In [1]:

```
import pandas as pd
import warnings
warnings.filterwarnings("ignore")
```

In [2]:

data1=pd.read_csv("/home/placement/Downloads/TelecomCustomerChurn.csv")

In [3]:

```
data1.isna().sum()
```

Out[3]:

customerID	0
gender	0
SeniorCitizen	0
Partner	0
Dependents	0
tenure	0
PhoneService	0
MultipleLines	0
InternetService	0
OnlineSecurity	0
OnlineBackup	0
DeviceProtection	0
TechSupport	0
StreamingTV	0
StreamingMovies	0
Contract	0
PaperlessBilling	0
PaymentMethod	0
MonthlyCharges	0
TotalCharges	0
Churn	0
dtype: int64	

In [4]:

```
data1.info()
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 7043 entries, 0 to 7042
Data columns (total 21 columns):
                       Non-Null Count
#
     Column
                                        Dtype
                       -----
     -----
                                        ----
0
     customerID
                       7043 non-null
                                        object
 1
     gender
                       7043 non-null
                                        object
 2
     SeniorCitizen
                       7043 non-null
                                        int64
 3
     Partner
                       7043 non-null
                                        object
 4
     Dependents
                       7043 non-null
                                        object
 5
     tenure
                       7043 non-null
                                        int64
 6
     PhoneService
                       7043 non-null
                                        object
 7
     MultipleLines
                       7043 non-null
                                        object
 8
     InternetService
                       7043 non-null
                                        object
 9
     OnlineSecurity  
                       7043 non-null
                                        object
 10
    OnlineBackup
                       7043 non-null
                                        object
 11
    DeviceProtection
                       7043 non-null
                                        object
 12
     TechSupport
                       7043 non-null
                                        object
 13
     StreamingTV
                       7043 non-null
                                        object
 14
    StreamingMovies
                       7043 non-null
                                        object
 15
    Contract
                       7043 non-null
                                        object
 16
    PaperlessBilling
                       7043 non-null
                                        object
 17
     PaymentMethod
                       7043 non-null
                                        object
 18
     MonthlyCharges
                       7043 non-null
                                        float64
 19
     TotalCharges
                       7043 non-null
                                        object
 20
     Churn
                       7043 non-null
                                        object
dtypes: float64(1), int64(2), object(18)
memory usage: 1.1+ MB
```

In [5]:

```
data1['TotalCharges']=pd.to_numeric(data1['TotalCharges'],errors='coerce')
```

In [6]:

datal.isna().sum()

Out[6]:

0 customerID gender 0 0 SeniorCitizen 0 Partner Dependents 0 tenure 0 0 PhoneService MultipleLines 0 InternetService 0 **OnlineSecurity** 0 0 **OnlineBackup** DeviceProtection 0 TechSupport 0 0 StreamingTV StreamingMovies 0 Contract 0 PaperlessBilling 0 PaymentMethod 0 MonthlyCharges 0 TotalCharges 11 Churn 0

dtype: int64

In [7]:

data1=data1.fillna(data1.median())
data1

Out[7]:

	customerID	gender	SeniorCitizen	Partner	Dependents	tenure	PhoneService	MultipleL
0	7590- VHVEG	Female	0	Yes	No	1	No	No pl se
1	5575- GNVDE	Male	0	No	No	34	Yes	
2	3668- QPYBK	Male	0	No	No	2	Yes	
3	7795- CFOCW	Male	0	No	No	45	No	No pł se
4	9237- HQITU	Female	0	No	No	2	Yes	
7038	6840- RESVB	Male	0	Yes	Yes	24	Yes	
7039	2234- XADUH	Female	0	Yes	Yes	72	Yes	
7040	4801-JZAZL	Female	0	Yes	Yes	11	No	No pł se
7041	8361- LTMKD	Male	1	Yes	No	4	Yes	
7042	3186-AJIEK	Male	0	No	No	66	Yes	

