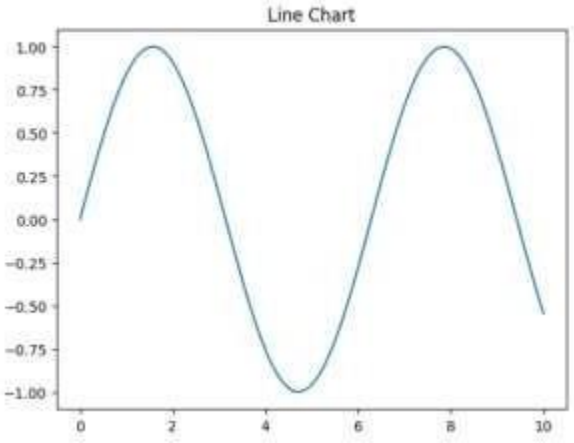
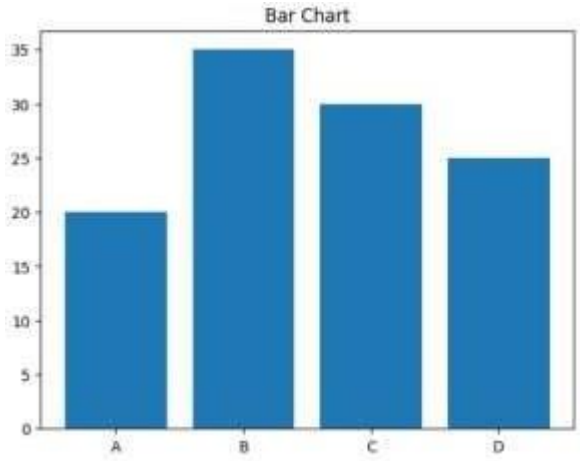
DATA SCIENCE LAB PROGRAMS

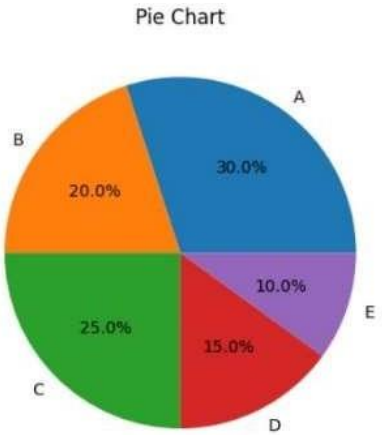
1. Demonstrate all the basic plots using Matplotlib package and python programming.

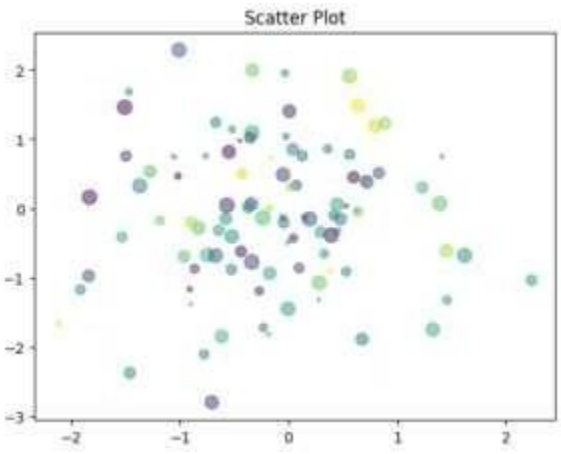
```
import matplotlib.pyplot as plt
import numpy as np

# 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
```

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-learns. 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