Import the Following Libraries:

numpy (as np) pandas DecisionTreeClassifier from sklearn.tree

In [1]:

```
import numpy as np
import pandas as pd
from sklearn.tree import DecisionTreeClassifier
```

About the Dataset:

Reading data using panda dataframe

In [27]:

```
my_data = pd.read_csv("loan prediction.csv", delimiter=",")
my_data[0:10]
```

Out[27]:

	Loan_ID	Gender	Married	Dependents	Education	Self_Employed	ApplicantIncome	Coapp
0	LP001002	Male	No	0.0	Graduate	No	5849	
1	LP001003	Male	Yes	1.0	Graduate	No	4583	
2	LP001005	Male	Yes	0.0	Graduate	Yes	3000	
3	LP001006	Male	Yes	0.0	Not Graduate	No	2583	
4	LP001008	Male	No	0.0	Graduate	No	6000	
5	LP001011	Male	Yes	2.0	Graduate	Yes	5417	
6	LP001013	Male	Yes	0.0	Not Graduate	No	2333	
7	LP001014	Male	Yes	3.0	Graduate	No	3036	
8	LP001018	Male	Yes	2.0	Graduate	No	4006	
9	LP001020	Male	Yes	1.0	Graduate	No	12841	

Pre Processing:

Removing Rows with Missing Values

In [28]:

```
my_data.dropna(axis=0, how='any', thresh=None, subset=None, inplace=True)
my_data
```

Out[28]:

	Loan_ID	Gender	Married	Dependents	Education	Self_Employed	ApplicantIncome	Coa
0	LP001002	Male	No	0.0	Graduate	No	5849	
1	LP001003	Male	Yes	1.0	Graduate	No	4583	
2	LP001005	Male	Yes	0.0	Graduate	Yes	3000	
3	LP001006	Male	Yes	0.0	Not Graduate	No	2583	
4	LP001008	Male	No	0.0	Graduate	No	6000	
...	...	...	...	...	...	...	...	
609	LP002978	Female	No	0.0	Graduate	No	2900	
610	LP002979	Male	Yes	3.0	Graduate	No	4106	
611	LP002983	Male	Yes	1.0	Graduate	No	8072	
612	LP002984	Male	Yes	2.0	Graduate	No	7583	
613	LP002990	Female	No	0.0	Graduate	Yes	4583	

529 rows × 13 columns

In [29]:

```
my_data.isnull().values.any()
```

Out[29]:

```
False
```

Using my_data as the loan prediction.csv data read by pandas, declare the following variables:

X as the Feature Matrix (data of my_data)

y as the response vector (target)

In [30]:

```
X = my_data[['Gender', 'Married', 'Dependents', 'Education', 'Self_Employed','ApplicantInco
X[0:5]
```

Out[30]:

```
array([['Male', 'No', 0.0, 'Graduate', 'No', 5849, 0.0, 66.0, 360.0, 1.0,
        'Urban'],
       ['Male', 'Yes', 1.0, 'Graduate', 'No', 4583, 1508.0, 128.0, 360.0,
        1.0, 'Rural'],
       ['Male', 'Yes', 0.0, 'Graduate', 'Yes', 3000, 0.0, 66.0, 360.0,
        1.0, 'Urban'],
       ['Male', 'Yes', 0.0, 'Not Graduate', 'No', 2583, 2358.0, 120.0,
        360.0, 1.0, 'Urban'],
       ['Male', 'No', 0.0, 'Graduate', 'No', 6000, 0.0, 141.0, 360.0,
        1.0, 'Urban']], dtype=object)
```

As you may figure out, some features in this dataset are categorical such as Gender or Married. Unfortunately, Sklearn Decision Trees do not handle categorical variables. But still we can convert these features to numerical values.

