```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.ticker as mtick
import matplotlib.pyplot as plt
%matplotlib inline
```

```
telecom = pd.read_csv('/content/WA_Fn-UseC_-Telco-Customer-Churn.csv')
```

```
telecom.head()
```

	customerID	gender	SeniorCitizen	Partner	Dependents	tenure	PhoneService	MultipleLines	InternetService	OnlineSecurity	...	Dev:
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 rows × 21 columns

```
telecom.shape
```

```
(7043, 21)
```

```
telecom.columns.values
```

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

```
telecom.dtypes
```

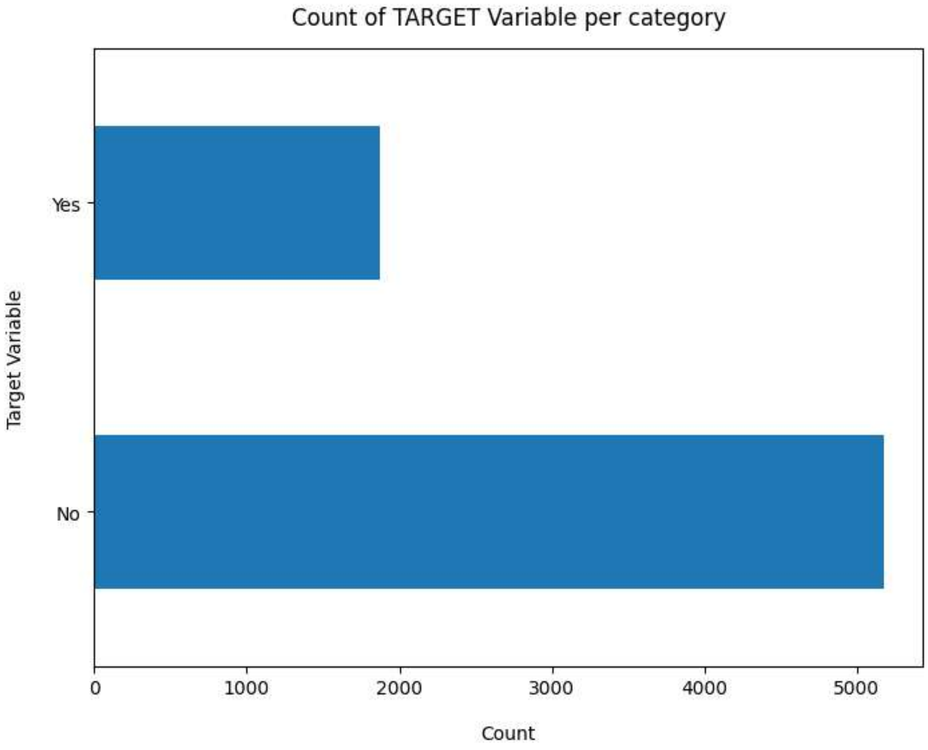
```
customerID           object
gender               object
SeniorCitizen         int64
Partner              object
Dependents           object
tenure                int64
PhoneService         object
MultipleLines        object
InternetService      object
OnlineSecurity       object
OnlineBackup         object
DeviceProtection     object
TechSupport          object
StreamingTV          object
StreamingMovies      object
Contract             object
PaperlessBilling     object
PaymentMethod        object
MonthlyCharges      float64
TotalCharges         object
Churn                object
dtype: object
```

```
telecom.describe()
```

	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

```
telecom['Churn'].value_counts().plot(kind='barh', figsize=(8, 6))
plt.xlabel("Count", labelpad=14)
plt.ylabel("Target Variable", labelpad=14)
plt.title("Count of TARGET Variable per category", y=1.02)
```

```
Text(0.5, 1.02, 'Count of TARGET Variable per category')
```



```
100*telecom['Churn'].value_counts()/len(telecom['Churn'])
```

```
No     73.463013
Yes    26.536987
Name: Churn, dtype: float64
```

```
telecom['Churn'].value_counts()
```

```
No     5174
Yes    1869
Name: Churn, dtype: int64
```

```
telecom.info(verbose = True)
```

```
<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
```

```
telco_data = telecom.copy()
```

```
telco_data.TotalCharges = pd.to_numeric(telco_data.TotalCharges, errors='coerce')
telco_data.isnull().sum()
```

```
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        11
Churn                0
dtype: int64
```

```
telco_data.loc[telco_data ['TotalCharges'].isnull() == True]
```

endents	tenure	PhoneService	MultipleLines	InternetService	OnlineSecurity	...
Yes	0	No	No phone service	DSL	Yes	...
Yes	0	Yes	No	No	No internet service	...
Yes	0	Yes	No	DSL	Yes	...
Yes	0	Yes	Yes	No	No internet service	...
Yes	0	No	No phone service	DSL	Yes	...
Yes	0	Yes	No	No	No internet service	...
Yes	0	Yes	Yes	No	No internet service	...
Yes	0	Yes	No	No	No internet service	...
Yes	0	Yes	No	No	No internet service	...
Yes	0	Yes	Yes	DSL	No	...
Yes	0	Yes	Yes	DSL	Yes	...

```
telco_data.dropna(how = 'any', inplace = True)
#telco_data.fillna(0)
```

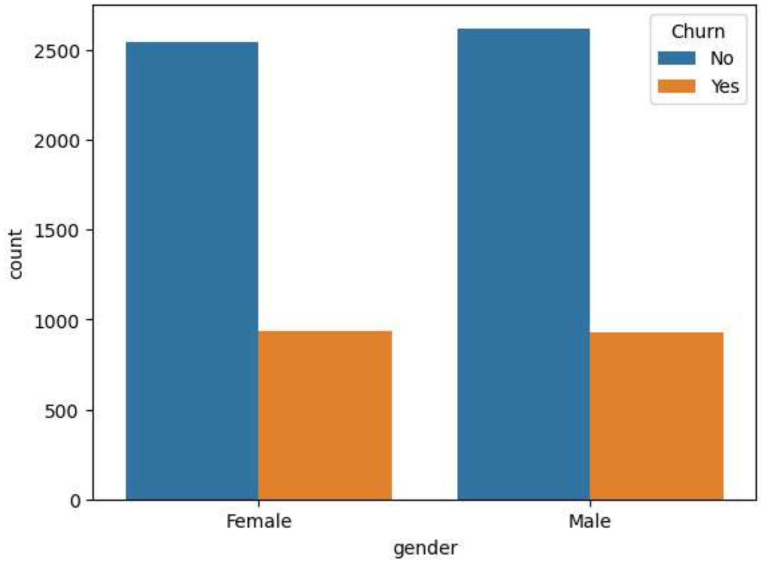
```
print(telco_data['tenure'].max())
```

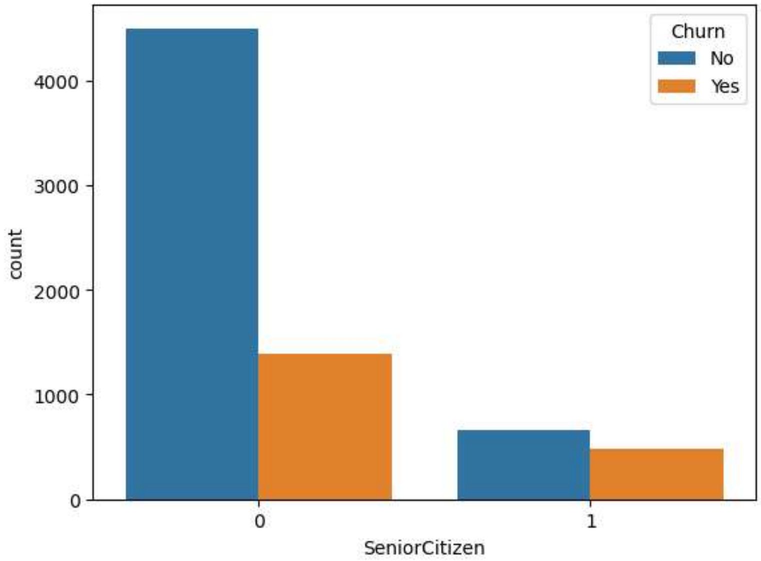
```
72
```

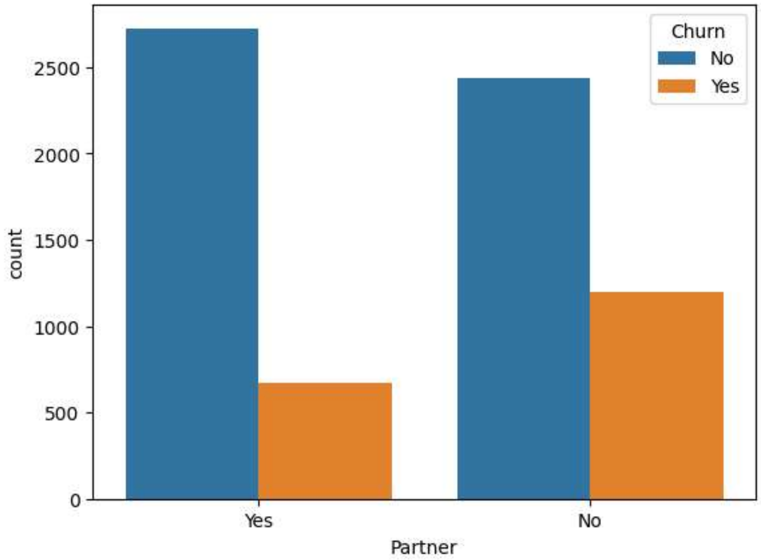
```
telco_data.drop(columns= ['customerID','tenure'], axis=1, inplace=True)
telco_data.head()
```

	gender	SeniorCitizen	Partner	Dependents	PhoneService	MultipleLines	InternetService	OnlineSecurity	OnlineBackup	DeviceProtecti
0	Female	0	Yes	No	No	No phone service	DSL	No	Yes	I
1	Male	0	No	No	Yes	No	DSL	Yes	No	Y
2	Male	0	No	No	Yes	No	DSL	Yes	Yes	I
3	Male	0	No	No	No	No phone service	DSL	Yes	No	Y
4	Female	0	No	No	Yes	No	Fiber optic	No	No	I

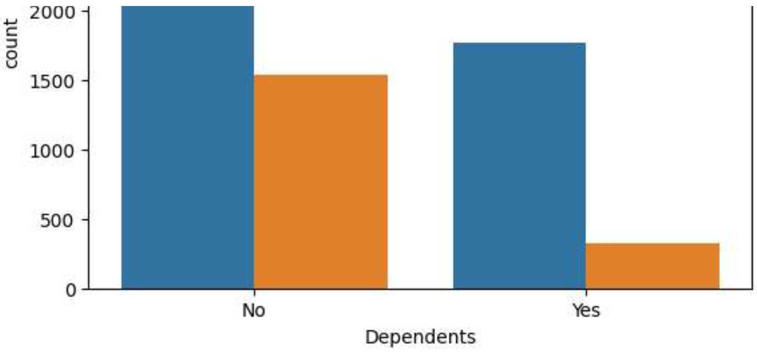
```
for i, predictor in enumerate(telco_data.drop(columns=['Churn', 'TotalCharges', 'MonthlyCharges'])):
    plt.figure(i)
    sns.countplot(data=telco_data, x=predictor, hue='Churn')
```

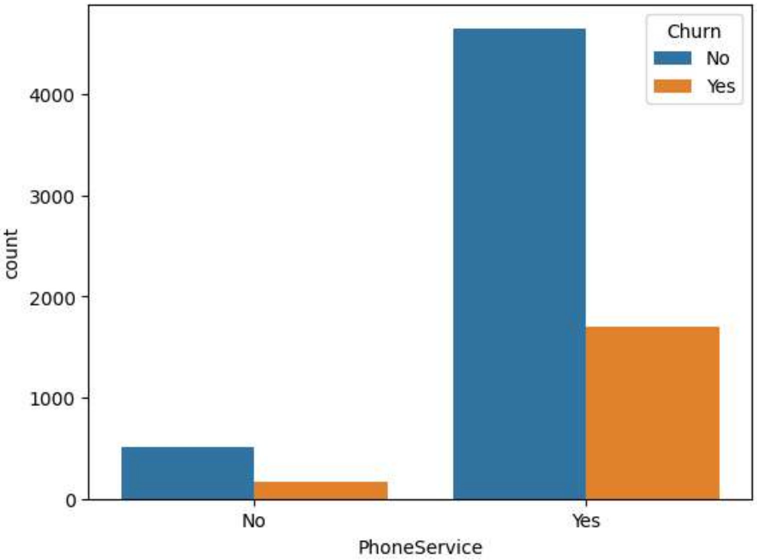

Churn
No
Yes
count
0
500
1000
1500
2000
2500
Female
Male
gender

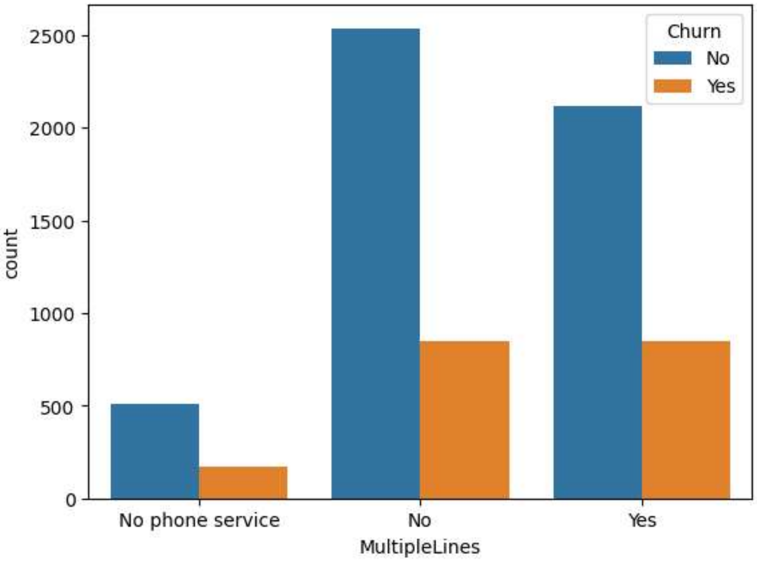

Churn
No
Yes
count
0
1000
2000
3000
4000
0
1
SeniorCitizen

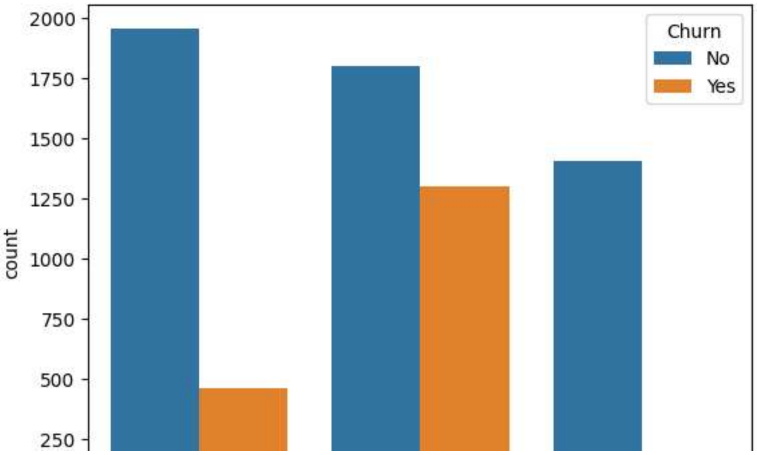

Churn
No
Yes
count
0
500
1000
1500
2000
2500
Yes
No
Partner

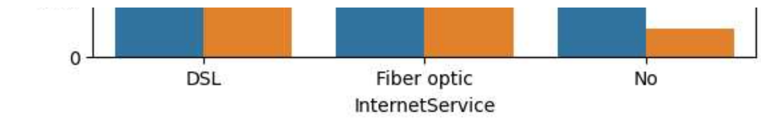
Churn
No
Yes
2500
3000
3500

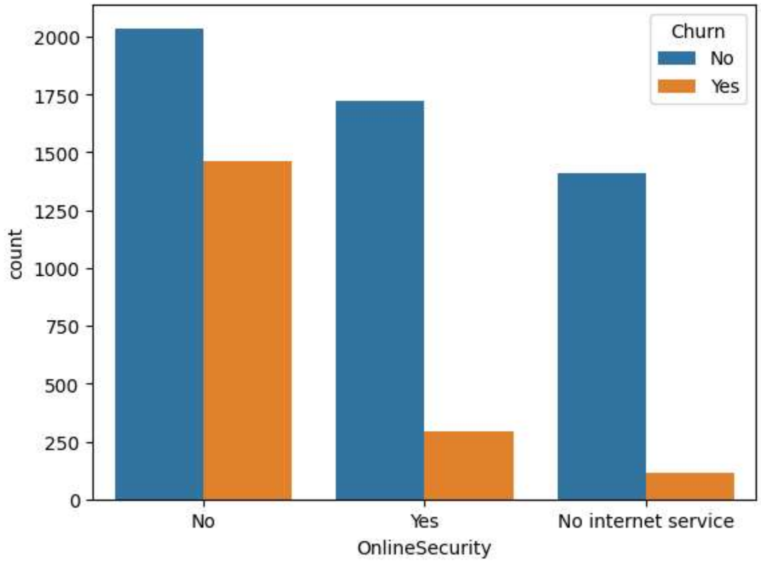

count
2000
1500
1000
500
0
No
Yes
Dependents

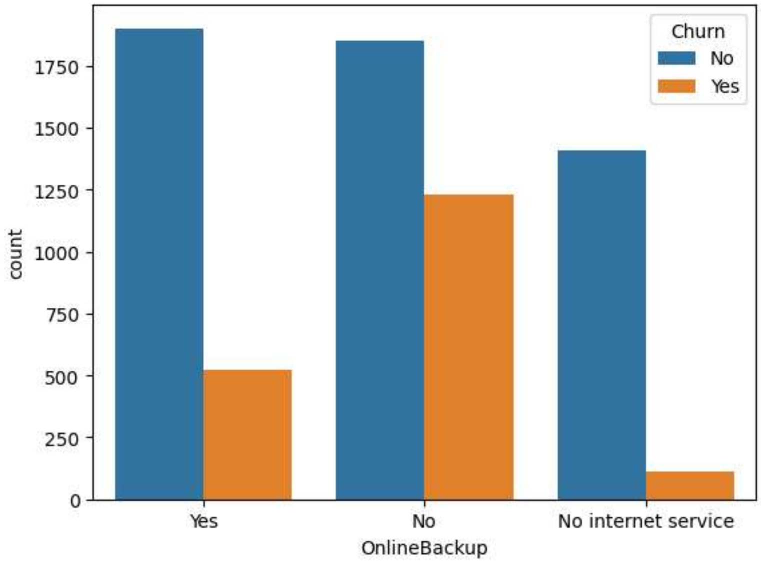

Churn
No
Yes
count
4000
3000
2000
1000
0
No
Yes
PhoneService

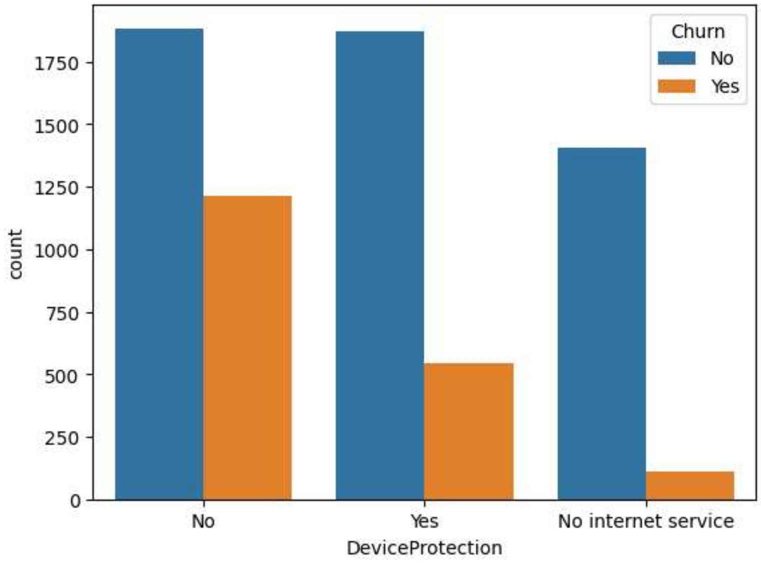

Churn
No
Yes
count
2500
2000
1500
1000
500
0
No phone service
No
Yes
MultipleLines


Churn
No
Yes
count
2000
1750
1500
1250
1000
750
500
250

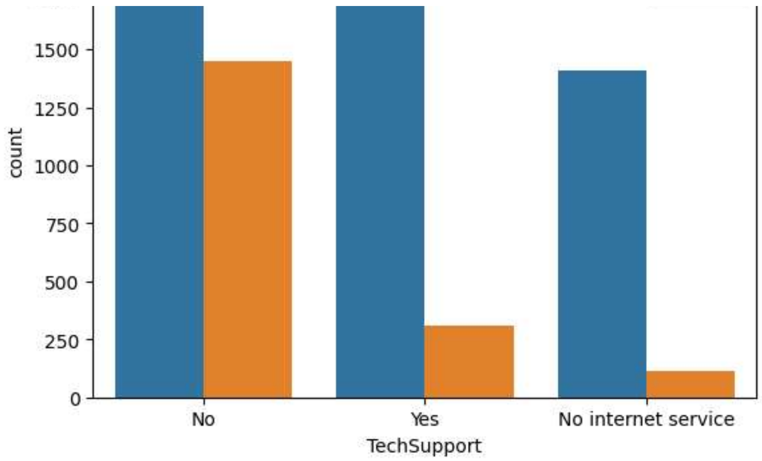

0
DSL
Fiber optic
No
InternetService

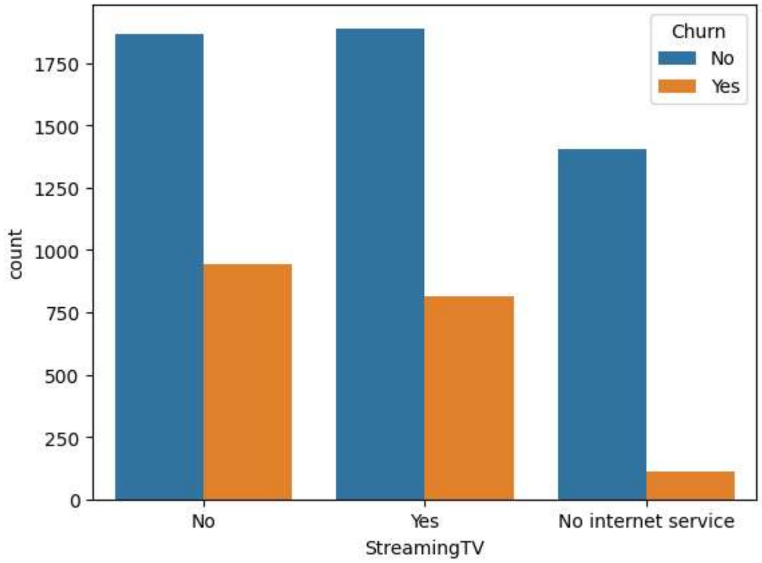

Churn
No
Yes
count
2000
1750
1500
1250
1000
750
500
250
0
No
Yes
No internet service
OnlineSecurity

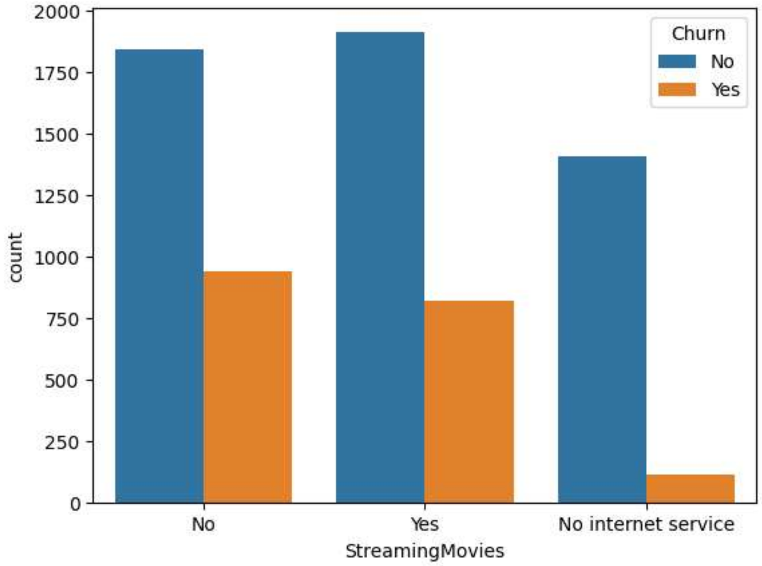

Churn
No
Yes
count
1750
1500
1250
1000
750
500
250
0
Yes
No
No internet service
OnlineBackup

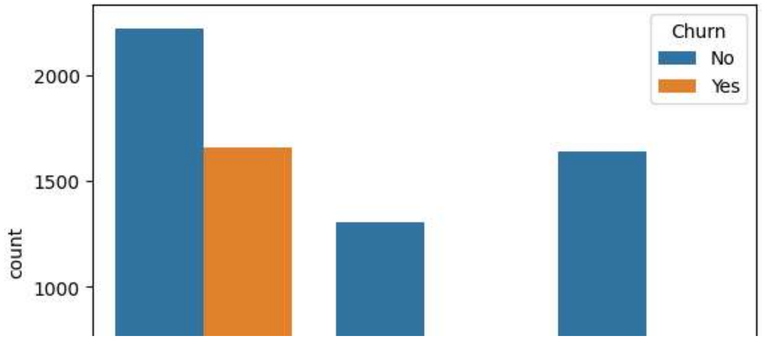

Churn
No
Yes
count
1750
1500
1250
1000
750
500
250
0
No
Yes
No internet service
DeviceProtection

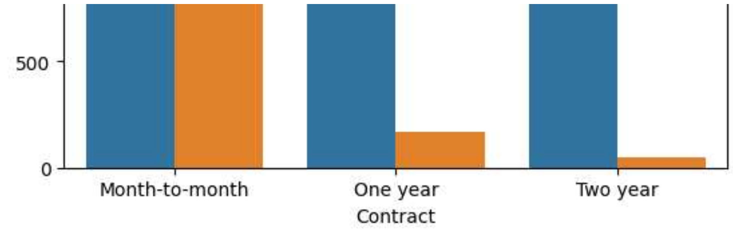
Churn
No
Yes
2000
1750


count
1500
1250
1000
750
500
250
0
No
Yes
No internet service
TechSupport


Churn
No
Yes
count
1750
1500
1250
1000
750
500
250
0
No
Yes
No internet service
StreamingTV


Churn
No
Yes
count
2000
1750
1500
1250
1000
750
500
250
0
No
Yes
No internet service
StreamingMovies


Churn
No
Yes
count
2000
1500
1000



```
telco_data['Churn'] = np.where(telco_data.Churn == 'Yes',1,0)
telco_data.head()
```

	gender	SeniorCitizen	Partner	Dependents	PhoneService	MultipleLines	InternetService	OnlineSecurity	OnlineBackup	DeviceProtecti
0	Female	0	Yes	No	No	No phone service	DSL	No	Yes	I
1	Male	0	No	No	Yes	No	DSL	Yes	No	Y
2	Male	0	No	No	Yes	No	DSL	Yes	Yes	I
3	Male	0	No	No	No	No phone service	DSL	Yes	No	Y
4	Female	0	No	No	Yes	No	Fiber optic	No	No	I

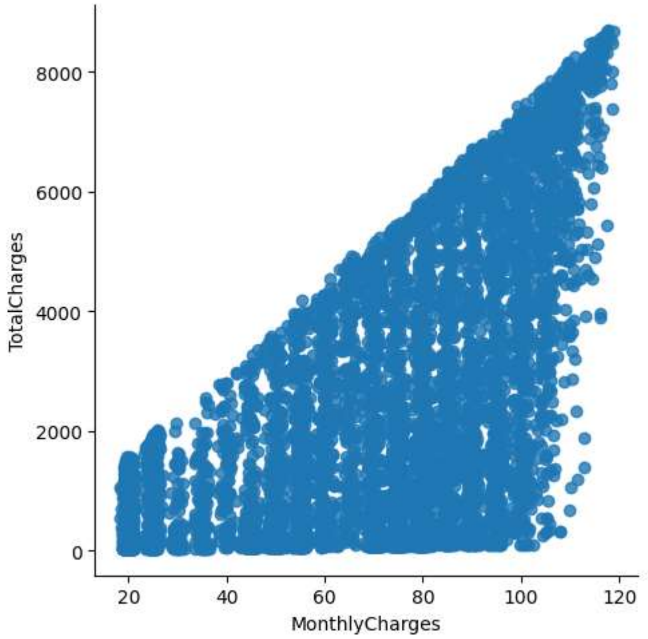
```
telco_data_dummies = pd.get_dummies(telco_data)
telco_data_dummies.head()
```

	SeniorCitizen	MonthlyCharges	TotalCharges	Churn	gender_Female	gender_Male	Partner_No	Partner_Yes	Dependents_No	Dependents_Yes
0	0	29.85	29.85	0	1	0	0	1	1	0
1	0	56.95	1889.50	0	0	1	1	0	1	0
2	0	53.85	108.15	1	0	1	1	0	1	0
3	0	42.30	1840.75	0	0	1	1	0	1	0
4	0	70.70	151.65	1	1	0	1	0	1	0

5 rows × 45 columns

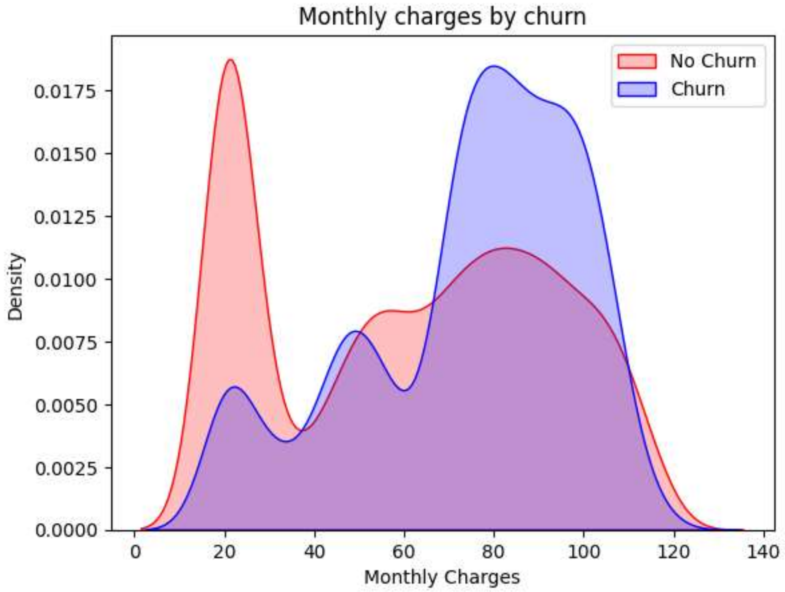
```
sns.lmplot(data=telco_data_dummies, x='MonthlyCharges', y='TotalCharges', fit_reg=False)
```

```
<seaborn.axisgrid.FacetGrid at 0x7857fca16bc0>
```



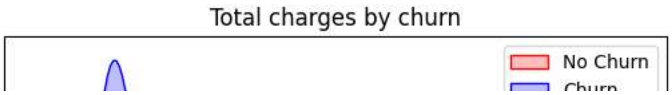
```
Mth = sns.kdeplot(telco_data_dummies.MonthlyCharges[(telco_data_dummies["Churn"] == 0) ],
                color="Red", shade = True)
Mth = sns.kdeplot(telco_data_dummies.MonthlyCharges[(telco_data_dummies["Churn"] == 1) ],
                ax =Mth, color="Blue", shade= True)
Mth.legend(["No Churn","Churn"],loc='upper right')
Mth.set_ylabel('Density')
Mth.set_xlabel('Monthly Charges')
Mth.set_title('Monthly charges by churn')
```

```
<ipython-input-31-940d64c03b8e>:1: FutureWarning:

`shade` is now deprecated in favor of `fill`; setting `fill=True`.
This will become an error in seaborn v0.14.0; please update your code.

  Mth = sns.kdeplot(telco_data_dummies.MonthlyCharges[(telco_data_dummies["Churn"] == 0) ],
<ipython-input-31-940d64c03b8e>:3: FutureWarning:

`shade` is now deprecated in favor of `fill`; setting `fill=True`.
This will become an error in seaborn v0.14.0; please update your code.

  Mth = sns.kdeplot(telco_data_dummies.MonthlyCharges[(telco_data_dummies["Churn"] == 1) ],
Text(0.5, 1.0, 'Monthly charges by churn')
```



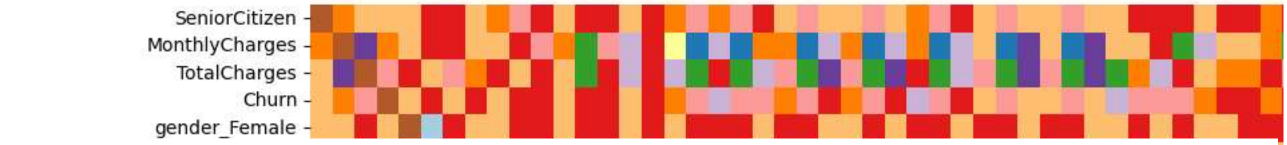
```
Tot = sns.kdeplot(telco_data_dummies.TotalCharges[(telco_data_dummies["Churn"] == 0) ],
                color="Red", shade = True)
Tot = sns.kdeplot(telco_data_dummies.TotalCharges[(telco_data_dummies["Churn"] == 1) ],
                ax =Tot, color="Blue", shade= True)
Tot.legend(["No Churn","Churn"],loc='upper right')
Tot.set_ylabel('Density')
Tot.set_xlabel('Total Charges')
Tot.set_title('Total charges by churn')
```

```
<ipython-input-32-aa9d55a4850a>:1: FutureWarning:

`shade` is now deprecated in favor of `fill`; setting `fill=True`.
This will become an error in seaborn v0.14.0; please update your code.

  Tot = sns.kdeplot(telco_data_dummies.TotalCharges[(telco_data_dummies["Churn"] == 0) ]
<ipython-input-32-aa9d55a4850a>:3: FutureWarning:

`shade` is now deprecated in favor of `fill`; setting `fill=True`.
This will become an error in seaborn v0.14.0; please update your code.

  Tot = sns.kdeplot(telco_data_dummies.TotalCharges[(telco_data_dummies["Churn"] == 1) ]
Text(0.5, 1.0, 'Total charges by churn')
```



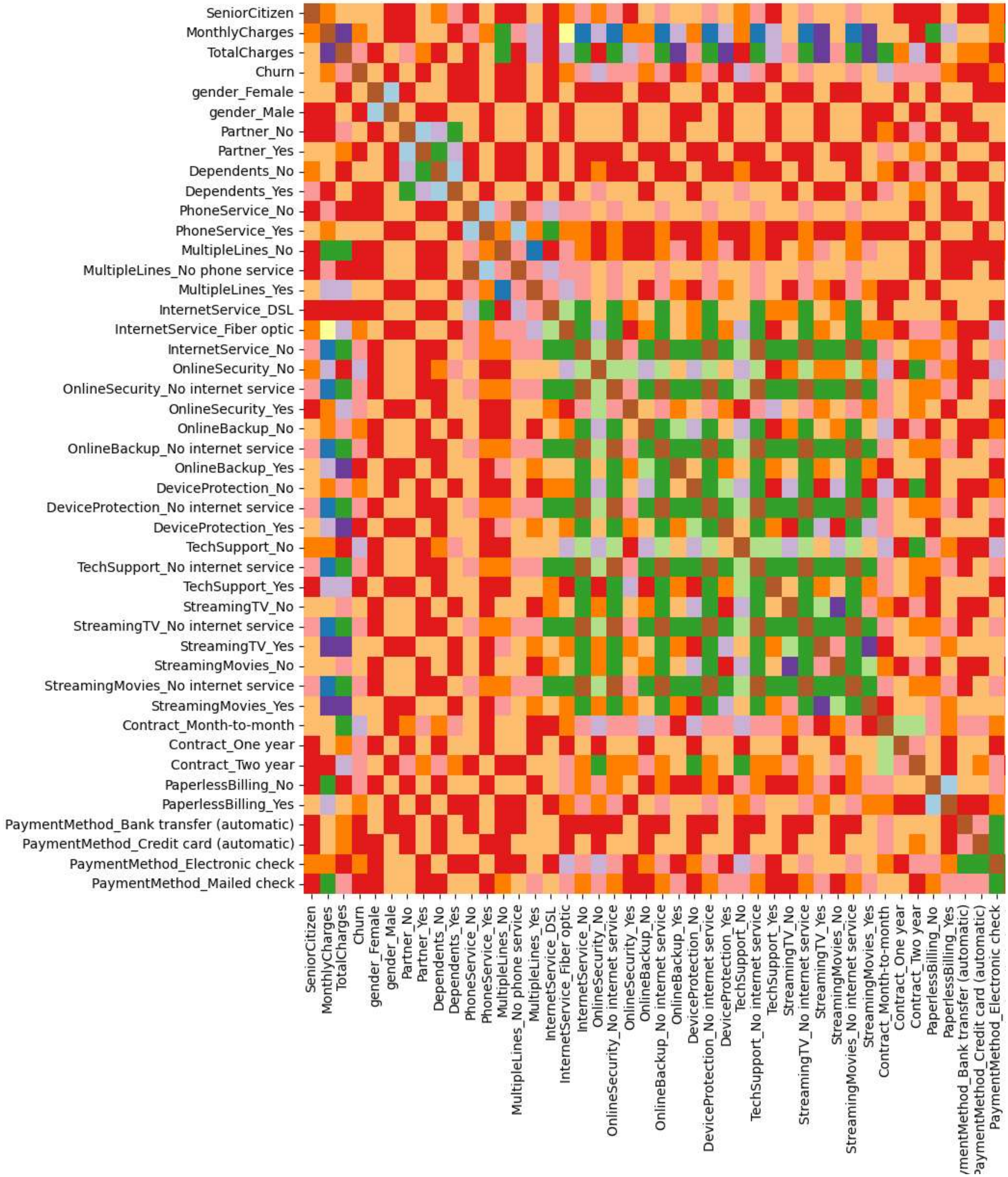
```
plt.figure(figsize=(12,12))
sns.heatmap(telco_data_dummies.corr(), cmap="Paired")
```

```
<Axes: >
```



```
plt.figure(figsize=(12,12))
sns.heatmap(telco_data_dummies.corr(), cmap="Paired")
```

```
<Axes: >
```


SeniorCitizen
MonthlyCharges
TotalCharges
Churn
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 internet service
OnlineSecurity_Yes
OnlineBackup_No
OnlineBackup_No internet service
OnlineBackup_Yes
DeviceProtection_No
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_Yes
Contract_Month-to-month
Contract_One year
Contract_Two year
PaperlessBilling_No
PaperlessBilling_Yes
PaymentMethod_Bank transfer (automatic)
PaymentMethod_Credit card (automatic)
PaymentMethod_Electronic check
PaymentMethod_Mailed check
SeniorCitizen
MonthlyCharges
TotalCharges
Churn
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 internet service
OnlineSecurity_Yes
OnlineBackup_No
OnlineBackup_No internet service
OnlineBackup_Yes
DeviceProtection_No
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_Yes
Contract_Month-to-month
Contract_One year
Contract_Two year
PaperlessBilling_No
PaperlessBilling_Yes
ymentMethod_Bank transfer (automatic)
aymentMethod_Credit card (automatic)
PaymentMethod_Electronic check