Predicting customer loan eligibility Using a Pipeline and a DecisionTreeClassifier

Dream Housing Finance company deals in all kinds of home loans. They have presence across all urban, semi urban and rural areas. Customer first applies for home loan and after that company validates the customer eligibility for loan.

Company wants to automate the loan eligibility process (real time) based on customer detail provided while filling online application form. These details are Gender, Marital Status, Education, Number of Dependents, Income, Loan Amount, Credit History and others. To automate this process, they have provided a dataset to identify the customers segments that are eligible for loan amount so that they can specifically target these customers.

In [370]:
```
import numpy as np
import pandas as pd

loan_data = pd.read_csv('loan_data_set.csv')
print(loan_data.shape)
loan_data.head()
```

```
(614, 13)
```

Out[370]:

	Loan_ID	Gender	Married	Dependents	Education	Self_Employed	ApplicantIncome	Coapplica
0	LP001002	Male	No	0	Graduate	No	5849	
1	LP001003	Male	Yes	1	Graduate	No	4583	
2	LP001005	Male	Yes	0	Graduate	Yes	3000	
3	LP001006	Male	Yes	0	Not Graduate	No	2583	
4	LP001008	Male	No	0	Graduate	No	6000	

Handling Missing Values

In [371]:
```
#Explore the data for missing values
loan_data.isnull().sum()
```

Out[371]:
```
Loan_ID               0
Gender               13
Married               3
Dependents           15
Education             0
Self_Employed        32
ApplicantIncome       0
CoapplicantIncome     0
LoanAmount           22
Loan_Amount_Term     14
Credit_History       50
Property_Area         0
Loan_Status           0
dtype: int64
```

In [372]:
```
#Drop 13 rows with missing values in the gender column
loan_data1 = loan_data[loan_data['Gender'].notna()]
print(loan_data1.shape)
loan_data1.isnull().sum()
```

```
(601, 13)
```

Out[372]:
```
Loan_ID               0
Gender                0
Married               3
Dependents           15
Education             0
Self_Employed        32
ApplicantIncome       0
CoapplicantIncome     0
LoanAmount           22
Loan_Amount_Term     14
Credit_History       49
Property_Area         0
Loan_Status           0
dtype: int64
```

In [373]:
```
#Fill missing values in 'Married' column with 'Yes' if Loan value is equal or gre
m = loan_data1['Married'].isna()
loan_data1.loc[m, 'Married'] = np.where(loan_data1.loc[m, 'LoanAmount']>=153, 'Ye

loan_data1.isnull().sum()
```

```
c:\users\elijah\appdata\local\programs\python\python39\lib\site-packages\pandas
\core\indexing.py:1676: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/sta
ble/user_guide/indexing.html#returning-a-view-versus-a-copy (https://pandas.pyd
ata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-c
opy)
  self._setitem_single_column(ilocs[0], value, pi)
```

Out[373]:
```
Loan_ID              0
Gender               0
Married              0
Dependents          15
Education            0
Self_Employed       32
ApplicantIncome      0
CoapplicantIncome    0
LoanAmount          22
Loan_Amount_Term    14
Credit_History      49
Property_Area        0
Loan_Status          0
dtype: int64
```

In [374]:
```
#Fill missing values in the numerical columns with the respective column means
loan_data2 = loan_data1.fillna(loan_data1.mean())

#drop the remaining rows with missing values
loan_data2 = loan_data2.dropna()

#drop the Loan_ID column
loan_data3 = loan_data2.drop('Loan_ID', axis=1)

print(loan_data3.shape)
loan_data3.isnull().sum()
```

```
(554, 12)
```

Out[374]:
```
Gender               0
Married              0
Dependents           0
Education            0
Self_Employed        0
ApplicantIncome      0
CoapplicantIncome    0
LoanAmount           0
Loan_Amount_Term     0
Credit_History       0
Property_Area        0
Loan_Status          0
dtype: int64
```

Data Preprocessing

In [375]:
```
from sklearn.preprocessing import LabelEncoder

#Do label encoding to the 'Dependents' categorical column(ordinal) and drop the c
label_enc = LabelEncoder()
loan_data3['Dependents1'] = label_enc.fit_transform(loan_data3['Dependents'])
loan_data4 = loan_data3.drop('Dependents', axis=1)

#Split the data into X and y. Label encode y into a binary classification
X = loan_data4.drop('Loan_Status', axis=1)
y = loan_data4['Loan_Status']
y = label_enc.fit_transform(y)

#Split the dataset into train and test sets
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_s
```

In [376]:
```
#Create a column transformer to one-hot encode all other categorical features wit
from sklearn.compose import make_column_transformer
from sklearn.preprocessing import OneHotEncoder

categorical_columns = ['Gender', 'Married', 'Education', 'Self_Employed', 'Proper
col_trans = make_column_transformer((OneHotEncoder(drop='first', sparse=False),ca
```

In [377]:
```
#Create a pipeline to preprocess(as above) the data then fit a classification moc
from sklearn.tree import DecisionTreeClassifier
from sklearn.pipeline import make_pipeline

svc_model = DecisionTreeClassifier(max_depth=3, min_samples_leaf = 30)
pipe = make_pipeline(col_trans, svc_model)

pipe.fit(X_train, y_train)
```

...

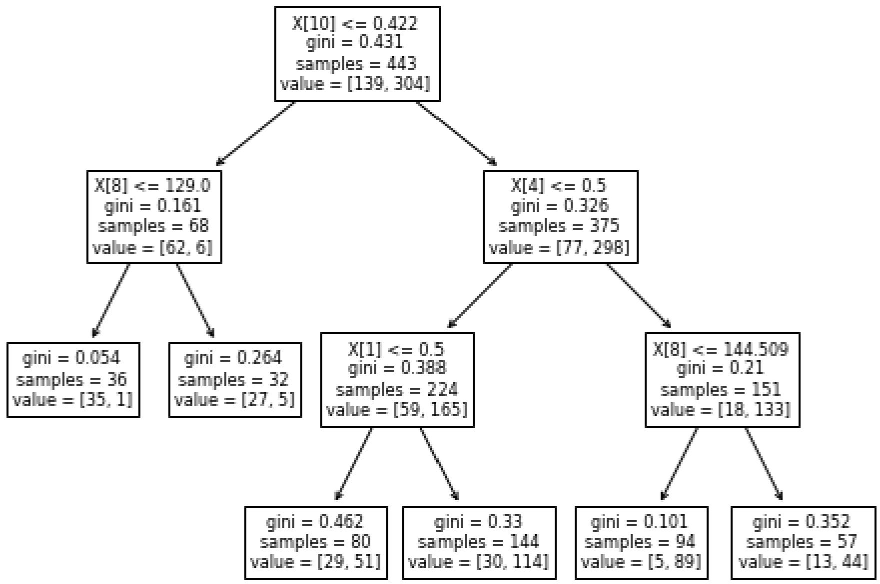
In [378]:
```
#Since it is a classification task, we shall evaluate the model using the F1 Scor
from sklearn.metrics import f1_score, confusion_matrix

y_pred = pipe.predict(X_test)

print(f'F1-Score {round(f1_score(y_test, y_pred)*100,3)} %\n')
print('Confusion Matrix')
pd.crosstab(y_test, y_pred, rownames=['True'], colnames=['Predicted'], margins=Tr
```

```
F1-Score 87.006 %

Confusion Matrix
```

Out[378]:

Predicted	**0**	**1**	**All**
True			
0	11	22	33
1	1	77	78
All	12	99	111

In [379]:
```
#Visualize the decision process using a tree
from sklearn import tree

import matplotlib.pyplot as plt
plt.figure(figsize=(8,6))
tree.plot_tree(svc_model)
plt.show()
```



In [380]:
```
#We can also view the decision making process described using text
text_representation = tree.export_text(svc_model)

print(text_representation)
```

```
|--- feature_10 <= 0.42
|   |--- feature_8 <= 129.00
|   |   |--- class: 0
|   |--- feature_8 >  129.00
|   |   |--- class: 0
|--- feature_10 >  0.42
|   |--- feature_4 <= 0.50
|   |   |--- feature_1 <= 0.50
|   |   |   |--- class: 1
|   |   |--- feature_1 >  0.50
|   |   |   |--- class: 1
|   |--- feature_4 >  0.50
|   |   |--- feature_8 <= 144.51
|   |   |   |--- class: 1
|   |   |--- feature_8 >  144.51
|   |   |   |--- class: 1
```

In [381]:
```
#Get some random sampled from the testing data to see the predictions
X_new = X_test.sample(5, random_state=4)
X_new
```

Out[381]:

	Gender	Married	Education	Self_Employed	ApplicantIncome	CoapplicantIncome	LoanAmour
612	Male	Yes	Graduate	No	7583	0.0	187.
46	Male	Yes	Graduate	No	5649	0.0	44.
415	Female	No	Graduate	No	2995	0.0	60.
564	Male	Yes	Graduate	No	8799	0.0	258.
169	Male	Yes	Graduate	No	8000	0.0	200.

In [382]:
```
pipe.predict(X_new)
```

Out[382]:
```
array([1, 1, 1, 0, 1])
```