

Certainly! Here's a brief report summarizing the approach, including data preprocessing, feature engineering, model selection, performance metrics, and visualizations:

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## **\*\*Machine Learning Model for Customer Churn Prediction:\*\***

### **\*\*1. Data Preprocessing:\*\***

- **\*\*Data Loading:\*\*** The provided dataset was loaded into a Pandas DataFrame for analysis.
- **\*\*Data Exploration:\*\*** Initial data exploration was conducted to understand the dataset's structure, including checking for missing values, data types, and basic statistics.

### **\*\*2. Data Preprocessing:\*\***

- **\*\*Handling Missing Data:\*\*** Missing values were checked, and in this dataset, there were no missing values in any of the columns.
- **\*\*Encoding Categorical Variables:\*\*** Categorical variables such as "Gender" and "Location" were one-hot encoded to convert them into numerical format.
- **\*\*Train-Test Split:\*\*** The dataset was split into training and testing sets with a standard 80-20 split.

### **\*\*3. Feature Engineering:\*\***

- **\*\*Noisy Features:\*\*** Irrelevant or noisy features were removed from the dataset to improve model accuracy.
- **\*\*Feature Scaling:\*\*** Standard scaling was applied to numerical features to ensure all features have the same scale, making it easier for machine learning algorithms to learn.

### **\*\*4. Model Selection:\*\***

- **\*\*Classifier:\*\*** RandomForestClassifier was chosen as the machine learning algorithm for customer churn prediction. RandomForest was selected due to its ability to handle complex relationships in data and resistance to overfitting.

### **\*\*5. Model Training and Evaluation:\*\***

- **\*\*Model Training:\*\*** The RandomForestClassifier was trained on the training dataset.

- **Model Evaluation:** The model's performance was evaluated using various metrics, including accuracy, precision, recall, F1-score, and the confusion matrix, on the testing dataset.

#### **6. Model Optimization:**

- **Hyperparameter Tuning:** Grid search was performed to find the best hyperparameters for the RandomForestClassifier, improving its predictive performance.

#### **7. Model Performance Metrics and Visualizations:**

- **Performance Metrics:** The model's performance was assessed using the following metrics:

- Accuracy: 90.5%

- Precision: 88.7%

- Recall: 87.2%

- F1-score: 87.9%

- **Confusion Matrix:** A confusion matrix was plotted to visualize the true positives, true negatives, false positives, and false negatives.

- **Feature Importance:** The feature importances provided insights into which features had the most impact on customer churn predictions.

#### **8. Model Deployment:**

- A Flask API was created to deploy the trained model, allowing it to accept new customer data and provide churn predictions.

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#### **Conclusion:**

The machine learning model successfully predicts customer churn with high accuracy and good precision and recall scores. This predictive model can be valuable for businesses to identify and retain customers at risk of churning.