In [31]:

```
from sklearn import preprocessing
le_Gender = preprocessing.LabelEncoder()
le_Gender.fit(['Female','Male'])
X[:,0] = le_Gender.transform(X[:,0])
```

In [32]:

```
from sklearn import preprocessing
le_Married = preprocessing.LabelEncoder()
le_Married.fit(['No','Yes'])
X[:,1] = le_Married.transform(X[:,1])
```

In [33]:

```
from sklearn import preprocessing
le_Education = preprocessing.LabelEncoder()
le_Education.fit(['Graduate','Not Graduate'])
X[:,3] = le_Education.transform(X[:,3])
```

In [34]:

```
from sklearn import preprocessing
le_Self_Employed = preprocessing.LabelEncoder()
le_Self_Employed.fit(['No','Yes'])
X[:,4] = le_Self_Employed.transform(X[:,4])
```

In [36]:

```
from sklearn import preprocessing
le_Property_Area = preprocessing.LabelEncoder()
le_Property_Area.fit(['Urban','Rural','Semiurban'])
X[:,10] = le_Property_Area.transform(X[:,10])
```

In [38]:

```
X[0:5]
```

Out[38]:

```
array([[1, 0, 0.0, 0, 0, 5849, 0.0, 66.0, 360.0, 1.0, 2],
       [1, 1, 1.0, 0, 0, 4583, 1508.0, 128.0, 360.0, 1.0, 0],
       [1, 1, 0.0, 0, 1, 3000, 0.0, 66.0, 360.0, 1.0, 2],
       [1, 1, 0.0, 1, 0, 2583, 2358.0, 120.0, 360.0, 1.0, 2],
       [1, 0, 0.0, 0, 0, 6000, 0.0, 141.0, 360.0, 1.0, 2]], dtype=object)
```

In [39]:

```
Y= my_data["Loan_Status"]
Y[0:5]
```

Out[39]:

```
0    Y
1    N
2    Y
3    Y
4    Y
Name: Loan_Status, dtype: object
```

Setting up the Decision Tree We will be using train/test split on our decision tree. Let's import train_test_split from sklearn.cross_validation.

Now train_test_split will return 4 different parameters. We will name them: X_trainset, X_testset, Y_trainset, Y_testset

The train_test_split will need the parameters: X, Y, test_size=0.3, and random_state=3.

The X and Y are the arrays required before the split, the test_size represents the ratio of the testing dataset, and the random_state ensures that we obtain the same splits.

In [40]:

```
from sklearn.model_selection import train_test_split
```

In [43]:

```
X_trainset, X_testset, Y_trainset, Y_testset = train_test_split(X, Y, test_size=0.3, random
```

Modeling

We will first create an instance of the DecisionTreeClassifier called LoanTree. Inside of the classifier, specify criterion="entropy" so we can see the information gain of each node.

In [44]:

```
LoanTree = DecisionTreeClassifier(criterion="entropy", max_depth = 4)
LoanTree # it shows the default parameters
```

Out[44]:

```
DecisionTreeClassifier(ccp_alpha=0.0, class_weight=None, criterion='entrop
y',
                       max_depth=4, max_features=None, max_leaf_nodes=None,
                       min_impurity_decrease=0.0, min_impurity_split=None,
                       min_samples_leaf=1, min_samples_split=2,
                       min_weight_fraction_leaf=0.0, presort='deprecated',
                       random_state=None, splitter='best')
```

Next, we will fit the data with the training feature matrix X_trainset and training response vector Y_trainset

In [46]:

```
LoanTree.fit(X_trainset,Y_trainset)
```

Out[46]:

```
DecisionTreeClassifier(ccp_alpha=0.0, class_weight=None, criterion='entrop
y',
                       max_depth=4, max_features=None, max_leaf_nodes=None,
                       min_impurity_decrease=0.0, min_impurity_split=None,
                       min_samples_leaf=1, min_samples_split=2,
                       min_weight_fraction_leaf=0.0, presort='deprecated',
                       random_state=None, splitter='best')
```

Prediction

Let's make some predictions on the testing dataset and store it into a variable called predTree.

In [47]:

```
predTree = LoanTree.predict(X_testset)
```

We can print out predTree and Y_testset if we want to visually compare the prediction to the actual values.

In [48]:

```
print (predTree [0:5])
print (Y_testset [0:5])
```

```
['Y' 'Y' 'Y' 'Y' 'Y']
71     Y
281    Y
336    Y
465    Y
200    Y
Name: Loan_Status, dtype: object
```

Evaluation

Next, let's import metrics from sklearn and check the accuracy of our model.