7043 rows × 21 columns

In [8]:

```
data1.info()
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 7043 entries, 0 to 7042
Data columns (total 21 columns):
                       Non-Null Count
#
     Column
                                        Dtype
                       -----
     -----
                                        ----
0
     customerID
                       7043 non-null
                                        object
 1
     gender
                       7043 non-null
                                        object
 2
     SeniorCitizen
                       7043 non-null
                                        int64
 3
     Partner
                       7043 non-null
                                        object
 4
     Dependents
                       7043 non-null
                                        object
 5
     tenure
                       7043 non-null
                                        int64
 6
     PhoneService
                       7043 non-null
                                        object
 7
     MultipleLines
                       7043 non-null
                                        object
 8
     InternetService
                       7043 non-null
                                        object
 9
     OnlineSecurity
                       7043 non-null
                                        object
 10
    OnlineBackup
                       7043 non-null
                                        object
 11
    DeviceProtection
                       7043 non-null
                                        object
 12
     TechSupport
                       7043 non-null
                                        object
 13
     StreamingTV
                       7043 non-null
                                        object
 14
     StreamingMovies
                       7043 non-null
                                        object
 15
    Contract
                       7043 non-null
                                        object
 16
    PaperlessBilling
                       7043 non-null
                                        object
 17
     PaymentMethod
                       7043 non-null
                                        object
 18
     MonthlyCharges
                       7043 non-null
                                        float64
 19
     TotalCharges
                       7043 non-null
                                        float64
 20
     Churn
                       7043 non-null
                                        object
dtypes: float64(2), int64(2), object(17)
memory usage: 1.1+ MB
In [9]:
```

```
y=data1['Churn']
x=data1.drop(['customerID','Churn'],axis=1)
```

In [10]:

```
x=pd.get_dummies(x)
x.isna().sum()
```

Out[10]:

tenure MonthlyCharges TotalCharges gender_Female gender_Male Partner_No Partner_Yes Dependents_No Dependents_Yes PhoneService_No MultipleLines_No MultipleLines_No phone service MultipleLines_Yes InternetService_DSL InternetService_Fiber optic InternetService_No OnlineSecurity_No internet service OnlineBackup_No DeviceProtection_No internet service DeviceProtection_No internet service DeviceProtection_No internet service DeviceProtection_Yes TrechSupport_No internet service DeviceProtection_Yes TechSupport_No internet service TechSupport_No internet service TechSupport_Yes StreamingTV_No internet service DeviceProtection_Yes TechSupport_Yes StreamingTV_No internet service TechSupport_Yes StreamingTV_No internet service TechSupport_Yes StreamingTV_No internet service TechSupport_Yes StreamingTV_No internet service Office StreamingMovies_No internet service TechSupport_Yes TechSupport_Yes TechSupport_Yes TechSupport_Yes Office StreamingTV_No internet service TechSupport_Yes TechSupport_Yes TechSupport_Yes TechSupport_Yes Office StreamingTV_No internet service TechSupport_Yes TechSuppo	SeniorCitizen	0
TotalCharges gender_Female gender_Male Partner_No Partner_Yes Dependents_No Dependents_Yes PhoneService_No PhoneService_Yes MultipleLines_No MultipleLines_No phone service MultipleLines_Yes InternetService_DSL InternetService_Fiber optic InternetService_No OnlineSecurity_No OnlineSecurity_No OnlineSecurity_No internet service OnlineBackup_No InlineBackup_Yes DeviceProtection_No DeviceProtection_No internet service DeviceProtection_Yes TechSupport_No TechSupport_No internet service DeviceProtection_Yes TechSupport_Yes StreamingTV_No StreamingTV_No StreamingTV_No StreamingTV_No StreamingTV_Yes Onlineat_On StreamingTV_No StreamingTV_No Internet service OnlineBackup_No OnlineTection_No DeviceProtection_Yes TechSupport_No TechSupport_No internet service ObeviceProtection_Yes TechSupport_Yes StreamingTV_No StreamingTV_No StreamingTV_No StreamingTV_Yes OnlineTract_Month-to-month Contract_One year Contract_Month-to-month Contract_Two year PaperlessBilling_No PaperlessBilling_Yes PaymentMethod_Bank transfer (automatic) PaymentMethod_Credit card (automatic)		
TotalCharges gender_Female gender_Male Partner_No Partner_Yes Dependents_No Dependents_Yes PhoneService_No PhoneService_Yes MultipleLines_No MultipleLines_No phone service MultipleLines_Yes InternetService_DSL InternetService_Fiber optic InternetService_No OnlineSecurity_No OnlineSecurity_No OnlineSecurity_No internet service OnlineBackup_No InlineBackup_Yes DeviceProtection_No DeviceProtection_No internet service DeviceProtection_Yes TechSupport_No TechSupport_No internet service DeviceProtection_Yes TechSupport_Yes StreamingTV_No StreamingTV_No StreamingTV_No StreamingTV_No StreamingTV_Yes Onlineator StreamingTV_No StreamingTV_Yes OnlineTreat service OnlineBackup_No OnlineBackup_No OnlineBackup_No OnlineBackup_No OnlineBackup_No OnlineBackup_No OnlineBackup_Yes OnlineBackup_Yes OnlineBackup_Yes OnlineBackup_Yes OnlineBackup_Yes OnlineBackup_No OnlineBackup_No OnlineBackup_No OnlineBackup_No OnlineBackup_Yes OnlineBackup_Yes OnlineBackup_Yes OnlineBackup_Yes OnlineBackup_Yes OnlineBackup_Yes OnlineBackup_Yes OnlineBackup_No OnlineBackup_No OnlineBackup_Yes Onl	MonthlyCharges	0
gender_Female gender_Male Partner_No Partner_Yes Dependents_No Dependents_Yes PhoneService_No PhoneService_Yes MultipleLines_No MultipleLines_No MultipleLines_Yes InternetService_DSL InternetService_Fiber optic InternetService_No OnlineSecurity_No OnlineSecurity_No OnlineSecurity_Yes OnlineBackup_No InienBackup_No InienBackup_No InienBackup_No InienBackup_Yes DeviceProtection_No DeviceProtection_No DeviceProtection_Yes TechSupport_No Internet service StreamingTV_No StreamingTV_No Internet service OnlineBackup_Yes OnlineBackup_Y	· · · · · · · · · · · · · · · · · · ·	
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InternetService_DSL InternetService_Fiber optic InternetService_No OnlineSecurity_No OnlineSecurity_No internet service OnlineSecurity_Yes OnlineBackup_No OnlineBackup_No internet service OnlineBackup_Yes OnlineBackup_Yes DeviceProtection_No DeviceProtection_No internet service DeviceProtection_Yes TechSupport_No internet service TechSupport_No internet service TechSupport_Yes StreamingTV_No streamingTV_No internet service StreamingTV_Yes StreamingTV_Yes StreamingTV_Yes StreamingTV_Yes Ontract_Month-to-month Contract_One year Contract_Two year PaperlessBilling_No PaperlessBilling_Yes PaymentMethod_Bank transfer (automatic) PaymentMethod_Credit card (automatic)		
InternetService_Fiber optic InternetService_No OnlineSecurity_No OnlineSecurity_Yes OnlineBackup_No OnlineBackup_No OnlineBackup_No OnlineBackup_Yes DeviceProtection_No DeviceProtection_No internet service DeviceProtection_Yes TechSupport_No TechSupport_No TechSupport_Yes StreamingTV_No StreamingTV_No StreamingTV_Yes StreamingMovies_No StreamingMovies_No StreamingMovies_Yes Contract_Month-to-month Contract_One year Contract_Two year PaperlessBilling_No PaperlessBilling_Yes PaymentMethod_Credit card (automatic) PaymentMethod_Credit card (automatic)		
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OnlineSecurity_No internet service OnlineBackup_No OnlineBackup_No internet service OnlineBackup_Yes OnlineBackup_Yes OnlineBackup_Yes OnlineBackup_Yes OnlineBackup_Yes OnlineBackup_Yes OpeviceProtection_No DeviceProtection_No internet service OpeviceProtection_Yes TechSupport_No internet service OpeviceProtection_Yes OpeviceProtection_No OpeviceProtectio	—	
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DeviceProtection_No internet service 0 DeviceProtection_Yes 0 TechSupport_No 0 TechSupport_No internet service 0 TechSupport_Yes 0 StreamingTV_No 0 StreamingTV_No 0 StreamingTV_No internet service 0 StreamingTV_Yes 0 StreamingMovies_No 0 StreamingMovies_No 1 StreamingMovies_No 1 StreamingMovies_Yes 0 Contract_Month-to-month 0 Contract_One year 0 Contract_Two year 0 PaperlessBilling_No 0 PaperlessBilling_Yes 0 PaymentMethod_Bank transfer (automatic) 0 PaymentMethod_Credit card (automatic) 0	· -	
DeviceProtection_No internet service DeviceProtection_Yes TechSupport_No TechSupport_No internet service TechSupport_Yes StreamingTV_No StreamingTV_No internet service StreamingTV_Yes StreamingMovies_No StreamingMovies_No internet service StreamingMovies_No internet service OstreamingMovies_Yes Contract_Month-to-month Contract_One year Contract_Two year PaperlessBilling_No PaperlessBilling_Yes PaymentMethod_Bank transfer (automatic) PaymentMethod_Credit card (automatic)	· -	
DeviceProtection_Yes TechSupport_No TechSupport_No internet service OtechSupport_Yes StreamingTV_No StreamingTV_No internet service StreamingTV_Yes StreamingMovies_No StreamingMovies_No StreamingMovies_No internet service StreamingMovies_Yes Contract_Month-to-month Contract_One year Contract_Two year PaperlessBilling_No PaperlessBilling_Yes PaymentMethod_Bank transfer (automatic) PaymentMethod_Credit card (automatic)		
TechSupport_No internet service 0 TechSupport_Yes 0 StreamingTV_No 0 StreamingTV_No internet service 0 StreamingTV_Yes 0 StreamingMovies_No 0 StreamingMovies_No 1 StreamingMovies_No internet service 0 StreamingMovies_Yes 0 Contract_Month-to-month 0 Contract_One year 0 Contract_Two year 0 PaperlessBilling_No 0 PaperlessBilling_Yes 0 PaymentMethod_Bank transfer (automatic) 0 PaymentMethod_Credit card (automatic) 0	-	
TechSupport_No internet service 0 TechSupport_Yes 0 StreamingTV_No 0 StreamingTV_No internet service 0 StreamingTV_Yes 0 StreamingMovies_No 0 StreamingMovies_No internet service 0 StreamingMovies_Yes 0 Contract_Month-to-month 0 Contract_One year 0 Contract_Two year 0 PaperlessBilling_No 0 PaperlessBilling_Yes 0 PaymentMethod_Bank transfer (automatic) 0 PaymentMethod_Credit card (automatic) 0	-	
TechSupport_Yes 0 StreamingTV_No 0 StreamingTV_No internet service 0 StreamingTV_Yes 0 StreamingMovies_No 0 StreamingMovies_No internet service 0 StreamingMovies_Yes 0 Contract_Month-to-month 0 Contract_One year 0 Contract_Two year 0 PaperlessBilling_No 0 PaperlessBilling_Yes 0 PaymentMethod_Bank transfer (automatic) 0 PaymentMethod_Credit card (automatic) 0	· · · —	
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StreamingTV_No internet service 0 StreamingTV_Yes 0 StreamingMovies_No 0 StreamingMovies_No internet service 0 StreamingMovies_Yes 0 Contract_Month-to-month 0 Contract_One year 0 Contract_Two year 0 PaperlessBilling_No 0 PaperlessBilling_Yes 0 PaymentMethod_Bank transfer (automatic) 0 PaymentMethod_Credit card (automatic) 0	· · · —	
StreamingTV_Yes 0 StreamingMovies_No 0 StreamingMovies_No internet service 0 StreamingMovies_Yes 0 Contract_Month-to-month 0 Contract_One year 0 Contract_Two year 0 PaperlessBilling_No 0 PaperlessBilling_Yes 0 PaymentMethod_Bank transfer (automatic) 0 PaymentMethod_Credit card (automatic) 0		
StreamingMovies_No 0 StreamingMovies_No internet service 0 StreamingMovies_Yes 0 Contract_Month-to-month 0 Contract_One year 0 Contract_Two year 0 PaperlessBilling_No 0 PaperlessBilling_Yes 0 PaymentMethod_Bank transfer (automatic) 0 PaymentMethod_Credit card (automatic) 0		
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StreamingMovies_Yes 0 Contract_Month-to-month 0 Contract_One year 0 Contract_Two year 0 PaperlessBilling_No 0 PaperlessBilling_Yes 0 PaymentMethod_Bank transfer (automatic) 0 PaymentMethod_Credit card (automatic) 0		0
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raymenthethod_ftectronic theck	PaymentMethod_Electronic check	0
PaymentMethod_Mailed check 0	PaymentMethod_Mailed check	0
dtype: int64		

In []:

```
In [11]:
```

```
x.head()
```

Out[11]:

	SeniorCitizen	tenure	MonthlyCharges	TotalCharges	gender_Female	gender_Male	Partner_l
0	0	1	29.85	29.85	1	0	
1	0	34	56.95	1889.50	0	1	
2	0	2	53.85	108.15	0	1	
3	0	45	42.30	1840.75	0	1	
4	0	2	70.70	151.65	1	0	

5 rows × 45 columns

In [12]:

```
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,random_state=42)
```

In [13]:

```
from sklearn.model_selection import GridSearchCV #GridSearchCV is for parameter tun
from sklearn.ensemble import RandomForestClassifier
cls=RandomForestClassifier()
n_estimators=[25,50,75,100,125,150,175,200] #number of decision trees in the forest
criterion=['gini', 'entropy'] #criteria for choosing nodes default = 'gini'
max_depth=[3,5,10] #maximum number of nodes in a tree default = None (it will go ti
parameters={'n_estimators': n_estimators, 'criterion':criterion, 'max_depth':max_dept
RFC_cls = GridSearchCV(cls, parameters)
RFC_cls.fit(x_train,y_train)
```

Out[13]:

```
▶ GridSearchCV▶ estimator: RandomForestClassifier▶ RandomForestClassifier
```

In [14]:

```
RFC_cls.best_params_
```

Out[14]:

```
{'criterion': 'gini', 'max depth': 10, 'n estimators': 150}
```

In [15]:

```
cls=RandomForestClassifier(n_estimators=200,criterion='entropy',max_depth=10)
```

```
In [16]:
```

```
cls.fit(x_train,y_train)
```

Out[16]:

```
RandomForestClassifier
RandomForestClassifier(criterion='entropy', max_depth=10, n_estimator s=200)
```

In [17]:

```
p=cls.predict(x_test)
```

In [18]:

```
p
```

Out[18]:

```
array(['Yes', 'No', 'No', ..., 'Yes', 'No', 'No'], dtype=object)
```

In [19]:

```
from sklearn.metrics import confusion_matrix
confusion_matrix(y_test,p)
```

Out[19]:

```
array([[1552, 145], [ 297, 331]])
```

In [20]:

```
from sklearn.metrics import accuracy_score
accuracy_score(y_test,p)
```

Out[20]:

0.8098924731182796

In [21]:

```
from sklearn.linear_model import LogisticRegression
clas=LogisticRegression()
clas.fit(x_train,y_train)
```

Out[21]:

```
▼ LogisticRegression
LogisticRegression()
```

In [22]:

```
y_pred=clas.predict(x_test)
```

```
In [23]:

y_pred

Out[23]:
```

array(['Yes', 'No', 'No', ..., 'Yes', 'No', 'No'], dtype=object)

In [24]:

```
from sklearn.metrics import confusion_matrix
confusion_matrix(y_test,y_pred)
```

Out[24]:

```
array([[1526, 171], [ 266, 362]])
```

In [25]:

```
from sklearn.metrics import accuracy_score
accuracy_score(y_test,y_pred)
```

Out[25]:

0.8120430107526881

In []: