Load Libraries and Data

In [1]:

```
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
from sklearn.metrics import classification_report, confusion_matrix

# Load data
data = pd.read_csv("E:/Customer Churn Analysis/Telco-Customer-Churn.csv")
data.head()
```

Out[1]:

	customerID	gender	SeniorCitizen	Partner	Dependents	tenure	PhoneService	Multi
0	7590-VHVEG	Female	0	Yes	No	1	No	N
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	N
4	9237-HQITU	Female	0	No	No	2	Yes	

5 rows × 21 columns

Data Exploration

This method provides a summary of the DataFrame, showing the row count, column names, non-null counts, data types, and memory usage, helping quickly identify the dataset's structure and any missing values.

In [2]:

```
print(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   object 
 20  Churn             7043 non-null   object 
dtypes: float64(1), int64(2), object(18)
memory usage: 1.1+ MB
None
```

This methods provides summary statistics (count, mean, std deviation, min, 25%, median, 75%, max) for each numeric column, offering a quick overview of value distribution and spread.

```
In [3]: print(data.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
50%         0.000000    29.000000       70.350000
75%         0.000000    55.000000       89.850000
max         1.000000    72.000000      118.750000
```

```
In [4]: print(data['Churn'].value_counts())
```

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

Data Cleaning

Handle any missing values, encode categorical variables, and prepare the data for analysis.

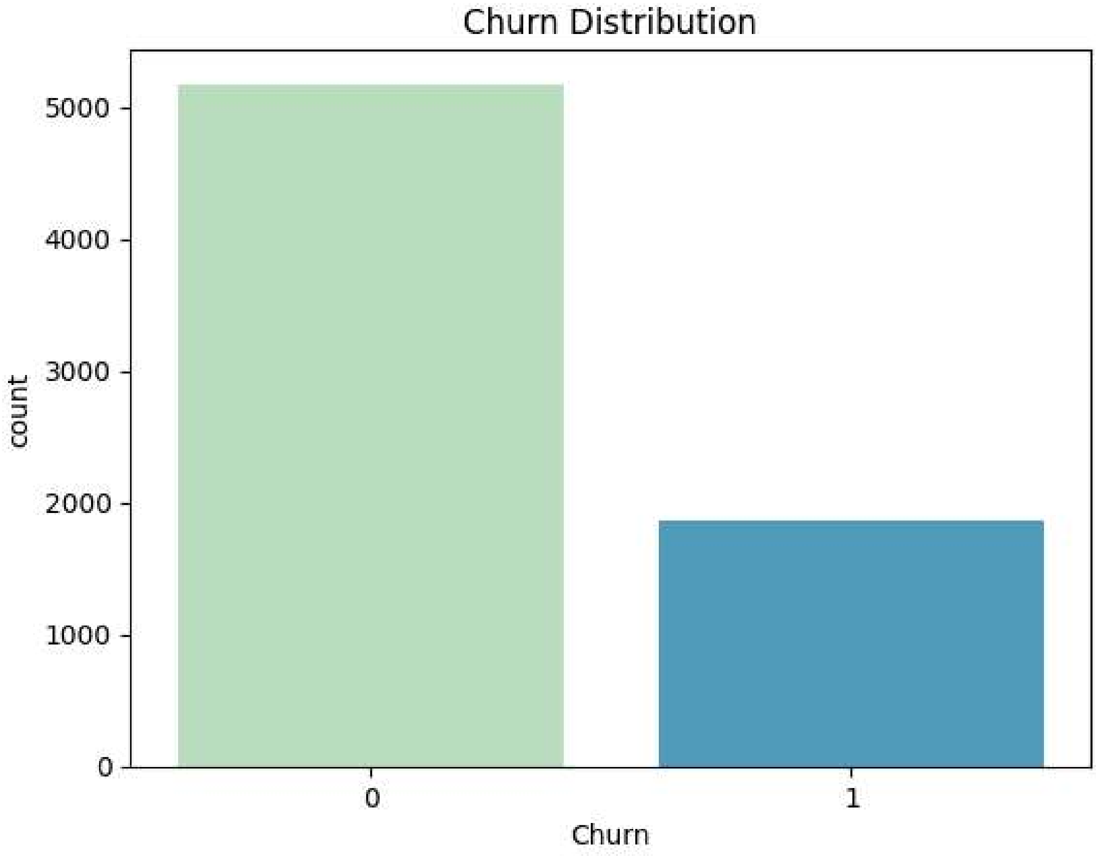
```
In [5]: data = data.dropna()
```

```
In [6]: for column in data.select_dtypes(include=['object']).columns:
            if data[column].nunique() == 2:
                data[column] = LabelEncoder().fit_transform(data[column])
            else:
                data = pd.get_dummies(data, columns=[column], drop_first=True)
```

Data Visualization

Visualize churn and other significant variables.

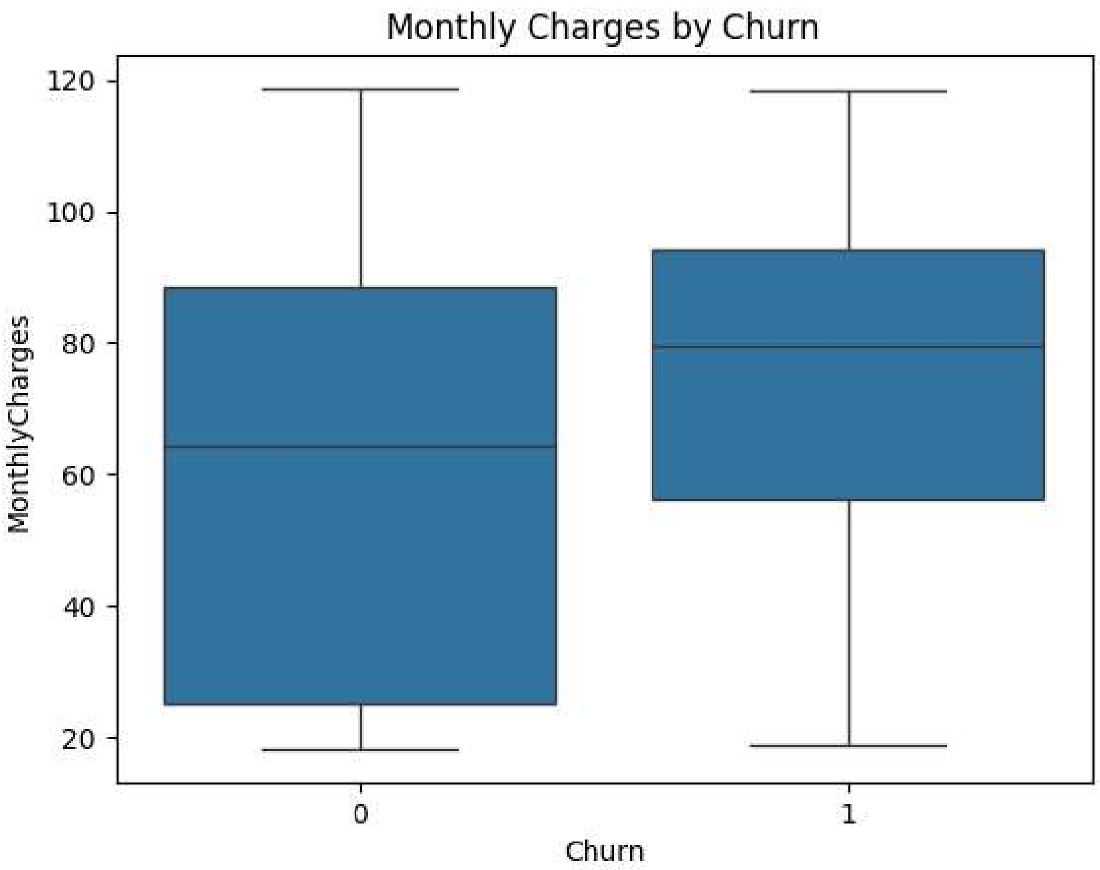
```
In [7]: sns.countplot(x="Churn", data=data, palette="GnBu", hue="Churn", dodge=False
        plt.legend([],[], frameon=False)
        plt.title('Churn Distribution')
        plt.show()
```

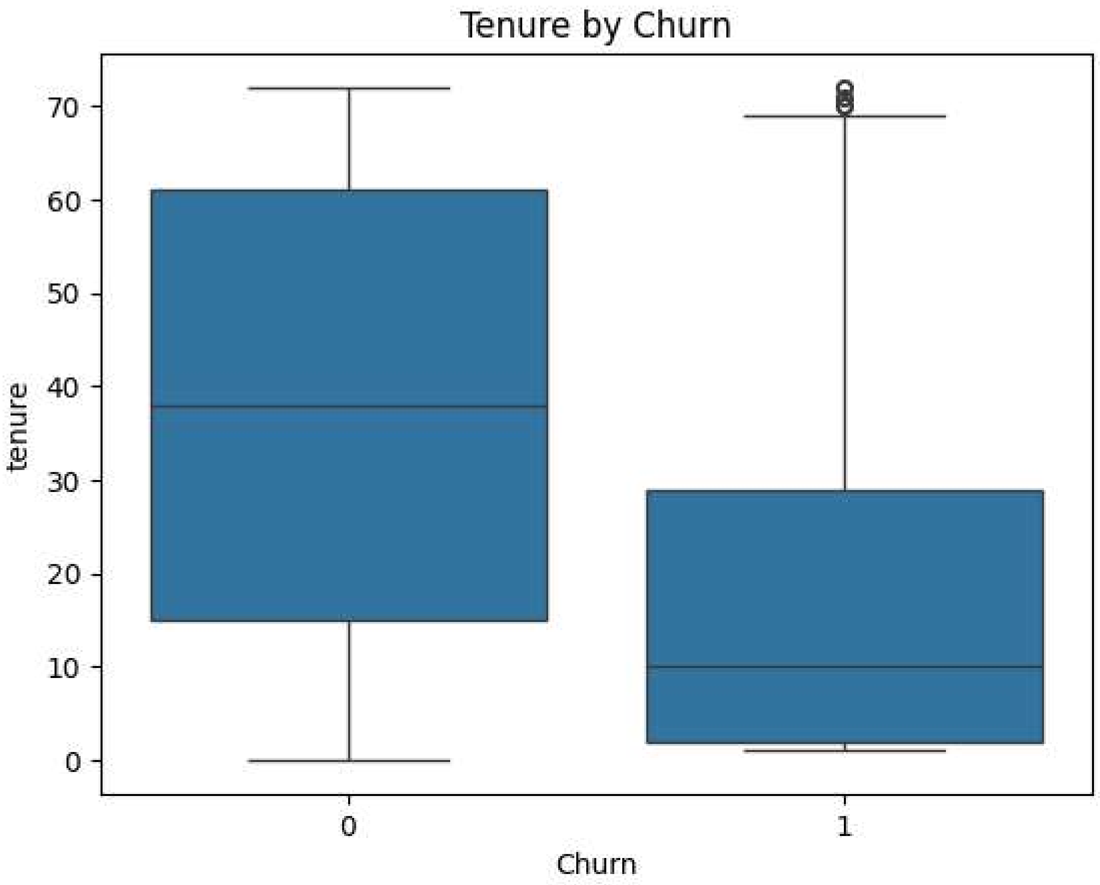


```
In [8]: sns.boxplot(x='Churn', y='MonthlyCharges', data=data,orient="vertical",flier
        plt.title('Monthly Charges by Churn')
        plt.show()

        sns.boxplot(x='Churn', y='tenure', data=data,orient="vertical",fliersize=5)
```

```
plt.title('Tenure by Churn')
plt.show()
```





Feature Selection and Scaling

Select relevant features and scale them for modeling.

In [9]:
```
X = data.drop(columns=['Churn'])
y = data['Churn']
```

In [10]:
```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, ra
```

In [11]:
```
scaler = StandardScaler()
X_train = scaler.fit_transform(X_train)
X_test = scaler.transform(X_test)
```

Model Building

We'll use a Random Forest model for churn prediction.

In [12]:
```
model = RandomForestClassifier(random_state=42)
model.fit(X_train, y_train)

y_pred = model.predict(X_test)
```

In [13]:
```
print(classification_report(y_test, y_pred))
```

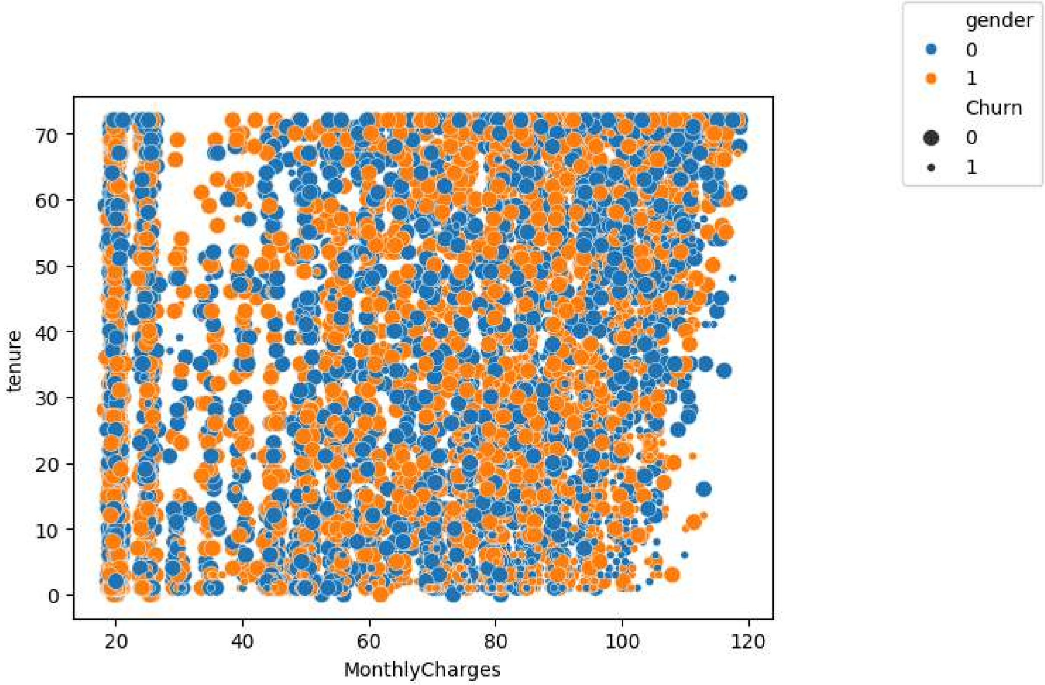
```
              precision    recall  f1-score   support

           0       0.82      0.93      0.87      1036
           1       0.70      0.44      0.54       373

    accuracy                           0.80      1409
   macro avg       0.76      0.69      0.71      1409
weighted avg       0.79      0.80      0.78      1409
```

The code creates a scatter plot of MonthlyCharges vs. tenure, with point size indicating Churn status and color representing gender, helping visualize relationships among these variables.

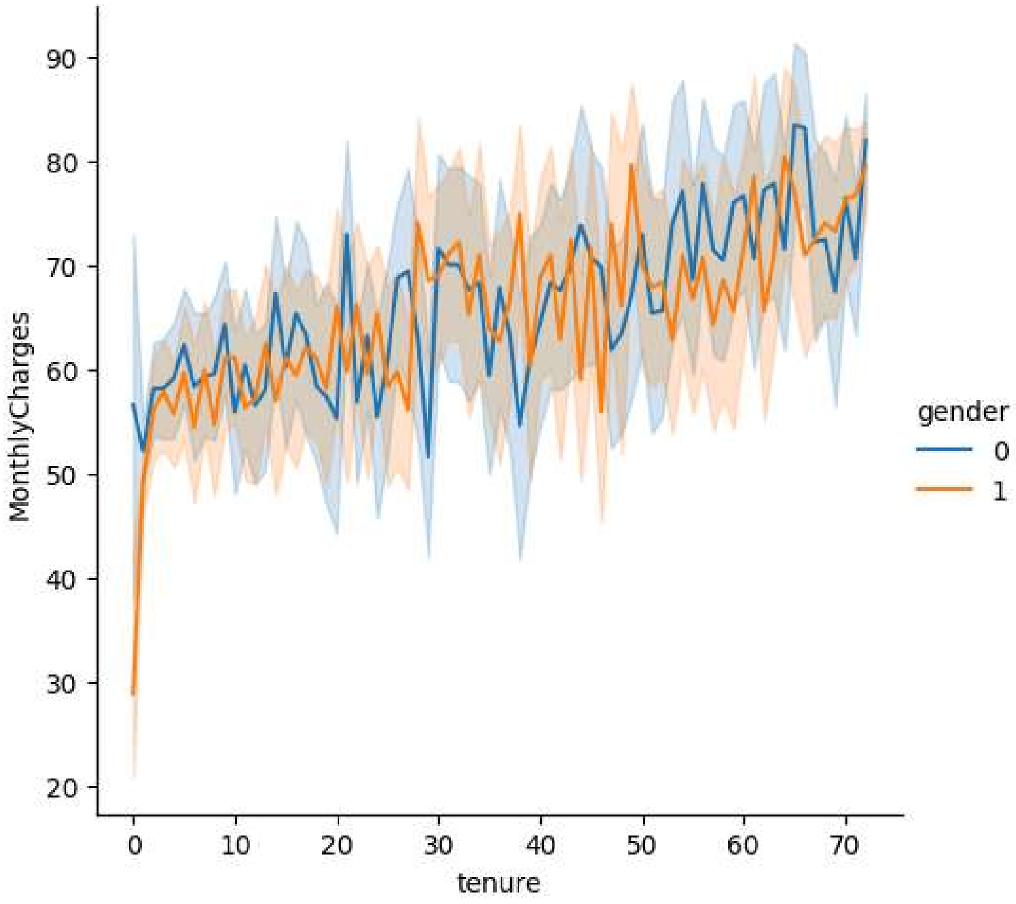
In [15]:
```
sns.scatterplot(data=data, x="MonthlyCharges", y="tenure", size="Churn",
plt.legend(bbox_to_anchor=(0.2, 0, 1.2,1.2)) #(x,y,width,height)
plt.show()
```



The code plots a line chart of MonthlyCharges over tenure segmented by gender, showing spending trends across customer duration.

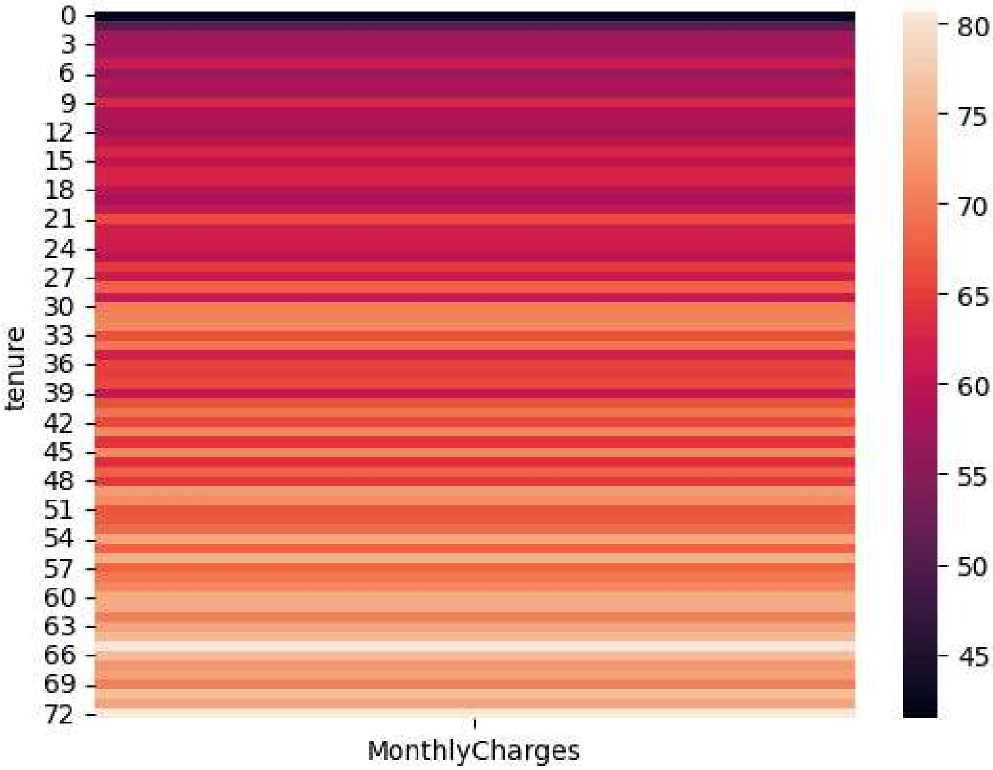
In [16]:

```
sns.relplot(data=data,x="tenure",y="MonthlyCharges",hue="gender",kind=
plt.show()
```



The code calculates the average MonthlyCharges for each tenure group and visualizes it as a heatmap, highlighting how charges vary over customer tenure.

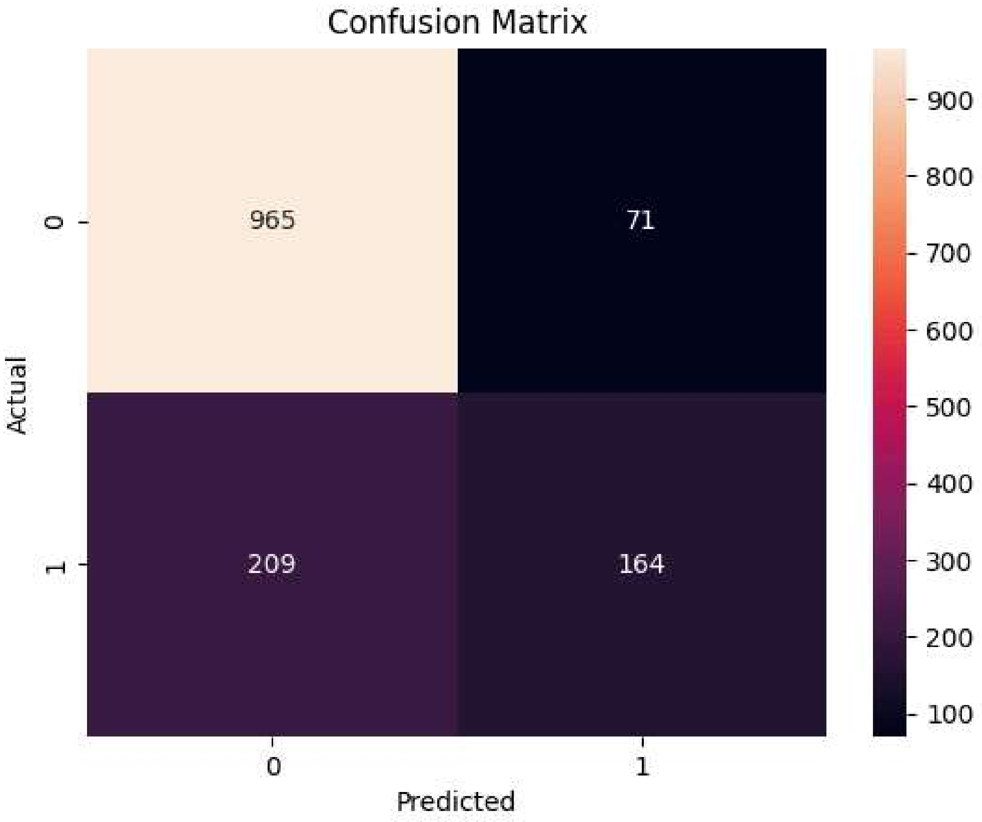
```
In [17]: gp=data.groupby("tenure").agg({"MonthlyCharges":"mean"})
         sns.heatmap(gp)
         plt.show()
```



Evaluate the Model

Evaluate model performance with a classification report and confusion matrix.

In [18]:
```
sns.heatmap(confusion_matrix(y_test, y_pred), annot=True, fmt="d")
plt.title('Confusion Matrix')
plt.xlabel('Predicted')
plt.ylabel('Actual')
plt.show()
```


Confusion Matrix
0
1
Actual
965
71
209
164
0
1
Predicted
900
800
700
600
500
400
300
200
100