AMITY SCHOOL OF ENGINEERING AND TECHNOLOGY
AMITY UNIVERSITY
NOIDA

MACHINE LEARNING LAB FILE

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Submitted by
Daksh Dagar
5 CSE 12-X
A2305219710

Submitted to
Sangeeta Chugh

INDEX

Experiment 1

AIM

To install Jupyter Notebook and implement small python programs

CODE

```
num = int(input("Enter a number: "))
if (num % 2) == 0:
   print("It is Even number")
else:
   print("It is Odd number")


i=1
num = int(input("Enter a limit: "))
while (i < num):
    print("Count: ",i)
    i = i+1


area = 0
len = int(input("Enter lenght: "))
bre = int(input("Enter breadth: "))
area = len*bre
print("Area: ",area)


i=0
num = int(input("Enter the limit: "))
for i in list(range(num)):
    print(i)
```

OUTPUT

```
In [1]: num = int(input("Enter a number: "))
        if (num % 2) == 0:
           print("It is Even number")
        else:
           print("It is Odd number")

        Enter a number: 20
        It is Even number

In [2]: i=1
        num = int(input("Enter a limit: "))
        while (i < num):
            print("Count: ",i)
            i = i+1

        Enter a limit: 4
        Count:  1
        Count:  2
        Count:  3
```

In [1]:
```
area = 0
len = int(input("Enter lenght: "))
bre = int(input("Enter breadth: "))
area = len*bre
print("Area: ",area)
```

```
Enter lenght: 10
Enter breadth: 20
Area:  200
```

In [4]:
```
i=0
num = int(input("Enter the limit: "))
for i in list(range(num)):
    print(i)
```

```
Enter the limit: 5
0
1
2
3
4
```

Experiment 2

AIM

Implementation of logical rules in python

CODE

```
str1 = print("It is raining ")
str2 = print("I carry an Umbrella")

a = int(input("Set the value for first String: "))
b = int(input("Set the value for second String: "))

if(a == 1):
    A = True
else:
    A = False

if(b == 1):
    B = True
else:
    B = False

if(A == True and B == True):
    print("Both the statements are True")
elif(A == True or B == True):
    print("One of the statement is True")
    if(A == True):
        print("It is raining")
    else:
        print("I carry an Umbrella")
else:
    print("Both statement are False")

if(not A or B):
    print("If it rains then I carry an Umbrella")

if((not A or B) and (not B or A)):
    print("If and only if it rains then I carry an Umbrella")
```

OUTPUT

In [1]:
```
str1 = print("It is raining ")
str2 = print("I carry an Umbrella")

a = int(input("Set the value for first String: "))
b = int(input("Set the value for second String: "))

if(a == 1):
    A = True
else:
    A = False

if(b == 1):
    B = True
else:
    B = False

if(A == True and B == True):
    print("Both the statements are True")
elif(A == True or B == True):
    print("One of the statement is True")
    if(A == True):
        print("It is raining")
    else:
        print("I carry an Umbrella")
else:
    print("Both statement are False")

if(not A or B):
    print("If it rains then I carry an Umbrella")

if((not A or B) and (not B or A)):
    print("If and only if it rains then I carry an Umbrella")
```

```
It is raining
I carry an Umbrella
Set the value for first String: 1
Set the value for second String: 1
Both the statements are True
If it rains then I carry an Umbrella
If and only if it rains then I carry an Umbrella
```

Experiment 3

AIM

Implementation of linear regression using given values of constants

CODE

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as py

train = pd.read_csv("usa_house.csv")

x_train = train[['avg_area_income']]
y_train = train[['house_price']]

py.scatter(x_train,y_train,c='blue')
py.xlabel('House price')
py.ylabel('Average income')

theta0 = 0
theta1 = 20
predicted = theta0 + theta1*x_train
py.scatter(x_train,y_train,c='blue')
py.plot(x_train,predicted,'-y')
py.xlabel('House price')
py.ylabel('Average income')
py.show()
```

OUTPUT

```
In [13]: import pandas as pd
         import numpy as np
         import matplotlib.pyplot as py
```

