```
from sklearn.preprocessing import LabelEncoder
from sklearn.model_selection import train_test_split
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import accuracy_score, classification_report, confusion_matrix, roc_curve, auc
import matplotlib.pyplot as plt
import seaborn as sns
import numpy as np
import pandas as pd
import warnings
warnings.filterwarnings("ignore")
```

```
df=pd.read_csv('Churn_Modelling.csv')
df
```

	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProc
0	1	15634602	Hargrave	619	France	Female	42	2	0.00	
1	2	15647311	Hill	608	Spain	Female	41	1	83807.86	
2	3	15619304	Onio	502	France	Female	42	8	159660.80	
3	4	15701354	Boni	699	France	Female	39	1	0.00	
4	5	15737888	Mitchell	850	Spain	Female	43	2	125510.82	
...	...	...	...	...	...	...	...	...	...	
9995	9996	15606229	Obijiaku	771	France	Male	39	5	0.00	
9996	9997	15569892	Johnstone	516	France	Male	35	10	57369.61	
9997	9998	15584532	Liu	709	France	Female	36	7	0.00	
9998	9999	15682355	Sabbatini	772	Germany	Male	42	3	75075.31	
9999	10000	15628319	Walker	792	France	Female	28	4	130142.79	

10000 rows × 14 columns

Next steps: View recommended plots

```
df.info()
```

```
<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
```

```
df["Geography"].unique()
```

```
array(['France', 'Spain', 'Germany'], dtype=object)
```

```
df.describe()
```

	RowNumber	CustomerId	CreditScore	Age	Tenure	Balance
count	10000.00000	1.000000e+04	10000.000000	10000.000000	10000.000000	10000.000000
mean	5000.50000	1.569094e+07	650.528800	38.921800	5.012800	76485.889288
std	2886.89568	7.193619e+04	96.653299	10.487806	2.892174	62397.405202
min	1.00000	1.556570e+07	350.000000	18.000000	0.000000	0.000000
25%	2500.75000	1.562853e+07	584.000000	32.000000	3.000000	0.000000
50%	5000.50000	1.569074e+07	652.000000	37.000000	5.000000	97198.540000
75%	7500.25000	1.575323e+07	718.000000	44.000000	7.000000	127644.240000
max	10000.00000	1.581569e+07	850.000000	92.000000	10.000000	250898.090000

```
df.drop(columns=['RowNumber','CustomerId','Surname'],inplace=True)
df
```

	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard
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
...	...	...	...	...	...	...	...	...
9995	771	France	Male	39	5	0.00	2	1
9996	516	France	Male	35	10	57369.61	1	1
9997	709	France	Female	36	7	0.00	1	0
9998	772	Germany	Male	42	3	75075.31	2	1
9999	792	France	Female	28	4	130142.79	1	1

10000 rows × 11 columns

Next steps: View recommended plots

```
labelencoder=LabelEncoder()
df['Gender']=labelencoder.fit_transform(df['Gender'])
df['Geography']=labelencoder.fit_transform(df['Geography'])
df
```

	CreditScore	Geography	Gender	Age	Tenure	Balance	NumOfProducts	HasCrCard
0	619	0	0	42	2	0.00	1	1
1	608	2	0	41	1	83807.86	1	0
2	502	0	0	42	8	159660.80	3	1
3	699	0	0	39	1	0.00	2	0
4	850	2	0	43	2	125510.82	1	1
...	...	...	...	...	...	...	...	...
9995	771	0	1	39	5	0.00	2	1
9996	516	0	1	35	10	57369.61	1	1
9997	709	0	0	36	7	0.00	1	0
9998	772	1	1	42	3	75075.31	2	1
9999	792	0	0	28	4	130142.79	1	1

10000 rows × 11 columns

Next steps: View recommended plots

```
df.dtypes
```

```
CreditScore          int64
Geography            int64
Gender               int64
Age                  int64
Tenure               int64
Balance            float64
NumOfProducts        int64
HasCrCard            int64
IsActiveMember       int64
EstimatedSalary    float64
Exited               int64
dtype: object
```

```
x=df.drop(columns='Exited')
y=df['Exited']
```

```
x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.3,shuffle=True,random_state=40)
```

```
model=RandomForestClassifier()
model.fit(x_train,y_train)
```

```
▾ RandomForestClassifier
RandomForestClassifier()
```

```
model.score(x_train,y_train)
```

```
0.9998571428571429
```

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

```
array([0, 0, 0, ..., 1, 0, 1])
```

```
len(y_pred)
```

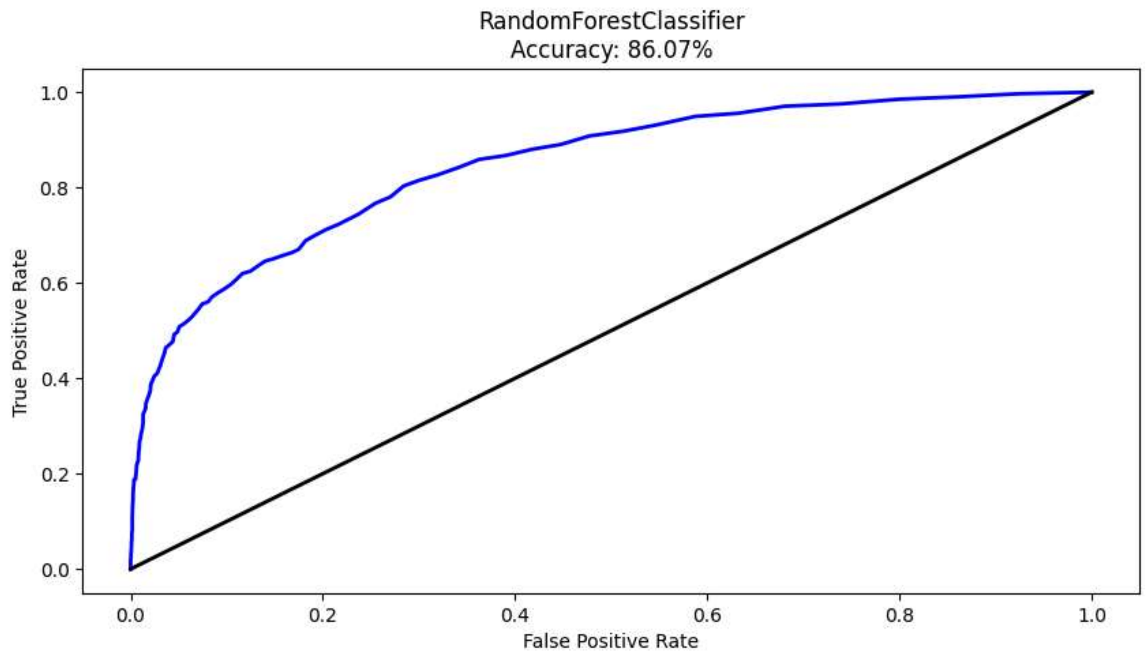
```
3000
```

```
accuracy = accuracy_score(y_test, y_pred)
print("Accuracy: {:.2f}%".format(accuracy * 100))
```

```
Accuracy: 86.07%
```

```
y_prob = model.predict_proba(x_test)[:, 1]
fpr, tpr, thresholds = roc_curve(y_test, y_prob)

plt.figure(figsize=(10, 5))
plt.plot(fpr, tpr, color='blue', lw=2)
plt.plot([0, 1], [0, 1], color='black', lw=2)
plt.xlabel('False Positive Rate')
plt.ylabel('True Positive Rate')
plt.title('RandomForestClassifier\nAccuracy: {:.2f}%'.format(accuracy * 100))
plt.show()
```


RandomForestClassifier
Accuracy: 86.07%
True Positive Rate
False Positive Rate