In [112]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
%matplotlib inline
import seaborn as sns
```

In [113]:
```
df=pd.read_csv("loan_data.csv")
df.head()
```

Out[113]:

| | credit.policy | purpose | int.rate | installment | log.annual.inc | dti | fico | days.with.cr.line | revol.bal | revol.util | inq.last.6mths | delinq.2yrs | pub.rec | not.fully.paid |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 1 | debt_consolidation | 0.1189 | 829.10 | 11.350407 | 19.48 | 737 | 5639.958333 | 28854 | 52.1 | 0 | 0 | 0 | 0 |
| **1** | 1 | credit_card | 0.1071 | 228.22 | 11.082143 | 14.29 | 707 | 2760.000000 | 33623 | 76.7 | 0 | 0 | 0 | 0 |
| **2** | 1 | debt_consolidation | 0.1357 | 366.86 | 10.373491 | 11.63 | 682 | 4710.000000 | 3511 | 25.6 | 1 | 0 | 0 | 0 |
| **3** | 1 | debt_consolidation | 0.1008 | 162.34 | 11.350407 | 8.10 | 712 | 2699.958333 | 33667 | 73.2 | 1 | 0 | 0 | 0 |
| **4** | 1 | credit_card | 0.1426 | 102.92 | 11.299732 | 14.97 | 667 | 4066.000000 | 4740 | 39.5 | 0 | 1 | 0 | 0 |

In [114]:
```
df.info()
```

```
<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
```

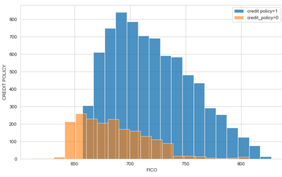
In [115]:
```
df.describe()
```

Out[115]:

| | credit.policy | int.rate | installment | log.annual.inc | dti | fico | days.with.cr.line | revol.bal | revol.util | inq.last.6mths | delinq.2yrs | pub.rec | not.fully.paid |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **count** | 9578.000000 | 9578.000000 | 9578.000000 | 9578.000000 | 9578.000000 | 9578.000000 | 9578.000000 | 9.578000e+03 | 9578.000000 | 9578.000000 | 9578.000000 | 9578.000000 | 9578.000000 |
| **mean** | 0.804970 | 0.122640 | 319.089413 | 10.932117 | 12.606679 | 710.846314 | 4560.767197 | 1.691396e+04 | 46.799236 | 1.577469 | 0.163708 | 0.062122 | 0.160054 |
| **std** | 0.396245 | 0.026847 | 207.071301 | 0.614813 | 6.883970 | 37.970537 | 2496.930377 | 3.375619e+04 | 29.014417 | 2.200245 | 0.546215 | 0.262126 | 0.366676 |
| **min** | 0.000000 | 0.060000 | 15.670000 | 7.547502 | 0.000000 | 612.000000 | 178.958333 | 0.000000e+00 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| **25%** | 1.000000 | 0.103900 | 163.770000 | 10.558414 | 7.212500 | 682.000000 | 2820.000000 | 3.187000e+03 | 22.600000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| **50%** | 1.000000 | 0.122100 | 268.950000 | 10.928884 | 12.665000 | 707.000000 | 4139.958333 | 8.596000e+03 | 46.300000 | 1.000000 | 0.000000 | 0.000000 | 0.000000 |
| **75%** | 1.000000 | 0.140700 | 432.762500 | 11.291293 | 17.950000 | 737.000000 | 5730.000000 | 1.824950e+04 | 70.900000 | 2.000000 | 0.000000 | 0.000000 | 0.000000 |
| **max** | 1.000000 | 0.216400 | 940.140000 | 14.528354 | 29.960000 | 827.000000 | 17639.958330 | 1.207359e+06 | 119.000000 | 33.000000 | 13.000000 | 5.000000 | 1.000000 |

In [116]:
```
sns.set_style("whitegrid")
plt.figure(figsize=(10,6))
df[df["credit.policy"]==1]["fico"].hist(alpha=0.8,bins=20,label="credit policy=1")

df[df["credit.policy"]==0]["fico"].hist(alpha=0.6,bins=20,label="credit_policy=0")

plt.legend()
plt.xlabel("FICO")
plt.ylabel("CREDIT POLICY")
```

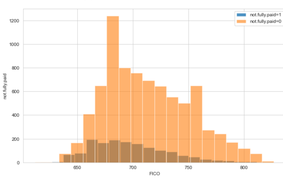
Out[116]:
```
Text(0, 0.5, 'CREDIT POLICY')
```




In [ ]:

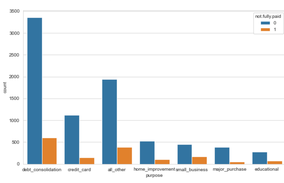
In [117]:
```
sns.set_style("whitegrid")
plt.figure(figsize=(10,6))
df[df["not.fully.paid"]==1]["fico"].hist(alpha=0.8,bins=20,label="not.fully.paid=1")

df[df["not.fully.paid"]==0]["fico"].hist(alpha=0.6,bins=20,label="not.fully.paid=0")

plt.legend()
plt.xlabel("FICO")
plt.ylabel("not.fully.paid")
```

Out[117]:
```
Text(0, 0.5, 'not.fully.paid')
```



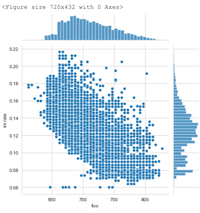

In [118]:
```
plt.figure(figsize=(10,6))
sns.countplot(data=df,x="purpose",hue='not.fully.paid')
```

Out[118]:
```
<AxesSubplot:xlabel='purpose', ylabel='count'>
```




In [119]:
```
plt.figure(figsize=(10,6))
sns.jointplot(x="fico",y="int.rate",data=df)
```

Out[119]:
```
<seaborn.axisgrid.JointGrid at 0x1eba74a5c10>
<Figure size 720x432 with 0 Axes>
```




In [120]:
```
plt.figure(figsize=(10,6))
sns.lmplot(data=df,x="fico",y="int.rate",col="not.fully.paid",hue="credit.policy")
```

Out[120]:
```
<seaborn.axisgrid.FacetGrid at 0x1eba865fcd0>
<Figure size 720x432 with 0 Axes>
```


In [121]:
```
df.info()
```

```
<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
```

In [122]:
```
cat_feats=["purpose"]
```

In [123]:
```
final_data=pd.get_dummies(df,columns=cat_feats,drop_first=True)
final_data.head()
```

Out[123]:

| | credit.policy | int.rate | installment | log.annual.inc | dti | fico | days.with.cr.line | revol.bal | revol.util | inq.last.6mths | delinq.2yrs | pub.rec | not.fully.paid | purpose_credit_card | purpose_debt_consolidation | purpose_educational | purpose_home_improvement | purpose_major_purchase | purpose_small_bus |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 1 | 0.1189 | 829.10 | 11.350407 | 19.48 | 737 | 5639.958333 | 28854 | 52.1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| **1** | 1 | 0.1071 | 228.22 | 11.082143 | 14.29 | 707 | 2760.000000 | 33623 | 76.7 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| **2** | 1 | 0.1357 | 366.86 | 10.373491 | 11.63 | 682 | 4710.000000 | 3511 | 25.6 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| **3** | 1 | 0.1008 | 162.34 | 11.350407 | 8.10 | 712 | 2699.958333 | 33667 | 73.2 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| **4** | 1 | 0.1426 | 102.92 | 11.299732 | 14.97 | 667 | 4066.000000 | 4740 | 39.5 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |

In [124]:
```
from sklearn.model_selection import train_test_split
```

In [125]:
```
X=final_data.drop("not.fully.paid",axis=1)
y=final_data["not.fully.paid"]

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.33, random_state=42)
```

In [126]:
```
from sklearn.tree import DecisionTreeClassifier
```

In [127]:
```
d_tree=DecisionTreeClassifier()
```

In [128]:
```
d_tree.fit(X_train,y_train)
```

Out[128]:
```
DecisionTreeClassifier()
```

In [129]:
```
from sklearn.metrics import classification_report, confusion_matrix
```

In [130]:
```
predictions= d_tree.predict(X_test)
```

In [131]:
```
print(classification_report(y_test,predictions))
```

```
              precision    recall  f1-score   support

           0       0.85      0.84      0.84      2650
           1       0.21      0.23      0.22       511

    accuracy                           0.74      3161
   macro avg       0.53      0.53      0.53      3161
weighted avg       0.75      0.74      0.74      3161
```

In [132]:
```
print(confusion_matrix(y_test,predictions))
```

```
[[2223  427]
 [ 396  115]]
```

In [133]:
```
from sklearn.ensemble import RandomForestClassifier
```

In [134]:
```
rfc= RandomForestClassifier()
```

In [135]:
```
rfc.fit(X_train,y_train)
```

Out[135]:
```
RandomForestClassifier()
```

In [136]:
```
predictions = rfc.predict(X_test)
```

In [137]:
```
print(classification_report(y_test,predictions))
```

```
              precision    recall  f1-score   support

           0       0.84      0.99      0.91      2650
           1       0.32      0.02      0.04       511

    accuracy                           0.83      3161
   macro avg       0.58      0.51      0.48      3161
weighted avg       0.76      0.83      0.77      3161
```

In [138]:
```
print(confusion_matrix(y_test,predictions))
```

```
[[2625   25]
 [ 499   12]]
```