In [1]:
```python
import numpy as np
import pandas as pd
import seaborn as sns
```

In [2]:
```python
from sklearn.ensemble import ...
```

In [3]:
```python
df_train=pd.read_csv("C8_loan-train.csv")
df_test=pd.read_csv("C8_loan-test.csv")
```

Out[3]:

	Loan_ID	Gender	Married	Dependents	Education	Self_Employed	ApplicantIncome	Coap
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	
...	...	...	...	...	...	...	...	
609	LP002978	Female	No	0	Graduate	No	2900	
610	LP002979	Male	Yes	3+	Graduate	No	4106	
611	LP002983	Male	Yes	1	Graduate	No	8072	
612	LP002984	Male	Yes	2	Graduate	No	7583	
613	LP002990	Female	No	0	Graduate	Yes	4583	

614 rows × 13 columns

In [4]:
```python
df_test
```

Out[4]:

	Loan_ID	Gender	Married	Dependents	Education	Self_Employed	ApplicantIncome	Coap
0	LP001015	Male	Yes	0	Graduate	No	5720	
1	LP001022	Male	Yes	1	Graduate	No	3076	
2	LP001031	Male	Yes	2	Graduate	No	5000	
3	LP001035	Male	Yes	2	Graduate	No	2340	
4	LP001051	Male	No	0	Not Graduate	No	3276	
...	...	...	...	...	...	...	...	
362	LP002971	Male	Yes	3+	Not Graduate	Yes	4009	
363	LP002975	Male	Yes	0	Graduate	No	4158	
364	LP002980	Male	No	0	Graduate	No	3250	
365	LP002986	Male	Yes	0	Graduate	No	5000	

In [5]:

In [6]:

In [7]:

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 480 entries, 1 to 613
Data columns (total 13 columns):
 #   Column             Non-Null Count  Dtype
---  ------             --------------  -----
 0   Loan_ID            480 non-null    object
 1   Gender             480 non-null    object
 2   Married            480 non-null    object
 3   Dependents         480 non-null    object
 4   Education          480 non-null    object
 5   Self_Employed      480 non-null    object
 6   ApplicantIncome    480 non-null    int64
 7   CoapplicantIncome  480 non-null    float64
 8   LoanAmount         480 non-null    float64
 9   Loan_Amount_Term   480 non-null    float64
 10  Credit_History     480 non-null    float64
 11  Property_Area      480 non-null    object
 12  Loan_Status        480 non-null    object
dtypes: float64(4), int64(1), object(8)
memory usage: 52.5+ KB
```

In [8]:

Out[8]:
```
Index(['Loan_ID', 'Gender', 'Married', 'Dependents', 'Education',
       'Self_Employed', 'ApplicantIncome', 'CoapplicantIncome', 'LoanAmount',
       'Loan_Amount_Term', 'Credit_History', 'Property_Area', 'Loan_Status'],
      dtype='object')
```

In [9]:
```python
feature_matrix=df1[['ApplicantIncome', 'CoapplicantIncome', 'LoanAmount',
        'Loan_Amount_Term', 'Credit_History']]
```

In [10]:

Out[10]: (480, 5)

In [11]:

Out[11]: (480, 1)

In [12]:

In [13]:

```
In [14]: logr=LogisticRegression()
```

```
C:\ProgramData\Anaconda3\lib\site-packages\sklearn\utils\validation.py:63: Da
taConversionWarning: A column-vector y was passed when a 1d array was expecte
d. Please change the shape of y to (n_samples, ), for example using ravel().
  return f(*args, **kwargs)
```

Out[14]: LogisticRegression()

In [15]:

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 289 entries, 0 to 366
Data columns (total 12 columns):
 #   Column             Non-Null Count  Dtype
---  ------             --------------  -----
 0   Loan_ID            289 non-null    object
 1   Gender             289 non-null    object
 2   Married            289 non-null    object
 3   Dependents         289 non-null    object
 4   Education          289 non-null    object
 5   Self_Employed      289 non-null    object
 6   ApplicantIncome    289 non-null    int64
 7   CoapplicantIncome  289 non-null    int64
 8   LoanAmount         289 non-null    float64
 9   Loan_Amount_Term   289 non-null    float64
 10  Credit_History     289 non-null    float64
 11  Property_Area      289 non-null    object
dtypes: float64(3), int64(2), object(7)
memory usage: 29.4+ KB
```

In [16]:

```
Out[16]: Index(['Loan_ID', 'Gender', 'Married', 'Dependents', 'Education',
         'Self_Employed', 'ApplicantIncome', 'CoapplicantIncome', 'LoanAmount',
         'Loan_Amount_Term', 'Credit_History', 'Property_Area'],
        dtype='object')
```

```
In [17]: observation=df2[['ApplicantIncome', 'CoapplicantIncome', 'LoanAmount',
```

```
In [18]: prediction=logr.predict(observation)
```

```
['Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes'
 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes'
 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes'
 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes'
 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes'
 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes'
 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes'
 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'No' 'Yes' 'Yes' 'Yes'
 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes'
 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes'
 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes'
 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes'
 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes'
 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes'
 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes'
 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes'
 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes'
 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes'
 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes'
 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes'
 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes'
 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes'
 'Yes']
```

```
In [19]:
```

```
Out[19]: array(['No', 'Yes'], dtype=object)
```

```
In [20]:
```

```
Out[20]: array([[0.       , 1.        ],
                [0.       , 1.        ],
                [0.       , 1.        ],
                [0.       , 1.        ],
                [0.       , 1.        ],
                [0.       , 1.        ],
                [0.       , 1.        ],
                [0.       , 1.        ],
                [0.       , 1.        ],
                [0.       , 1.        ],
                [0.       , 1.        ],
                [0.       , 1.        ],
                [0.       , 1.        ],
                [0.       , 1.        ],
                [0.       , 1.        ],
                [0.       , 1.        ],
                [0.       , 1.        ],
                [0.       , 1.        ],
                [0.       , 1.        ],
```

In [21]:

Out[21]: 0.0

RANDOM FOREST

In [22]:

Out[22]: No   257
          Yes   32
          Name: Self_Employed, dtype: int64

In [23]:
```python
x=df2[['ApplicantIncome', 'CoapplicantIncome', 'LoanAmount',
        'Loan_Amount_Term', 'Credit_History']]
```

In [24]:
```python
g1={'Self_Employed':{'No':1, 'Yes':2}}
df2=df2.replace(g1)
```

Out[24]:

	Loan_ID	Gender	Married	Dependents	Education	Self_Employed	ApplicantIncome	Coap
0	LP001015	Male	Yes	0	Graduate	1	5720	
1	LP001022	Male	Yes	1	Graduate	1	3076	
2	LP001031	Male	Yes	2	Graduate	1	5000	
4	LP001051	Male	No	0	Not Graduate	1	3276	
5	LP001054	Male	Yes	0	Not Graduate	2	2165	
...	...	...	...	...	...	...	...	
361	LP002969	Male	Yes	1	Graduate	1	2269	
362	LP002971	Male	Yes	3+	Not Graduate	2	4009	
363	LP002975	Male	Yes	0	Graduate	1	4158	
365	LP002986	Male	Yes	0	Graduate	1	5000	
366	LP002989	Male	No	0	Graduate	2	9200	

289 rows × 12 columns

In [25]:

In [26]:

In [27]:

In [28]:
```python
rfc=RandomForestClassifier()
rfc.fit(x_train,y_train)
```
Out[28]: RandomForestClassifier()

```
In [29]: parameters={'max_depth':[1,2,3,4,5],
                      'min_samples_leaf':[5,10,15,20,25],
                      'n_estimators':[10,20,30,40,50]
```

```
In [30]: from sklearn.model_selection import GridSearchCV
         grid_search =GridSearchCV(estimator=rfc,param_grid=parameters,cv=2,scoring="ac
```

```
Out[30]: GridSearchCV(cv=2, estimator=RandomForestClassifier(),
                      param_grid={'max_depth': [1, 2, 3, 4, 5],
                                  'min_samples_leaf': [5, 10, 15, 20, 25],
                                  'n_estimators': [10, 20, 30, 40, 50]},
                      scoring='accuracy')
```

```
In [31]:
```

```
Out[31]: 0.9108910891089109
```

```
In [32]:
```

```
In [33]: from sklearn.tree import plot_tree

         plt.figure(figsize=(80,40))
```

```
Out[33]: [Text(2232.0, 1630.8000000000002, 'Credit_History <= 0.5\ngini = 0.085\nsampl
         es = 125\nvalue = [193, 9]\nclass = a'),
          Text(1116.0, 543.5999999999999, 'gini = 0.111\nsamples = 20\nvalue = [32,
         2]\nclass = a'),
          Text(3348.0, 543.5999999999999, 'gini = 0.08\nsamples = 105\nvalue = [161,
         7]\nclass = a')]
```