Part B: Customer Churn Prediction

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

```
data = pd.read_csv('Customer_data.csv')
data.head()
```

:ipleLines	InternetService	OnlineSecurity	...
No phone service	DSL	No	...
No	DSL	Yes	...
No	DSL	Yes	...
No phone service	DSL	Yes	...
No	Fiber optic	No	...

```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 7043 entries, 0 to 7042
Data columns (total 23 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      7032 non-null   float64
 20  Churn             7043 non-null   object 
 21  Unnamed: 21       0 non-null      float64
 22  Unnamed: 22       0 non-null      float64
dtypes: float64(4), int64(2), object(17)
memory usage: 1.2+ MB
```

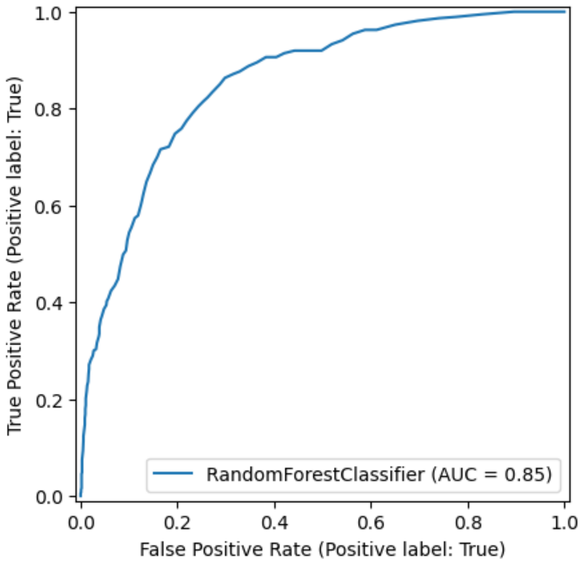
```
data.describe()
```

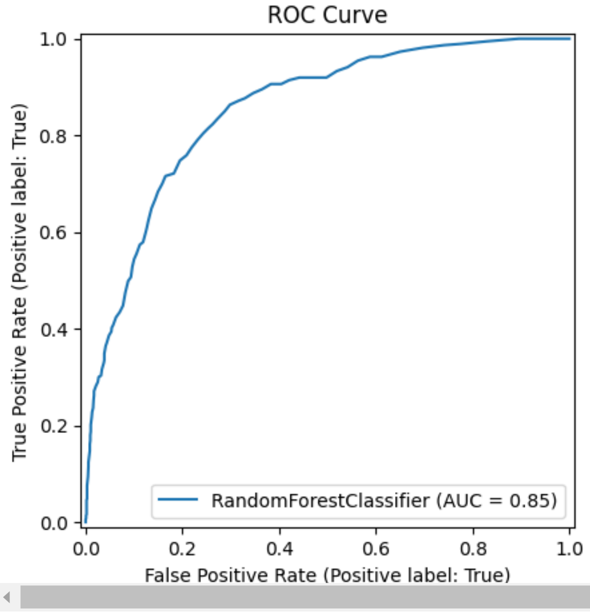
	SeniorCitizen	tenure	MonthlyCharges	TotalCharges	Unnamed: 21	Unnamed: 22
count	7043.000000	7043.000000	7043.000000	7032.000000	0.0	0.0
mean	0.162147	32.371149	64.761692	2283.300441	NaN	NaN
std	0.368612	24.559481	30.090047	2266.771362	NaN	NaN
min	0.000000	0.000000	18.250000	18.800000	NaN	NaN
25%	0.000000	9.000000	35.500000	401.450000	NaN	NaN
50%	0.000000	29.000000	70.350000	1397.475000	NaN	NaN
75%	0.000000	55.000000	89.850000	3794.737500	NaN	NaN
max	1.000000	72.000000	118.750000	8684.800000	NaN	NaN

```
data.fillna(data.ffill(), inplace=True)

data = pd.get_dummies(data, drop_first=True)

from sklearn.preprocessing import StandardScaler
scaler = StandardScaler()
numerical_features = ['tenure', 'MonthlyCharges']
data[numerical_features] = scaler.fit_transform(data[numerical_features])



if 'Churn' in data.columns:
    data = pd.get_dummies(data, columns=['Churn'], prefix='Churn', drop_first=True)
    print(data.columns)  # Check new columns to verify

# Adjusted column access after encoding
X = data.drop('Churn_Yes', axis=1)  # Assuming 'Churn_Yes' is the correct column name after encoding
y = data['Churn_Yes']


from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)



from sklearn.ensemble import RandomForestClassifier

model = RandomForestClassifier()

# Fit the model on training data and making predictions
model.fit(X_train, y_train)

predictions = model.predict(X_test)



from sklearn.metrics import accuracy_score, precision_score, recall_score, f1_score, confusion_matrix

print('Accuracy:', accuracy_score(y_test, predictions))
print('Precision:', precision_score(y_test, predictions))
print('Recall:', recall_score(y_test, predictions))
print('F1 Score:', f1_score(y_test, predictions))
print('Confusion Matrix:\n', confusion_matrix(y_test, predictions))
```

```
Accuracy: 0.7984386089425124
Precision: 0.6893617021276596
Recall: 0.4343163538873995
F1 Score: 0.5328947368421053
Confusion Matrix:
 [[963  73]
 [211 162]]
```

```
from sklearn.metrics import RocCurveDisplay
import matplotlib.pyplot as plt

RocCurveDisplay.from_estimator(model, X_test, y_test).plot()
plt.title('ROC Curve')
plt.show()
```


1.0
0.8
0.6
0.4
0.2
0.0
True Positive Rate (Positive label: True)
RandomForestClassifier (AUC = 0.85)
0.0
0.2
0.4
0.6
0.8
1.0
False Positive Rate (Positive label: True)


ROC Curve
1.0
0.8
0.6
0.4
0.2
0.0
True Positive Rate (Positive label: True)
RandomForestClassifier (AUC = 0.85)
0.0
0.2
0.4
0.6
0.8
1.0
False Positive Rate (Positive label: True)