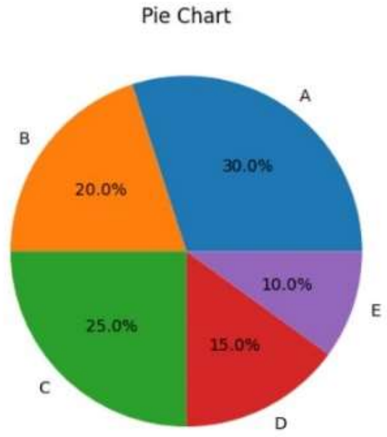
DATA SCIENCE LAB PROGRAMS

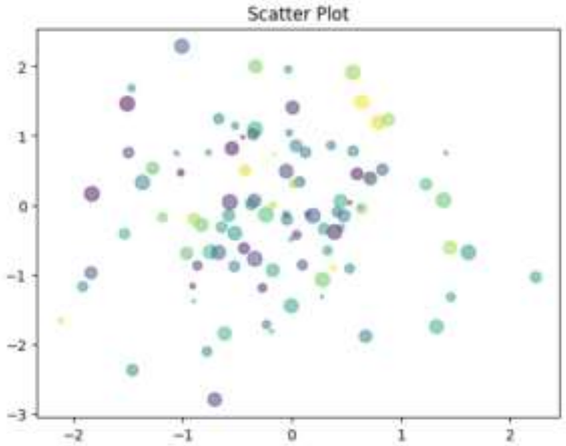
1. Demonstrate all the basic plots using Matplotlib package and python programming.

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

# Generate some data for plotting
x = np.linspace(0, 10, 100)
y = np.sin(x)
plt.figure()
plt.plot(x,y)
plt.title("Line Chart")

categories=['A','B','C','D']
values=[20,35,30,25]
plt.figure()
plt.bar(categories,values)
plt.title("Bar Chart")

x=np.random.randn(100)
y=np.random.randn(100)
colors=np.random.rand(100)
sizes=100*np.random.rand(100)
plt.figure()
plt.scatter(x,y,c=colors, s=sizes, alpha=0.5)
plt.title("Scatter Plot")


sizes = [30, 20, 25, 15, 10]
labels = ['A', 'B', 'C', 'D', 'E']
plt.figure()
plt.pie(sizes, labels=labels, autopct="%1.1f%%")
plt.title("Pie Chart")
plt.show()
```





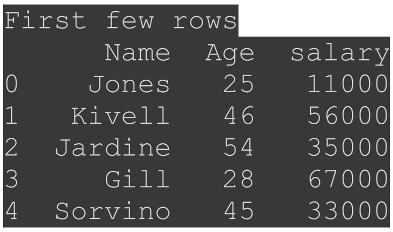




2. Implement a python program to perform File Operations on Excel Dataset.

```
import pandas as pd

df=pd.read_excel('data.xlsx')

print("First few rows")

print(df.head())

print("\n Summary statistics:")

print(df.describe())

filtered_data=df[df['Age']>30]

print("\n Filtered data(Age>30):")

print(filtered_data)


sorted_data=df.sort_values(by='salary',ascending=False)

print("\nSorted data(by Salary):")

print(sorted_data)

df['Bonus']=df['salary']*0.1

print("\n Data with new column(Bonus)")

print(df)

df.to_excel('Output.xlsx',index=False)

print("\n Data written to output.xlsx")
```

OUTPUT:



```
First few rows
      Name  Age  salary
0    Jones   25   11000
1   Kivell   46   56000
2  Jardine   54   35000
3     Gill   28   67000
4  Sorvino   45   33000
```

```
 Summary statistics:
             Age         salary
count  21.000000      21.000000
mean   39.285714   53404.761905
std    11.895978   50922.396607
min    23.000000    9000.000000
25%    30.000000   30500.000000
50%    38.000000   35000.000000
75%    45.000000   62000.000000
max    67.000000  220000.000000
```

```
 Filtered data(Age>30):
        Name  Age  salary
1     Kivell   46   56000
2    Jardine   54   35000
4    Sorvino   45   33000
5      Jones   34   21000
6    Andrews   67   54000
8   Thompson   33   65000
11    Howard   38   23000
12    Parent   56    9000
13     Jones   45   34000
14     Smith   36   31000
15     Jones   56  170000
17     Jones   45   65000
18    Parent   33   62000
19    Kivell   38   41000
20     Smith   40   30500
```

```
Sorted data(by Salary):
        Name  Age  salary
7    Jardine   23  220000
15     Jones   56  170000
3       Gill   28   67000
8   Thompson   33   65000
17     Jones   45   65000
18    Parent   33   62000
1     Kivell   46   56000
6    Andrews   67   54000
9      Jones   29   45000
19    Kivell   38   41000
2    Jardine   54   35000
10    Morgan   30   34000
13     Jones   45   34000
4    Sorvino   45   33000
14     Smith   36   31000
20     Smith   40   30500
11    Howard   38   23000
5      Jones   34   21000
16    Morgan   24   15000
0      Jones   25   11000
12    Parent   56    9000
```

```
 Data with new column(Bonus)
        Name  Age  salary    Bonus
0      Jones   25   11000   1100.0
1     Kivell   46   56000   5600.0
2    Jardine   54   35000   3500.0
3       Gill   28   67000   6700.0
4    Sorvino   45   33000   3300.0
5      Jones   34   21000   2100.0
6    Andrews   67   54000   5400.0
7    Jardine   23  220000  22000.0
8   Thompson   33   65000   6500.0
9      Jones   29   45000   4500.0
10    Morgan   30   34000   3400.0
11    Howard   38   23000   2300.0
12    Parent   56    9000    900.0
13     Jones   45   34000   3400.0
14     Smith   36   31000   3100.0
15     Jones   56  170000  17000.0
16    Morgan   24   15000   1500.0
17     Jones   45   65000   6500.0
18    Parent   33   62000   6200.0
19    Kivell   38   41000   4100.0
20     Smith   40   30500   3050.0
```

```
 Data written to output.xlsx
```

3. Write a python program to perform Array operations using the Numpy package.

```
import numpy as np
# Create arrays
a = np.array([1, 2, 3, 4, 5])
b = np.array([6, 7, 8, 9, 10])

print("Array a", a)
print("Array b", b)
print("Sum of array a and b", np.add(a,b))
print("Difference of array a and b", np.subtract(a,b))
print("Product of arrays a and b", np.multiply(a,b))
print("Division of arrays a and b", np.divide(a,b))
print("Square root of array a:",np.sqrt(a))
print("Exponential of array a:",np.exp(a))
print("Minimum value of array a:",np.min(a))
print("Maximum value of array b:",np.max(b))
print("Mean of array a:",np.mean(a))
print("Standard deviation of array b:",np.std(b))
print("Sum of elements in array a:",np.sum(a))
c=np.array([[1,2],[3,4],[5,6]])
print("Array c:")
print(c)
print("Reshaped array c:")
print(np.reshape(c,(2,3)))
```

```
d=np.array([[1,2,3],[4,5,6]])

print("Array d:")

print(d)

print("Transposed array d:")

print(np.transpose(d))
```

Output:

```
Array a [1 2 3 4 5]

Array b [ 6  7  8  9 10]

Sum of array a and b [ 7  9 11 13 15]

Difference of array a and b [-5 -5 -5 -5 -5]

Product of arrays a and b [ 6 14 24 36 50]

Division of arrays a and b [0.16666667 0.28571429 0.375      0.44444444 0.5       ]

Square root of array a: [1.         1.41421356 1.73205081 2.         2.23606798]

Exponential of array a: [  2.71828183   7.3890561   20.08553692  54.59815003 148.4131591 ]

Minimum value of array a: 1

Maximum value of array b: 10

Mean of array a: 3.0

Standard deviation of array b: 1.4142135623730951

Sum of elements in array a: 15

Array c:
[[1 2]
 [3 4]
 [5 6]]

Reshaped array c:
[[1 2 3]
 [4 5 6]]

Array d:
[[1 2 3]
 [4 5 6]]

Transposed array d:
[[1 4]
 [2 5]
 [3 6]]
```

4. Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.

```
import numpy as np

x=np.array(([2,9],[1,9],[3,6]),dtype=float)

y=np.array(([92],[86],[89]),dtype=float)

x=x/np.amax(x,axis=0)

y=y/100


def sigmoid(x):

    return 1/(1+np.exp(-x))


def derivation_sigmoid(x):

    return x*(1-x)


epoch=5000

lr=0.1

inputlayer_neurons=2

hiddenlayer_neurons=3

outputlayer_neurons=1


wb=np.random.uniform(size=(inputlayer_neurons,hiddenlayer_neurons))

bb=np.random.uniform(size=(1,hiddenlayer_neurons))

wout=np.random.uniform(size=(hiddenlayer_neurons,outputlayer_neurons))

bout=np.random.uniform(size=(1,outputlayer_neurons))

for i in range(epoch):

    hinp1=np.dot(x,wb)
    hinp=hinp1+bb
    hlayer_act=sigmoid(hinp)
    outinp1=np.dot(hlayer_act,wout)
    outinp=outinp1+bout
    output=sigmoid(outinp)

    EO=y-output
    outgrad=derivation_sigmoid(output)
    d_output=EO*outgrad
    EH=d_output.dot(wout.T)
    hiddengrad=derivation_sigmoid(hlayer_act)
    d_hiddenlayer=EH*hiddengrad
    wout+=hlayer_act.T.dot(d_output)*lr
    wb+=x.T.dot(d_output)*lr

print("Inpput:\n" +str(x))
print("Actual:\n" +str(y))
print("Predicted:\n",output)
```

OUTPUT:-

```
Inpput:
[[0.66666667 1.        ]
 [0.33333333 1.        ]
 [1.         0.66666667]]
Actual:
[[0.92]
 [0.86]
 [0.89]]
Predicted:
 [[0.89184048]
 [0.88433366]
 [0.89399225]]
```

5. Demonstrate Linear Regression operation using python programming.

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
dataset = pd.read_csv('advertising.csv')
dataset.head(10)
dataset.shape
dataset.isna().sum()
dataset.duplicated().any()
fig, axs = plt.subplots(3, figsize = (5,5))
plt1 = sns.boxplot(dataset['TV'], ax = axs[0])
plt2 = sns.boxplot(dataset['Newspaper'], ax = axs[1])
plt3 = sns.boxplot(dataset['Radio'], ax = axs[2])
plt.tight_layout()
sns.distplot(dataset['Sales']);
sns.pairplot(dataset, x_vars=['TV', 'Radio', 'Newspaper'], y_vars='Sales', height=4, aspect=1, kind='scatter')
plt.show()
sns.heatmap(dataset.corr(), annot = True)
plt.show()
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn import metrics
x = dataset[['TV']]
y = dataset['Sales']
```

```
x_train, x_test, y_train, y_test = train_test_split(x, y, test_size = 0.3, random_state = 100)
slr= LinearRegression()
slr.fit(x_train, y_train)
print('Intercept: ', slr.intercept_)
print('Coefficient:', slr.coef_)
print('Regression Equation: Sales = 6.948 + 0.054 * TV')
plt.scatter(x_train, y_train)
plt.plot(x_train, 6.948 + 0.054*x_train, 'r')
plt.show()
#Prediction of Test and Training set result
y_pred_slr= slr.predict(x_test)
x_pred_slr= slr.predict(x_train)
print("Prediction for test set: {}".format(y_pred_slr))
slr_diff = pd.DataFrame({'Actual value': y_test, 'Predicted value': y_pred_slr})
slr_diff
#Predict for any value
slr.predict([[56]])
# print the R-squared value for the model
from sklearn.metrics import accuracy_score
print('R squared value of the model: {:.2f}'.format(slr.score(x,y)*100))
```

OUTPUT:

https://classroom.google.com/c/NTc4MTM5NzE3NDYx/m/NjQ4ODAwOTUyMTg2/details

6. Train a regularized logistic regression classifier on the in-build iris dataset using scikit-learn. Train the model and report the best classification accuracy.

```
# Importing the necessary libraries
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
# Importing the dataset
dataset = pd.read_csv('iris.csv')
dataset.describe()
dataset.info()
# Splitting the dataset into the Training set and Test set
X = dataset.iloc[:, [0,1,2, 3]].values
y = dataset.iloc[:, 4].values

from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size = 0.25, random_state = 0)
# Feature Scaling
from sklearn.preprocessing import StandardScaler
sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)
# Fitting Logistic Regression to the Training set
from sklearn.linear_model import LogisticRegression
classifier = LogisticRegression(random_state = 0, solver='lbfgs', multi_class='auto')
```

```
classifier.fit(X_train, y_train)

# Predicting the Test set results

y_pred = classifier.predict(X_test)

# Predict probabilities

probs_y=classifier.predict_proba(X_test)

probs_y = np.round(probs_y, 2)

res = "{:<10} | {:<10} | {:<10} | {:<13} | {:<5}".format("y_test", "y_pred", "Setosa(%)",
"versicolor(%)", "virginica(%)\n")

res += "-"*65+"\n"

res += "\n".join("{:<10} | {:<10} | {:<10} | {:<13} | {:<10}".format(x, y, a, b, c) for x, y, a, b,
c in zip(y_test, y_pred, probs_y[:,0], probs_y[:,1], probs_y[:,2]))

res += "\n"+"-"*65+"\n"

print(res)

# Making the Confusion Matrix

from sklearn.metrics import confusion_matrix

cm = confusion_matrix(y_test, y_pred)

print(cm)


# Plot confusion matrix

import seaborn as sns

import pandas as pd

# confusion matrix sns heatmap

## https://www.kaggle.com/agungor2/various-confusion-matrix-plots

ax = plt.axes()

df_cm = cm

sns.heatmap(df_cm, annot=True, annot_kws={"size": 30}, fmt='d',cmap="Blues", ax = ax )

ax.set_title('Confusion Matrix')
```

```
plt.show()
```

OUTPUT:

https://classroom.google.com/c/NTc4MTM5NzE3NDYx/m/NjY1Mjg0NzYwOTkz/details

7. Write a python program to perform Data Manipulation operations using Pandas package.

```
import pandas as pd
data={
    'Name':['John','Emma','Sant','Lisa','Tom'],
    'Age':[25,30,28,32,27],
    'Country':['USA','Canada','India','UK','Australia'],
    'Salary':[50000,60000,70000,80000,65000]
}

df=pd.DataFrame(data)
print("Original DataFrame")
print(df)

name_age=df[['Name','Age']]
print("Original DataFrame")
print(df)
name_age=df[['Name','Age']]
print("Name and Age columns")
print(name_age)
```

```
filtered_df=df[df['Country']=='USA']

print("\nfiltered DataFrame(Country='USA')")

print(filtered_df)


sorted_df=df.sort_values("Salary",ascending=False)

print("\nsorted DataFrame(by ssalary in descending order)")

print(sorted_df)

average_Salary=df['Salary'].mean()


print("\nAverage salary",average_Salary)




df['Experience']=[3,6,4,8,5]

print("\nDataFrame with added experience")

print(df)

df.loc[df['Name']=='Emma','Salary']=65000

print("\nDataFrame with updating emma salary")

print(df)




df.drop('Experience',axis=1)

print("\nDataFrame after deleting the column ")

print(df)
```

OUTPUT:-

```
 Original DataFrame
   Name  Age    Country  Salary
0  John   25        USA   50000
1  Emma   30     Canada   60000
2  Sant   28      India   70000
3  Lisa   32         UK   80000
4   Tom   27  Australia   65000
Original DataFrame
   Name  Age    Country  Salary
0  John   25        USA   50000
1  Emma   30     Canada   60000
2  Sant   28      India   70000
3  Lisa   32         UK   80000
4   Tom   27  Australia   65000
Name and Age columns
   Name  Age
0  John   25
1  Emma   30
2  Sant   28
3  Lisa   32
```

```
4   Tom   27

filtered DataFrame(Country='USA')
   Name  Age Country  Salary
0  John   25     USA   50000

sorted DataFrame(by ssalary in descending order)
   Name  Age    Country  Salary
3  Lisa   32         UK   80000
2  Sant   28      India   70000
4   Tom   27  Australia   65000
1  Emma   30     Canada   60000
0  John   25        USA   50000

Average salary 65000.0

DataFrame with added experience
   Name  Age    Country  Salary  Experience
0  John   25        USA   50000           3
1  Emma   30     Canada   60000           6
2  Sant   28      India   70000           4
3  Lisa   32         UK   80000           8
4   Tom   27  Australia   65000           5

DataFrame with updating emma salary
```

```
   Name  Age    Country  Salary  Experience
0  John   25        USA   50000           3
1  Emma   30     Canada   65000           6
2  Sant   28      India   70000           4
3  Lisa   32         UK   80000           8
4   Tom   27  Australia   65000           5

DataFrame after deleting the column
   Name  Age    Country  Salary  Experience
0  John   25        USA   50000           3
1  Emma   30     Canada   65000           6
2  Sant   28      India   70000           4
3  Lisa   32         UK   80000           8
4   Tom   27  Australia   65000           5
```