```
In [11]: train = pd.read_csv("C:\\Users\\Chaitanya\\OneDrive\\Desktop\\usa_house.csv")
         train
```

Out[11]:

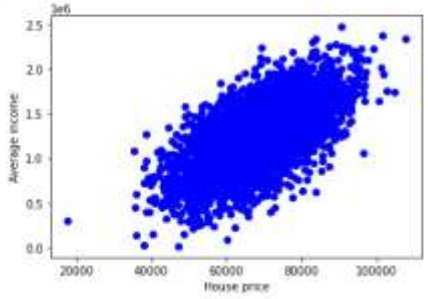
	avg_area_income	avg_house_age	avg_nb_rooms	avg_nb_bathrooms	area_population	house_price	address
0	79545.45857	5.682861	7.009188	4.09	23086.80050	1.059034e+06	208 Michael Ferry Apt. 674\nLaurabury, NE 3701...
1	79248.64245	6.002900	6.730821	3.09	40173.07217	1.505891e+06	188 Johnson Views Suite 079\nLake Kathleen, CA...
2	61287.06718	5.865890	8.512727	5.13	36882.15940	1.058988e+06	9127 Elizabeth Stravenue\nDanielton, WI 06482...
3	63345.24005	7.188236	5.586729	3.26	34310.24283	1.260617e+06	USS Barnett\nFPO AP 44820
4	59982.19723	5.040555	7.839388	4.23	26354.10947	6.309435e+05	USNS Raymond\nFPO AE 09386
...	...	...	...	...	...	...	...
4029	60567.94414	7.830362	6.137356	3.46	22837.36103	1.060194e+06	USNS Williams\nFPO AP 30153-7653
4030	78491.27543	6.999135	6.576763	4.02	25616.11549	1.482618e+06	PSC 9258, Box 8489\nAPO AA 42991-3352
4031	63390.68689	7.250591	4.805081	2.13	33266.14549	1.030730e+06	4215 Tracy Garden Suite 076\nJoshualand, VA 01...
4032	68001.33124	5.534388	7.130144	5.44	42625.62016	1.198657e+06	USS Wallace\nFPO AE 73316
4033	65510.58180	5.992305	6.792336	4.07	46501.28380	1.298950e+06	37778 George Ridges Apt. 509\nEast Holly, NV 2...

4034 rows × 7 columns

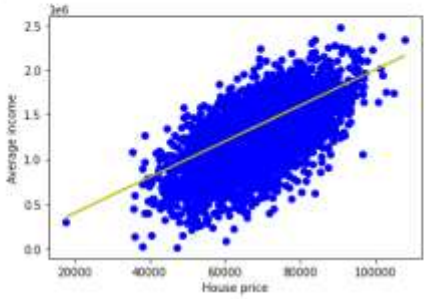
```
In [12]: x_train = train[['avg_area_income']]
         y_train = train[['house_price']]
```

In [14]:
```
py.scatter(x_train,y_train,c='blue')
py.xlabel('House price')
py.ylabel('Average income')
```

Out[14]:
```
Text(0, 0.5, 'Average income')
```



In [15]:
```
theta0 = 0
theta1 = 20

predicted = theta0 + theta1*x_train
py.scatter(x_train,y_train,c='blue')
py.plot(x_train,predicted,'-y')
py.xlabel('House price')
py.ylabel('Average income')
py.show()
```



Experiment 4

AIM

Implementation of linear regression by finding the optimal values of theta0 and theta1

CODE

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as py

train = pd.read_csv("usa_house.csv")

x_train = train[['avg_area_income']]
y_train = train[['house_price']]

py.scatter(x_train,y_train,c='blue')
py.xlabel('House price')
py.ylabel('Average income')

def val(x_train,y_train):
    theta1=theta0=0
    a=len(x_train)
    itr=1000
    lr=0.0000000001
    for i in range(itr):
        y_pre = theta1*x_train +theta0
        cost=(1/a) *sum ( [val**2 for val in (y_train-y_pre)])
        md= -(2/a) *sum (x_train*(y_train-y_pre))
        cd= -(2/a) *sum(y_train-y_pre)
        theta1=theta1-lr*md
        theta0=theta0-lr*cd
        print("m {}, {}, cost{},itr {}".format(theta1, theta0 ,cost, i))
    return theta1,theta0

py.scatter(x_train,y_train,c='blue')
py.xlabel('house price')
py.ylabel('average income')

theta1,theta0=val(x_train,y_train)
predicted = theta0 + theta1*x_train
py.scatter(x_train,y_train,c='blue')
py.plot(x_train,predicted,'-y')
py.xlabel('house price')
py.ylabel('average income')
py.show()
```

OUTPUT

In [1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as py
```

In [3]:
```
train = pd.read_csv("C:\\Users\\Chaitanya\\OneDrive\\Desktop\\AI Lab\\usa_house.csv")
train
```

Out[3]:

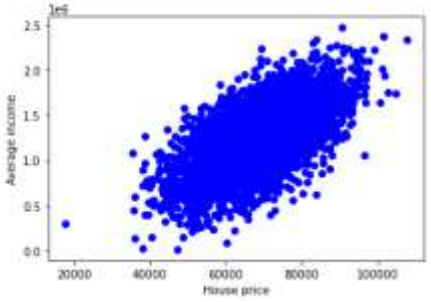
	avg_area_income	avg_house_age	avg_nb_rooms	avg_nb_bathrooms	area_population	house_price	address
0	79545.45857	5.682861	7.009188	4.09	23086.80050	1.059034e+06	208 Michael Ferry Apt. 674\nLaurabury, NE 3701...
1	79248.64245	6.002900	6.730821	3.09	40173.07217	1.505891e+06	188 Johnson Views Suite 079\nLake Kathleen, CA...
2	61287.06718	5.865890	8.512727	5.13	36882.15940	1.058988e+06	9127 Elizabeth Stravenue\nDanielton, WI 06482...
3	63345.24005	7.188236	5.586729	3.26	34310.24283	1.260617e+06	USS Barnett\nFPO AP 44820
4	59982.19723	5.040555	7.839388	4.23	26354.10947	6.309435e+05	USNS Raymond\nFPO AE 09386
...	...	...	...	...	...	...	...
4029	60567.94414	7.830362	6.137356	3.46	22837.36103	1.060194e+06	USNS Williams\nFPO AP 30153-7653
4030	78491.27543	6.999135	6.576763	4.02	25616.11549	1.482618e+06	PSC 9258, Box 8489\nAPO AA 42991-3352
4031	63390.68689	7.250591	4.805081	2.13	33266.14549	1.030730e+06	4215 Tracy Garden Suite 076\nJoshualand, VA 01...
4032	68001.33124	5.534388	7.130144	5.44	42625.62016	1.198657e+06	USS Wallace\nFPO AE 73316
4033	65510.58188	5.992305	6.792336	4.07	46501.28380	1.298950e+06	37778 George Ridges Apt. 509\nEast Holly, NV 2...

4034 rows × 7 columns

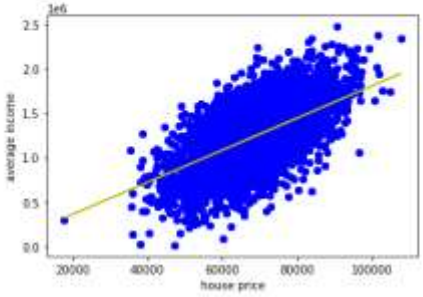
In [4]:
```
x_train = train[['avg_area_income']]
y_train = train[['house_price']]
```

In [5]:
```
py.scatter(x_train,y_train,c='blue')
py.xlabel('House price')
py.ylabel('Average income')
```

Out[5]: Text(0, 0.5, 'Average income')



In [10]:
```
def val(x_train,y_train):
    theta1=theta0=0
    a=len(x_train)
    itr=1000
    lr=0.0000000001
    for i in range(itr):
        y_pre = theta1*x_train +theta0
        cost=(1/a) *sum ( [val**2 for val in (y_train-y_pre)])
        md= -(2/a) *sum (x_train*(y_train-y_pre))
        cd= -(2/a) *sum(y_train-y_pre)
        theta1=theta1-lr*md
        theta0=theta0-lr*cd
    return theta1,theta0

py.scatter(x_train,y_train,c='blue')
py.xlabel('house price')
py.ylabel('average income')

theta1,theta0=val(x_train,y_train)
predicted = theta0 + theta1*x_train
py.scatter(x_train,y_train,c='blue')
py.plot(x_train,predicted,'-y')
py.xlabel('house price')
py.ylabel('average income')
py.show()
```



Experiment 5

AIM

EDA analysis of given dataset

CODE

```
import pandas as pd
import matplotlib.pyplot as py
import seaborn
import numpy as np
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split
from sklearn.metrics import mean_squared_error
from math import sqrt

data = pd.read_csv("nyc.csv")
data

x = data[['Food']]
y = data[['Price']]

print(data.info())

print(data.corr())

py.boxplot(x)

py.boxplot(y)

x_train,x_test,y_train,y_test =
train_test_split(x,y,test_size=0.3,random_state=0)

Lr = LinearRegression()
Lr.fit(x_train,y_train)
y_pred = Lr.predict(x_test)

rms = sqrt(mean_squared_error(y_test, y_pred))
print(rms)
```

OUTPUT

In [1]:
```
import pandas as pd
import matplotlib.pyplot as py
import seaborn
import numpy as np
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split
```

In [2]:
```
data = pd.read_csv("nyc.csv")
data
```

Out[2]:

	Food	Decor	Service	East	Price
0	22	18	20	0	43
1	20	19	19	0	32
2	21	13	18	0	34
3	20	20	17	0	41
4	24	19	21	0	54
...	...	...	...	...	...
163	17	15	16	0	31
164	20	16	17	0	26
165	18	16	17	0	31
166	22	17	21	0	38
167	24	10	16	0	34

168 rows × 5 columns

In [3]:
```
x = data[['Food']]
y = data[['Price']]
```

In [4]:
```
print(data.info())
```

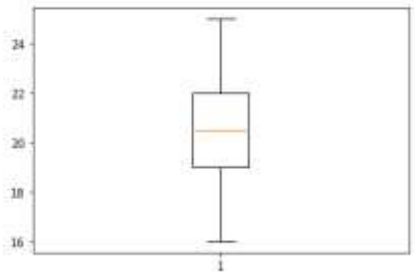
```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 168 entries, 0 to 167
Data columns (total 5 columns):
 #   Column   Non-Null Count  Dtype
---  ------   --------------  -----
 0   Food     168 non-null    int64
 1   Decor    168 non-null    int64
 2   Service  168 non-null    int64
 3   East     168 non-null    int64
 4   Price    168 non-null    int64
dtypes: int64(5)
memory usage: 6.7 KB
None
```

In [5]:
```
print(data.corr())
```

```
             Food     Decor   Service      East     Price
Food     1.000000  0.503916  0.794525  0.188371  0.627043
Decor    0.503916  1.000000  0.645331  0.035749  0.724352
Service  0.794525  0.645331  1.000000  0.209004  0.641140
East     0.188371  0.035749  0.209004  1.000000  0.186630
Price    0.627043  0.724352  0.641140  0.186630  1.000000
```

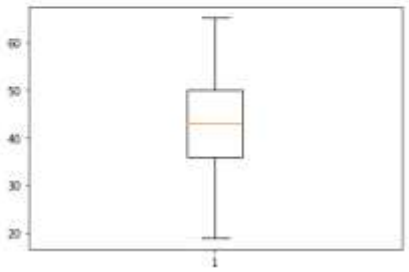
In [6]:
```
py.boxplot(x)
```

Out[6]:
```
{'whiskers': [<matplotlib.lines.Line2D at 0x1799b559fa0>,
  <matplotlib.lines.Line2D at 0x1799d57a2b0>],
 'caps': [<matplotlib.lines.Line2D at 0x1799d57a640>,
  <matplotlib.lines.Line2D at 0x1799d57a9d0>],
 'boxes': [<matplotlib.lines.Line2D at 0x1799b559b50>],
 'medians': [<matplotlib.lines.Line2D at 0x1799d57ad60>],
 'fliers': [<matplotlib.lines.Line2D at 0x1799d584130>],
 'means': []}
```



In [7]:
```
py.boxplot(y)
```

Out[7]:
```
{'whiskers': [<matplotlib.lines.Line2D at 0x1799d65d220>,
  <matplotlib.lines.Line2D at 0x1799d65d5b0>],
 'caps': [<matplotlib.lines.Line2D at 0x1799d65d940>,
  <matplotlib.lines.Line2D at 0x1799d65dcd0>],
 'boxes': [<matplotlib.lines.Line2D at 0x1799d64de50>],
 'medians': [<matplotlib.lines.Line2D at 0x1799d6680a0>],
 'fliers': [<matplotlib.lines.Line2D at 0x1799d668430>],
 'means': []}
```



In [8]:
```
x_train,x_test,y_train,y_test = train_test_split(x,y,test_size=0.3,random_state=0)
```

In [9]:
```
Lr = LinearRegression()
Lr.fit(x_train,y_train)
y_pred = Lr.predict(x_test)
```

In [10]:
```
from sklearn.metrics import mean_squared_error
from math import sqrt
```

In [11]:
```
rms = sqrt(mean_squared_error(y_test, y_pred))
print(rms)
```

```
6.464679171753509
```

Experiment 6

AIM

Implementation of Logistics Regression in Python

CODE

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from sklearn.linear_model import LogisticRegression
from sklearn.preprocessing import StandardScaler
from sklearn.model_selection import train_test_split
from sklearn.metrics import confusion_matrix
from sklearn.metrics import accuracy_score

data = pd.read_csv("Social_Network_Ads.csv")
data

x = data.iloc[:,[2,3]].values
y = data.iloc[:,4].values
x_test,x_train,y_test,y_train =
train_test_split(x,y,test_size=0.25,random_state=1)


Scaler = StandardScaler()
x_train_scld = Scaler.fit_transform(x_train)
x_test_scld = Scaler.transform(x_test)

LR = LogisticRegression()
LR.fit(x_train_scld,y_train)
y_pred = LR.predict(x_test_scld)

Score = accuracy_score(y_test,y_pred)
print(Score)
```

OUTPUT

In [1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from sklearn.linear_model import LogisticRegression
from sklearn.preprocessing import StandardScaler
from sklearn.model_selection import train_test_split
from sklearn.metrics import confusion_matrix
from sklearn.metrics import accuracy_score
```

In [2]:
```
data = pd.read_csv("Social_Network_Ads.csv")
data
```

Out[2]:

	User ID	Gender	Age	EstimatedSalary	Purchased
0	15624510	Male	19	19000	0
1	15810944	Male	35	20000	0
2	15668575	Female	26	43000	0
3	15603246	Female	27	57000	0
4	15804002	Male	19	76000	0
...	...	...	...	...	...
395	15691863	Female	46	41000	1
396	15706071	Male	51	23000	1
397	15654296	Female	50	20000	1
398	15755018	Male	36	33000	0
399	15594041	Female	49	36000	1

400 rows × 5 columns

In [3]:
```
x = data.iloc[:,[2,3]].values
y = data.iloc[:,4].values
x_test,x_train,y_test,y_train = train_test_split(x,y,test_size=0.25,random_state=1)
```

In [4]:
```
Scaler = StandardScaler()
x_train_scld = Scaler.fit_transform(x_train)
x_test_scld = Scaler.transform(x_test)
```

In [5]:
```
LR = LogisticRegression()
LR.fit(x_train_scld,y_train)
y_pred = LR.predict(x_test_scld)
```

In [6]:
```
Score = accuracy_score(y_test,y_pred)
print(Score)
```

```
0.86
```

Experiment 7

AIM

Implementation of K-means Clustering in Python

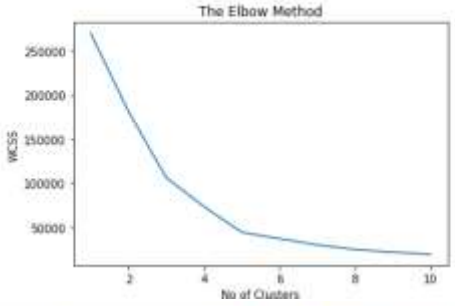
CODE

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

dataset = pd.read_csv("Mall_Customers.csv")
X = dataset.iloc[:, [3 ,4]].values

# Using the elbow method to find the optimal no of clusters
from sklearn.cluster import KMeans
wcss = []
for i in range(1, 11):
      kmeans = KMeans(n_clusters=i, init ='k-means++', n_init=10, max_iter
=300 , random_state =None)
      kmeans.fit(X)
      wcss.append(kmeans.inertia_)
plt.plot(range(1,11), wcss)
plt.title('The Elbow Method')
plt.xlabel('No of Clusters')
plt.ylabel('WCSS')
plt.show()


kmeans = KMeans(n_clusters=5, init ='k-means++', n_init=10, max_iter =300
, random_state =None)
y_kmeans = kmeans.fit_predict(X)

#Visualizing the Clusters
plt.scatter(X[y_kmeans==0,0],X[y_kmeans==0,1],s=10, c='red',
label='Cluster1')
plt.scatter(X[y_kmeans==1,0],X[y_kmeans==1,1],s=10, c='blue',
label='Cluster2')
plt.scatter(X[y_kmeans==2,0],X[y_kmeans==2,1],s=10, c='green',
label='Cluster3')
plt.scatter(X[y_kmeans==3,0],X[y_kmeans==3,1],s=10, c='cyan',
label='Cluster4')
plt.scatter(X[y_kmeans==4,0],X[y_kmeans==4,1],s=10, c='magenta',
label='Cluster5')
plt.scatter(kmeans.cluster_centers_[:,0],kmeans.cluster_centers_[:,1],s=30
, c='yellow', label='Centroid')
plt.title('Cluster of Clients')
plt.xlabel('Annual Income')
plt.ylabel('spending Score(1-100)')
plt.legend()
plt.show()
```

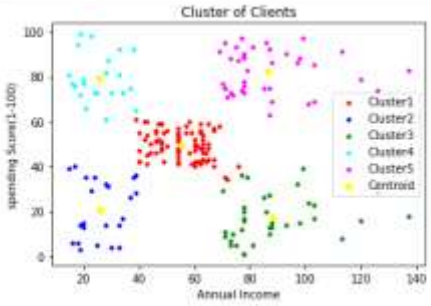
OUTPUT

In [1]:
```
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
```

In [2]:
```
dataset = pd.read_csv("Mall_Customers.csv")
X = dataset.iloc[:, [3 ,4]].values

# Using the elbow method to find the optimal no of clusters
from sklearn.cluster import KMeans
wcss = []
for i in range(1, 11):
      kmeans = KMeans(n_clusters=i, init ='k-means++', n_init=10, max_iter =300 , random_state =None)
      kmeans.fit(X)
      wcss.append(kmeans.inertia_)
plt.plot(range(1,11), wcss)
plt.title('The Elbow Method')
plt.xlabel('No of Clusters')
plt.ylabel('WCSS')
plt.show()
```



In [3]:
```
kmeans = KMeans(n_clusters=5, init ='k-means++', n_init=10, max_iter =300 , random_state =None)
y_kmeans = kmeans.fit_predict(X)

#Visualizing the Clusters
plt.scatter(X[y_kmeans==0,0],X[y_kmeans==0,1],s=10, c='red', label='Cluster1')
plt.scatter(X[y_kmeans==1,0],X[y_kmeans==1,1],s=10, c='blue', label='Cluster2')
plt.scatter(X[y_kmeans==2,0],X[y_kmeans==2,1],s=10, c='green', label='Cluster3')
plt.scatter(X[y_kmeans==3,0],X[y_kmeans==3,1],s=10, c='cyan', label='Cluster4')
plt.scatter(X[y_kmeans==4,0],X[y_kmeans==4,1],s=10, c='magenta', label='Cluster5')
plt.scatter(kmeans.cluster_centers_[:,0],kmeans.cluster_centers_[:,1],s=30, c='yellow', label='Centroid')
plt.title('Cluster of Clients')
plt.xlabel('Annual Income')
plt.ylabel('spending Score(1-100)')
plt.legend()
plt.show()
```



Experiment 8

AIM

Implementation of KNN algorithm in Python

CODE

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

from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.neighbors import KNeighborsClassifier
from sklearn.neighbors import KNeighborsRegressor
from sklearn.metrics import accuracy_score
from sklearn.metrics import classification_report

data = pd.read_csv("Diabetic.csv")
data.head()

data.info()

data.describe()

plt.hist(data)

y = data["Outcome"].values
x = data.drop(["Outcome"],axis=1)

SS = StandardScaler()
data = SS.fit_transform(data)

x_train,x_test,y_train,y_test = train_test_split(x,y,test_size=0.3)

train_score = []
test_score = []
k_value = []
accuracy = []
y_p = []

for k in range(1,21):
    k_value.append(k)
    knn = KNeighborsClassifier(n_neighbors = k)
    knn.fit(x_train,y_train)

    y_pred = knn.predict(x_test)
    y_p.append(y_pred)

    a_score = accuracy_score(y_test,y_pred)
    accuracy.append(a_score)

    tr_score = knn.score(x_train,y_train)
    train_score.append(tr_score)

    te_score = knn.score(x_test,y_test)
    test_score.append(te_score)

plt.xlabel('Different Values of K')
plt.ylabel('Model score')
plt.plot(k_value, train_score, color = 'r', label = "training score")
plt.plot(k_value, test_score, color = 'b', label = 'test score')
```

```
plt.xlabel('Different Values of K')
plt.ylabel('Accuracy score')
plt.plot(k_value, accuracy, color = 'r', label = "accuracy")

print("Maximum training accuracy at:
",train_score.index(max(train_score))+1)
print("Accuracy: ",max(train_score))

print("Maximum testing accuracy at: ",test_score.index(max(test_score))+1)
print("Accuracy: ",max(test_score))

knn = KNeighborsClassifier(n_neighbors = 17)
knn.fit(x_train,y_train)
y_pred = knn.predict(x_test)

print("Accuracy: ",accuracy_score(y_test,y_pred))

print(classification_report(y_test,y_pred))
```

OUTPUT

```
In [1]: import pandas as pd
        import numpy as np
        import matplotlib.pyplot as plt

        from sklearn.model_selection import train_test_split
        from sklearn.preprocessing import StandardScaler
        from sklearn.neighbors import KNeighborsClassifier
        from sklearn.neighbors import KNeighborsRegressor
        from sklearn.metrics import accuracy_score
        from sklearn.metrics import classification_report
```

```
In [2]: data = pd.read_csv("Diabetic.csv")
        data.head()
```

Out[2]:

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	DiabetesPedigreeFunction	Age	Outcome
0	6	148	72	35	0	33.6	0.627	50	1
1	1	85	66	29	0	26.6	0.351	31	0
2	8	183	64	0	0	23.3	0.672	32	1
3	1	89	66	23	94	28.1	0.167	21	0
4	0	137	40	35	168	43.1	2.288	33	1

```
In [3]: data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 768 entries, 0 to 767
Data columns (total 9 columns):
 #   Column                    Non-Null Count  Dtype
---  ------                    --------------  -----
 0   Pregnancies               768 non-null    int64
 1   Glucose                   768 non-null    int64
 2   BloodPressure             768 non-null    int64
 3   SkinThickness             768 non-null    int64
 4   Insulin                   768 non-null    int64
 5   BMI                       768 non-null    float64
 6   DiabetesPedigreeFunction  768 non-null    float64
 7   Age                       768 non-null    int64
 8   Outcome                   768 non-null    int64
dtypes: float64(2), int64(7)
memory usage: 54.1 KB
```

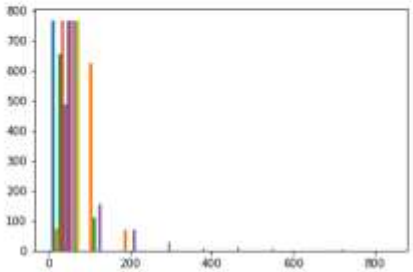
In [4]:
```
data.describe()
```

Out[4]:

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	DiabetesPedigreeFunction	Age	Outcome
count	768.000000	768.000000	768.000000	768.000000	768.000000	768.000000	768.000000	768.000000	768.000000
mean	3.845052	120.894531	69.105469	20.536458	79.799479	31.992578	0.471876	33.240885	0.348958
std	3.369578	31.972618	19.355807	15.952218	115.244002	7.884160	0.331329	11.760232	0.476951
min	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.078000	21.000000	0.000000
25%	1.000000	99.000000	62.000000	0.000000	0.000000	27.300000	0.243750	24.000000	0.000000
50%	3.000000	117.000000	72.000000	23.000000	30.500000	32.000000	0.372500	29.000000	0.000000
75%	6.000000	140.250000	80.000000	32.000000	127.250000	36.600000	0.626250	41.000000	1.000000
max	17.000000	199.000000	122.000000	99.000000	846.000000	67.100000	2.420000	81.000000	1.000000

In [5]:
```
plt.hist(data)
```

Out[5]:
```
(array([[768.,   0.,   0.,   0.,   0.,   0.,   0.,   0.,   0.,   0.],
        [ 72., 625.,  71.,   0.,   0.,   0.,   0.,   0.,   0.,   0.],
        [656., 112.,   0.,   0.,   0.,   0.,   0.,   0.,   0.,   0.],
        [767.,   1.,   0.,   0.,   0.,   0.,   0.,   0.,   0.,   0.],
        [487., 155.,  70.,  30.,   8.,   9.,   5.,   1.,   2.,   1.],
        [768.,   0.,   0.,   0.,   0.,   0.,   0.,   0.,   0.,   0.],
        [768.,   0.,   0.,   0.,   0.,   0.,   0.,   0.,   0.,   0.],
        [768.,   0.,   0.,   0.,   0.,   0.,   0.,   0.,   0.,   0.],
        [768.,   0.,   0.,   0.,   0.,   0.,   0.,   0.,   0.,   0.]]),
 array([  0. ,  84.6, 169.2, 253.8, 338.4, 423. , 507.6, 592.2, 676.8,
        761.4, 846. ]),
 <a list of 9 BarContainer objects>)
```



In [6]:
```
y = data["Outcome"].values
x = data.drop(["Outcome"],axis=1)
```

In [7]:
```
SS = StandardScaler()
data = SS.fit_transform(data)
```

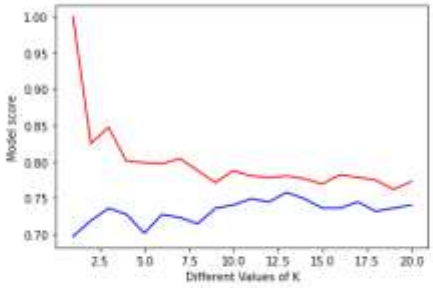
In [8]:
```
x_train,x_test,y_train,y_test = train_test_split(x,y,test_size=0.3)
```

In [9]:
```
train_score = []
test_score = []
k_value = []
accuracy = []
y_p = []
```

In [10]:
```
for k in range(1,21):
    k_value.append(k)
    knn = KNeighborsClassifier(n_neighbors = k)
    knn.fit(x_train,y_train)

    y_pred = knn.predict(x_test)
    y_p.append(y_pred)

    a_score = accuracy_score(y_test,y_pred)
    accuracy.append(a_score)

    tr_score = knn.score(x_train,y_train)
    train_score.append(tr_score)

    te_score = knn.score(x_test,y_test)
    test_score.append(te_score)
```

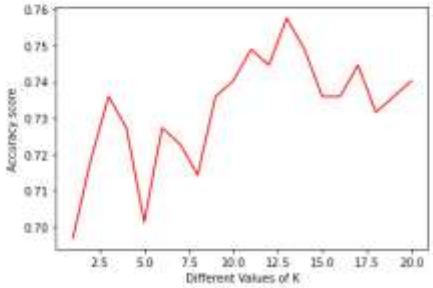
In [11]:
```
plt.xlabel('Different Values of K')
plt.ylabel('Model score')
plt.plot(k_value, train_score, color = 'r', label = "training score")
plt.plot(k_value, test_score, color = 'b', label = 'test score')
```

Out[11]: [<matplotlib.lines.Line2D at 0x14856b289d0>]



In [12]:
```
plt.xlabel('Different Values of K')
plt.ylabel('Accuracy score')
plt.plot(k_value, accuracy, color = 'r', label = "accuracy")
```

Out[12]: [<matplotlib.lines.Line2D at 0x14856ba2340>]



In [13]:
```
print("Maximum training accuracy at: ",train_score.index(max(train_score))+1)
print("Accuracy: ",max(train_score))
```

```
Maximum training accuracy at:  1
Accuracy:  1.0
```

In [14]:
```
print("Maximum testing accuracy at: ",test_score.index(max(test_score))+1)
print("Accuracy: ",max(test_score))
```

```
Maximum testing accuracy at:  13
Accuracy:  0.7575757575757576
```

In [15]:
```
knn = KNeighborsClassifier(n_neighbors = 17)
knn.fit(x_train,y_train)
y_pred = knn.predict(x_test)

print("Accuracy: ",accuracy_score(y_test,y_pred))
```

```
Accuracy:  0.7445887445887448
```

In [16]:
```
print(classification_report(y_test,y_pred))
```

```
              precision    recall  f1-score   support

           0       0.77      0.87      0.81       149
           1       0.68      0.52      0.59        82

    accuracy                           0.74       231
   macro avg       0.73      0.70      0.70       231
weighted avg       0.74      0.74      0.74       231
```