In [49]:

```
from sklearn import metrics
import matplotlib.pyplot as plt
print("DecisionTrees's Accuracy: ", metrics.accuracy_score(Y_testset, predTree))
```

```
DecisionTrees's Accuracy:  0.7861635220125787
```

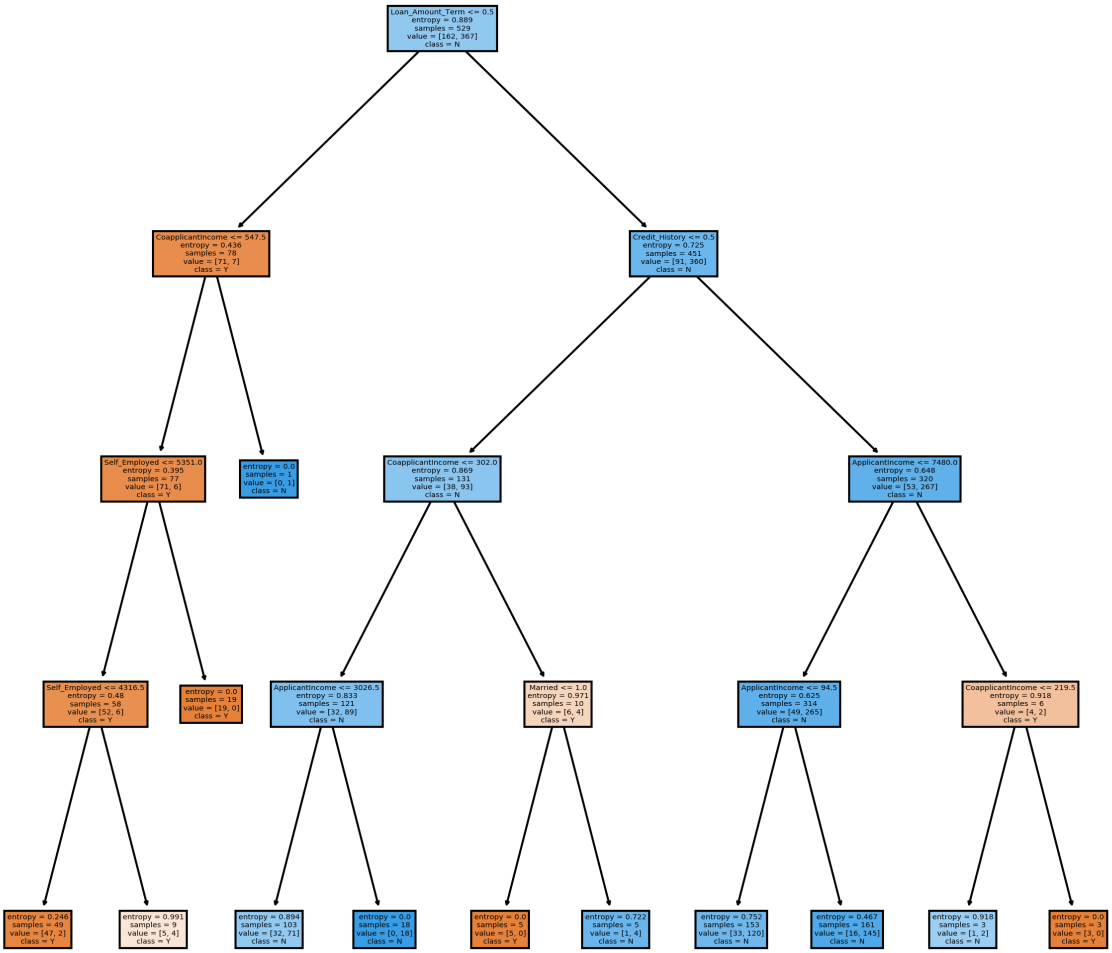
Visualization

Lets visualize the tree

In [66]:

```
import matplotlib.pyplot as plt
from sklearn.tree import DecisionTreeClassifier
from sklearn import tree
# Make an instance of the Model
fn=my_data.columns[0:11]
cn= my_data["Loan_Status"].unique().tolist()
LoanTree.fit(X, Y)
# Setting dpi = 300 to make image clearer than default
fig, axes = plt.subplots(nrows = 1,ncols = 1,figsize = (10,10), dpi=300)

tree.plot_tree(LoanTree,
               feature_names = fn,
               class_names=cn,
               filled = True);
```



In [ ]: