What Would be included...

- 📞 Telecom Customer Churn Prediction

This project predicts whether a telecom customer will **churn (leave the company)** or **stay**, using machine learning models such as Logistic Regression and Random Forest.
The goal is to help telecom companies **reduce customer loss** by identifying customers likely to churn.

📊 Dataset Overview

The dataset contains various information about telecom customers, including demographics, account details, and subscription types.

Column Name	Description
`customerID`	Unique ID assigned to each customer
`Gender`	Gender of the customer (Male/Female)
`SeniorCitizen`	Indicates if the customer is a senior citizen (1 = Yes, 0 = No)
`Partner`	Whether the customer has a partner (Yes/No)
`Dependents`	Whether the customer has dependents (Yes/No)
`Tenure`	Number of months the customer has stayed with the company
`PhoneService`	Whether the customer has a phone service (Yes/No)
`MultipleLines`	Whether the customer has multiple lines (Yes/No/No phone service)
`InternetService`	Type of internet service (DSL, Fiber optic, No)
`OnlineSecurity`	Whether the customer has online security (Yes/No/No internet service)
`DeviceProtection`	Whether the customer has device protection (Yes/No/No internet service)
`TechSupport`	Whether the customer has tech support (Yes/No/No internet service)
`StreamingTV`	Whether the customer has streaming TV service (Yes/No/No internet service)
`StreamingMovies`	Whether the customer has streaming movies (Yes/No/No internet service)
`Contract`	Type of contract (Month-to-month, One year, Two year)
`PaperlessBilling`	Whether billing is paperless (Yes/No)
`PaymentMethod`	Method of payment (e.g., Electronic check, Credit card, etc.)

Column Name	Description
`MonthlyCharges`	Amount charged per month
`TotalCharges`	Total amount charged to the customer
`Churn`	Target variable: whether the customer churned (Yes/No)

🎯 Objective

Predict whether a customer will churn based on their account and service details.

👨‍🎓 Author

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In [160…
```python
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import LabelEncoder, StandardScaler
from sklearn.ensemble import RandomForestClassifier    # ✅ <-- Add this import
from sklearn.metrics import accuracy_score, confusion_matrix, classification_report
```

In [161…
```python
df = pd.read_csv('TelecomCustomerChurn.csv')
df
```

Out[161…

	customerID	Gender	SeniorCitizen	Partner	Dependents	Tenure	PhoneService	Mu
0	7590-VHVEG	Female	0	Yes	No	1	No	
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	
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	
7041	8361-LTMKD	Male	1	Yes	No	4	Yes	
7042	3186-AJIEK	Male	0	No	No	66	Yes	

7043 rows × 21 columns

In [162…

```
df.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   object 
 20  Churn             7043 non-null   object 
dtypes: float64(1), int64(2), object(18)
memory usage: 1.1+ MB
```

In [163…
```
df.describe()
```

Out[163…

	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 [164…
```
df.isnull()
```

Out[164…

	customerID	Gender	SeniorCitizen	Partner	Dependents	Tenure	PhoneService	Mu
0	False	False	False	False	False	False	False	
1	False	False	False	False	False	False	False	
2	False	False	False	False	False	False	False	
3	False	False	False	False	False	False	False	
4	False	False	False	False	False	False	False	
...	...	...	...	...	...	...	...	
7038	False	False	False	False	False	False	False	
7039	False	False	False	False	False	False	False	
7040	False	False	False	False	False	False	False	
7041	False	False	False	False	False	False	False	
7042	False	False	False	False	False	False	False	

7043 rows × 21 columns

In [165…

```
df.isnull().sum()
```

Out[165…

```
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
```

- ## We are Clearly See there is no null values

In [166…

```
df.duplicated().sum()
```

Out[166…

```
np.int64(0)
```

In [167…

```
df.columns
```

Out[167…

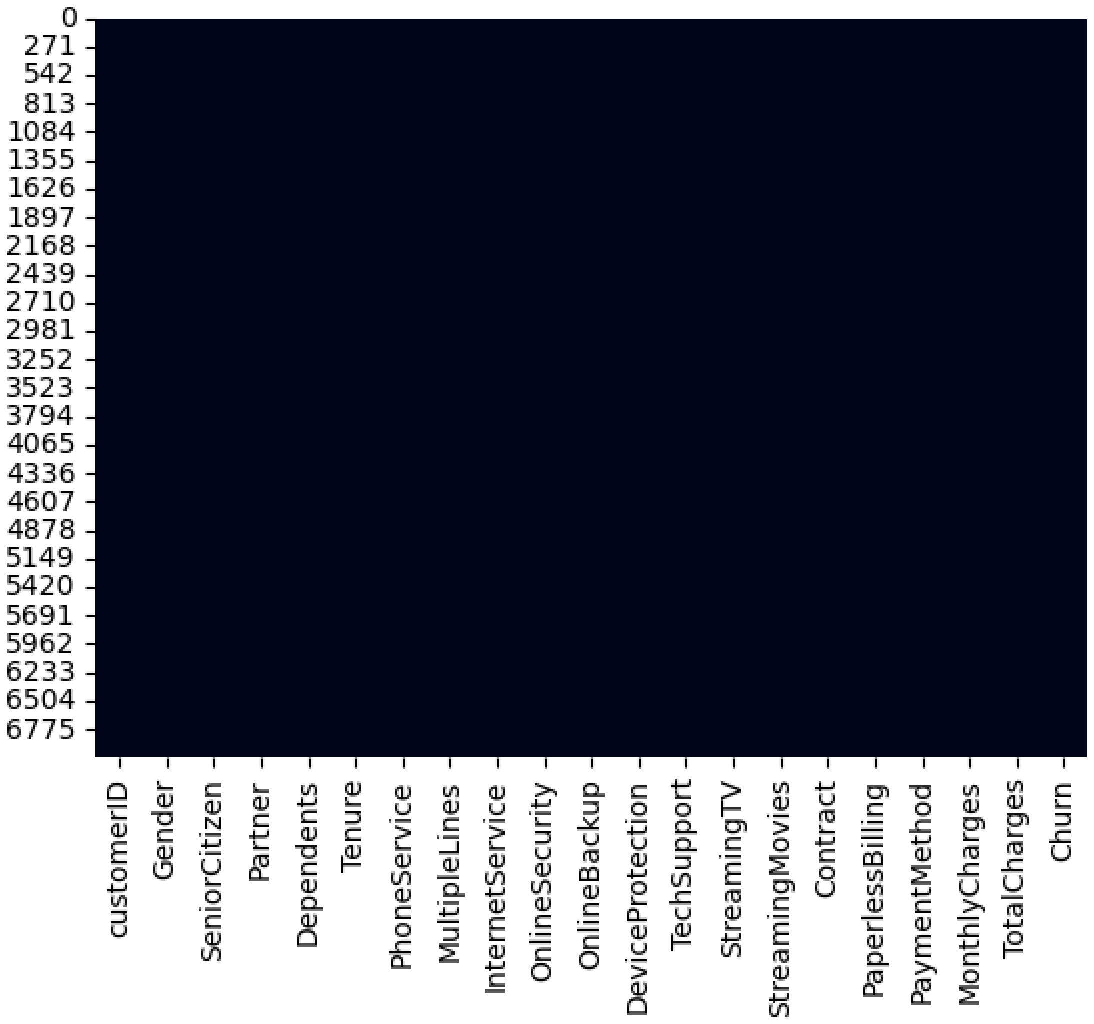
```
Index(['customerID', 'Gender', 'SeniorCitizen', 'Partner', 'Dependents',
       'Tenure', 'PhoneService', 'MultipleLines', 'InternetService',
       'OnlineSecurity', 'OnlineBackup', 'DeviceProtection', 'TechSupport',
       'StreamingTV', 'StreamingMovies', 'Contract', 'PaperlessBilling',
       'PaymentMethod', 'MonthlyCharges', 'TotalCharges', 'Churn'],
      dtype='object')
```

In [168…

```
sns.heatmap(df.isnull(), cbar=False)
```

Out[168…

```
<Axes: >
```

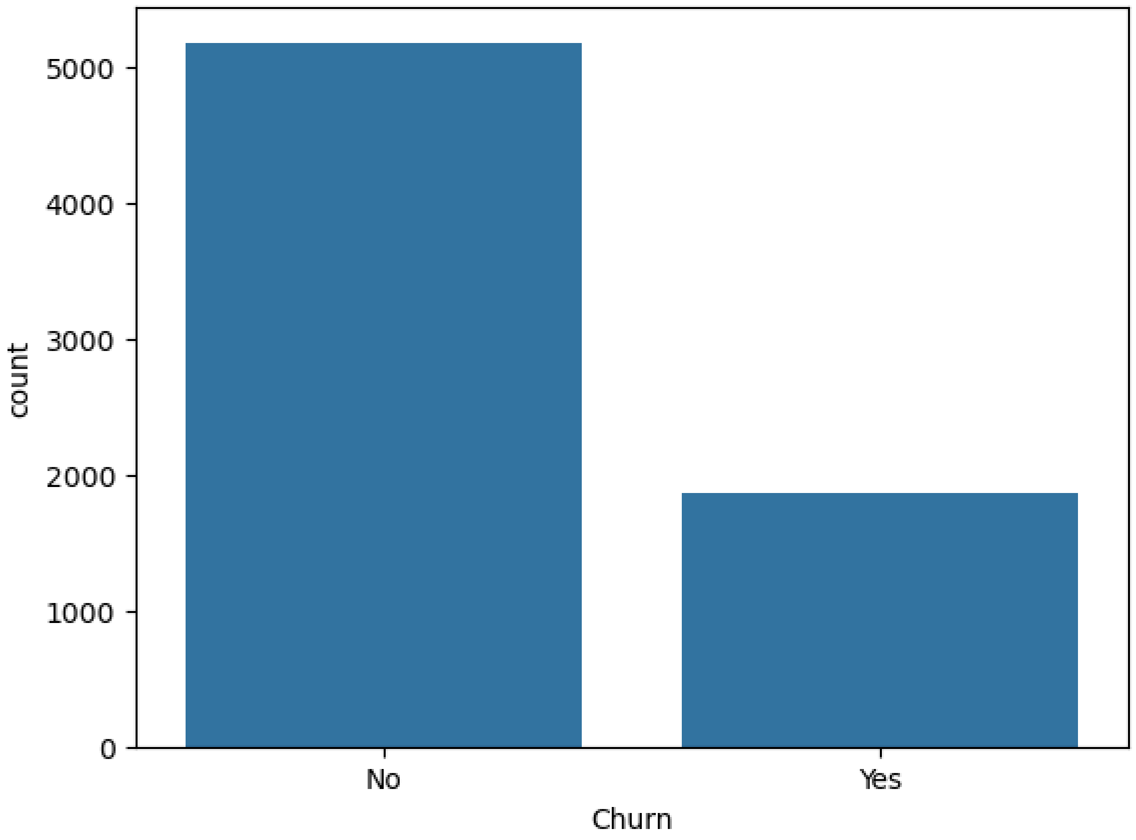


In [169…

```
df['Churn'].value_counts(normalize=True)
sns.countplot(x='Churn', data=df)
```

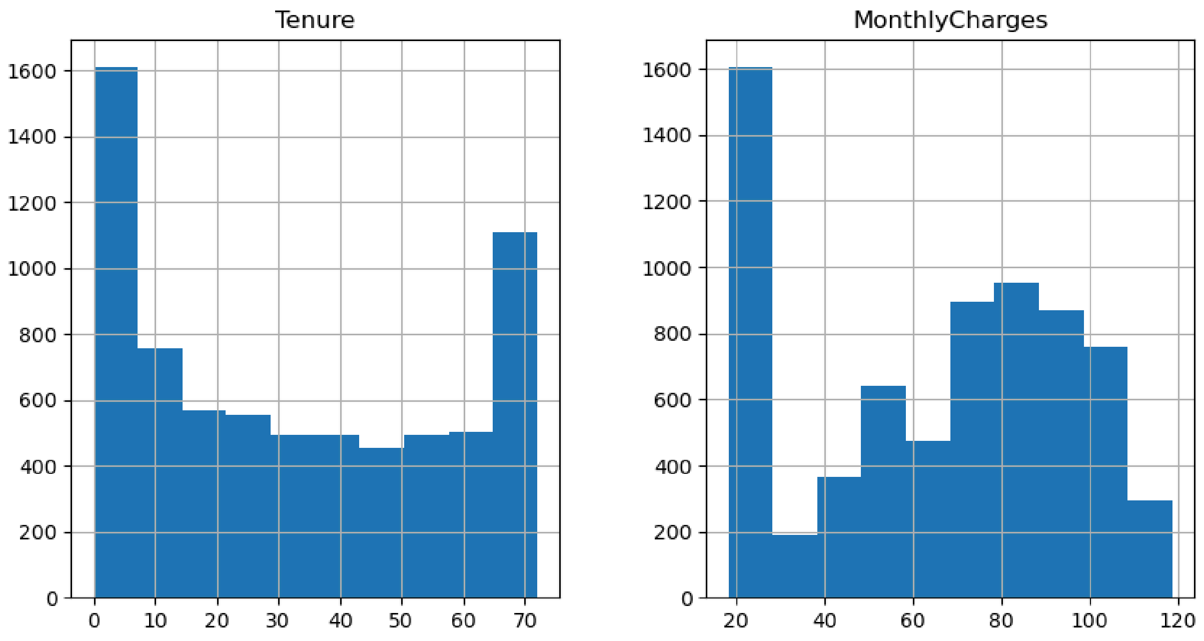
Out[169…

```
<Axes: xlabel='Churn', ylabel='count'>
```



```
In [170…  num_cols = ['Tenure', 'MonthlyCharges', 'TotalCharges']
          df[num_cols].hist(figsize=(10, 5))
```

```
Out[170…  array([[<Axes: title={'center': 'Tenure'}>,
                  <Axes: title={'center': 'MonthlyCharges'}>]], dtype=object)
```



```
In [171…  df.drop("customerID", axis=1, inplace=True)
```

```
In [172…  df["TotalCharges"] = pd.to_numeric(df["TotalCharges"], errors="coerce")
```

```
df["TotalCharges"].fillna(df["TotalCharges"].mean(), inplace=True)
```

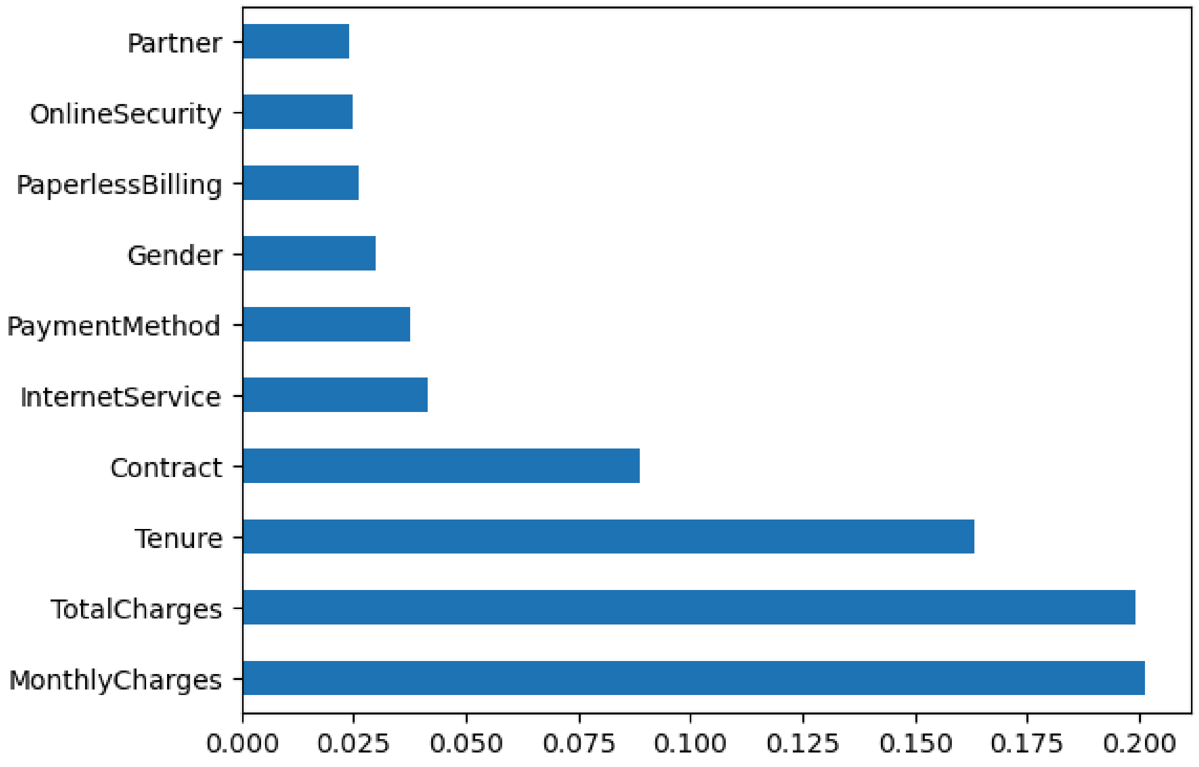
```
C:\Users\alihu\AppData\Local\Temp\ipykernel_17376\3639554342.py:2: FutureWarning: A
value is trying to be set on a copy of a DataFrame or Series through chained assignm
ent using an inplace method.
The behavior will change in pandas 3.0. This inplace method will never work because
the intermediate object on which we are setting values always behaves as a copy.

For example, when doing 'df[col].method(value, inplace=True)', try using 'df.method
({col: value}, inplace=True)' or df[col] = df[col].method(value) instead, to perform
the operation inplace on the original object.


  df["TotalCharges"].fillna(df["TotalCharges"].mean(), inplace=True)
```

In [173…
```
X = df.drop("Churn", axis=1)
y = df["Churn"]
```

In [174…
```
le = LabelEncoder()
for col in X.select_dtypes(include=['object']).columns:
    X[col] = le.fit_transform(X[col])
y = le.fit_transform(y)
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3, random_sta
```

In [175…
```
model = RandomForestClassifier(random_state=42)
model.fit(X_train, y_train)
importances = pd.Series(model.feature_importances_, index=X.columns)
importances.nlargest(10).plot(kind='barh')
```

Out[175…
```
<Axes: >
```



In [176…
```
X_train.dtypes
```

Out[176…
```
Gender                int64
SeniorCitizen         int64
Partner               int64
Dependents            int64
Tenure                int64
PhoneService          int64
MultipleLines         int64
InternetService       int64
OnlineSecurity        int64
OnlineBackup          int64
DeviceProtection      int64
TechSupport           int64
StreamingTV           int64
StreamingMovies       int64
Contract              int64
PaperlessBilling      int64
PaymentMethod         int64
MonthlyCharges      float64
TotalCharges        float64
dtype: object
```

In [177…
```
feature_names = X.columns.tolist()
```

In [178…
```
scaler = StandardScaler()
X_train = scaler.fit_transform(X_train)
X_test = scaler.transform(X_test)
```

In [179…
```
model = RandomForestClassifier(random_state=42)
model.fit(X_train, y_train)
```

Out[179…
```
▾ RandomForestClassifier
RandomForestClassifier(random_state=42)
```

In [180…
```
y_pred = model.predict(X_test)
print("✅ Accuracy:", accuracy_score(y_test, y_pred))
print("📊 Confusion Matrix:\n", confusion_matrix(y_test, y_pred))
print("📄 Classification Report:\n", classification_report(y_test, y_pred))
```

```
✅ Accuracy: 0.791292001893043
📊 Confusion Matrix:
 [[1401  138]
 [ 303  271]]
📜 Classification Report:
              precision    recall  f1-score   support

           0       0.82      0.91      0.86      1539
           1       0.66      0.47      0.55       574

    accuracy                           0.79      2113
   macro avg       0.74      0.69      0.71      2113
weighted avg       0.78      0.79      0.78      2113
```

In [182…

```
import pickle
model_data = {
    "model": model,
    "scaler": scaler,
    "feature_names": feature_names
}

with open("model.pkl", "wb") as file:
    pickle.dump(model_data, file)

print("✅ Model file saved successfully with feature names!")
```

```
✅ Model file saved successfully with feature names!
```

In [ ]: