Name: Gurjit Singh
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Importing Libraries and Dependencies

```
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.naive_bayes import GaussianNB
from sklearn.metrics import accuracy_score
import seaborn as sns
import matplotlib.pyplot as plt
```

Step 1: Load dataset

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

Step 2: Explore dataset

```
df.info()
print(df.head())
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 9578 entries, 0 to 9577
Data columns (total 14 columns):
 #   Column             Non-Null Count  Dtype  
---  ------             --------------  -----  
 0   credit.policy      9578 non-null   int64  
 1   purpose            9578 non-null   object 
 2   int.rate           9578 non-null   float64
 3   installment        9578 non-null   float64
 4   log.annual.inc     9578 non-null   float64
 5   dti                9578 non-null   float64
 6   fico               9578 non-null   int64  
 7   days.with.cr.line  9578 non-null   float64
 8   revol.bal          9578 non-null   int64  
 9   revol.util         9578 non-null   float64
 10  inq.last.6mths     9578 non-null   int64  
 11  delinq.2yrs        9578 non-null   int64  
 12  pub.rec            9578 non-null   int64  
 13  not.fully.paid     9578 non-null   int64  
dtypes: float64(6), int64(7), object(1)
memory usage: 1.0+ MB
```

```
   credit.policy             purpose  int.rate  installment  
log.annual.inc  \
0              1  debt_consolidation    0.1189       829.10       
11.350407   
1              1         credit_card    0.1071       228.22       
11.082143   
2              1  debt_consolidation    0.1357       366.86       
10.373491   
3              1  debt_consolidation    0.1008       162.34       
11.350407   
4              1         credit_card    0.1426       102.92       
11.299732   

     dti  fico  days.with.cr.line  revol.bal  revol.util  
inq.last.6mths  \
0  19.48   737        5639.958333      28854        52.1               
0   
1  14.29   707        2760.000000      33623        76.7               
0   
2  11.63   682        4710.000000       3511        25.6               
1   
3   8.10   712        2699.958333      33667        73.2               
1   
4  14.97   667        4066.000000       4740        39.5               
0   

   delinq.2yrs  pub.rec  not.fully.paid  
0            0        0               0  
1            0        0               0  
2            0        0               0  
3            0        0               0  
4            1        0               0  
```

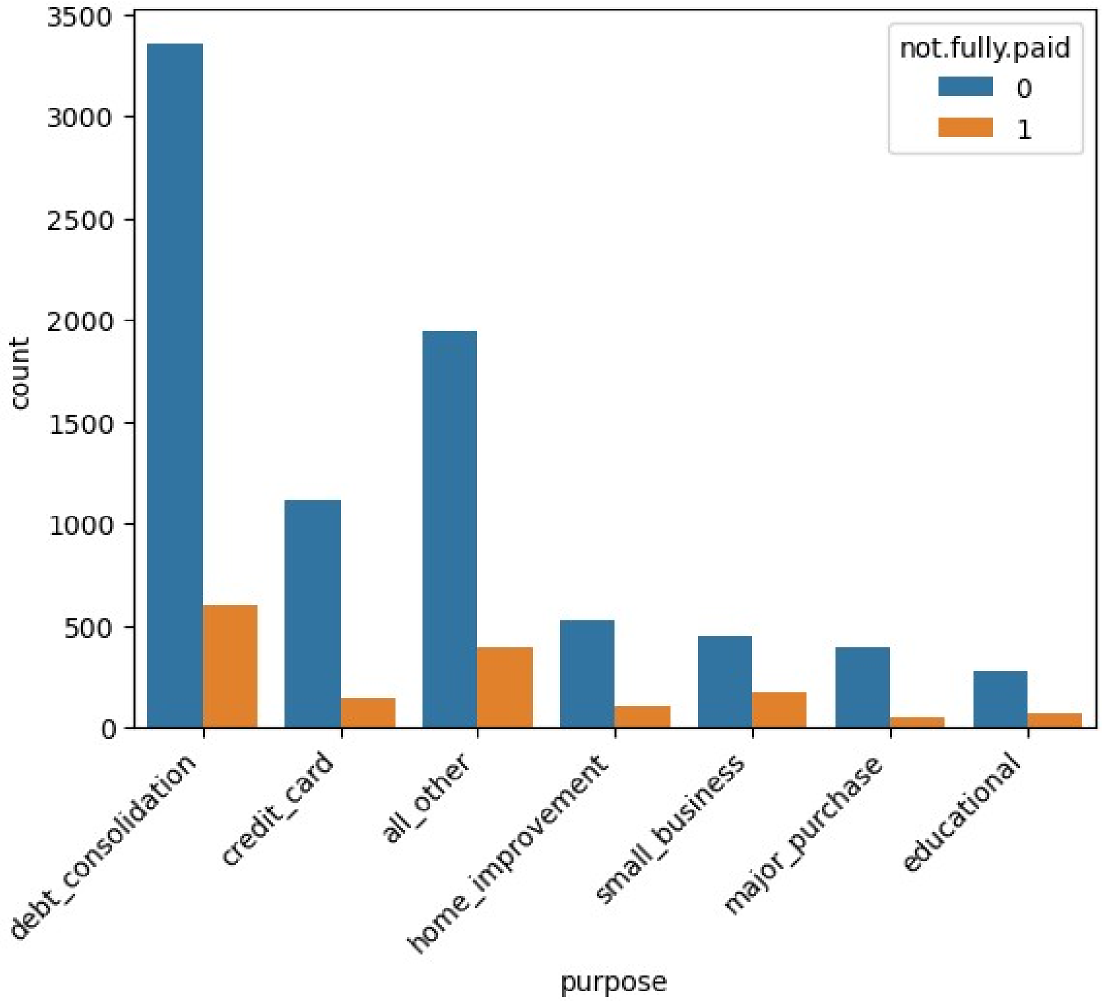
Step 3 Data Visualization and Preprocessing

```python
import seaborn as sns
import matplotlib.pyplot as plt

# Convert 'not.fully.paid' to categorical and ensure no numerical 
issues
df['not.fully.paid'] = df['not.fully.paid'].astype(str)  # Convert to 
string (categorical)
df['purpose'] = df['purpose'].astype(str)  # Ensure 'purpose' is also 
string

# Step 3: Data Visualization
sns.countplot(data=df, x='purpose', hue='not.fully.paid')
```

```
plt.xticks(rotation=45, ha='right')
plt.show()
```



Step 4: Data Preprocessing

```
# Convert categorical target variable to string for encoding
df['not.fully.paid'] = df['not.fully.paid'].astype(str)

# One-hot encoding for categorical features
pre_df = pd.get_dummies(df, columns=['purpose'], drop_first=True)
```

Step 5: Split dataset into training and testing sets

```
X = pre_df.drop('not.fully.paid', axis=1)
y = pre_df['not.fully.paid'].astype(int)  # Convert target to
numerical

X_train, X_test, y_train, y_test = train_test_split(
    X, y, test_size=0.33, random_state=125
)
```

Step 6: Train Naïve Bayes model with Laplacian correction

```
laplace_model = GaussianNB(var_smoothing=1e-9)  # Laplacian correction
laplace_model.fit(X_train, y_train)
```

```
GaussianNB()
```

Step 7: Make Predictions

```
y_pred = laplace_model.predict(X_test)
```

Step 8: Evaluate the model

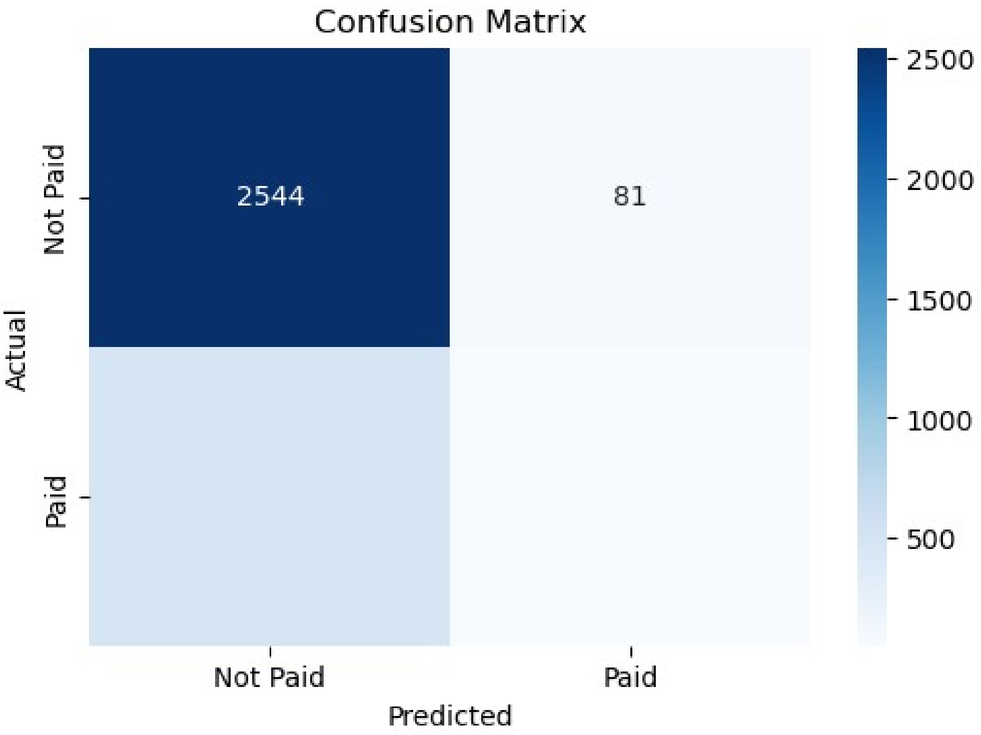
```
accuracy = accuracy_score(y_test, y_pred)
print(f'Accuracy after Laplacian correction: {accuracy:.2%}')
```

```
Accuracy after Laplacian correction: 82.06%
```

Step 9: Compute and Visualize the Confusion Matrix

```
conf_matrix = confusion_matrix(y_test, y_pred)
```

```python
plt.figure(figsize=(6,4))
sns.heatmap(conf_matrix, annot=True, fmt='d', cmap='Blues',
xticklabels=["Not Paid", "Paid"], yticklabels=["Not Paid", "Paid"])
plt.xlabel("Predicted")
plt.ylabel("Actual")
plt.title("Confusion Matrix")
plt.show()
```


Confusion Matrix
Not Paid
Paid
Actual
Not Paid
Paid
Predicted