In [148]: `import pandas as pd`

In [149]: `data=pd.read_csv("/home/placement/Downloads/TelecomCustomerChurn.csv")`

In [150]: `data.describe()`

Out[150]:

	SeniorCitizen	tenure	MonthlyCharges
count	7043.000000	7043.000000	7043.000000
mean	0.162147	32.371149	64.761692
std	0.368612	24.559481	30.090047
min	0.000000	0.000000	18.250000
25%	0.000000	9.000000	35.500000
50%	0.000000	29.000000	70.350000
75%	0.000000	55.000000	89.850000
max	1.000000	72.000000	118.750000

In [151]:
```python
data.head(10)
```

Out[151]:

	customerID	gender	SeniorCitizen	Partner	Dependents	tenure	PhoneService	MultipleLines	InternetService	OnlineSecurity	...	DeviceProtec
0	7590-VHVEG	Female	0	Yes	No	1	No	No phone service	DSL	No	...	
1	5575-GNVDE	Male	0	No	No	34	Yes	No	DSL	Yes	...	
2	3668-QPYBK	Male	0	No	No	2	Yes	No	DSL	Yes	...	
3	7795-CFOCW	Male	0	No	No	45	No	No phone service	DSL	Yes	...	
4	9237-HQITU	Female	0	No	No	2	Yes	No	Fiber optic	No	...	
5	9305-CDSKC	Female	0	No	No	8	Yes	Yes	Fiber optic	No	...	
6	1452-KIOVK	Male	0	No	Yes	22	Yes	Yes	Fiber optic	No	...	
7	6713-OKOMC	Female	0	No	No	10	No	No phone service	DSL	Yes	...	
8	7892-POOKP	Female	0	Yes	No	28	Yes	Yes	Fiber optic	No	...	
9	6388-TABGU	Male	0	No	Yes	62	Yes	No	DSL	Yes	...	

10 rows × 21 columns

In [152]:
```python
data["TotalCharges"] = pd.to_numeric(data['TotalCharges'],errors='coerce')
```

In [153]:
```python
data['TotalCharges'] =data['TotalCharges'].fillna(data['TotalCharges'].median())
```

```
In [154]: data.isna().sum()
```

```
Out[154]: 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 [155]:
```python
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 7043 entries, 0 to 7042
Data columns (total 21 columns):
 #   Column            Non-Null Count  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 [156]:
```python
data['SeniorCitizen']=data['SeniorCitizen'].map({0:'No',1:'Yes'})
```

In [157]: `data.tail(20)`

Out[157]:

	customerID	gender	SeniorCitizen	Partner	Dependents	tenure	PhoneService	MultipleLines	InternetService	OnlineSecurity	...	DevicePro
7023	1035-IPQPU	Female	Yes	Yes	No	63	Yes	Yes	Fiber optic	No	...	
7024	7398-LXGYX	Male	No	Yes	No	44	Yes	Yes	Fiber optic	Yes	...	
7025	2823-LKABH	Female	No	No	No	18	Yes	Yes	Fiber optic	No	...	
7026	8775-CEBBJ	Female	No	No	No	9	Yes	No	DSL	No	...	
7027	0550-DCXLH	Male	No	No	No	13	Yes	No	DSL	No	...	
7028	9281-CEDRU	Female	No	Yes	No	68	Yes	No	DSL	No	...	
7029	2235-DWLJU	Female	Yes	No	No	6	No	No phone service	DSL	No	...	
7030	0871-OPBXW	Female	No	No	No	2	Yes	No	No	No internet service	...	No
7031	3605-JISKB	Male	Yes	Yes	No	55	Yes	Yes	DSL	Yes	...	
7032	6894-LFHLY	Male	Yes	No	No	1	Yes	Yes	Fiber optic	No	...	
7033	9767-FFLEM	Male	No	No	No	38	Yes	No	Fiber optic	No	...	
7034	0639-TSIQW	Female	No	No	No	67	Yes	Yes	Fiber optic	Yes	...	
7035	8456-QDAVC	Male	No	No	No	19	Yes	No	Fiber optic	No	...	
7036	7750-EYXWZ	Female	No	No	No	12	No	No phone service	DSL	No	...	
7037	2569-WGERO	Female	No	No	No	72	Yes	No	No	No internet service	...	No
7038	6840-RESVB	Male	No	Yes	Yes	24	Yes	Yes	DSL	Yes	...	

	customerID	gender	SeniorCitizen	Partner	Dependents	tenure	PhoneService	MultipleLines	InternetService	OnlineSecurity	...	DevicePro
7039	2234-XADUH	Female	No	Yes	Yes	72	Yes	Yes	Fiber optic	No	...	
7040	4801-JZAZL	Female	No	Yes	Yes	11	No	No phone service	DSL	Yes	...	
7041	8361-LTMKD	Male	Yes	Yes	No	4	Yes	Yes	Fiber optic	No	...	
7042	3186-AJIEK	Male	No	No	No	66	Yes	No	Fiber optic	Yes	...	

20 rows × 21 columns

In [158]:
```python
#backup
databackup=data.copy()
```

In [159]:
```python
x=data.drop(['customerID','Churn'],axis=1)
y=data['Churn']
```

In [160]:
```python
x=pd.get_dummies(x)
```

In [161]:
```python
x.head()
```

Out[161]:

	tenure	MonthlyCharges	TotalCharges	gender_Female	gender_Male	SeniorCitizen_No	SeniorCitizen_Yes	Partner_No	Partner_Yes	Dependents
0	1	29.85	29.85	1	0	1	0	0	1	
1	34	56.95	1889.50	0	1	1	0	1	0	
2	2	53.85	108.15	0	1	1	0	1	0	
3	45	42.30	1840.75	0	1	1	0	1	0	
4	2	70.70	151.65	1	0	1	0	1	0	

5 rows × 46 columns

In [162]:
```python
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 [163]:
```python
from sklearn.model_selection import GridSearchCV #GridSearchCV is for parameter tuning
from sklearn.ensemble import RandomForestClassifier
cls=RandomForestClassifier()
n_estimators=[25,50,75,100,125,150,175,200] #number of decision trees in the forest, default = 100
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 till all possible nodes)
parameters={'n_estimators': n_estimators,'criterion':criterion,'max_depth':max_depth} #this will undergo 8*2
RFC_cls = GridSearchCV(cls, parameters)
RFC_cls.fit(x_train,y_train)
```

Out[163]:
```
GridSearchCV(estimator=RandomForestClassifier(),
             param_grid={'criterion': ['gini', 'entropy'],
                         'max_depth': [3, 5, 10],
                         'n_estimators': [25, 50, 75, 100, 125, 150, 175, 200]})
```

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In [166]: `RFC_cls.best_params_`

Out[166]: `{'criterion': 'entropy', 'max_depth': 10, 'n_estimators': 75}`

In [167]: `cls=RandomForestClassifier(n_estimators=200,criterion='entropy',max_depth=10)`

In [168]: `cls.fit(x_train,y_train)`

Out[168]: `RandomForestClassifier(criterion='entropy', max_depth=10, n_estimators=200)`

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In [169]: `rfy_pred=cls.predict(x_test)`

In [170]: `rfy_pred`

Out[170]: `array(['Yes', 'No', 'No', ..., 'Yes', 'No', 'No'], dtype=object)`

In [171]:
```
from sklearn.metrics import confusion_matrix
confusion_matrix(y_test,rfy_pred)
```

Out[171]:
```
array([[1552,  145],
       [ 306,  322]])
```

In [173]:
```
from sklearn.metrics import accuracy_score
accuracy_score(y_test,rfy_pred)
```

Out[173]: `0.8060215053763441`

In [174]:
```python
import warnings
warnings.filterwarnings('ignore')
from sklearn.linear_model import LogisticRegression
classifier=LogisticRegression()
classifier.fit(x_train,y_train)
```

Out[174]: LogisticRegression()

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In [ ]: