In [1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
%matplotlib inline
```

In [3]:
```
dataset=pd.read_csv(r"C:/Users/PRIYANKA.M/OneDrive/Documents/Figma/archive/Train.csv")
```

In [4]:
```
dataset.head()
```

Out[4]:

	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	

In [5]:
```
dataset.shape
```

Out[5]:
```
(614, 13)
```

In [6]:
```
dataset.info
```

Out[6]:
```
<bound method DataFrame.info of       Loan_ID  Gender Married Dependents     Educatio
n Self_Employed  \
0    LP001002    Male      No          0      Graduate            No
1    LP001003    Male     Yes          1      Graduate            No
2    LP001005    Male     Yes          0      Graduate           Yes
3    LP001006    Male     Yes          0  Not Graduate            No
4    LP001008    Male      No          0      Graduate            No
..        ...     ...     ...        ...           ...           ...
609  LP002978  Female      No          0      Graduate            No
610  LP002979    Male     Yes         3+      Graduate            No
611  LP002983    Male     Yes          1      Graduate            No
612  LP002984    Male     Yes          2      Graduate            No
613  LP002990  Female      No          0      Graduate           Yes

     ApplicantIncome  CoapplicantIncome  LoanAmount  Loan_Amount_Term  \
0               5849                0.0         NaN             360.0
1               4583             1508.0       128.0             360.0
2               3000                0.0        66.0             360.0
3               2583             2358.0       120.0             360.0
4               6000                0.0       141.0             360.0
..               ...                ...         ...               ...
609             2900                0.0        71.0             360.0
610             4106                0.0        40.0             180.0
611             8072              240.0       253.0             360.0
612             7583                0.0       187.0             360.0
613             4583                0.0       133.0             360.0

     Credit_History Property_Area Loan_Status
0               1.0         Urban           Y
1               1.0         Rural           N
2               1.0         Urban           Y
3               1.0         Urban           Y
4               1.0         Urban           Y
..              ...           ...         ...
609             1.0         Rural           Y
610             1.0         Rural           Y
611             1.0         Urban           Y
612             1.0         Urban           Y
613             0.0     Semiurban           N

[614 rows x 13 columns]>
```

In [7]:
```
dataset.describe()
```

Out[7]:

	ApplicantIncome	CoapplicantIncome	LoanAmount	Loan_Amount_Term	Credit_History
count	614.000000	614.000000	592.000000	600.00000	564.000000
mean	5403.459283	1621.245798	146.412162	342.00000	0.842199
std	6109.041673	2926.248369	85.587325	65.12041	0.364878
min	150.000000	0.000000	9.000000	12.00000	0.000000
25%	2877.500000	0.000000	100.000000	360.00000	1.000000
50%	3812.500000	1188.500000	128.000000	360.00000	1.000000
75%	5795.000000	2297.250000	168.000000	360.00000	1.000000
max	81000.000000	41667.000000	700.000000	480.00000	1.000000

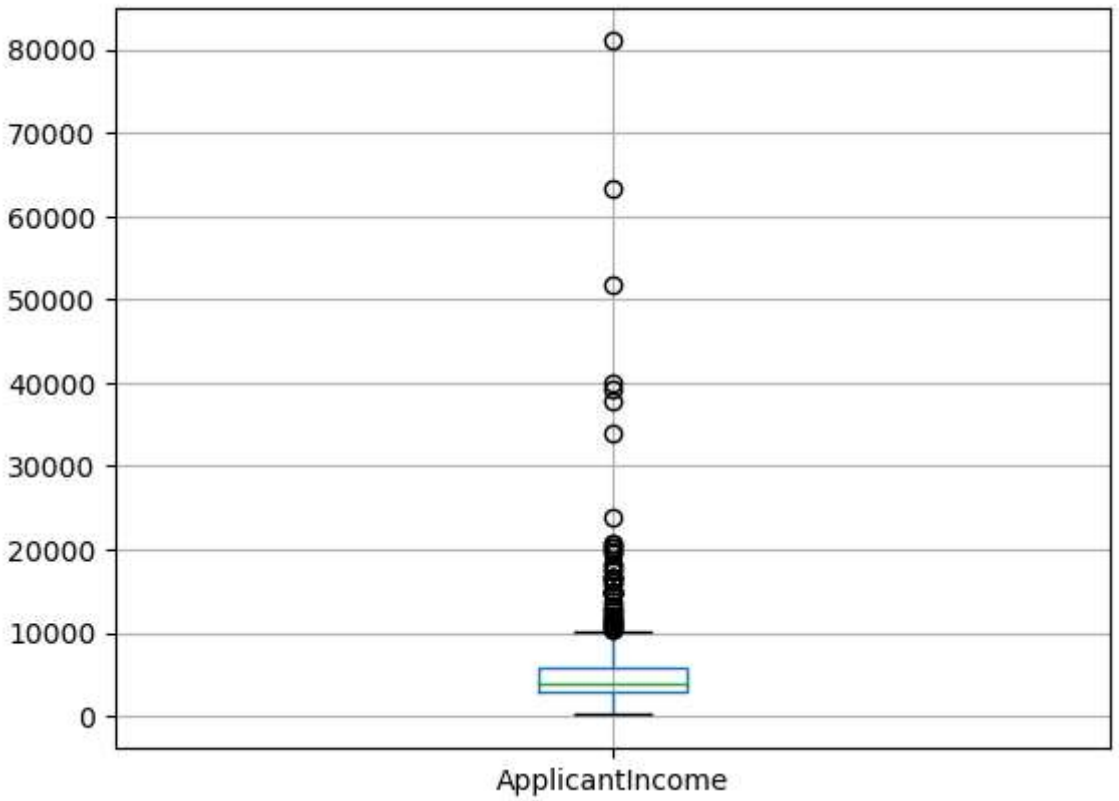
In [8]:
```
pd.crosstab(dataset["Credit_History"],dataset["Loan_Status"],margins=True)
```

Out[8]:

Loan_Status	N	Y	All
Credit_History			
0.0	82	7	89
1.0	97	378	475
All	179	385	564

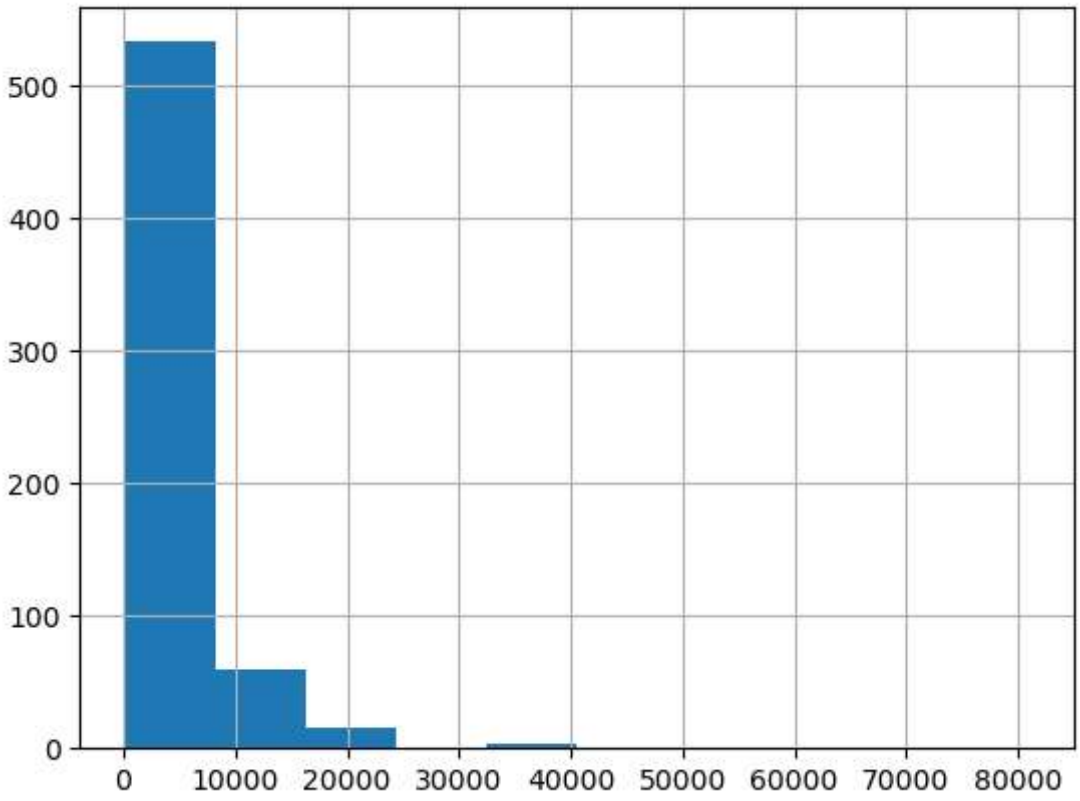
In [13]:
```
dataset.boxplot(column="ApplicantIncome")
```

Out[13]:
```
<Axes: >
```



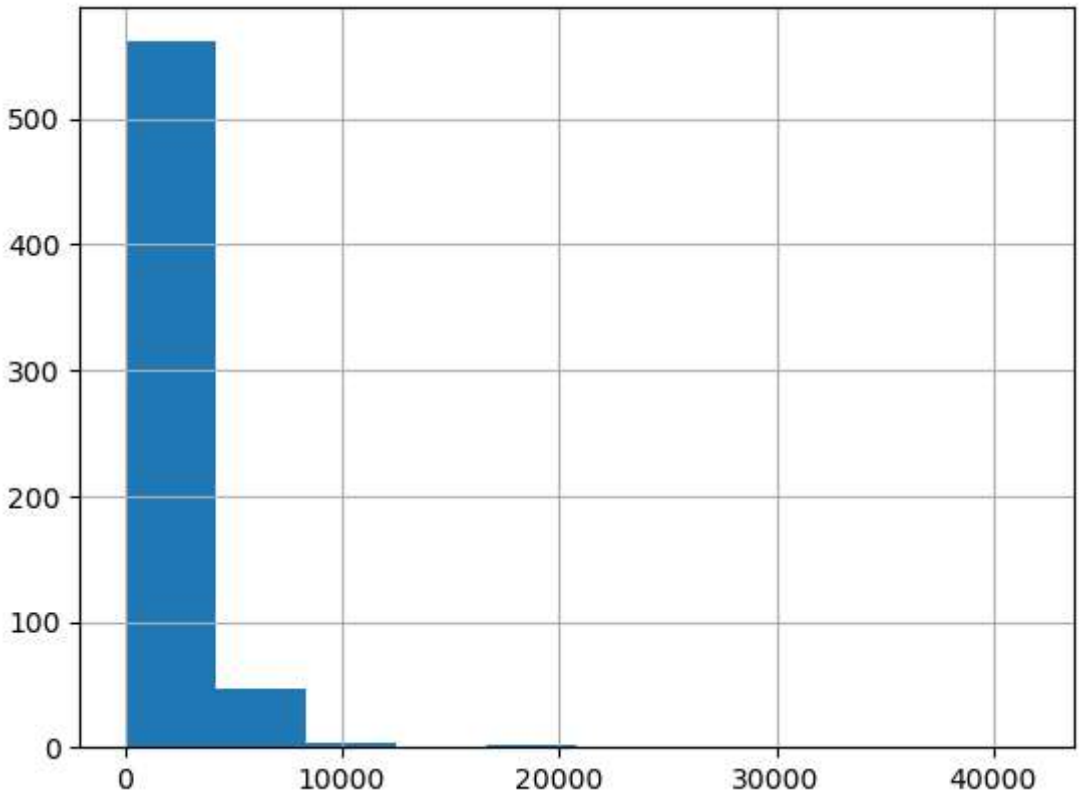
In [18]:
```
dataset["ApplicantIncome"].hist(bins=10)
```

Out[18]:
```
<Axes: >
```



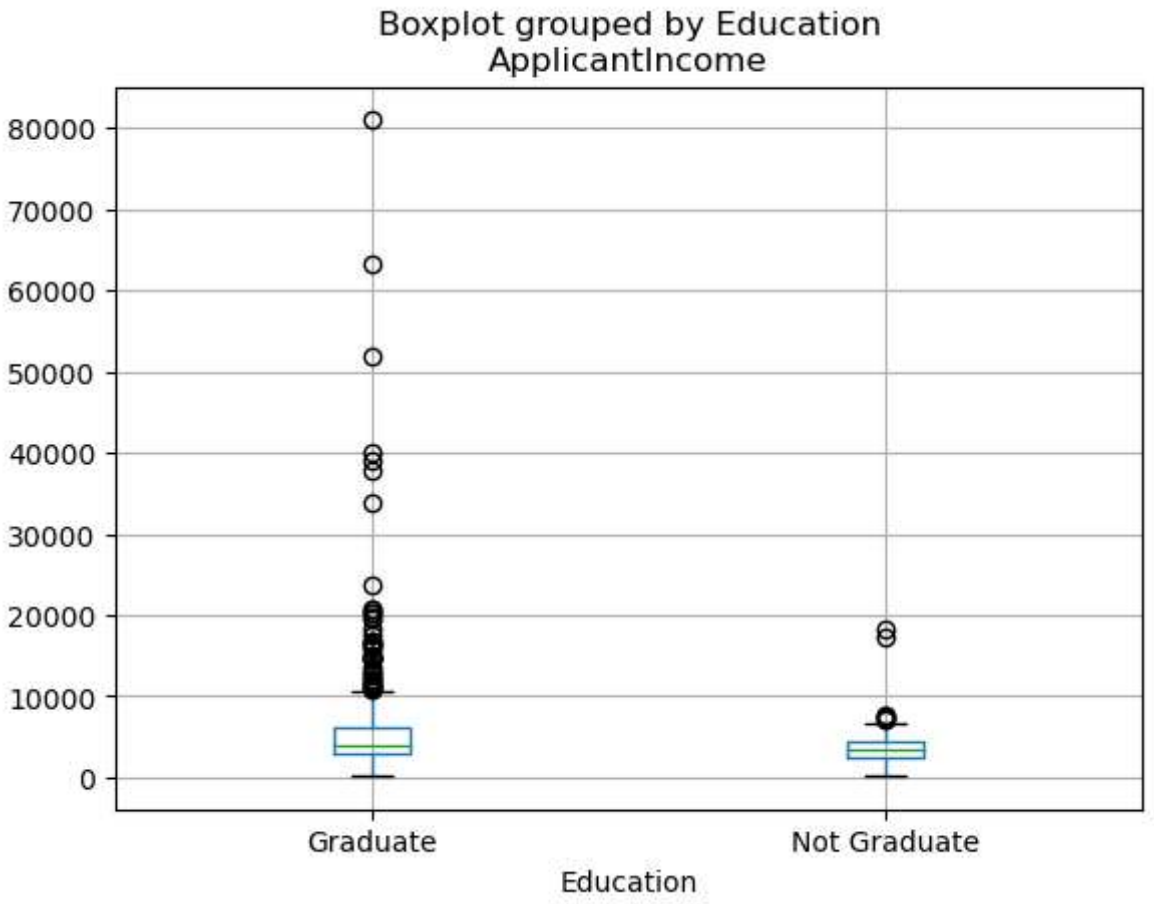
In [17]:
```
dataset["CoapplicantIncome"].hist(bins=10)
```

Out[17]:
```
<Axes: >
```



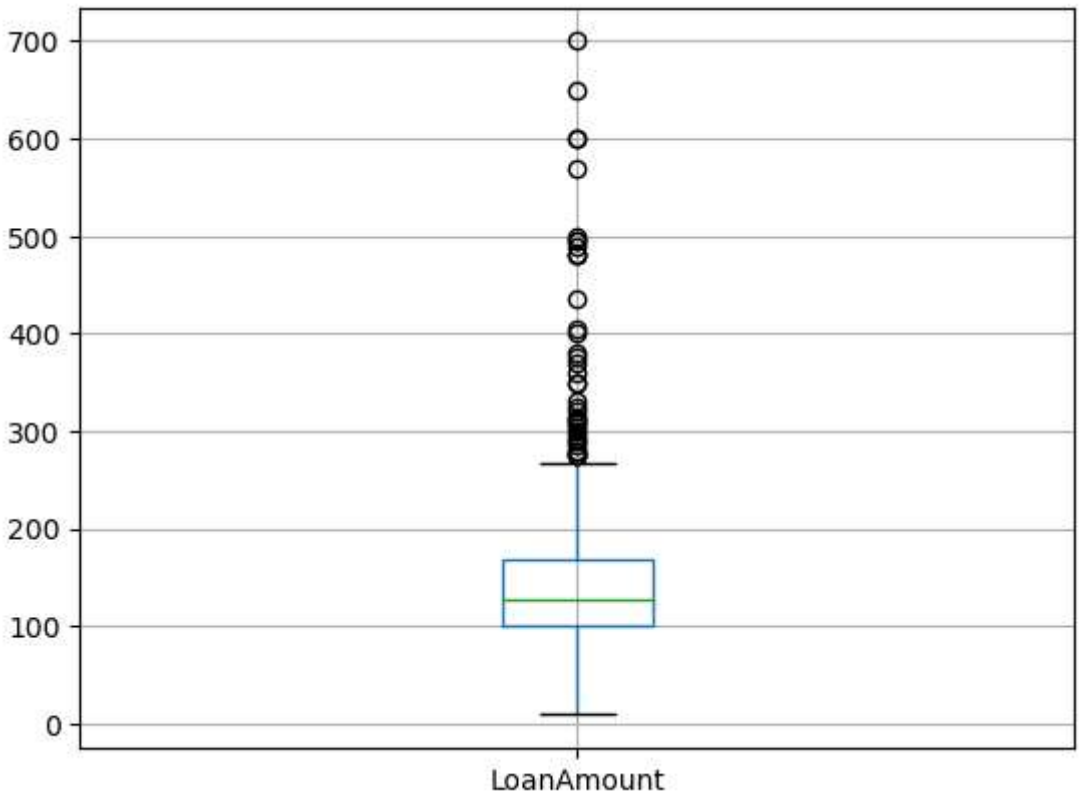
In [19]:
```
dataset.boxplot(column="ApplicantIncome",by="Education")
```

Out[19]:
```
<Axes: title={'center': 'ApplicantIncome'}, xlabel='Education'>
```



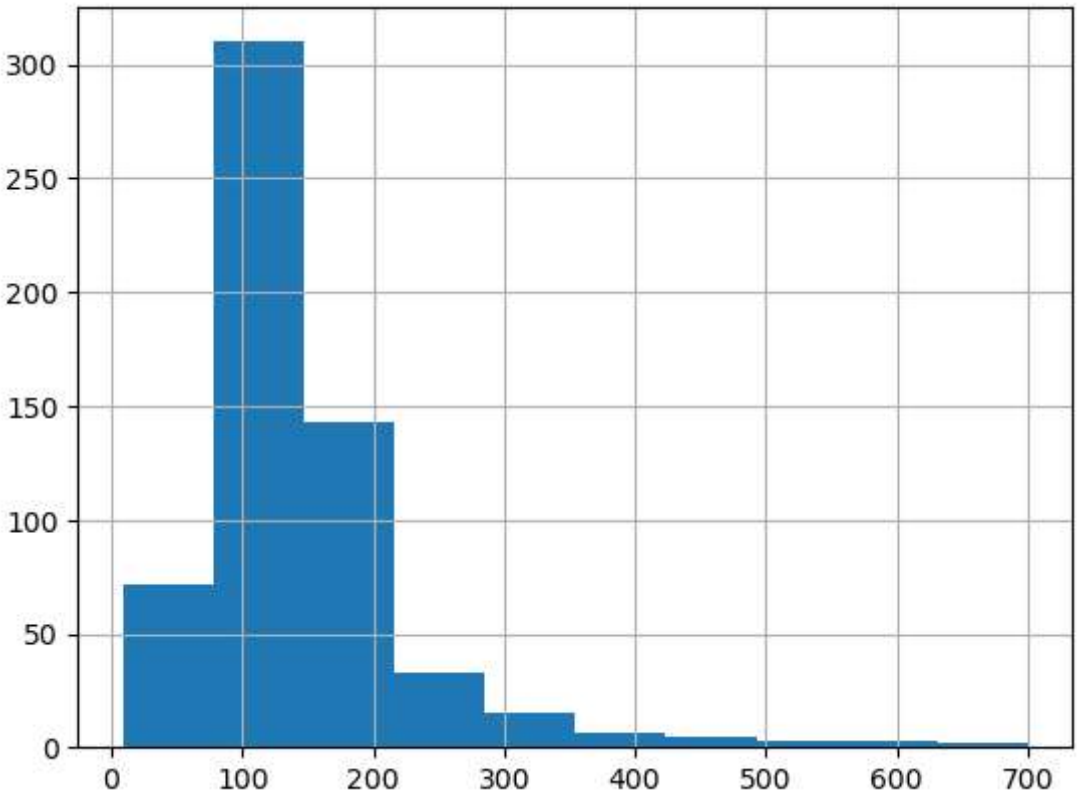
In [21]:
```
dataset.boxplot(column="LoanAmount")
```

Out[21]: <Axes: >



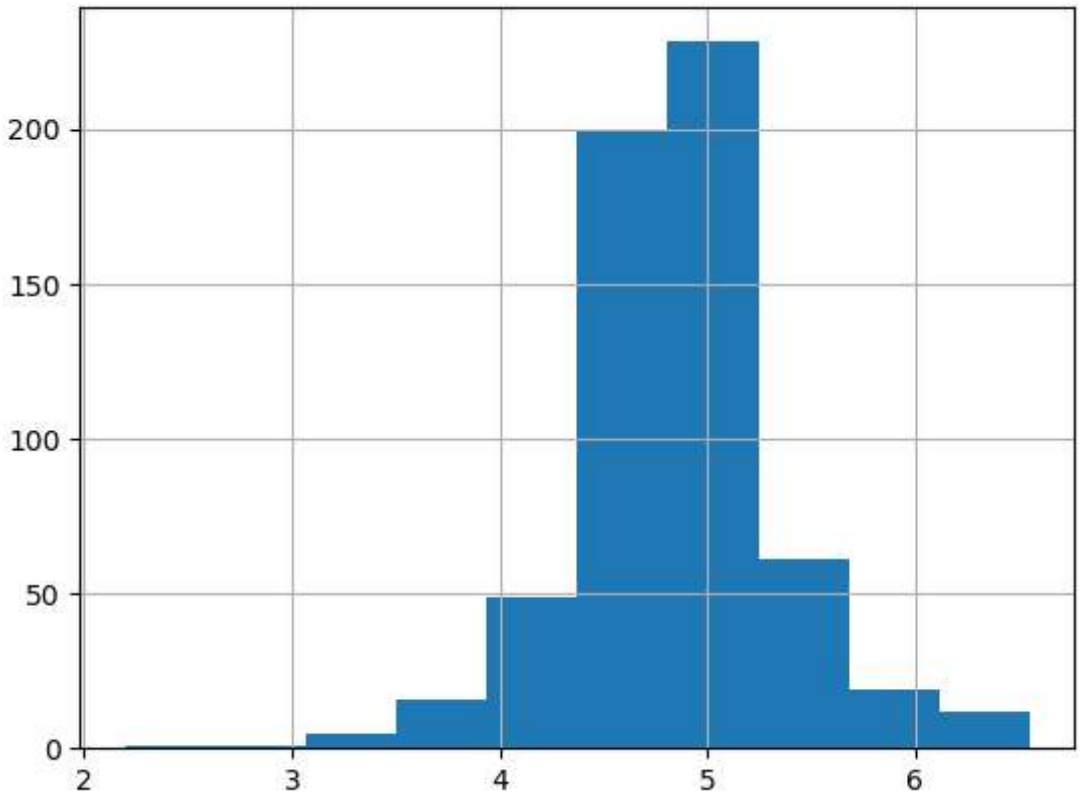
In [22]:
```
dataset["LoanAmount"].hist(bins=10)
```

Out[22]:
```
<Axes: >
```



In [23]:
```
dataset['LoanAmount_log']=np.log(dataset['LoanAmount'])
dataset['LoanAmount_log'].hist(bins=10)
```

Out[23]:
```
<Axes: >
```



To find misssing values

In [24]:
```
dataset.isnull().sum()
```

Out[24]:
```
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
LoanAmount_log       22
dtype: int64
```

Handling missing values

For categorical values we can use mode

In [35]:
```
dataset['Gender'].fillna(dataset['Gender'].mode()[0],inplace=True)
```

In [36]:
```
dataset['Married'].fillna(dataset['Married'].mode()[0],inplace=True)
```

In [37]:
```
dataset['Dependents'].fillna(dataset['Dependents'].mode()[0],inplace=True)
```

In [38]:
```
dataset['Self_Employed'].fillna(dataset['Self_Employed'].mode()[0],inplace=True)
```

In [39]:
```
dataset['Loan_Amount_Term'].fillna(dataset['Loan_Amount_Term'].mode()[0],inplace=True)
```

In [40]:
```
dataset['Credit_History'].fillna(dataset['Credit_History'].mode()[0],inplace=True)
```

For LoanAmount also we are going to handle the missing values but it is not the categoral type.So we can use mean function

In [31]:
```
dataset.LoanAmount=dataset.LoanAmount.fillna(dataset.LoanAmount.mean())
dataset.LoanAmount_log=dataset.LoanAmount_log.fillna(dataset.LoanAmount_log.mean())
```

Rechecking whether there is any missing values are there or not

In [41]:
```
dataset.isnull().sum()
```

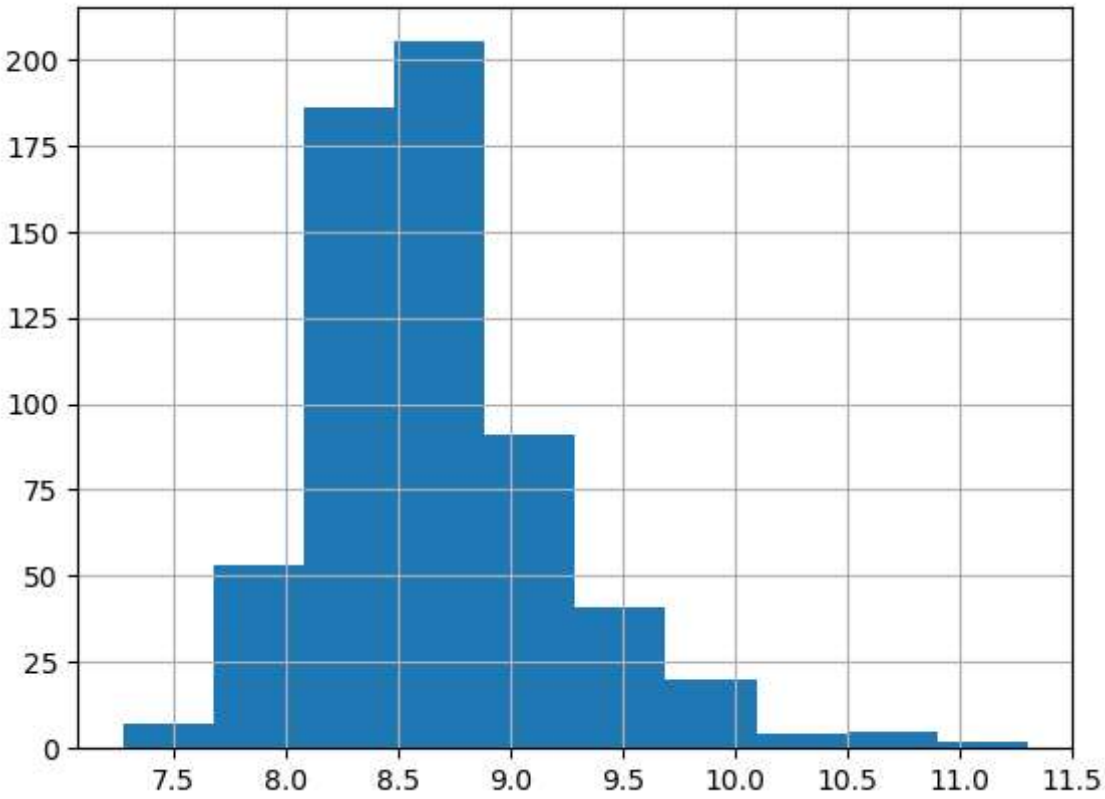
Out[41]:
```
Loan_ID              0
Gender               0
Married              0
Dependents           0
Education            0
Self_Employed        0
ApplicantIncome      0
CoapplicantIncome    0
LoanAmount           0
Loan_Amount_Term     0
Credit_History       0
Property_Area        0
Loan_Status          0
LoanAmount_log       0
dtype: int64
```

Now there are no missing values.And we have successfully handled the missing values

In [42]:
```
dataset['TotalIncome']=dataset['ApplicantIncome']+dataset['CoapplicantIncome']
dataset['TotalIncome_log']=np.log(dataset['TotalIncome'])
```

In [44]:
```
dataset['TotalIncome_log'].hist(bins=10)
```

Out[44]:
```
<Axes: >
```



In [45]:
```
dataset.head()
```

Out[45]:

	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	

Dealing with dependant and independant variables

In [48]:
```
x=dataset.iloc[:,np.r_[1:5,9:11,13:15]].values
y=dataset.iloc[:,12].values
```

In [49]:
```
x
```

Out[49]:
```
array([['Male', 'No', '0', ..., 1.0, 4.857444178729352, 5849.0],
       ['Male', 'Yes', '1', ..., 1.0, 4.852030263919617, 6091.0],
       ['Male', 'Yes', '0', ..., 1.0, 4.189654742026425, 3000.0],
       ...,
       ['Male', 'Yes', '1', ..., 1.0, 5.53338948872752, 8312.0],
       ['Male', 'Yes', '2', ..., 1.0, 5.231108616854587, 7583.0],
       ['Female', 'No', '0', ..., 0.0, 4.890349128221754, 4583.0]],
      dtype=object)
```

In [50]:
```
y
```

Out[50]:
```
array(['Y', 'N', 'Y', 'Y', 'Y', 'Y', 'Y', 'N', 'Y', 'N', 'Y', 'Y', 'Y',
       'N', 'Y', 'Y', 'Y', 'N', 'N', 'Y', 'N', 'Y', 'N', 'N', 'N', 'Y',
       'Y', 'Y', 'N', 'Y', 'N', 'N', 'N', 'Y', 'N', 'Y', 'N', 'Y', 'Y',
       'Y', 'N', 'Y', 'Y', 'Y', 'Y', 'Y', 'Y', 'Y', 'N', 'Y', 'Y', 'Y',
       'N', 'N', 'N', 'Y', 'Y', 'N', 'Y', 'Y', 'Y', 'Y', 'N', 'N', 'N',
       'N', 'N', 'Y', 'Y', 'N', 'Y', 'Y', 'Y', 'N', 'Y', 'N', 'N', 'N',
       'N', 'Y', 'Y', 'Y', 'N', 'N', 'Y', 'Y', 'Y', 'Y', 'Y', 'Y', 'Y',
       'Y', 'Y', 'Y', 'Y', 'N', 'Y', 'Y', 'Y', 'Y', 'Y', 'Y', 'Y', 'Y',
       'Y', 'Y', 'Y', 'N', 'N', 'Y', 'Y', 'Y', 'N', 'Y', 'Y', 'Y', 'Y',
       'Y', 'N', 'Y', 'Y', 'Y', 'Y', 'Y', 'Y', 'Y', 'Y', 'Y', 'N', 'N',
       'Y', 'Y', 'Y', 'Y', 'Y', 'N', 'N', 'Y', 'N', 'N', 'N', 'Y', 'Y',
       'Y', 'Y', 'Y', 'Y', 'Y', 'N', 'Y', 'N', 'Y', 'N', 'N', 'Y', 'Y',
       'Y', 'Y', 'Y', 'Y', 'Y', 'N', 'N', 'Y', 'Y', 'Y', 'N', 'Y', 'N',
       'Y', 'Y', 'Y', 'N', 'Y', 'N', 'Y', 'Y', 'N', 'Y', 'N', 'N', 'N',
       'Y', 'N', 'Y', 'Y', 'N', 'Y', 'Y', 'Y', 'Y', 'N', 'N', 'Y', 'Y',
       'N', 'Y', 'Y', 'Y', 'N', 'Y', 'Y', 'N', 'Y', 'Y', 'Y', 'Y', 'Y',
       'Y', 'N', 'N', 'N', 'Y', 'Y', 'Y', 'Y', 'N', 'Y', 'N', 'Y', 'N',
       'Y', 'Y', 'Y', 'Y', 'N', 'N', 'Y', 'Y', 'Y', 'Y', 'Y', 'Y', 'Y',
       'Y', 'Y', 'N', 'Y', 'Y', 'Y', 'Y', 'N', 'Y', 'Y', 'Y', 'N', 'Y',
       'Y', 'Y', 'Y', 'N', 'N', 'Y', 'Y', 'N', 'Y', 'N', 'N', 'N', 'N',
       'Y', 'Y', 'N', 'Y', 'Y', 'Y', 'Y', 'Y', 'N', 'Y', 'Y', 'Y', 'Y',
       'Y', 'Y', 'Y', 'Y', 'Y', 'Y', 'Y', 'Y', 'N', 'Y', 'Y', 'Y', 'N', 'Y',
       'N', 'Y', 'Y', 'Y', 'Y', 'N', 'Y', 'N', 'Y', 'Y', 'Y', 'Y', 'N',
       'N', 'N', 'Y', 'Y', 'Y', 'Y', 'N', 'Y', 'N', 'N', 'Y', 'Y', 'Y',
       'Y', 'Y', 'N', 'Y', 'Y', 'Y', 'Y', 'N', 'Y', 'Y', 'Y', 'Y', 'Y',
       'N', 'Y', 'Y', 'N', 'Y', 'Y', 'Y', 'Y', 'Y', 'Y', 'Y', 'Y', 'Y',
       'N', 'Y', 'N', 'N', 'Y', 'Y', 'Y', 'Y', 'N', 'Y', 'Y', 'Y', 'Y',
       'N', 'Y', 'N', 'Y', 'Y', 'Y', 'Y', 'N', 'N', 'Y', 'N', 'Y', 'Y', 'Y',
       'Y', 'N', 'N', 'N', 'Y', 'N', 'Y', 'Y', 'Y', 'N', 'Y', 'Y', 'Y',
       'Y', 'N', 'Y', 'Y', 'Y', 'Y', 'Y', 'N', 'Y', 'Y', 'N', 'Y', 'Y',
       'Y', 'Y', 'Y', 'Y', 'Y', 'Y', 'N', 'Y', 'Y', 'N', 'N', 'N', 'Y',
       'Y', 'N', 'Y', 'Y', 'Y', 'N', 'N', 'N', 'Y', 'N', 'Y', 'N', 'Y',
       'N', 'N', 'Y', 'Y', 'Y', 'N', 'Y', 'N', 'Y', 'Y', 'N', 'Y', 'Y',
       'Y', 'Y', 'N', 'Y', 'Y', 'Y', 'Y', 'Y', 'Y', 'Y', 'N', 'Y', 'Y', 'Y',
       'Y', 'Y', 'Y', 'Y', 'Y', 'Y', 'N', 'N', 'N', 'N', 'Y', 'N', 'Y', 'Y',
       'Y', 'Y', 'N', 'Y', 'N', 'Y', 'Y', 'Y', 'Y', 'Y', 'N', 'Y', 'N', 'Y',
       'Y', 'N', 'Y', 'N', 'Y', 'Y', 'Y', 'Y', 'Y', 'N', 'Y', 'N', 'Y',
       'Y', 'Y', 'Y', 'Y', 'Y', 'N', 'N', 'Y', 'N', 'Y', 'Y', 'Y', 'Y',
       'N', 'Y', 'Y', 'Y', 'Y', 'N', 'Y', 'Y', 'Y', 'N', 'Y', 'Y', 'Y',
       'N', 'Y', 'Y', 'N', 'Y', 'Y', 'N', 'N', 'Y', 'Y', 'N', 'N', 'N',
       'Y', 'Y', 'Y', 'Y', 'Y', 'N', 'Y', 'Y', 'Y', 'Y', 'Y', 'Y', 'N',
       'N', 'Y', 'Y', 'Y', 'Y', 'N', 'Y', 'Y', 'N', 'Y', 'Y', 'Y', 'Y',
       'N', 'Y', 'N', 'Y', 'N', 'Y', 'Y', 'N', 'N', 'Y', 'Y', 'Y', 'Y',
       'Y', 'Y', 'Y', 'Y', 'Y', 'N', 'Y', 'Y', 'N', 'N', 'N', 'Y', 'N',
       'Y', 'N', 'N', 'Y', 'N', 'Y', 'Y', 'Y', 'Y', 'N', 'Y', 'N', 'N',
       'N', 'Y', 'Y', 'Y', 'N', 'Y', 'N', 'Y', 'Y', 'Y', 'Y', 'N', 'N',
       'Y', 'Y', 'N', 'Y', 'Y', 'Y', 'Y', 'N', 'Y', 'Y', 'Y', 'Y', 'Y',
       'Y', 'Y', 'N'], dtype=object)
```

In [51]:
```
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_state=0)
```

In [52]:
```
print(x_train)
```

```
[['Male' 'Yes' '0' ... 1.0 4.875197323201151 5858.0]
 ['Male' 'No' '1' ... 1.0 5.278114659230517 11250.0]
 ['Male' 'Yes' '0' ... 0.0 5.003946305945459 5681.0]
 ...
 ['Male' 'Yes' '3+' ... 1.0 5.298317366548036 8334.0]
 ['Male' 'Yes' '0' ... 1.0 5.075173815233827 6033.0]
 ['Female' 'Yes' '0' ... 1.0 5.204006687076795 6486.0]]
```

To convert data from categoral form to numerical form

In [53]:
```
from sklearn.preprocessing import LabelEncoder
labelencoder_x=LabelEncoder()
```

In [55]:
```
for i in range(0,5):
    x_train[:,i]=labelencoder_x.fit_transform(x_train[:,i])
```

In [56]:
```
x_train[:,7]=labelencoder_x.fit_transform(x_train[:,7])
```

In [57]:
```
x_train
```

Out[57]:
```
array([[1, 1, 0, ..., 1.0, 4.875197323201151, 267],
       [1, 0, 1, ..., 1.0, 5.278114659230517, 407],
       [1, 1, 0, ..., 0.0, 5.003946305945459, 249],
       ...,
       [1, 1, 3, ..., 1.0, 5.298317366548036, 363],
       [1, 1, 0, ..., 1.0, 5.075173815233827, 273],
       [0, 1, 0, ..., 1.0, 5.204006687076795, 301]], dtype=object)
```

In [58]:
```
labelencoder_y=LabelEncoder()
y_train=labelencoder_y.fit_transform(y_train)
```

In [59]:
```
y_train
```

Out[59]:
```
array([1, 0, 0, 1, 1, 0, 1, 1, 1, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1,
       0, 1, 1, 0, 0, 1, 1, 1, 0, 1, 1, 1, 1, 1, 0, 1, 0, 1, 0, 1, 1, 1,
       1, 0, 0, 0, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 0, 1, 1, 0,
       1, 1, 1, 1, 1, 0, 0, 1, 1, 0, 1, 0, 0, 1, 0, 0, 1, 1, 1, 1, 1, 1,
       1, 1, 0, 1, 0, 1, 0, 1, 1, 1, 1, 0, 0, 1, 1, 1, 0, 1, 1, 0, 0, 0,
       1, 1, 1, 0, 1, 0, 0, 1, 0, 0, 0, 1, 1, 1, 1, 1, 0, 0, 0, 0, 1, 1,
       0, 1, 1, 1, 1, 1, 1, 0, 0, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 0, 1, 1, 1, 1, 0,
       0, 1, 0, 1, 0, 0, 0, 1, 0, 1, 1, 1, 1, 1, 0, 0, 1, 0, 1, 1, 1, 1,
       0, 0, 1, 1, 1, 1, 1, 0, 0, 1, 1, 1, 1, 0, 1, 1, 1, 1, 0, 0, 1, 1,
       0, 1, 1, 1, 0, 1, 1, 1, 0, 1, 0, 1, 0, 1, 1, 0, 0, 0, 1, 0, 1, 1,
       1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 0, 1, 0, 1, 0, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 0, 0, 1, 0, 1, 1, 1, 0, 1, 1, 0, 1, 0, 1, 0, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 0, 1, 1, 0, 1, 1, 1, 0, 0, 1, 1, 1, 1, 0, 1, 0, 1, 1,
       1, 1, 1, 0, 1, 0, 1, 0, 0, 1, 1, 0, 1, 1, 0, 1, 1, 0, 0, 1, 1, 1,
       1, 1, 1, 0, 1, 1, 1, 0, 1, 0, 0, 0, 0, 1, 1, 1, 1, 0, 0, 1, 1, 1,
       1, 0, 1, 0, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 0, 1, 0, 0, 0,
       1, 1, 0, 1, 1, 1, 1, 0, 1, 1, 0, 1, 0, 0, 0, 1, 1, 1, 1, 1, 1, 1,
       1, 0, 1, 0, 1, 1, 1, 0, 1, 1, 1, 0, 0, 1, 1, 1, 1, 0, 1, 1, 1, 1,
       1, 1, 0, 1, 0, 1, 0, 1, 1, 0, 0, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 0,
       1, 1, 0, 0, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 0, 0, 1, 0, 0, 0, 0, 0, 1,
       1, 1, 1, 1, 1, 0, 1, 0, 1, 0, 0, 1, 1, 1, 0, 1, 1, 0, 0, 0, 0, 1,
       1, 1, 1, 0, 1, 0, 1])
```

In [60]:
```
for i in range(0,5):
    x_test[:,i]=labelencoder_x.fit_transform(x_test[:,i])
```

In [61]:
```
x_test[:,7]=labelencoder_x.fit_transform(x_test[:,7])
```

In [62]:
```
 y_test=labelencoder_y.fit_transform(y_test)
```

In [63]:
```
x_test
```

Out[63]:
```
array([[1, 0, 0, 0, 5, 1.0, 4.430816798843313, 85],
       [0, 0, 0, 0, 5, 1.0, 4.718498871295094, 28],
       [1, 1, 0, 0, 5, 1.0, 5.780743515792329, 104],
       [1, 1, 0, 0, 5, 1.0, 4.700480365792417, 80],
       [1, 1, 2, 0, 5, 1.0, 4.574710978503383, 22],
       [1, 1, 0, 1, 3, 0.0, 5.10594547390058, 70],
       [1, 1, 3, 0, 3, 1.0, 5.056245805348308, 77],
       [1, 0, 0, 0, 5, 1.0, 6.003887067106539, 114],
       [1, 0, 0, 0, 5, 0.0, 4.820281565605037, 53],
       [1, 1, 0, 0, 5, 1.0, 4.852030263919617, 55],
       [0, 0, 0, 0, 5, 1.0, 4.430816798843313, 4],
       [1, 1, 1, 0, 5, 1.0, 4.553876891600541, 2],
       [0, 0, 0, 0, 5, 1.0, 5.634789603169249, 96],
       [1, 1, 2, 0, 5, 1.0, 5.4638318050256105, 97],
       [1, 1, 0, 0, 5, 1.0, 4.564348191467836, 117],
       [1, 1, 1, 0, 5, 1.0, 4.204692619390966, 22],
       [1, 0, 1, 1, 5, 1.0, 5.247024072160486, 32],
       [1, 0, 0, 1, 5, 1.0, 4.882801922586371, 25],
       [0, 0, 0, 0, 5, 1.0, 4.532599493153256, 1],
       [1, 1, 0, 1, 5, 0.0, 5.198497031265826, 44],
       [0, 1, 0, 0, 5, 0.0, 4.787491742782046, 71],
       [1, 1, 0, 0, 5, 1.0, 4.962844630259907, 43],
       [1, 1, 2, 0, 5, 1.0, 4.68213122712422, 91],
       [1, 1, 2, 0, 5, 1.0, 5.10594547390058, 111],
       [1, 1, 0, 0, 5, 1.0, 4.060443010546419, 35],
       [1, 1, 1, 0, 5, 1.0, 5.521460917862246, 94],
       [1, 0, 0, 0, 5, 1.0, 5.231108616854587, 98],
       [1, 1, 0, 0, 5, 1.0, 5.231108616854587, 110],
       [1, 1, 3, 0, 5, 0.0, 4.852030263919617, 41],
       [0, 0, 0, 0, 5, 0.0, 4.634728988229636, 50],
       [1, 1, 0, 0, 5, 1.0, 5.429345628954441, 99],
       [1, 0, 0, 1, 5, 1.0, 3.871201010907891, 46],
       [1, 1, 1, 1, 5, 1.0, 4.499809670330265, 52],
       [1, 1, 0, 0, 5, 1.0, 5.19295685089021, 102],
       [1, 1, 0, 0, 5, 1.0, 4.857444178729352, 95],
       [0, 1, 0, 1, 5, 0.0, 5.181783550292085, 57],
       [1, 1, 0, 0, 5, 1.0, 5.147494476813453, 65],
       [1, 0, 0, 1, 5, 1.0, 4.836281906951478, 39],
       [1, 1, 0, 0, 5, 1.0, 4.852030263919617, 75],
       [1, 1, 2, 1, 5, 1.0, 4.68213122712422, 24],
       [0, 0, 0, 0, 5, 1.0, 4.382026634673881, 9],
       [1, 1, 3, 0, 5, 0.0, 4.812184355372417, 68],
       [1, 1, 2, 0, 2, 1.0, 2.833213344056216, 0],
       [1, 1, 1, 1, 5, 1.0, 5.062595033026967, 67],
       [1, 0, 0, 0, 5, 1.0, 4.330733340286331, 21],
       [1, 0, 0, 0, 5, 1.0, 5.231108616854587, 113],
       [1, 1, 1, 0, 5, 1.0, 4.7535901911063645, 18],
       [0, 0, 0, 0, 5, 1.0, 4.74493212836325, 37],
       [1, 1, 1, 0, 5, 1.0, 4.852030263919617, 72],
       [1, 0, 0, 0, 5, 1.0, 4.941642422609304, 78],
       [1, 1, 3, 1, 5, 1.0, 4.30406509320417, 8],
       [1, 1, 0, 0, 5, 1.0, 4.867534450455582, 84],
       [1, 1, 0, 1, 5, 1.0, 4.672828834461906, 31],
       [1, 0, 0, 0, 5, 1.0, 4.857444178729352, 61],
       [1, 1, 0, 0, 5, 1.0, 4.718498871295094, 19],
       [1, 1, 0, 0, 5, 1.0, 5.556828061699537, 107],
       [1, 1, 0, 0, 5, 1.0, 4.553876891600541, 34],
       [1, 0, 0, 1, 5, 1.0, 4.890349128221754, 74],
       [1, 1, 2, 0, 5, 1.0, 5.123963979403259, 62],
       [1, 0, 0, 0, 5, 1.0, 4.787491742782046, 27],
```

```
[0, 0, 0, 0, 5, 0.0, 4.919980925828125, 108],
[0, 0, 0, 0, 5, 1.0, 5.365976015021851, 103],
[1, 1, 0, 1, 5, 1.0, 4.74493212836325, 38],
[0, 0, 0, 0, 5, 0.0, 4.330733340286331, 13],
[1, 1, 2, 0, 5, 1.0, 4.890349128221754, 69],
[1, 1, 1, 0, 5, 1.0, 5.752572638825633, 112],
[1, 1, 0, 0, 5, 1.0, 5.075173815233827, 73],
[1, 0, 0, 0, 5, 1.0, 4.912654885736052, 47],
[1, 1, 0, 0, 5, 1.0, 5.204006687076795, 81],
[1, 0, 0, 1, 5, 1.0, 4.564348191467836, 60],
[1, 0, 0, 0, 5, 1.0, 4.204692619390966, 83],
[0, 1, 0, 0, 5, 1.0, 4.867534450455582, 5],
[1, 1, 2, 1, 5, 1.0, 5.056245805348308, 58],
