In [1]:

```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
```

In [2]:

```
from sklearn.linear_model import LogisticRegression
```

In [3]:

```
df_train=pd.read_csv("C8_loan-train.csv")
df_test=pd.read_csv("C8_loan-test.csv")
df_train
```

Out[3]:

	Loan_ID	Gender	Married	Dependents	Education	Self_Employed	ApplicantIncome	CoapplicantI
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]:

```
df_test
```

Out[4]:

	Loan_ID	Gender	Married	Dependents	Education	Self_Employed	ApplicantIncome	CoapplicantI
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	
...	...	...	...	...	...	...	...	

	Loan_ID	Gender	Married	Dependents	Education	Self_Employed	ApplicantIncome	CoapplicantI
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	
366	LP002989	Male	No	0	Graduate	Yes	9200	

367 rows × 12 columns

In [5]:

```
df1=df_train.dropna()
```

In [6]:

```
df2=df_test.dropna()
```

In [7]:

```
df1.info()
```

```
<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]:

```
df1.columns
```

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]:

```
feature_matrix=df1[['ApplicantIncome', 'CoapplicantIncome', 'LoanAmount',
       'Loan_Amount_Term', 'Credit_History']]
target_vector=df1[['Self_Employed']]
```

In [10]:

```
feature_matrix.shape
```

Out[10]:

```
(480, 5)
```

In [11]:

```
target_vector.shape
```

Out[11]:

```
(480, 1)
```

In [12]:

```
from sklearn.preprocessing import StandardScaler
```

In [13]:

```
fs=StandardScaler().fit_transform(feature_matrix)
```

In [14]:

```
logr=LogisticRegression()
logr.fit(fs,target_vector)
```

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

Out[14]:

```
LogisticRegression()
```

In [15]:

```
df2.info()
```

```
<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]:

```
df2.columns
```

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',
       'Loan_Amount_Term', 'Credit_History']]
```

In [18]:

```
prediction=logr.predict(observation)
print(prediction)
```

```
['Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes'
 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes'
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 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes' 'Yes'
 'Yes']
```

In [19]:

```
logr.classes_
```

Out[19]:

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

In [20]:

```
logr.predict_proba(observation)
```

Out[20]:

```
array([[0.        , 1.        ],
       [0.        , 1.        ],
       [0.        , 1.        ],
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        [0.        , 1.        ],
        [0.        , 1.        ]])
```

In [21]:
```
logr.predict_proba(observation)[0][0]
```

Out[21]:
```
0.0
```

In [22]:
```
df2['Self_Employed'].value_counts()
```

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

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

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

Out[24]:

	Loan_ID	Gender	Married	Dependents	Education	Self_Employed	ApplicantIncome	CoapplicantI
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]:
```
from sklearn.model_selection import train_test_split
```

In [26]:

```
x_train,x_test,y_train,y_test=train_test_split(x,y,train_size=0.70)
```

In [27]:

```
from sklearn.ensemble import RandomForestClassifier
```

In [28]:

```
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="accuracy")
grid_search.fit(x_train,y_train)
```

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]:

```
grid_search.best_score_
```

Out[31]:

```
0.8910891089108911
```

In [32]:

```
rfc_best=grid_search.best_estimator_
```

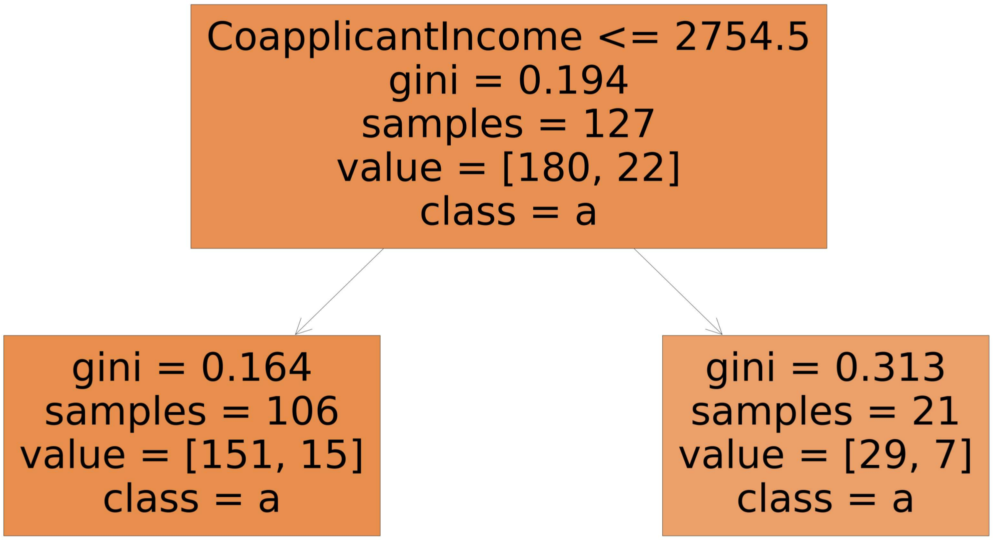
In [33]:

```
from sklearn.tree import plot_tree

plt.figure(figsize=(80,40))
plot_tree(rfc_best.estimators_[5],feature_names=x.columns,class_names=['a','b'],filled=
```

Out[33]:

```
[Text(2232.0, 1630.8000000000002, 'CoapplicantIncome <= 2754.5\ngini = 0.194\nsamples =
127\nvalue = [180, 22]\nclass = a'),
 Text(1116.0, 543.5999999999999, 'gini = 0.164\nsamples = 106\nvalue = [151, 15]\nclass
= a'),
 Text(3348.0, 543.5999999999999, 'gini = 0.313\nsamples = 21\nvalue = [29, 7]\nclass =
a')]
```


CoapplicantIncome <= 2754.5
gini = 0.194
samples = 127
value = [180, 22]
class = a
gini = 0.164
samples = 106
value = [151, 15]
class = a
gini = 0.313
samples = 21
value = [29, 7]
class = a