Group B : MACHINE LEARNING

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Assignment No: 1

Title Name: Predict the price of the Uber ride from a given pickup point to the agreed drop-off location.

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Class : BE **Div**: 1 **Batch**: A

Roll No: 405A005

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In [1]:

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

In [2]:

```
df = pd.read_csv("uber.csv")
```

In [3]:

```
df.head()
df.info() #To get the required information of the dataset
df.columns #TO get number of columns in the dataset
df = df.drop(['Unnamed: 0', 'key'], axis= 1) #To drop unnamed column as it isn't req
df.head()
df.shape #To get the total (Rows,Columns)
df.dtypes #To get the type of each column
df.info()
df.describe() #To get statistics of each columns
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 200000 entries, 0 to 199999
Data columns (total 9 columns):
 #   Column             Non-Null Count   Dtype
---  ------             --------------   -----
 0   Unnamed: 0         200000 non-null  int64
 1   key                200000 non-null  object
 2   fare_amount        200000 non-null  float64
 3   pickup_datetime    200000 non-null  object
 4   pickup_longitude   200000 non-null  float64
 5   pickup_latitude    200000 non-null  float64
 6   dropoff_longitude  199999 non-null  float64
 7   dropoff_latitude   199999 non-null  float64
 8   passenger_count    200000 non-null  int64
dtypes: float64(5), int64(2), object(2)
memory usage: 13.7+ MB
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 200000 entries, 0 to 199999
Data columns (total 7 columns):
 #   Column             Non-Null Count   Dtype
---  ------             --------------   -----
 0   fare_amount        200000 non-null  float64
 1   pickup_datetime    200000 non-null  object
 2   pickup_longitude   200000 non-null  float64
 3   pickup_latitude    200000 non-null  float64
 4   dropoff_longitude  199999 non-null  float64
 5   dropoff_latitude   199999 non-null  float64
 6   passenger_count    200000 non-null  int64
dtypes: float64(5), int64(1), object(1)
memory usage: 10.7+ MB
```

Out[3]:

	fare_amount	pickup_longitude	pickup_latitude	dropoff_longitude	dropoff_latitude	passen

count	200000.000000	200000.000000	200000.000000	199999.000000	199999.000000	2000
mean	11.359955	-72.527638	39.935885	-72.525292	39.923890	
std	9.901776	11.437787	7.720539	13.117408	6.794829	
min	-52.000000	-1340.648410	-74.015515	-3356.666300	-881.985513	
25%	6.000000	-73.992065	40.734796	-73.991407	40.733823	
50%	8.500000	-73.981823	40.752592	-73.980093	40.753042	
75%	12.500000	-73.967154	40.767158	-73.963658	40.768001	

	fare_amount	pickup_longitude	pickup_latitude	dropoff_longitude	dropoff_latitude	passen
max	499.000000	57.418457	1644.421482	1153.572603	872.697628	2

In [4]:

```
df.isnull().sum()
df['dropoff_latitude'].fillna(value=df['dropoff_latitude'].mean(),inplace = True)
df['dropoff_longitude'].fillna(value=df['dropoff_longitude'].median(),inplace =  True
df.isnull().sum()
df.dtypes
```

Out[4]:

```
fare_amount          float64
pickup_datetime       object
pickup_longitude     float64
pickup_latitude      float64
dropoff_longitude    float64
dropoff_latitude     float64
passenger_count        int64
dtype: object
```

In [5]:

```
df.pickup_datetime  =  pd.to_datetime(df.pickup_datetime,  errors='coerce')
df.dtypes
```

Out[5]:

```
fare_amount                      float64
pickup_datetime    datetime64[ns,    UTC]
pickup_longitude                 float64
pickup_latitude                  float64
dropoff_longitude                float64
dropoff_latitude                 float64
passenger_count                    int64
dtype: object
```

In [6]:

```
df= df.assign(hour = df.pickup_datetime.dt.hour,
 day= df.pickup_datetime.dt.day,
 month  =  df.pickup_datetime.dt.month,
 year = df.pickup_datetime.dt.year,
 dayofweek  =  df.pickup_datetime.dt.dayofweek)
df.head()
```

Out[6]:

	fare_amount	pickup_datetime	pickup_longitude	pickup_latitude	dropoff_longitude	dropoff_latit
0	7.5	2015-05-07 19:52:06+00:00	-73.999817	40.738354	-73.999512	40.723
1	7.7	2009-07-17 20:04:56+00:00	-73.994355	40.728225	-73.994710	40.750
2	12.9	2009-08-24 21:45:00+00:00	-74.005043	40.740770	-73.962565	40.772
3	5.3	2009-06-26 08:22:21+00:00	-73.976124	40.790844	-73.965316	40.803
4	16.0	2014-08-28 17:47:00+00:00	-73.925023	40.744085	-73.973082	40.761

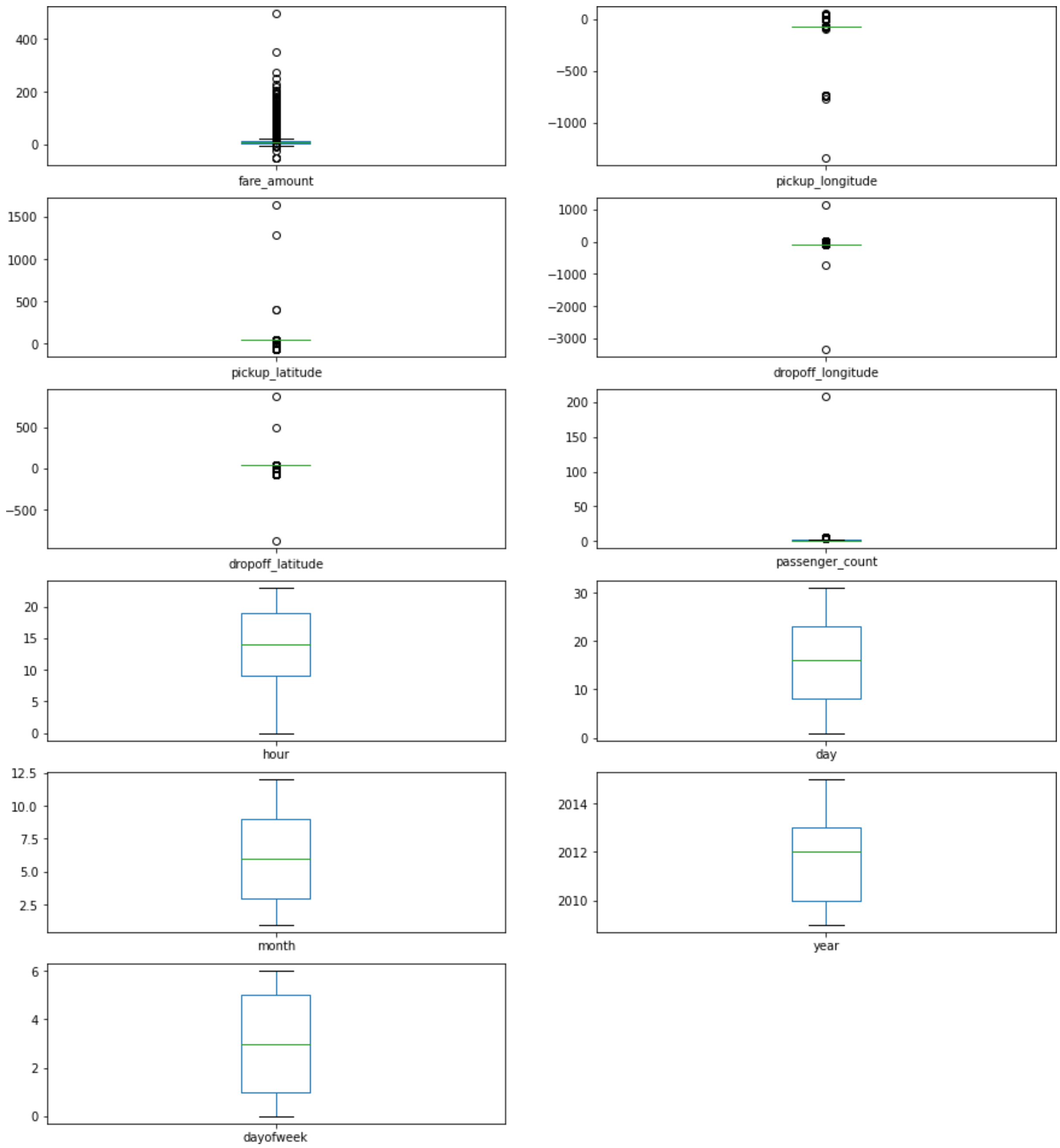
In [7]:

```
df  =  df.drop('pickup_datetime',axis=1)
df.head()
df.dtypes
```

Out[7]:
```
fare_amount          float64
pickup_longitude     float64
pickup_latitude      float64
dropoff_longitude    float64
dropoff_latitude     float64
passenger_count        int64
hour                   int64
day                    int64
month                  int64
year                   int64
dayofweek              int64
dtype: object
```

In [8]:
```
df.plot(kind = "box",subplots = True,layout = (7,2),figsize=(15,20))
```

Out[8]:
```
fare_amount             AxesSubplot(0.125,0.787927;0.352273x0.0920732)
pickup_longitude     AxesSubplot(0.547727,0.787927;0.352273x0.0920732)
pickup_latitude         AxesSubplot(0.125,0.677439;0.352273x0.0920732)
dropoff_longitude    AxesSubplot(0.547727,0.677439;0.352273x0.0920732)
dropoff_latitude        AxesSubplot(0.125,0.566951;0.352273x0.0920732)
passenger_count      AxesSubplot(0.547727,0.566951;0.352273x0.0920732)
hour                    AxesSubplot(0.125,0.456463;0.352273x0.0920732)
day                  AxesSubplot(0.547727,0.456463;0.352273x0.0920732)
month                   AxesSubplot(0.125,0.345976;0.352273x0.0920732)
year                 AxesSubplot(0.547727,0.345976;0.352273x0.0920732)
dayofweek               AxesSubplot(0.125,0.235488;0.352273x0.0920732)
dtype: object
```



In [9]:

```
def remove_outlier(df1 , col):
 Q1 = df1[col].quantile(0.25)
 Q3 = df1[col].quantile(0.75)
 IQR = Q3 - Q1
 lower_whisker = Q1-1.5*IQR
 upper_whisker = Q3+1.5*IQR
 df[col] = np.clip(df1[col] , lower_whisker , upper_whisker)
 return df1
```

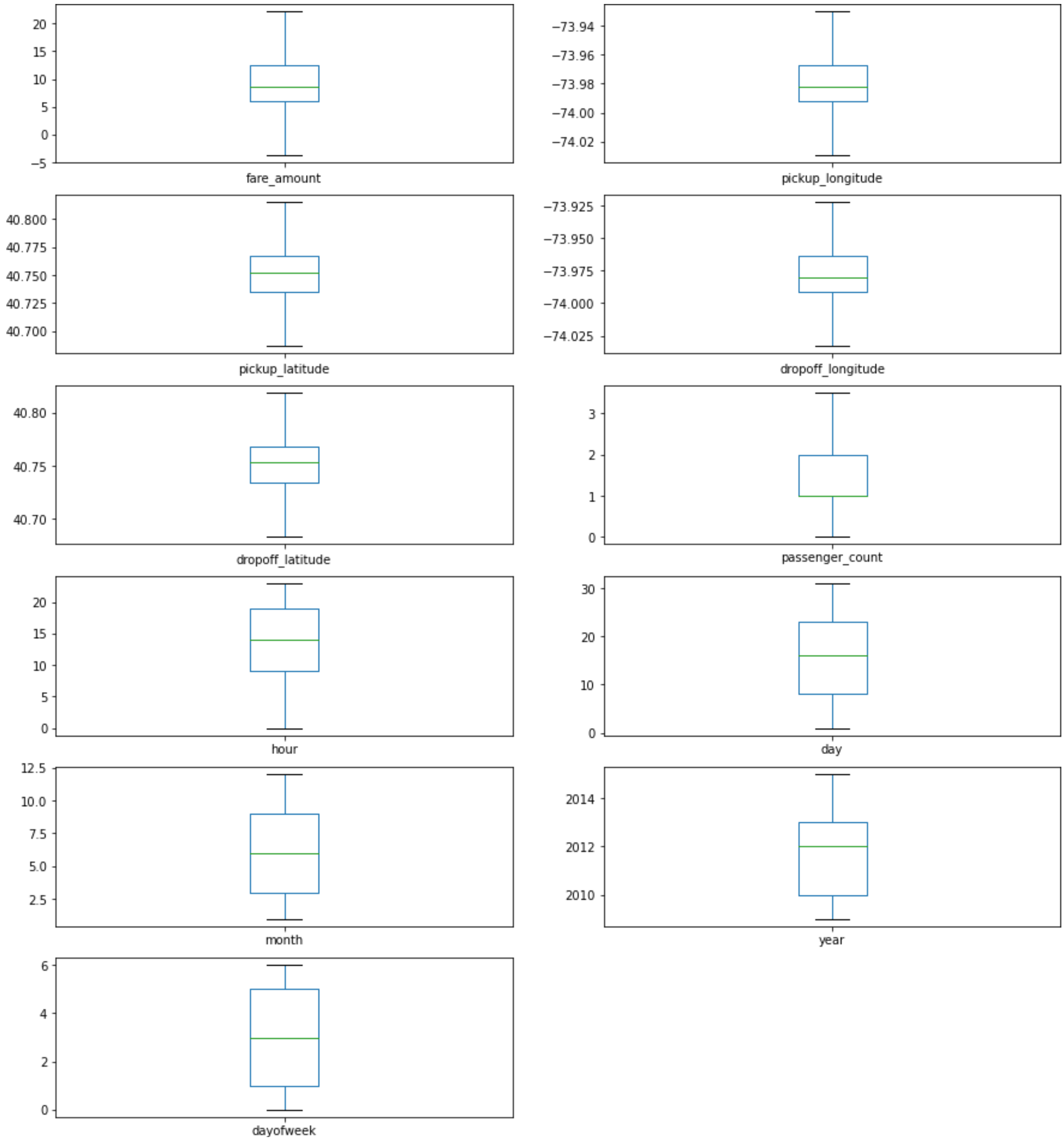
In [12]:

```
def treat_outliers_all(df1 , col_list):
 for c in col_list:
  df1 = remove_outlier(df , c)
 return df1
df = treat_outliers_all(df , df.iloc[: , 0::])
df.plot(kind = "box",subplots = True,layout = (7,2),figsize=(15,20)) #Boxplot shows
```

Out[12]:

```
fare_amount            AxesSubplot(0.125,0.787927;0.352273x0.0920732)
pickup_longitude    AxesSubplot(0.547727,0.787927;0.352273x0.0920732)
pickup_latitude        AxesSubplot(0.125,0.677439;0.352273x0.0920732)
dropoff_longitude  AxesSubplot(0.547727,0.677439;0.352273x0.0920732)
```

```
dropoff_latitude        AxesSubplot(0.125,0.566951;0.352273x0.0920732)
passenger_count      AxesSubplot(0.547727,0.566951;0.352273x0.0920732)
hour                    AxesSubplot(0.125,0.456463;0.352273x0.0920732)
day                  AxesSubplot(0.547727,0.456463;0.352273x0.0920732)
month                   AxesSubplot(0.125,0.345976;0.352273x0.0920732)
year                 AxesSubplot(0.547727,0.345976;0.352273x0.0920732)
dayofweek               AxesSubplot(0.125,0.235488;0.352273x0.0920732)
dtype: object
```



In [14]:

```
pip install haversine
```

```
Collecting haversine
  Downloading haversine-2.7.0-py2.py3-none-any.whl (6.9 kB)
Installing collected packages: haversine
Successfully installed haversine-2.7.0
Note: you may need to restart the kernel to use updated packages.
```

In [22]:

```
import haversine as hs #Calculate the distance using Haversine to calculate the dist
travel_dist = []
for pos in range(len(df['pickup_longitude'])):
    long1,lati1,long2,lati2 = [df['pickup_longitude'][pos],df['pickup_latitude'][pos
    loc1=(lati1,long1)
    loc2=(lati2,long2)
```

```
    c = hs.haversine(loc1,loc2)
    travel_dist.append(c)
print(travel_dist)
df['dist_travel_km'] = travel_dist
df.head()
```

```
IOPub data rate exceeded.
The notebook server will temporarily stop sending output
to the client in order to avoid crashing it.
To change this limit, set the config variable
`--NotebookApp.iopub_data_rate_limit`.

Current values:
NotebookApp.iopub_data_rate_limit=1000000.0 (bytes/sec)
NotebookApp.rate_limit_window=3.0 (secs)
```

Out[22]:

	fare_amount	pickup_longitude	pickup_latitude	dropoff_longitude	dropoff_latitude	passenger_co
0	7.5	-73.999817	40.738354	-73.999512	40.723217	
1	7.7	-73.994355	40.728225	-73.994710	40.750325	
2	12.9	-74.005043	40.740770	-73.962565	40.772647	
3	5.3	-73.976124	40.790844	-73.965316	40.803349	
4	16.0	-73.929786	40.744085	-73.973082	40.761247	

In [23]:

```
df= df.loc[(df.dist_travel_km >= 1) | (df.dist_travel_km <= 130)]
print("Remaining observastions in the dataset:", df.shape)
```

```
Remaining observastions in the dataset: (200000, 12)
```

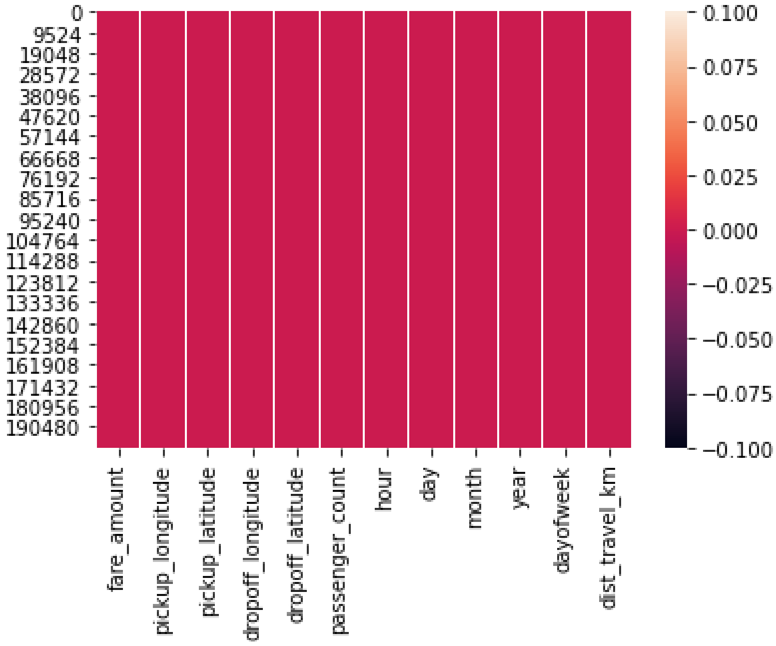
In [26]:

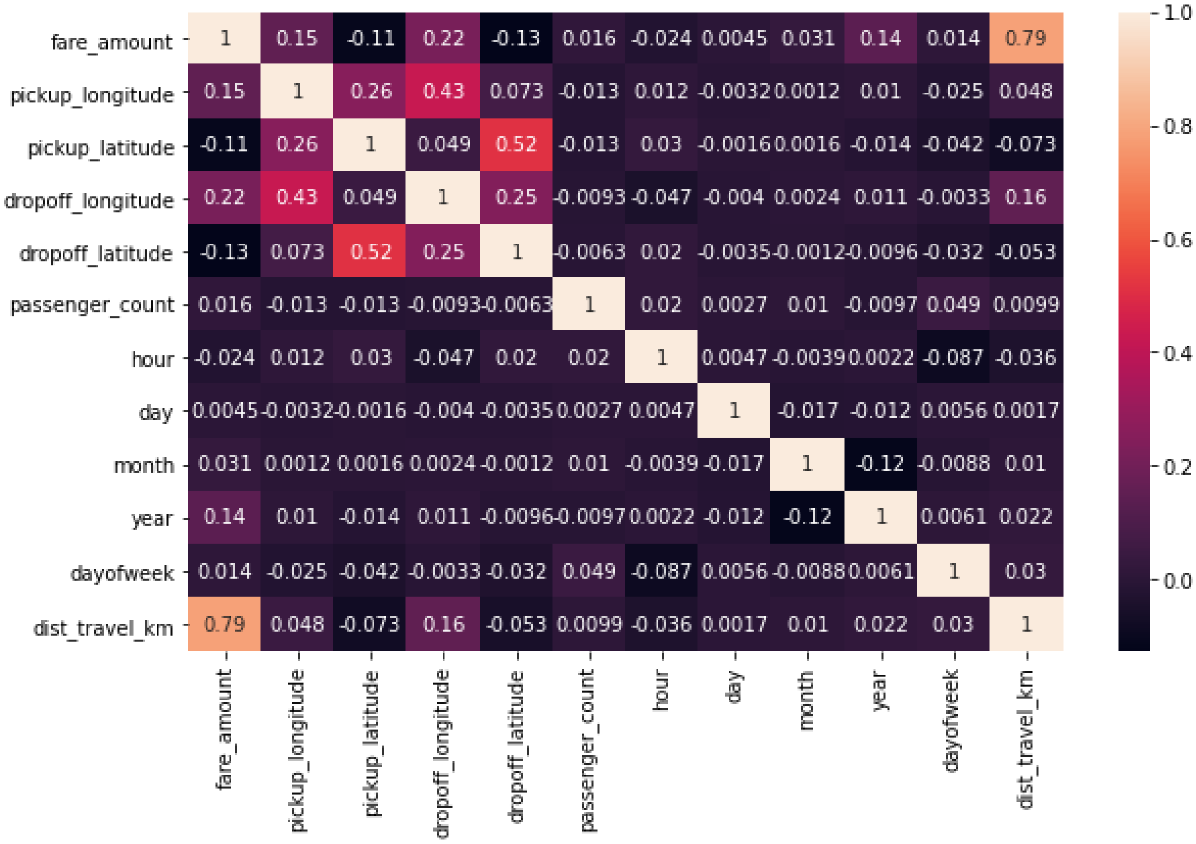
```
incorrect_coordinates = df.loc[(df.pickup_latitude > 90) |(df.pickup_latitude < -90)
 (df.dropoff_latitude > 90) |(df.dropoff_latitude < -90) |
 (df.pickup_longitude > 180) |(df.pickup_longitude < -180) |
 (df.dropoff_longitude > 90) |(df.dropoff_longitude < -90)
 ]



df.drop(incorrect_coordinates, inplace = True, errors = 'ignore')
df.head()
df.isnull().sum()
sns.heatmap(df.isnull()) #Free for null values
corr = df.corr() #Function to find the correlation
corr
fig,axis = plt.subplots(figsize = (10,6))
sns.heatmap(df.corr(),annot = True)
```

Out[26]: <AxesSubplot:>





In [28]:

```
x  =  df[['pickup_longitude','pickup_latitude','dropoff_longitude','dropoff_latitude',
y = df['fare_amount']
```

In [29]:

```
from sklearn.model_selection import train_test_split
X_train,X_test,y_train,y_test = train_test_split(x,y,test_size = 0.33)
```

In [31]:

```
from sklearn.linear_model import LinearRegression
regression = LinearRegression()
regression.fit(X_train,y_train)
regression.coef_ #To find the linear coeeficient
regression.intercept_ #To find the linear intercept
prediction = regression.predict(X_test) #To predict the target values
```

```
print(prediction)
y_test
```

```
[17.28050585 11.44946862 13.22284482 ... 15.04497674 18.34524502
  9.91445235]
```

Out[31]:

```
30406     18.50
122525    13.00
145989    22.25
50071     17.50
2065       4.50
          ...  
95147      4.50
107084    14.10
36958     11.50
65775     14.10
39173      8.50
Name: fare_amount, Length: 66000, dtype: float64
```

In [33]:

```
from sklearn.metrics  import  r2_score
r2_score(y_test,prediction)
from sklearn.metrics  import  mean_squared_error
MSE  =  mean_squared_error(y_test,prediction)
MSE
RMSE = np.sqrt(MSE)
RMSE
3.156187085348032
```

Out[33]:

```
3.156187085348032
```

In [ ]:

****

Assignment No: 2

Title Name: Classify the email using the binary classification method. Email Spam detection has two states: a) Normal State – Not Spam, b) Abnormal State – Spam. Use K-Nearest Neighbors and Support Vector Machine for classification. Analyze their performance.

Name: Aditi Shivani

Class : BE **Div**: 1 **Batch**: A

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In [4]:
```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
%matplotlib inline
import warnings
warnings.filterwarnings('ignore')
from sklearn.model_selection import train_test_split
from sklearn.svm import SVC
from sklearn import metrics
df=pd.read_csv('emails.csv')
df.head()
df.columns
df.isnull().sum()
df.dropna(inplace = True)
df.drop(['Email No.'],axis=1,inplace=True)
X = df.drop(['Prediction'],axis = 1)
y = df['Prediction']
from sklearn.preprocessing import scale
X = scale(X)
# split into train and test
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size = 0.3, random_st
```

In [5]:
```
from sklearn.neighbors import KNeighborsClassifier
knn = KNeighborsClassifier(n_neighbors=7)
knn.fit(X_train, y_train)
y_pred = knn.predict(X_test)
print("Prediction",y_pred)
print("KNN accuracy = ",metrics.accuracy_score(y_test,y_pred))
print("Confusion matrix",metrics.confusion_matrix(y_test,y_pred))
```

```
Prediction [0 0 1 ... 1 1 1]
KNN accuracy =  0.8009020618556701
Confusion matrix [[804 293]
 [ 16 439]]
```

In [6]:
```
# cost C = 1
model = SVC(C = 1)
# fit
model.fit(X_train, y_train)
# predict
y_pred = model.predict(X_test)
metrics.confusion_matrix(y_true=y_test, y_pred=y_pred)
print("SVM accuracy = ",metrics.accuracy_score(y_test,y_pred))
```

```
SVM accuracy =  0.9381443298969072
```

****

Assignment No: 3

Title Name: Given a bank customer, build a neural network-based classifier that can determine whether they will leave or not in the next 6 months

Name: Aditi Shivani

Class : BE **Div**: 1 **Batch**: A

Roll No: 405A005

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In [1]:

```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt #Importing the libraries
df = pd.read_csv("Churn_Modelling.csv")
```

In [2]:

```
df.head()
df.shape
df.describe()
df.isnull()
df.isnull().sum()
df.info()
df.dtypes
df.columns
df = df.drop(['RowNumber', 'Surname', 'CustomerId'], axis= 1) #Dropping the unnecess
df.head()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10000 entries, 0 to 9999
Data columns (total 14 columns):
 #   Column           Non-Null Count  Dtype
---  ------           --------------  -----
 0   RowNumber        10000 non-null  int64
 1   CustomerId       10000 non-null  int64
 2   Surname          10000 non-null  object
 3   CreditScore      10000 non-null  int64
 4   Geography        10000 non-null  object
 5   Gender           10000 non-null  object
 6   Age              10000 non-null  int64
 7   Tenure           10000 non-null  int64
 8   Balance          10000 non-null  float64
 9   NumOfProducts    10000 non-null  int64
 10  HasCrCard        10000 non-null  int64
 11  IsActiveMember   10000 non-null  int64
 12  EstimatedSalary  10000 non-null  float64
 13  Exited           10000 non-null  int64
dtypes: float64(2), int64(9), object(3)
memory usage: 1.1+ MB
```

Out[2]:

	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard	IsActiveM
0	619	France	Female	42	2	0.00	1	1	
1	608	Spain	Female	41	1	83807.86	1	0	
2	502	France	Female	42	8	159660.80	3	1	
3	699	France	Female	39	1	0.00	2	0	
4	850	Spain	Female	43	2	125510.82	1	1	

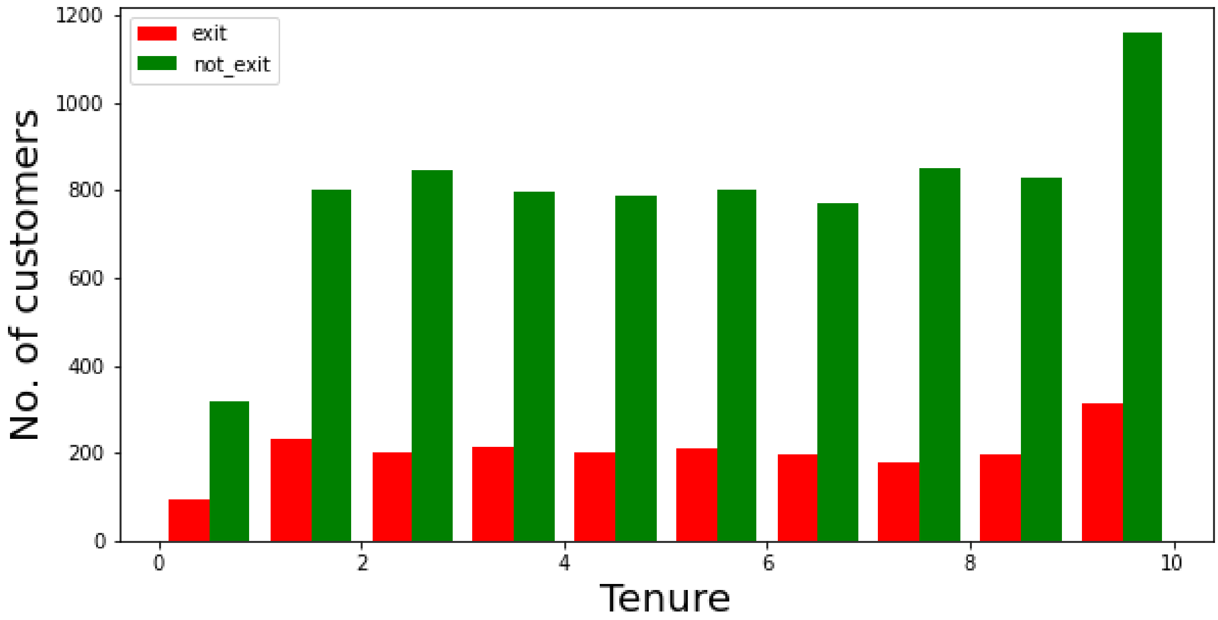
In [3]:

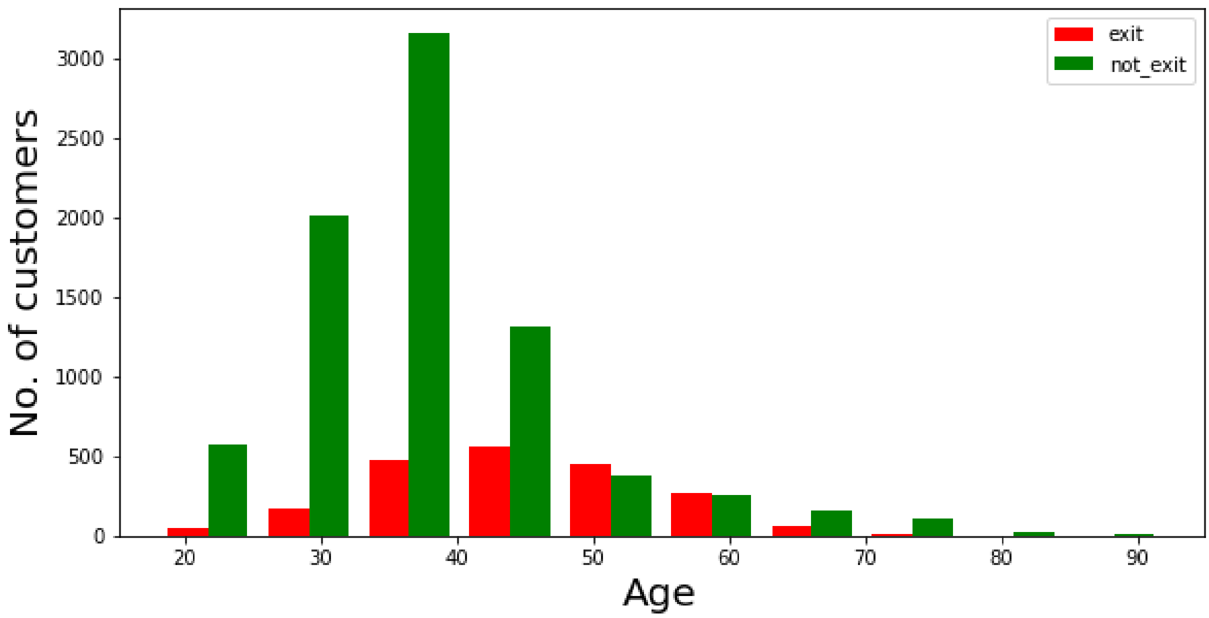
```
def visualization(x, y, xlabel):
     plt.figure(figsize=(10,5))
     plt.hist([x, y], color=['red', 'green'], label = ['exit', 'not_exit'])
     plt.xlabel(xlabel,fontsize=20)
     plt.ylabel("No. of customers", fontsize=20)
     plt.legend()
```

In [4]:

```
df_churn_exited = df[df['Exited']==1]['Tenure']
df_churn_not_exited  =  df[df['Exited']==0]['Tenure']
```

```
visualization(df_churn_exited, df_churn_not_exited, "Tenure")
df_churn_exited2 = df[df['Exited']==1]['Age']
df_churn_not_exited2 = df[df['Exited']==0]['Age']
visualization(df_churn_exited2, df_churn_not_exited2, "Age")
```





In [6]:

```
X = df[['CreditScore','Gender','Age','Tenure','Balance','NumOfProducts','HasCrCard',
states = pd.get_dummies(df['Geography'],drop_first = True)
gender = pd.get_dummies(df['Gender'],drop_first = True)
df = pd.concat([df,gender,states], axis = 1)
```

In [8]:

```
df.head()
X  =  df[['CreditScore','Age','Tenure','Balance','NumOfProducts','HasCrCard','IsActive
y = df['Exited']
from sklearn.model_selection import train_test_split
X_train,X_test,y_train,y_test  = train_test_split(X,y,test_size  =  0.30)
```

In [9]:

```
from sklearn.preprocessing import StandardScaler
sc = StandardScaler()
X_train  = sc.fit_transform(X_train)
X_test = sc.transform(X_test)
```

```
X_train
X_test
```

Out[9]:
```
array([[ 0.08909172,  2.03556129, -1.04195601, ...,  0.90636285,
        -0.57581067,  1.7581737 ],
       [-0.6935785 , -0.3592006 ,  0.33616247, ...,  0.90636285,
        -0.57581067, -0.56877202],
       [ 1.7066102 ,  3.18504699, -1.04195601, ..., -1.10331088,
        -0.57581067,  1.7581737 ],
       ...,
       [ 0.07865612, -0.93394345, -0.35289677, ...,  0.90636285,
        -0.57581067, -0.56877202],
       [-0.46399524, -0.3592006 , -1.73101525, ..., -1.10331088,
        -0.57581067, -0.56877202],
       [ 1.59181856, -0.55078155,  0.33616247, ...,  0.90636285,
        -0.57581067, -0.56877202]])
```

In [10]:
```
import keras#Can use Tenserflow as well but won't be able to understand the errors i
from keras.models import Sequential #To create sequential neural network
from keras.layers import Dense #To create hidden layers
classifier = Sequential()
#To add the layers
#Dense helps to contruct the neurons
#Input Dimension means we have 11 features
# Units is to create the hidden layers
```

In [11]:
```
classifier.add(Dense(activation = "relu",input_dim = 11,units = 6,kernel_initializer
classifier.add(Dense(activation = "relu",units = 6,kernel_initializer = "uniform"))
classifier.add(Dense(activation = "sigmoid",units = 1,kernel_initializer = "uniform"
classifier.compile(optimizer="adam",loss = 'binary_crossentropy',metrics = ['accurac
classifier.summary() #3 layers created. 6 neurons in 1st,6neurons in 2nd layer and 1
classifier.fit(X_train,y_train,batch_size=10,epochs=50) #Fitting the ANN to training
y_pred =classifier.predict(X_test)
y_pred = (y_pred > 0.5) #Predicting the result
from  sklearn.metrics  import  confusion_matrix,accuracy_score,classification_report
cm = confusion_matrix(y_test,y_pred)
cm
accuracy  = accuracy_score(y_test,y_pred)
accuracy
plt.figure(figsize = (10,7))
sns.heatmap(cm,annot = True)
plt.xlabel('Predicted')
plt.ylabel('Truth')
print(classification_report(y_test,y_pred))
```

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 dense (Dense)               (None, 6)                 72

 dense_1 (Dense)             (None, 6)                 42

 dense_2 (Dense)             (None, 1)                 7

=================================================================
Total params: 121
Trainable params: 121
Non-trainable params: 0
_________________________________________________________________
Epoch 1/50
700/700 [==============================] - 1s 675us/step - loss: 0.4841 - accuracy:
0.7970
Epoch 2/50
```

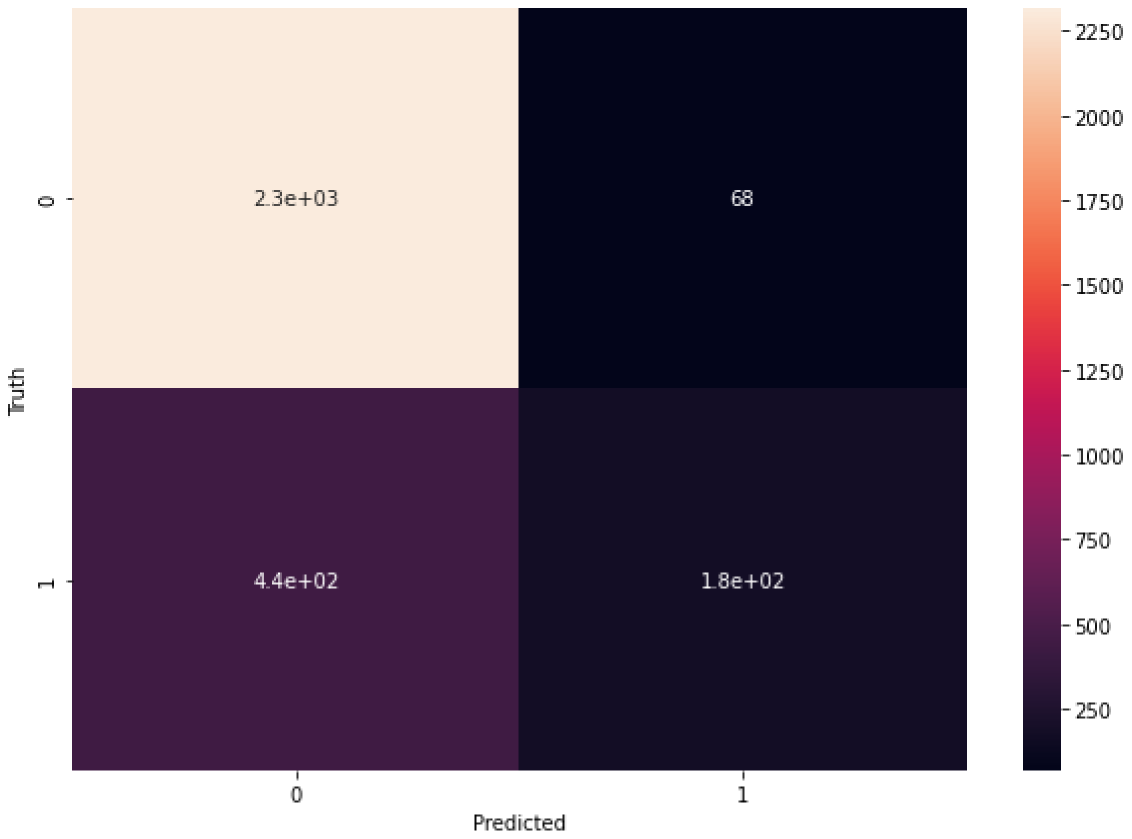
```
700/700 [==============================] - 5s 711us/step - loss: 0.4220 - accuracy:
0.7970
Epoch 3/50
700/700 [==============================] - 0s 715us/step - loss: 0.4165 - accuracy:
0.7990
Epoch 4/50
700/700 [==============================] - 0s 625us/step - loss: 0.4129 - accuracy:
0.8277
Epoch 5/50
700/700 [==============================] - 0s 634us/step - loss: 0.4109 - accuracy:
0.8280
Epoch 6/50
700/700 [==============================] - 1s 736us/step - loss: 0.4093 - accuracy:
0.8304
Epoch 7/50
700/700 [==============================] - 0s 650us/step - loss: 0.4078 - accuracy:
0.8321
Epoch 8/50
700/700 [==============================] - 0s 653us/step - loss: 0.4065 - accuracy:
0.8319
Epoch 9/50
700/700 [==============================] - 0s 640us/step - loss: 0.4053 - accuracy:
0.8350
Epoch 10/50
700/700 [==============================] - 0s 621us/step - loss: 0.4044 - accuracy:
0.8351
Epoch 11/50
700/700 [==============================] - 0s 643us/step - loss: 0.4035 - accuracy:
0.8360
Epoch 12/50
700/700 [==============================] - 0s 700us/step - loss: 0.4024 - accuracy:
0.8360
Epoch 13/50
700/700 [==============================] - 0s 648us/step - loss: 0.4016 - accuracy:
0.8349
Epoch 14/50
700/700 [==============================] - 0s 649us/step - loss: 0.4010 - accuracy:
0.8356
Epoch 15/50
700/700 [==============================] - 0s 712us/step - loss: 0.4005 - accuracy:
0.8361
Epoch 16/50
700/700 [==============================] - 1s 721us/step - loss: 0.3997 - accuracy:
0.8367
Epoch 17/50
700/700 [==============================] - 1s 716us/step - loss: 0.3996 - accuracy:
0.8364
Epoch 18/50
700/700 [==============================] - 0s 703us/step - loss: 0.3988 - accuracy:
0.8371
Epoch 19/50
700/700 [==============================] - 0s 695us/step - loss: 0.3985 - accuracy:
0.8360
Epoch 20/50
700/700 [==============================] - 0s 650us/step - loss: 0.3973 - accuracy:
0.8364
Epoch 21/50
700/700 [==============================] - 0s 641us/step - loss: 0.3978 - accuracy:
0.8369
Epoch 22/50
700/700 [==============================] - 0s 615us/step - loss: 0.3975 - accuracy:
0.8363
Epoch 23/50
700/700 [==============================] - 0s 639us/step - loss: 0.3962 - accuracy:
0.8377
Epoch 24/50
700/700 [==============================] - 0s 649us/step - loss: 0.3966 - accuracy:
0.8359
Epoch 25/50
```

```
700/700 [==============================] - 0s 666us/step - loss: 0.3961 - accuracy:
0.8371
Epoch 26/50
700/700 [==============================] - 0s 630us/step - loss: 0.3959 - accuracy:
0.8373
Epoch 27/50
700/700 [==============================] - 0s 666us/step - loss: 0.3957 - accuracy:
0.8369
Epoch 28/50
700/700 [==============================] - 0s 644us/step - loss: 0.3956 - accuracy:
0.8391
Epoch 29/50
700/700 [==============================] - 0s 594us/step - loss: 0.3956 - accuracy:
0.8379
Epoch 30/50
700/700 [==============================] - 0s 668us/step - loss: 0.3950 - accuracy:
0.8371
Epoch 31/50
700/700 [==============================] - 0s 715us/step - loss: 0.3949 - accuracy:
0.8393
Epoch 32/50
700/700 [==============================] - 0s 705us/step - loss: 0.3950 - accuracy:
0.8376
Epoch 33/50
700/700 [==============================] - 0s 652us/step - loss: 0.3955 - accuracy:
0.8386
Epoch 34/50
700/700 [==============================] - 0s 684us/step - loss: 0.3948 - accuracy:
0.8381
Epoch 35/50
700/700 [==============================] - 0s 661us/step - loss: 0.3944 - accuracy:
0.8387
Epoch 36/50
700/700 [==============================] - 0s 678us/step - loss: 0.3947 - accuracy:
0.8394
Epoch 37/50
700/700 [==============================] - 0s 663us/step - loss: 0.3942 - accuracy:
0.8394
Epoch 38/50
700/700 [==============================] - 0s 711us/step - loss: 0.3939 - accuracy:
0.8397
Epoch 39/50
700/700 [==============================] - 1s 996us/step - loss: 0.3941 - accuracy:
0.8383
Epoch 40/50
700/700 [==============================] - 1s 799us/step - loss: 0.3939 - accuracy:
0.8404
Epoch 41/50
700/700 [==============================] - 1s 863us/step - loss: 0.3938 - accuracy:
0.8396
Epoch 42/50
700/700 [==============================] - 1s 739us/step - loss: 0.3943 - accuracy:
0.8377
Epoch 43/50
700/700 [==============================] - 1s 761us/step - loss: 0.3933 - accuracy:
0.8374
Epoch 44/50
700/700 [==============================] - 1s 919us/step - loss: 0.3938 - accuracy:
0.8389
Epoch 45/50
700/700 [==============================] - 0s 630us/step - loss: 0.3938 - accuracy:
0.8387
Epoch 46/50
700/700 [==============================] - 1s 766us/step - loss: 0.3936 - accuracy:
0.8381
Epoch 47/50
700/700 [==============================] - 0s 623us/step - loss: 0.3935 - accuracy:
0.8386
Epoch 48/50
```

```
700/700 [==============================] - 0s 614us/step - loss: 0.3937 - accuracy:
0.8380
Epoch 49/50
700/700 [==============================] - 1s 763us/step - loss: 0.3934 - accuracy:
0.8399
Epoch 50/50
700/700 [==============================] - 1s 837us/step - loss: 0.3935 - accuracy:
0.8391
              precision    recall  f1-score   support

           0       0.84      0.97      0.90      2384
           1       0.72      0.29      0.41       616

    accuracy                           0.83      3000
   macro avg       0.78      0.63      0.66      3000
weighted avg       0.82      0.83      0.80      3000
```



In [ ]:

****

Assignment No: 4

Title Name: Implement Gradient Descent Algorithm.

Name: Aditi Shivani

Class : BE **Div**: 1 **Batch**: A

Roll No: 405A005

****

In [1]:

```
cur_x = 3 # The algorithm starts at x=3
rate = 0.01 # Learning rate
precision = 0.000001 #This tells us when to stop the algorithm
previous_step_size = 1 #
max_iters = 10000 # maximum number of iterations
iters = 0 #iteration counter
df = lambda x: 2*(x+5) #Gradient of our function
```

In [2]:

```
while previous_step_size > precision and iters < max_iters:
     prev_x = cur_x #Store current x value in prev_x
     cur_x = cur_x - rate * df(prev_x) #Grad descent
     previous_step_size = abs(cur_x - prev_x) #Change in x
     iters = iters+1 #iteration count
     print("Iteration",iters,"\nX value is",cur_x) #Print iterations
     print("The local minimum occurs at", cur_x)
```

```
Iteration 1
X value is 2.84
The local minimum occurs at 2.84
Iteration 2
X value is 2.6832
The local minimum occurs at 2.6832
Iteration 3
X value is 2.529536
The local minimum occurs at 2.529536
Iteration 4
X value is 2.37894528
The local minimum occurs at 2.37894528
Iteration 5
X value is 2.2313663744
The local minimum occurs at 2.2313663744
Iteration 6
X value is 2.0867390469119997
The local minimum occurs at 2.0867390469119997
Iteration 7
X value is 1.9450042659737599
The local minimum occurs at 1.9450042659737599
Iteration 8
X value is 1.8061041806542846
The local minimum occurs at 1.8061041806542846
Iteration 9
X value is 1.669982097041199
The local minimum occurs at 1.669982097041199
Iteration 10
X value is 1.5365824551003748
The local minimum occurs at 1.5365824551003748
Iteration 11
X value is 1.4058508059983674
The local minimum occurs at 1.4058508059983674
Iteration 12
X value is 1.2777337898784
The local minimum occurs at 1.2777337898784
Iteration 13
X value is 1.152179114080832
```

```
Iteration 17
X value is 0.6745741294451669
The local minimum occurs at 0.6745741294451669
Iteration 18
X value is 0.5610826468562635
The local minimum occurs at 0.5610826468562635
Iteration 19
X value is 0.44986099391913825
The local minimum occurs at 0.44986099391913825
Iteration 20
X value is 0.3408637740407555
The local minimum occurs at 0.3408637740407555
Iteration 21
X value is 0.23404649855994042
The local minimum occurs at 0.23404649855994042
Iteration 22
X value is 0.1293655685887416
The local minimum occurs at 0.1293655685887416
Iteration 23
X value is 0.026778257216966764
The local minimum occurs at 0.026778257216966764
Iteration 24
X value is -0.07375730792737258
The local minimum occurs at -0.07375730792737258
Iteration 25
X value is -0.1722821617688251
The local minimum occurs at -0.1722821617688251
Iteration 26
X value is -0.2688365185334486
The local minimum occurs at -0.2688365185334486
Iteration 27
X value is -0.36345978816277963
The local minimum occurs at -0.36345978816277963
Iteration 28
X value is -0.45619059239952403
The local minimum occurs at -0.45619059239952403
Iteration 29
X value is -0.5470667805515336
The local minimum occurs at -0.5470667805515336
Iteration 30
X value is -0.6361254449405029
The local minimum occurs at -0.6361254449405029
Iteration 31
X value is -0.7234029360416929
The local minimum occurs at -0.7234029360416929
Iteration 32
X value is -0.8089348773208591
The local minimum occurs at -0.8089348773208591
Iteration 33
X value is -0.8927561797744419
The local minimum occurs at -0.8927561797744419
Iteration 34
X value is -0.9749010561789531
The local minimum occurs at -0.9749010561789531
Iteration 35
X value is -1.055403035055374
The local minimum occurs at -1.055403035055374
Iteration 36
X value is -1.1342949743542665
The local minimum occurs at -1.1342949743542665
Iteration 37
X value is -1.2116090748671813
The local minimum occurs at -1.2116090748671813
Iteration 38
X value is -1.2873768933698377
The local minimum occurs at -1.2873768933698377
Iteration 39
X value is -1.361629355502441
The local minimum occurs at -1.361629355502441
```

```
Iteration 40
X value is -1.4343967683923922
The local minimum occurs at -1.4343967683923922
Iteration 41
X value is -1.5057088330245443
The local minimum occurs at -1.5057088330245443
Iteration 42
X value is -1.5755946563640535
The local minimum occurs at -1.5755946563640535
Iteration 43
X value is -1.6440827632367725
The local minimum occurs at -1.6440827632367725
Iteration 44
X value is -1.711201107972037
The local minimum occurs at -1.711201107972037
Iteration 45
X value is -1.7769770858125964
The local minimum occurs at -1.7769770858125964
Iteration 46
X value is -1.8414375440963444
The local minimum occurs at -1.8414375440963444
Iteration 47
X value is -1.9046087932144176
The local minimum occurs at -1.9046087932144176
Iteration 48
X value is -1.9665166173501292
The local minimum occurs at -1.9665166173501292
Iteration 49
X value is -2.0271862850031264
The local minimum occurs at -2.0271862850031264
Iteration 50
X value is -2.0866425593030637
The local minimum occurs at -2.0866425593030637
Iteration 51
X value is -2.1449097081170025
The local minimum occurs at -2.1449097081170025
Iteration 52
X value is -2.2020115139546625
The local minimum occurs at -2.2020115139546625
Iteration 53
X value is -2.257971283675569
The local minimum occurs at -2.257971283675569
Iteration 54
X value is -2.312811858002058
The local minimum occurs at -2.312811858002058
Iteration 55
X value is -2.3665556208420164
The local minimum occurs at -2.3665556208420164
Iteration 56
X value is -2.419224508425176
The local minimum occurs at -2.419224508425176
Iteration 57
X value is -2.4708400182566725
The local minimum occurs at -2.4708400182566725
Iteration 58
X value is -2.521423217891539
The local minimum occurs at -2.521423217891539
Iteration 59
X value is -2.570994753533708
The local minimum occurs at -2.570994753533708
Iteration 60
X value is -2.619574858463034
The local minimum occurs at -2.619574858463034
Iteration 61
X value is -2.667183361293773
The local minimum occurs at -2.667183361293773
Iteration 62
X value is -2.713839694067898
The local minimum occurs at -2.361629355502441
```

```
Iteration 63
X value is -2.75956290018654
The local minimum occurs at -2.75956290018654
Iteration 64
X value is -2.804371642182809
The local minimum occurs at -2.804371642182809
Iteration 65
X value is -2.8482842093391527
The local minimum occurs at -2.8482842093391527
Iteration 66
X value is -2.8913185251523696
The local minimum occurs at -2.8913185251523696
Iteration 67
X value is -2.9334921546493224
The local minimum occurs at -2.9334921546493224
Iteration 68
X value is -2.974822311556336
The local minimum occurs at -2.974822311556336
Iteration 69
X value is -3.015325865325209
The local minimum occurs at -3.015325865325209
Iteration 70
X value is -3.055019348018705
The local minimum occurs at -3.055019348018705
Iteration 71
X value is -3.093918961058331
The local minimum occurs at -3.093918961058331
Iteration 72
X value is -3.1320405818371646
The local minimum occurs at -3.1320405818371646
Iteration 73
X value is -3.1693997702004215
The local minimum occurs at -3.1693997702004215
Iteration 74
X value is -3.206011774796413
The local minimum occurs at -3.206011774796413
Iteration 75
X value is -3.2418915393004846
The local minimum occurs at -3.2418915393004846
Iteration 76
X value is -3.277053708514475
The local minimum occurs at -3.277053708514475
Iteration 77
X value is -3.3115126343441856
The local minimum occurs at -3.3115126343441856
Iteration 78
X value is -3.345282381657302
The local minimum occurs at -3.345282381657302
Iteration 79
X value is -3.378376734024156
The local minimum occurs at -3.378376734024156
Iteration 80
X value is -3.4108091993436727
The local minimum occurs at -3.4108091993436727
Iteration 81
X value is -3.4425930153567994
The local minimum occurs at -3.4425930153567994
Iteration 82
X value is -3.4737411550496633
The local minimum occurs at -3.4737411550496633
Iteration 83
X value is -3.50426633194867
The local minimum occurs at -3.50426633194867
Iteration 84
X value is -3.534181005309697
The local minimum occurs at -3.534181005309697
Iteration 85
X value is -3.563497385203503
The local minimum occurs at -3.361629355502441
```

```
Iteration 86
X value is -3.5922274374994325
The local minimum occurs at -3.5922274374994325
Iteration 87
X value is -3.620382888749444
The local minimum occurs at -3.620382888749444
Iteration 88
X value is -3.6479752309744553
The local minimum occurs at -3.6479752309744553
Iteration 89
X value is -3.675015726354966
The local minimum occurs at -3.675015726354966
Iteration 90
X value is -3.7015154118278666
The local minimum occurs at -3.7015154118278666
Iteration 91
X value is -3.7274851035913095
The local minimum occurs at -3.7274851035913095
Iteration 92
X value is -3.7529354015194833
The local minimum occurs at -3.7529354015194833
Iteration 93
X value is -3.7778766934890937
The local minimum occurs at -3.7778766934890937
Iteration 94
X value is -3.8023191596193118
The local minimum occurs at -3.8023191596193118
Iteration 95
X value is -3.8262727764269258
The local minimum occurs at -3.8262727764269258
Iteration 96
X value is -3.8497473208983872
The local minimum occurs at -3.8497473208983872
Iteration 97
X value is -3.8727523744804193
The local minimum occurs at -3.8727523744804193
Iteration 98
X value is -3.895297326990811
The local minimum occurs at -3.895297326990811
Iteration 99
X value is -3.917391380450995
The local minimum occurs at -3.917391380450995
Iteration 100
X value is -3.939043552841975
The local minimum occurs at -3.939043552841975
Iteration 101
X value is -3.9602626817851356
The local minimum occurs at -3.9602626817851356
Iteration 102
X value is -3.981057428149433
The local minimum occurs at -3.981057428149433
Iteration 103
X value is -4.001436279586445
The local minimum occurs at -4.001436279586445
Iteration 104
X value is -4.021407553994716
The local minimum occurs at -4.021407553994716
Iteration 105
X value is -4.040979402914822
The local minimum occurs at -4.040979402914822
Iteration 106
X value is -4.060159814856525
The local minimum occurs at -4.060159814856525
Iteration 107
X value is -4.078956618559395
The local minimum occurs at -4.078956618559395
Iteration 108
X value is -4.097377486188207
The local minimum occurs at -4.361629355502441
```

```
Iteration 109
X value is -4.115429936464443
The local minimum occurs at -4.115429936464443
Iteration 110
X value is -4.133121337735154
The local minimum occurs at -4.133121337735154
Iteration 111
X value is -4.150458910980451
The local minimum occurs at -4.150458910980451
Iteration 112
X value is -4.167449732760842
The local minimum occurs at -4.167449732760842
Iteration 113
X value is -4.1841007381056246
The local minimum occurs at -4.1841007381056246
Iteration 114
X value is -4.200418723343512
The local minimum occurs at -4.200418723343512
Iteration 115
X value is -4.216410348876642
The local minimum occurs at -4.216410348876642
Iteration 116
X value is -4.2320821418991095
The local minimum occurs at -4.2320821418991095
Iteration 117
X value is -4.247440499061128
The local minimum occurs at -4.247440499061128
Iteration 118
X value is -4.262491689079905
The local minimum occurs at -4.262491689079905
Iteration 119
X value is -4.277241855298307
The local minimum occurs at -4.277241855298307
Iteration 120
X value is -4.291697018192341
The local minimum occurs at -4.291697018192341
Iteration 121
X value is -4.305863077828494
The local minimum occurs at -4.305863077828494
Iteration 122
X value is -4.319745816271924
The local minimum occurs at -4.319745816271924
Iteration 123
X value is -4.333350899946486
The local minimum occurs at -4.333350899946486
Iteration 124
X value is -4.3466838819475555
The local minimum occurs at -4.3466838819475555
Iteration 125
X value is -4.359750204308605
The local minimum occurs at -4.359750204308605
Iteration 126
X value is -4.372555200222433
The local minimum occurs at -4.372555200222433
Iteration 127
X value is -4.385104096217984
The local minimum occurs at -4.385104096217984
Iteration 128
X value is -4.3974020142936245
The local minimum occurs at -4.3974020142936245
Iteration 129
X value is -4.409453974007752
The local minimum occurs at -4.409453974007752
Iteration 130
X value is -4.421264894527597
The local minimum occurs at -4.421264894527597
Iteration 131
X value is -4.432839596637045
The local minimum occurs at -4.432839596637045
```

```
Iteration 132
X value is -4.444182804704305
The local minimum occurs at -4.444182804704305
Iteration 133
X value is -4.4552991486102185
The local minimum occurs at -4.4552991486102185
Iteration 134
X value is -4.466193165638014
The local minimum occurs at -4.466193165638014
Iteration 135
X value is -4.4768693023252535
The local minimum occurs at -4.4768693023252535
Iteration 136
X value is -4.487331916278748
The local minimum occurs at -4.487331916278748
Iteration 137
X value is -4.497585277953173
The local minimum occurs at -4.497585277953173
Iteration 138
X value is -4.50763357239411
The local minimum occurs at -4.50763357239411
Iteration 139
X value is -4.517480900946228
The local minimum occurs at -4.517480900946228
Iteration 140
X value is -4.527131282927304
The local minimum occurs at -4.527131282927304
Iteration 141
X value is -4.536588657268758
The local minimum occurs at -4.536588657268758
Iteration 142
X value is -4.545856884123382
The local minimum occurs at -4.545856884123382
Iteration 143
X value is -4.5549397464409145
The local minimum occurs at -4.5549397464409145
Iteration 144
X value is -4.563840951512097
The local minimum occurs at -4.563840951512097
Iteration 145
X value is -4.572564132481855
The local minimum occurs at -4.572564132481855
Iteration 146
X value is -4.581112849832218
The local minimum occurs at -4.581112849832218
Iteration 147
X value is -4.589490592835574
The local minimum occurs at -4.589490592835574
Iteration 148
X value is -4.597700780978863
The local minimum occurs at -4.597700780978863
Iteration 149
X value is -4.605746765359285
The local minimum occurs at -4.605746765359285
Iteration 150
X value is -4.6136318300521
The local minimum occurs at -4.6136318300521
Iteration 151
X value is -4.621359193451058
The local minimum occurs at -4.621359193451058
Iteration 152
X value is -4.628932009582036
The local minimum occurs at -4.628932009582036
Iteration 153
X value is -4.636353369390395
The local minimum occurs at -4.636353369390395
Iteration 154
X value is -4.643626302002588
The local minimum occurs at -4.643626302002588
```

```
Iteration 155
X value is -4.650753775962536
The local minimum occurs at -4.650753775962536
Iteration 156
X value is -4.657738700443285
The local minimum occurs at -4.657738700443285
Iteration 157
X value is -4.664583926434419
The local minimum occurs at -4.664583926434419
Iteration 158
X value is -4.671292247905731
The local minimum occurs at -4.671292247905731
Iteration 159
X value is -4.6778664029476165
The local minimum occurs at -4.6778664029476165
Iteration 160
X value is -4.684309074888664
The local minimum occurs at -4.684309074888664
Iteration 161
X value is -4.6906228933908904
The local minimum occurs at -4.6906228933908904
Iteration 162
X value is -4.696810435523073
The local minimum occurs at -4.696810435523073
Iteration 163
X value is -4.702874226812612
The local minimum occurs at -4.702874226812612
Iteration 164
X value is -4.708816742276359
The local minimum occurs at -4.708816742276359
Iteration 165
X value is -4.714640407430832
The local minimum occurs at -4.714640407430832
Iteration 166
X value is -4.720347599282215
The local minimum occurs at -4.720347599282215
Iteration 167
X value is -4.725940647296571
The local minimum occurs at -4.725940647296571
Iteration 168
X value is -4.731421834350639
The local minimum occurs at -4.731421834350639
Iteration 169
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X value is -4.742057529710355
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The local minimum occurs at -4.766840436727223
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Iteration 407
X value is -4.997851661092361
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Iteration 591
X value is -4.999947796367794
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Iteration 592
X value is -4.999948840440438
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Iteration 593
X value is -4.999949863631629
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Iteration 594
X value is -4.999950866358997
The local minimum occurs at -4.999950866358997
Iteration 595
X value is -4.9999518490318176
The local minimum occurs at -4.9999518490318176
```

In [ ]:

****

Assignment No: 5

Title Name: Implement K-Nearest Neighbors algorithm

Name: Aditi Shivani

Class : BE **Div**: 1 **Batch**: A

Roll No: 405A005

****

In [1]:

```
import numpy as np
import pandas as pd
import math
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.neighbors import KNeighborsClassifier
from sklearn import metrics
from sklearn.model_selection import cross_val_score
from sklearn.model_selection import KFold
%matplotlib inline


location = 'diabetes.csv'
f = pd.read_csv(location)
data = pd.DataFrame(f)
data.head()
```

Out[1]:

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	Pedigree	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 [2]:

```
cols_clean  =  ['Glucose','BloodPressure','SkinThickness','Insulin','BMI','Pedigree']

# with this function , i dealt with missing values and NaN values
for i in cols_clean:
    data[i] = data[i].replace(0,np.NaN)
    cols_mean = int(data[i].mean(skipna=True))
    data[i] = data[i].replace(np.NaN, cols_mean)
data1 = data
data1.head().style.highlight_max(color="lightblue").highlight_min(color="red")
```

Out[2]:

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	Pedigree	Age	O
0	6	148.000000	72.000000	35.000000	155.000000	33.600000	0.627000	50	
1	1	85.000000	66.000000	29.000000	155.000000	26.600000	0.351000	31	
2	8	183.000000	64.000000	29.000000	155.000000	23.300000	0.672000	32	
3	1	89.000000	66.000000	23.000000	94.000000	28.100000	0.167000	21	

4	0	137.000000	40.000000	35.000000	168.000000	43.100000	2.288000	33

In [3]:

```
print(data1.describe())
```

```
       Pregnancies     Glucose  BloodPressure  SkinThickness    Insulin  \
count   768.000000  768.000000     768.000000     768.000000  768.00000
mean      3.845052  121.682292      72.386719      29.108073  155.28125
std       3.369578   30.435999      12.096642       8.791221   85.02155
min       0.000000   44.000000      24.000000       7.000000   14.00000
25%       1.000000   99.750000      64.000000      25.000000  121.50000
50%       3.000000  117.000000      72.000000      29.000000  155.00000
```

```
75%       6.000000  140.250000      80.000000      32.000000  155.00000
max      17.000000  199.000000     122.000000      99.000000  846.00000

              BMI    Pedigree         Age     Outcome
count  768.000000  768.000000  768.000000  768.000000
mean    32.450911    0.471876   33.240885    0.348958
std      6.875366    0.331329   11.760232    0.476951
min     18.200000    0.078000   21.000000    0.000000
25%     27.500000    0.243750   24.000000    0.000000
50%     32.000000    0.372500   29.000000    0.000000
75%     36.600000    0.626250   41.000000    1.000000
max     67.100000    2.420000   81.000000    1.000000
```

In [4]:

```
# for the purpose of simplicity and analysing the most relevent  data , we will sele
# Glucose , Insulin and BMI
q_cols = ['Glucose','Insulin','BMI','Outcome']

# defining variables and features for the dataset for splitting
df = data1[q_cols]
print(df.head(2))
```

```
   Glucose  Insulin   BMI  Outcome
0    148.0    155.0  33.6        1
1     85.0    155.0  26.6        0
```

In [5]:

```
# let's split the data into training and testing datasets
split = 0.75 # 75% train and 25% test dataset
total_len = len(df)
split_df  = int(total_len*split)
train, test  = df.iloc[:split_df,0:4],df.iloc[split_df:,0:4]
train_x = train[['Glucose','Insulin','BMI']]
train_y  = train['Outcome']
test_x  = test[['Glucose','Insulin','BMI']]
test_y = test['Outcome']
```

In [6]:

```
a = len(train_x)
b = len(test_x)
print(' Training data =',a,'\n','Testing data =',b,'\n','Total data length = ',a+b)
```

```
 Training data = 576
 Testing data = 192
 Total data length =  768
```

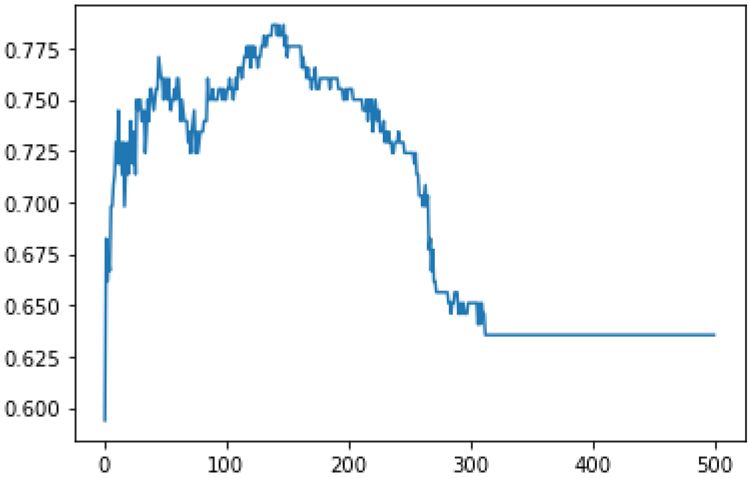
In [7]:

```
def knn(x_train, y_train, x_test, y_test,n):
    n_range = range(1, n)
    results = []
    for n in n_range:
        knn  = KNeighborsClassifier(n_neighbors=n)
        knn.fit(x_train, y_train)
        #Predict the response for test dataset
        predict_y = knn.predict(x_test)
        accuracy  = metrics.accuracy_score(y_test, predict_y)
        #matrix  = confusion_matrix(y_test,predict_y)
        #seaborn_matrix  = sns.heatmap(matrix, annot  = True, cmap="Blues",cbar=True)
        results.append(accuracy)
    return results
```

In [8]:

```
n= 500
output  = knn(train_x,train_y,test_x,test_y,n)
n_range  = range(1, n)
plt.plot(n_range, output)
```

Out[8]: [<matplotlib.lines.Line2D at 0x1f812813580>]



In [ ]:

****

Assignment : ML Mini Project

Title Name: Build a machine learning model that predicts the type of people who survived the Titanic shipwreck using passenger data (i.e. name, age, gender, socio-economic class, etc.).

Name: Aditi Shivani

Class : BE **Div**: 1 **Batch**: A

Roll No: 405A005

****

Title: Build a machine learning model that predicts the type of people who survived the Titanic shipwreck using passenger data (i.e. name, age, gender, socio-economic class, etc.).

Problem Statement: Write a program for building a model that predicts the type of people who survived the Titanic shipwreckusing passenger data (i.e. name, age, gender, socio-economic class, etc.).

Prerequisites: Random Forest Classifer

Objectives: To build a machine learning model that predicts the type of people who survived the Titanic shipwreck using passenger data (i.e. name, age, gender, socio-economic class, etc.).

Theory:

Random Forest Classifier:
Random Forest is a supervised learning algorithm.

It uses the *ensemble learning technique.*(Ensemble learning is using multiple algorithms at a time or a single algorithm multiple times to make a model more powerful) to build several decision trees at random data points. Then their predictions are averaged. Taking the average value of predictions made by several decision trees and then predict the final result.You can take reference from the above image.

Types of Random Forest models:

1. Random Forest Prediction for a classification problem.

2. Random Forest Prediction for a regression problem.

What is Random Forest Classification?

1. It is an ensemble tree-based learning algorithm.
2. The Random Forest Classifier is a set of decision trees from randomly selected subset of training set.
3. It *aggregates the votes from different decision trees* to decide the final class of the test object.
4. *Random forest algorithm creates decision trees on data samples and then gets the prediction from each of them and finally selects the best solution by means of voting.*

Structure of Random Forest

How does Random Forest Algorithm works?

Let us understand the working of Random Forest algorithm with the help of following steps −

- Step 1 − First, start with the selection of random samples from a given dataset.
- Step 2 − Next, this algorithm will construct a decision tree for every sample. Then it will get the prediction result from every decision tree.
- Step 3 − In this step, voting will be performed for every predicted result.
- Step 4 − At last, select the most voted prediction result as the final prediction result.

In [1]:

```python
# Linear algebra
import numpy as np

# data processing
import pandas as pd

# data visualization
import seaborn as sns
%matplotlib inline
from matplotlib import pyplot as plt
from matplotlib import style

# Algorithms
from sklearn import linear_model
from  sklearn.linear_model  import  LogisticRegression
from  sklearn.ensemble  import  RandomForestClassifier
from sklearn.linear_model import Perceptron
from sklearn.linear_model import  SGDClassifier
from sklearn.tree import DecisionTreeClassifier
from sklearn.neighbors import KNeighborsClassifier
from sklearn.svm import SVC, LinearSVC
from sklearn.naive_bayes import GaussianNB

from sklearn.datasets import  make_classification
from sklearn.model_selection import train_test_split
from sklearn.pipeline import make_pipeline
from sklearn.preprocessing import StandardScaler
from sklearn import preprocessing
```

In [2]:

```python
test_df = pd.read_csv("test.csv")
train_df = pd.read_csv("train.csv")
```

In [3]:

```python
train_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex:  891 entries,  0  to  890
Data columns (total 12 columns):
 #   Column      Non-Null Count  Dtype
----  ------------------------------  ---------
0    PassengerId 891  non-null    int64
1    Survived    891  non-null    int64
2    Pclass      891  non-null    int64
3    Name        891  non-null    object
4    Sex         891  non-null    object
5    Age         714  non-null    float64
6    SibSp       891  non-null    int64
7    Parch       891  non-null    int64
```

```
 8   Ticket    891   non-null    object
 9   Fare      891   non-null    float64
 10  Cabin     204   non-null    object
 11  Embarked  889   non-null    object
dtypes:  float64(2),  int64(5),  object(5)
memory usage: 83.7+ KB
```

In [4]:

```python
train_df.describe()
```

Out[4]:

	PassengerId	Survived	Pclass	Age	SibSp	Parch	Fare
count	891.000000	891.000000	891.000000	714.000000	891.000000	891.000000	891.000000

	PassengerId	Survived	Pclass	Age	SibSp	Parch	Fare
mean	446.000000	0.383838	2.308642	29.699118	0.523008	0.381594	32.204208
std	257.353842	0.486592	0.836071	14.526497	1.102743	0.806057	49.693429
min	1.000000	0.000000	1.000000	0.420000	0.000000	0.000000	0.000000
25%	223.500000	0.000000	2.000000	20.125000	0.000000	0.000000	7.910400
50%	446.000000	0.000000	3.000000	28.000000	0.000000	0.000000	14.454200
75%	668.500000	1.000000	3.000000	38.000000	1.000000	0.000000	31.000000
max	891.000000	1.000000	3.000000	80.000000	8.000000	6.000000	512.329200

In [5]:

```
train_df.head(8)
```

Out[5]:

	PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare	Cabin
0	1	0	3	Braund, Mr. Owen Harris	male	22.0	1	0	A/5 21171	7.2500	NaN
1	2	1	1	Cumings, Mrs. John Bradley (Florence Briggs Th...	female	38.0	1	0	PC 17599	71.2833	C85
2	3	1	3	Heikkinen, Miss. Laina	female	26.0	0	0	STON/O2. 3101282	7.9250	NaN
3	4	1	1	Futrelle, Mrs. Jacques Heath (Lily May Peel)	female	35.0	1	0	113803	53.1000	C123
4	5	0	3	Allen, Mr. Will am Henry	male	35.0	0	0	373450	8.0500	NaN
5	6	0	3	Mo an,	male	NaN	0	0	330877	8.4583	NaN
6	7	0	1	McCar hy, Mr. Timothy J	male	54.0	0	0	17463	51.8625	E46
7	8	0	3	Palsson, Master. Gosta Leonard	male	2.0	3	1	349909	21.0750	NaN

In [6]:

```
total = train_df.isnull().sum().sort_values(ascending=False)
percent_1 = train_df.isnull().sum()/train_df.isnull().count()*100
percent_2 = (round(percent_1, 1)).sort_values(ascending=False)
missing_data = pd.concat([total, percent_2], axis=1, keys=['Total', '%'])
missing_data.head(5)
```

Out[6]:

	Total	%
Cabin	687	77.1
Age	177	19.9
Embarked	2	0.2
PassengerId	0	0.0
Survived	0	0.0

In [7]:

```
train_df.columns.values
```

Out[7]:

```
array(['PassengerId', 'Survived', 'Pclass', 'Name', 'Sex', 'Age', 'SibSp',
       'Parch', 'Ticket', 'Fare', 'Cabin', 'Embarked'], dtype=object)
```

In [8]:

```
survived = 'survived'
not_survived = 'not survived'
fig, axes = plt.subplots(nrows=1, ncols=2,figsize=(10, 4))
women = train_df[train_df['Sex']=='female']
men = train_df[train_df['Sex']=='male']
ax = sns.distplot(women[women['Survived']==1].Age.dropna(), bins=18, label = survive
ax = sns.distplot(women[women['Survived']==0].Age.dropna(), bins=40, label = not_sur
ax.legend()
ax.set_title('Female')
ax = sns.distplot(men[men['Survived']==1].Age.dropna(), bins=18, label = survived, a
ax = sns.distplot(men[men['Survived']==0].Age.dropna(), bins=40, label = not_survive
ax.legend()
_ = ax.set_title('Male')
```

```
C:\Users\hp\anaconda3\lib\site-packages\seaborn\distributions.py:2557: FutureWarnin
g: `distplot` is a deprecated function and will be removed in a future version. Plea
se adapt your code to use either `displot` (a figure-level function with similar fle
xibility) or `histplot` (an axes-level function for histograms).
  warnings.warn(msg, FutureWarning)
C:\Users\hp\anaconda3\lib\site-packages\seaborn\distributions.py:2557: FutureWarnin
g: `distplot` is a deprecated function and will be removed in a future version. Plea
se adapt your code to use either `displot` (a figure-level function with similar fle
xibility) or `histplot` (an axes-level function for histograms).
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  warnings.warn(msg, FutureWarning)
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g: `distplot` is a deprecated function and will be removed in a future version. Plea
se adapt your code to use either `displot` (a figure-level function with similar fle
xibility) or `histplot` (an axes-level function for histograms).
  warnings.warn(msg, FutureWarning)
```
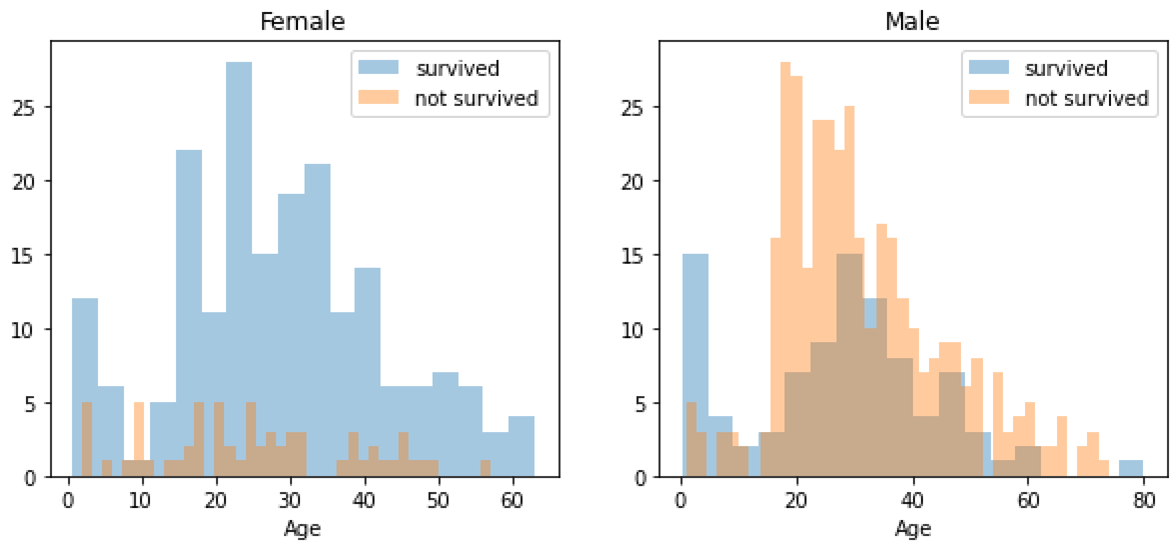
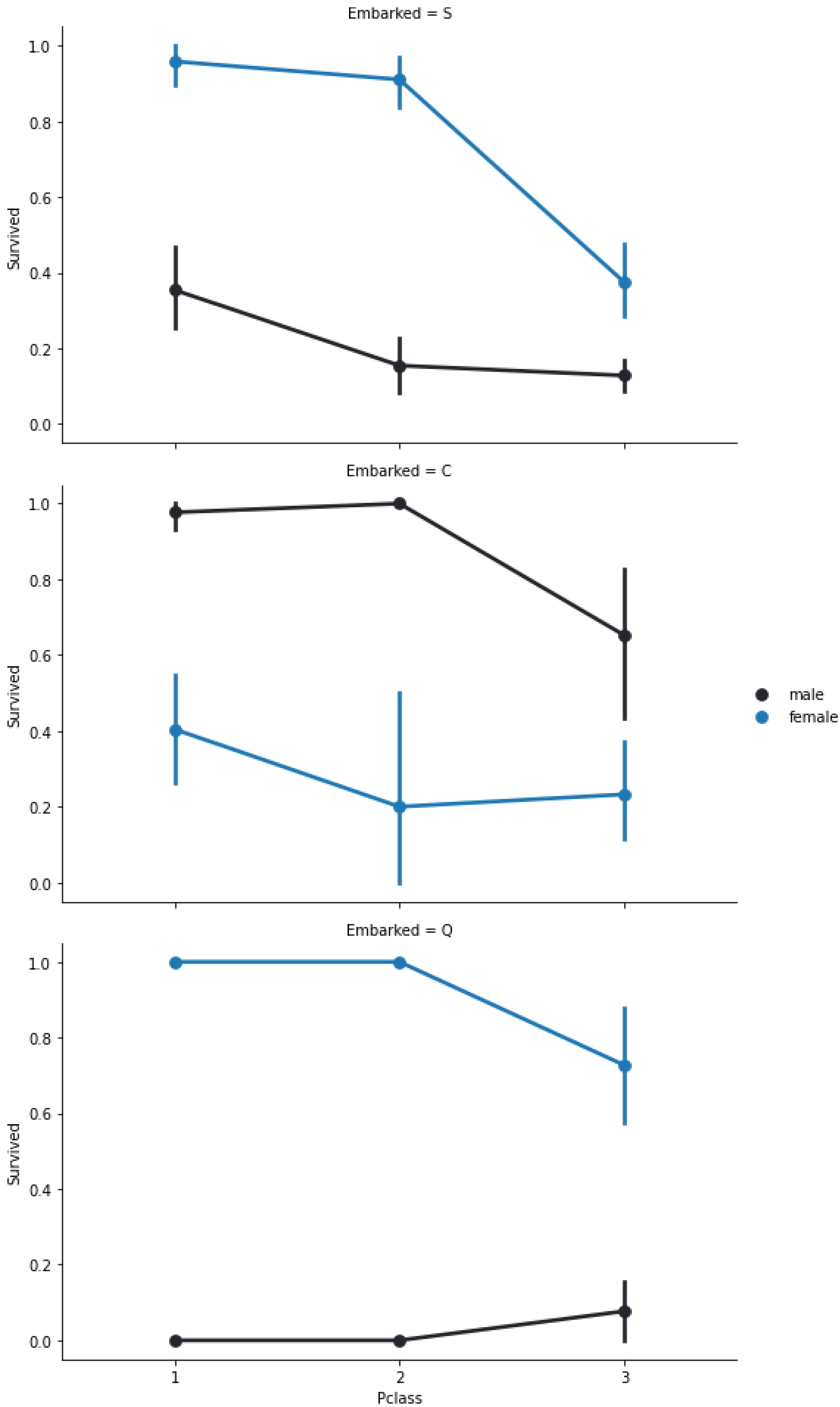



In [9]:

```
FacetGrid = sns.FacetGrid(train_df, row='Embarked', size=4.5, aspect=1.6)
FacetGrid.map(sns.pointplot, 'Pclass', 'Survived', 'Sex', palette=None, order=None,
FacetGrid.add_legend()
```

Out[9]:

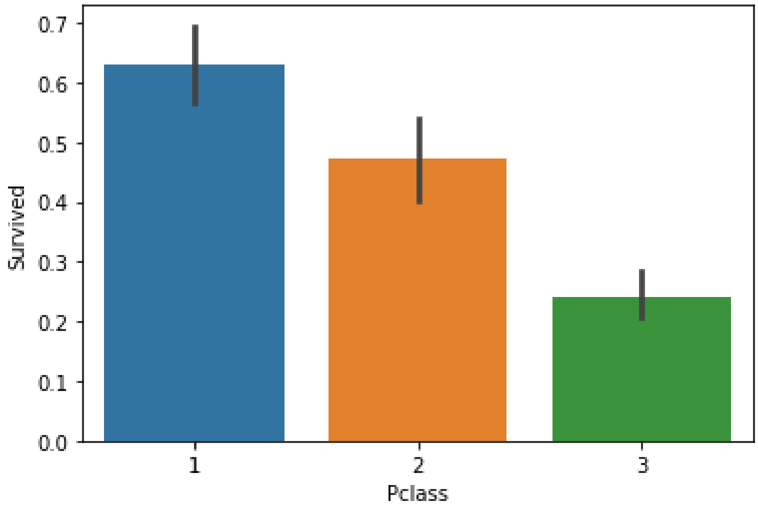
```
C:\Users\hp\anaconda3\lib\site-packages\seaborn\axisgrid.py:316: UserWarning: The `s
ize` parameter has been renamed to `height`; please update your code.
  warnings.warn(msg, UserWarning)
<seaborn.axisgrid.FacetGrid at 0x2903cbbd970>
```



In [10]:

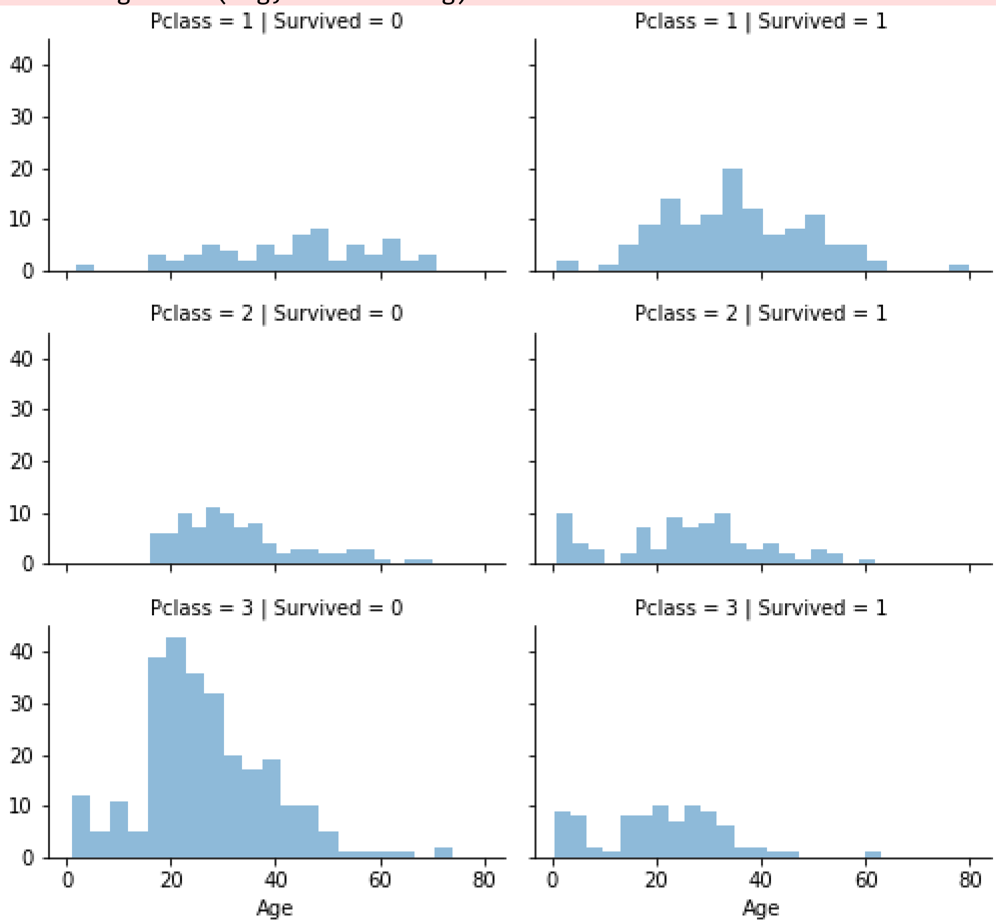
```
sns.barplot(x='Pclass', y='Survived', data=train_df)
```

Out[10]:
```
<AxesSubplot:xlabel='Pclass', ylabel='Survived'>
```



In [11]:
```python
grid = sns.FacetGrid(train_df, col='Survived', row='Pclass', size=2.2, aspect=1.6)
grid.map(plt.hist, 'Age', alpha=.5, bins=20)
grid.add_legend();
```

```
C:\Users\hp\anaconda3\lib\site-packages\seaborn\axisgrid.py:316: UserWarning: The `s
ize` parameter has been renamed to `height`; please update your code.
  warnings.warn(msg, UserWarning)
```

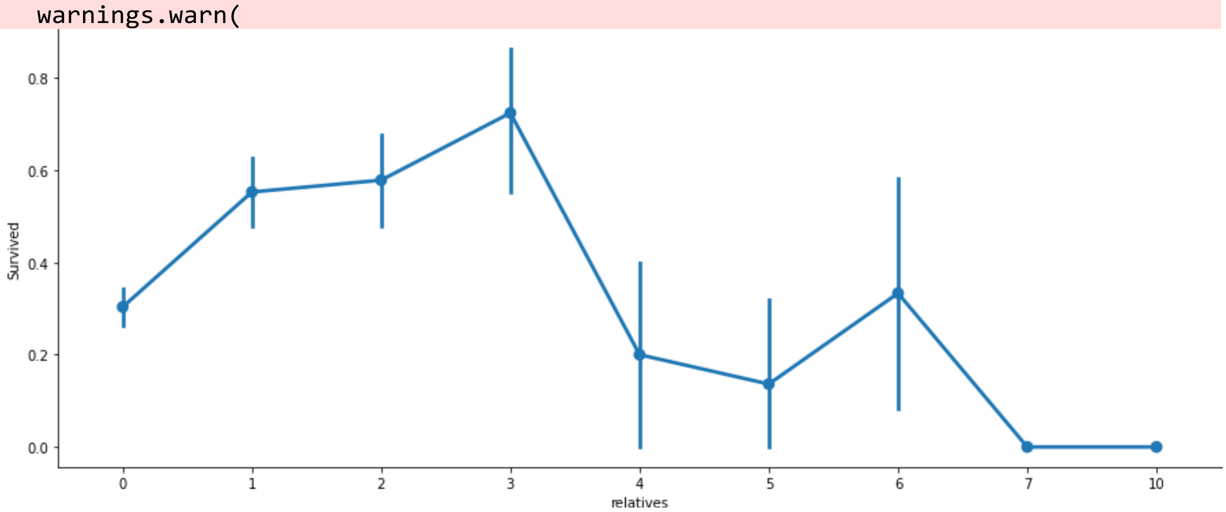


In [12]:
```python
data = [train_df, test_df]
for dataset in data:
    dataset['relatives'] = dataset['SibSp'] + dataset['Parch']
    dataset.loc[dataset['relatives'] > 0, 'not_alone'] = 0
    dataset.loc[dataset['relatives'] == 0, 'not_alone'] = 1
    dataset['not_alone'] = dataset['not_alone'].astype(int)
train_df['not_alone'].value_counts()
```

```
Out[12]: 1    537
         0    354
         Name: not_alone, dtype: int64
```

In [13]:
```
axes = sns.factorplot('relatives','Survived',
                      data=train_df, aspect = 2.5, )
```

```
C:\Users\hp\anaconda3\lib\site-packages\seaborn\categorical.py:3714:  UserWarning:  Th
e `factorplot` function has been renamed to `catplot`. The original name will be rem
oved in a future release. Please update your code. Note that the default `kind` in `
factorplot` (`'point'`) has changed `'strip'` in `catplot`.
  warnings.warn(msg)
C:\Users\hp\anaconda3\lib\site-packages\seaborn\_decorators.py:36:  FutureWarning:  Pa
ss the following variables as keyword args: x, y. From version 0.12, the only valid
positional argument will be `data`, and passing other arguments without an explicit
keyword will result in an error or misinterpretation.
  warnings.warn(
```



In [14]:
```
train_df = train_df.drop(['PassengerId'], axis=1)
```

In [15]:
```
import re
deck = {"A": 1, "B": 2, "C": 3, "D": 4, "E": 5, "F": 6, "G": 7, "U": 8}
data = [train_df, test_df]

for dataset in data:
    dataset['Cabin'] = dataset['Cabin'].fillna("U0")
    dataset['Deck'] = dataset['Cabin'].map(lambda x: re.compile("([a-zA-Z]+)").searc
    dataset['Deck'] = dataset['Deck'].map(deck)
    dataset['Deck'] = dataset['Deck'].fillna(0)
    dataset['Deck'] = dataset['Deck'].astype(int)
# we can now drop the cabin feature
train_df = train_df.drop(['Cabin'], axis=1)
test_df = test_df.drop(['Cabin'], axis=1)
```

In [16]:
```
data = [train_df, test_df]

for dataset in data:
    mean = train_df["Age"].mean()
    std = test_df["Age"].std()
    is_null = dataset["Age"].isnull().sum()
    # compute random numbers between the mean, std and is_null
    rand_age = np.random.randint(mean - std, mean + std, size = is_null)
    # fill NaN values in Age column with random values generated
    age_slice = dataset["Age"].copy()
```

```
        age_slice[np.isnan(age_slice)] = rand_age
        dataset["Age"] = age_slice
        dataset["Age"] = train_df["Age"].astype(int)
train_df["Age"].isnull().sum()
```

Out[16]: 0

In [17]:

```
train_df['Embarked'].describe()
```

Out[17]:

```
count     889
unique      3
top         S
freq      644
Name: Embarked, dtype: object
```

In [18]:

```
common_value = 'S'
data = [train_df, test_df]

for dataset in data:
    dataset['Embarked'] = dataset['Embarked'].fillna(common_value)
```

In [19]:

```
train_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 891 entries, 0 to 890
Data columns (total 13 columns):
 #   Column     Non-Null Count  Dtype
---  ------     --------------  -----
 0   Survived   891 non-null    int64
 1   Pclass     891 non-null    int64
 2   Name       891 non-null    object
 3   Sex        891 non-null    object
 4   Age        891 non-null    int32
 5   SibSp      891 non-null    int64
 6   Parch      891 non-null    int64
 7   Ticket     891 non-null    object
 8   Fare       891 non-null    float64
 9   Embarked   891 non-null    object
 10  relatives  891 non-null    int64
 11  not_alone  891 non-null    int32
 12  Deck       891 non-null    int32
dtypes: float64(1), int32(3), int64(5), object(4)
memory usage: 80.2+ KB
```

In [20]:

```
data = [train_df, test_df]

for dataset in data:
    dataset['Fare'] = dataset['Fare'].fillna(0)
    dataset['Fare'] = dataset['Fare'].astype(int)
```

In [21]:

```
data = [train_df, test_df]
titles = {"Mr": 1, "Miss": 2, "Mrs": 3, "Master": 4, "Rare": 5}

for dataset in data:
    # extract titles
    dataset['Title'] = dataset.Name.str.extract(' ([A-Za-z]+)\.', expand=False)
    # replace titles with a more common title or as Rare
    dataset['Title'] = dataset['Title'].replace(['Lady', 'Countess','Capt', 'Col','D
                                            'Major', 'Rev', 'Sir', 'Jonkheer', 'Dona
    dataset['Title'] = dataset['Title'].replace('Mlle', 'Miss')
```

```python
    dataset['Title'] = dataset['Title'].replace('Ms', 'Miss')
    dataset['Title'] = dataset['Title'].replace('Mme', 'Mrs')
    # convert titles into numbers
    dataset['Title'] = dataset['Title'].map(titles)
    # filling NaN with 0, to get safe
    dataset['Title'] = dataset['Title'].fillna(0)
train_df = train_df.drop(['Name'], axis=1)
test_df = test_df.drop(['Name'], axis=1)
```

In [22]:

```python
genders = {"male": 0, "female": 1}
data = [train_df, test_df]

for dataset in data:
    dataset['Sex'] = dataset['Sex'].map(genders)
```

In [23]:

```python
train_df['Ticket'].describe()
```

Out[23]:

```
count 891
unique681
top   347082
freq  7
Name: Ticket, dtype: object
```

In [24]:

```python
train_df = train_df.drop(['Ticket'], axis=1)
test_df = test_df.drop(['Ticket'], axis=1)
```

In [25]:

```python
ports = {"S": 0, "C": 1, "Q": 2}
data = [train_df, test_df]

for dataset in data:
    dataset['Embarked'] = dataset['Embarked'].map(ports)
```

In [26]:

```python
data = [train_df, test_df]
for dataset in data:
    dataset['Age'] = dataset['Age'].astype(int)
    dataset.loc[ dataset['Age'] <= 11, 'Age'] = 0
  dataset.loc[(dataset['Age'] > 11) & (dataset['Age'] <= 18), 'Age'] = 1
  dataset.loc[(dataset['Age'] > 18) & (dataset['Age'] <= 22), 'Age'] = 2
  dataset.loc[(dataset['Age'] > 22) & (dataset['Age'] <= 27), 'Age'] = 3
  dataset.loc[(dataset['Age'] > 27) & (dataset['Age'] <= 33), 'Age'] = 4
  dataset.loc[(dataset['Age'] > 33) & (dataset['Age'] <= 40), 'Age'] = 5
  dataset.loc[(dataset['Age'] > 40) & (dataset['Age'] <= 66), 'Age'] = 6
  dataset.loc[ dataset['Age'] > 66, 'Age'] = 6
```

In [27]:

```python
train_df['Age'].value_counts()
```

Out[27]:

```
4    164
6    164
5    139
3    137
2    122
1    97
0    68
Name: Age, dtype: int64
```

In [28]:

```python
train_df.head(10)
```

Out[28]:

	Survived	Pclass	Sex	Age	SibSp	Parch	Fare	Embarked	relatives	not_alone	Deck	Title
0	0	3	0	2	1	0	7	0	1	0	8	1
1	1	1	1	5	1	0	71	1	1	0	3	3
2	1	3	1	3	0	0	7	0	0	1	8	2
3	1	1	1	5	1	0	53	0	1	0	3	3
4	0	3	0	5	0	0	8	0	0	1	8	1
5	0	3	0	1	0	0	8	2	0	1	8	1
6	0	1	0	6	0	0	51	0	0	1	5	1
7	0	3	0	0	3	1	21	0	4	0	8	4
8	1	3	1	3	0	2	11	0	2	0	8	3
9	1	2	1	1	1	0	30	1	1	0	8	3

In [29]:

```
data = [train_df, test_df]

for dataset in data:
    dataset.loc[ dataset['Fare'] <= 7.91, 'Fare'] = 0
    dataset.loc[(dataset['Fare'] > 7.91) & (dataset['Fare'] <= 14.454), 'Fare'] = 1
    dataset.loc[(dataset['Fare'] > 14.454) & (dataset['Fare'] <= 31), 'Fare'] = 2
    dataset.loc[(dataset['Fare'] > 31) & (dataset['Fare'] <= 99), 'Fare'] = 3
    dataset.loc[(dataset['Fare'] > 99) & (dataset['Fare'] <= 250), 'Fare'] = 4
    dataset.loc[ dataset['Fare'] > 250, 'Fare'] = 5
    dataset['Fare'] = dataset['Fare'].astype(int)
```

In [30]:

```
data = [train_df, test_df]
for dataset in data:
    dataset['Age_Class']= dataset['Age']* dataset['Pclass']
```

In [31]:

```
for dataset in data:
    dataset['Fare_Per_Person'] = dataset['Fare']/(dataset['relatives']+1)
    dataset['Fare_Per_Person'] = dataset['Fare_Per_Person'].astype(int)
# Let's take a last look at the training set, before we start training the models.
train_df.head(10)
```

Out[31]:

	Survived	Pclass	Sex	Age	SibSp	Parch	Fare	Embarked	relatives	not_alone	Deck	Title	A
0	0	3	0	2	1	0	0	0	1	0	8	1	
1	1	1	1	5	1	0	3	1	1	0	3	3	
2	1	3	1	3	0	0	0	0	0	1	8	2	
3	1	1	1	5	1	0	3	0	1	0	3	3	
4	0	3	0	5	0	0	1	0	0	1	8	1	
5	0	3	0	1	0	0	1	2	0	1	8	1	
6	0	1	0	6	0	0	3	0	0	1	5	1	
7	0	3	0	0	3	1	2	0	4	0	8	4	
8	1	3	1	3	0	2	1	0	2	0	8	3	

	Survived	Pclass	Sex	Age	SibSp	Parch	Fare	Embarked	relatives	not_alone	Deck	Title	A
9	1	2	1	1	1	0	2	1	1	0	8	3	

In [32]:

```
X_train = train_df.drop("Survived", axis=1)
Y_train = train_df["Survived"]
X_test  = test_df.drop("PassengerId", axis=1).copy()
```

In [33]:

```
sgd = linear_model.SGDClassifier(max_iter=5, tol=None)
sgd.fit(X_train, Y_train)
Y_pred = sgd.predict(X_test)

sgd.score(X_train, Y_train)

acc_sgd = round(sgd.score(X_train, Y_train) * 100, 2)
```

In [34]:

```
random_forest = RandomForestClassifier(n_estimators=100)
random_forest.fit(X_train, Y_train)

Y_prediction = random_forest.predict(X_test)

random_forest.score(X_train, Y_train)
acc_random_forest = round(random_forest.score(X_train, Y_train) * 100, 2)
```

In [35]:

```
 X, y = make_classification(random_state=42)
X_train, X_test, y_train, y_test = train_test_split(X, y, random_state=42)
pipe = make_pipeline(StandardScaler(), LogisticRegression())
pipe.fit(X_train, y_train) # apply scaling on training data
#steps=[('standardscaler', StandardScaler()),
#                ('logisticregression', LogisticRegression())])

pipe.score(X_test, y_test)  # apply scaling on testing data, without leaking trainin
```

Out[35]:

```
0.96
```

In [ ]:

```
```