[1, 1, 1, 1, 3, 1.0, 4.919980925828125, 79],
[0, 1, 0, 0, 5, 1.0, 4.969813299576001, 54],
[1, 1, 0, 1, 4, 1.0, 4.820281565605037, 56],
[1, 0, 0, 0, 5, 1.0, 4.499809670330265, 120],
[1, 0, 3, 0, 5, 1.0, 5.768320995793772, 118],
[1, 1, 2, 0, 5, 1.0, 4.718498871295094, 101],
[0, 0, 0, 0, 5, 0.0, 4.7535901911063645, 26],
[0, 0, 0, 0, 6, 1.0, 4.727387818712341, 33],
[1, 1, 1, 0, 5, 1.0, 6.214608098422191, 119],
[0, 0, 0, 0, 5, 1.0, 5.267858159063328, 89],
[1, 1, 2, 0, 5, 1.0, 5.231108616854587, 92],
[1, 0, 0, 0, 6, 1.0, 4.2626798770413155, 6],
[1, 1, 0, 0, 0, 1.0, 4.709530201312334, 90],
[1, 1, 0, 0, 5, 1.0, 4.700480365792417, 45],
[1, 1, 2, 0, 5, 1.0, 5.298317366548036, 109],
[1, 0, 1, 0, 3, 1.0, 4.727387818712341, 17],
[1, 1, 1, 0, 5, 1.0, 4.6443908991413725, 36],
[0, 1, 0, 1, 5, 1.0, 4.605170185988092, 16],
[1, 0, 0, 0, 5, 1.0, 4.30406509320417, 7],
[1, 1, 1, 0, 1, 1.0, 5.147494476813453, 88],
[1, 1, 3, 0, 4, 0.0, 5.19295685089021, 87],
[0, 0, 0, 0, 5, 1.0, 4.2626798770413155, 3],
[1, 0, 0, 1, 3, 0.0, 4.836281906951478, 59],
[1, 0, 0, 0, 3, 1.0, 5.1647859739235145, 82],
[1, 0, 0, 0, 5, 1.0, 4.969813299576001, 66],
[1, 1, 2, 1, 5, 1.0, 4.394449154672439, 51],
[1, 1, 1, 0, 5, 1.0, 5.231108616854587, 100],
[1, 1, 0, 0, 5, 1.0, 5.351858133476067, 93],
[1, 1, 0, 0, 5, 1.0, 4.605170185988092, 15],
[1, 1, 2, 0, 5, 1.0, 4.787491742782046, 106],
[1, 0, 0, 0, 3, 1.0, 4.787491742782046, 105],
[1, 1, 3, 0, 5, 1.0, 4.852030263919617, 64],
[1, 0, 0, 0, 5, 1.0, 4.8283137373023015, 49],
[1, 0, 0, 1, 5, 1.0, 4.6443908991413725, 42],
[0, 0, 0, 0, 5, 1.0, 4.477336814478207, 10],
[1, 1, 0, 1, 5, 1.0, 4.553876891600541, 20],
[1, 1, 3, 1, 3, 1.0, 4.394449154672439, 14],
[1, 0, 0, 0, 5, 1.0, 5.298317366548036, 76],
[0, 0, 0, 0, 5, 1.0, 4.90527477843843, 11],
[1, 0, 0, 0, 6, 1.0, 4.727387818712341, 18],
[1, 1, 2, 0, 5, 1.0, 4.248495242049359, 23],
[1, 1, 0, 1, 5, 0.0, 5.303304908059076, 63],
[1, 1, 0, 0, 3, 0.0, 4.499809670330265, 48],
[0, 0, 0, 0, 5, 1.0, 4.430816798843313, 30],
[1, 0, 0, 0, 5, 1.0, 4.897839799950911, 29],
[1, 1, 2, 0, 5, 1.0, 5.170483995038151, 86],
[1, 1, 3, 0, 5, 1.0, 4.867534450455582, 115],
```

```
       [1, 1, 0, 0, 5, 1.0, 6.077642243349034, 116],
       [1, 1, 3, 1, 3, 0.0, 4.248495242049359, 40],
       [1, 1, 1, 0, 5, 1.0, 4.564348191467836, 12]], dtype=object)
```

In [64]:
```
y_test
```

Out[64]:
```
array([1, 0, 1, 0, 1, 0, 1, 1, 0, 1, 1, 1, 1, 1, 1, 0, 0, 1, 1, 0, 0, 1,
       1, 1, 1, 1, 1, 1, 0, 0, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 0, 1, 1,
       1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 0, 1, 0, 1, 1,
       1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 0, 0, 1, 0, 1, 0, 0, 1, 0, 1, 1, 1,
       1, 1, 1, 0, 0, 0, 1, 0, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 0,
       1, 0, 0, 1, 0, 1, 1, 1, 1, 1, 1, 0, 1])
```

Scaling our dataset to get much better predictions

In [66]:
```
from sklearn.preprocessing import StandardScaler
ss=StandardScaler()
x_train=ss.fit_transform(x_train)
x_test=ss.fit_transform(x_test)
```

Lets see how accurately it is predicting the outcome

In [67]:
```
from sklearn.tree import DecisionTreeClassifier
DTClassifier=DecisionTreeClassifier(criterion='entropy')
DTClassifier.fit(x_train,y_train)
```

Out[67]:
```
DecisionTreeClassifier(criterion='entropy')
```

In [78]:
```
y_pred=DTClassifier.predict(x_test)
y_pred
```

Out[78]:
```
array([0, 1, 0, 1, 1, 1, 0, 0, 0, 1, 1, 0, 0, 1, 1, 1, 0, 1, 1, 0, 0, 1,
       1, 1, 1, 1, 1, 1, 0, 0, 0, 1, 0, 1, 1, 0, 1, 1, 0, 1, 1, 0, 0, 1,
       1, 1, 1, 0, 0, 0, 1, 1, 1, 1, 1, 0, 1, 0, 1, 1, 0, 0, 1, 0, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 0, 1, 0, 1, 1, 0, 1, 1, 1, 1, 1,
       1, 0, 0, 1, 0, 0, 1, 0, 1, 1, 0, 1, 1, 0, 1, 1, 1, 1, 0, 1, 1, 1,
       1, 0, 1, 1, 0, 0, 1, 1, 0, 1, 0, 0, 1])
```

Testing the accuracy

In [81]:
```
from sklearn import metrics
print('The accuracy of decision tree is:',metrics.accuracy_score(y_pred,y_test))
```

```
The accuracy of decision tree is: 0.7154471544715447
```

It is showing 70% accuracy which is not great

For applying algorithms

In [82]:
```
from sklearn.naive_bayes import GaussianNB
NBClassifier=GaussianNB()
NBClassifier.fit(x_train,y_train)
```

Out[82]:
```
GaussianNB
GaussianNB()
```

In [83]:
```
y_pred= NBClassifier.predict(x_test)
y_pred
```

Out[83]:
```
array([1, 1, 1, 1, 1, 0, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 0, 1,
       1, 1, 1, 1, 1, 1, 0, 0, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 0, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 0, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 0, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 0, 0, 1, 1, 1, 1, 1, 0, 1])
```

In [84]:
```
print("The accuracy of the Naive Bayes is:",metrics.accuracy_score(y_pred,y_test))
```

```
The accuracy of the Naive Bayes is: 0.8292682926829268
```

In [85]:
```
testdata=pd.read_csv(r"C:/Users/PRIYANKA.M/OneDrive/Documents/Figma/archive (1)/Test D
```

In [86]:
```
testdata.head()
```

Out[86]:

	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	

In [87]:
```
testdata.info
```

Out[87]:
```
<bound method DataFrame.info of       Loan_ID Gender Married Dependents     Education
Self_Employed  \
0    LP001015   Male     Yes          0      Graduate            No
1    LP001022   Male     Yes          1      Graduate            No
2    LP001031   Male     Yes          2      Graduate            No
3    LP001035   Male     Yes          2      Graduate            No
4    LP001051   Male      No          0  Not Graduate            No
..        ...    ...     ...        ...           ...           ...
362  LP002971   Male     Yes         3+  Not Graduate           Yes
363  LP002975   Male     Yes          0      Graduate            No
364  LP002980   Male      No          0      Graduate            No
365  LP002986   Male     Yes          0      Graduate            No
366  LP002989   Male      No          0      Graduate           Yes

     ApplicantIncome  CoapplicantIncome  LoanAmount  Loan_Amount_Term  \
0               5720                  0       110.0             360.0
1               3076               1500       126.0             360.0
2               5000               1800       208.0             360.0
3               2340               2546       100.0             360.0
4               3276                  0        78.0             360.0
..               ...                ...         ...               ...
362             4009               1777       113.0             360.0
363             4158                709       115.0             360.0
364             3250               1993       126.0             360.0
365             5000               2393       158.0             360.0
366             9200                  0        98.0             180.0

     Credit_History Property_Area
0               1.0         Urban
1               1.0         Urban
2               1.0         Urban
3               NaN         Urban
4               1.0         Urban
..              ...           ...
362             1.0         Urban
363             1.0         Urban
364             NaN     Semiurban
365             1.0         Rural
366             1.0         Rural

[367 rows x 12 columns]>
```

In [88]:
```
testdata.isnull().sum()
```

Out[88]:
```
Loan_ID              0
Gender              11
Married              0
Dependents          10
Education            0
Self_Employed       23
ApplicantIncome      0
CoapplicantIncome    0
LoanAmount           5
Loan_Amount_Term     6
Credit_History      29
Property_Area        0
dtype: int64
```

Handling missing values in test data

In [97]:
```
testdata['Gender'].fillna(testdata['Gender'].mode()[0],inplace=True)
```

In [98]:
```
testdata['Dependents'].fillna(testdata['Dependents'].mode()[0],inplace=True)
```

In [99]:
```
testdata['Self_Employed'].fillna(testdata['Self_Employed'].mode()[0],inplace=True)
```

In [100…
```
testdata['Loan_Amount_Term'].fillna(testdata['Loan_Amount_Term'].mode()[0],inplace=Tru
```

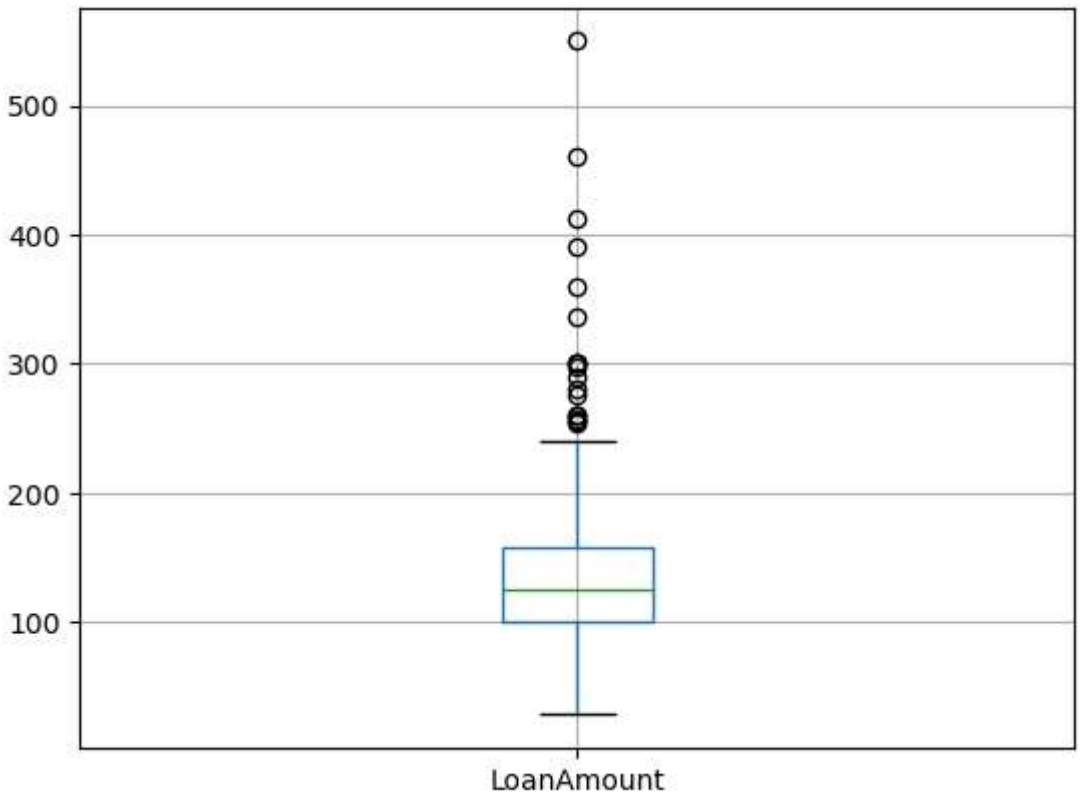
In [101…
```
testdata['Credit_History'].fillna(testdata['Credit_History'].mode()[0],inplace=True)
```

In [102…
```
testdata.isnull().sum()
```

Out[102]:
```
Loan_ID              0
Gender               0
Married              0
Dependents           0
Education            0
Self_Employed        0
ApplicantIncome      0
CoapplicantIncome    0
LoanAmount           5
Loan_Amount_Term     0
Credit_History       0
Property_Area        0
dtype: int64
```

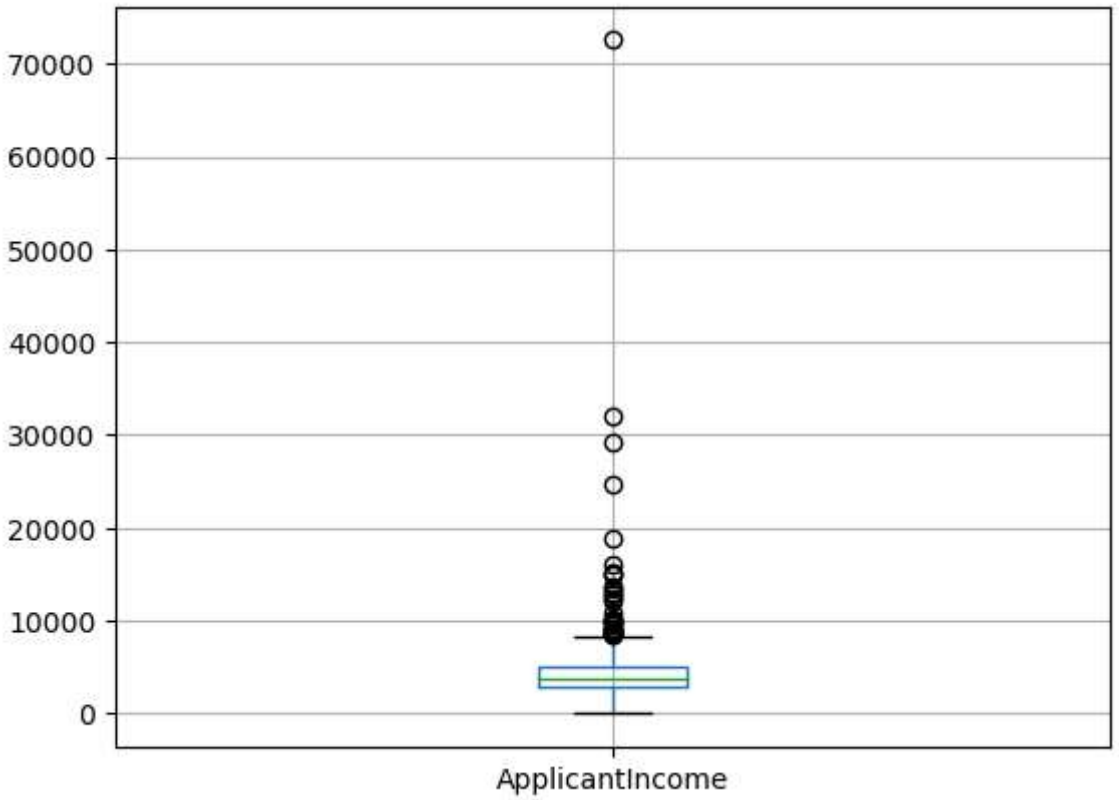
In [103…
```
testdata.boxplot(column='LoanAmount')
```

Out[103]:
```
<Axes: >
```



In [104…
```
testdata.boxplot(column='ApplicantIncome')
```

Out[104]: <Axes: >



Here we have outliers.So w eneed to fix thise outliers

Before that we need to fix the LoanAmount's missing values

In [108…
```
testdata.LoanAmount=testdata.LoanAmount.fillna(testdata.LoanAmount.mean())
```

In [109…
```
testdata["LoanAmount_log"]=np.log(testdata["LoanAmount"])
```

In [111…
```
testdata.isnull().sum()
```

Out[111]:
```
Loan_ID              0
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
LoanAmount_log       0
dtype: int64
```

Now we have fixed all the missing values

In [112…
```
testdata['TotalIncome']=testdata['ApplicantIncome']+testdata['CoapplicantIncome']
testdata['TotalIncome_log']=np.log(testdata['TotalIncome'])
```

In [113…
```
testdata.head()
```

Out[113]:

	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	

In [114…
```
test=testdata.iloc[:,np.r_[1:5,9:11,13:15]].values
```

converting data from categoral form to numberical form

In [116…
```
for i in range(0,5):
    test[:,i]=labelencoder_x.fit_transform(test[:,i])
```

In [117…
```
test[:,7]=labelencoder_x.fit_transform(test[:,7])
```

In [118…
```
test
```

Out[118]:
```
array([[1, 1, 0, ..., 1.0, 5720, 207],
       [1, 1, 1, ..., 1.0, 4576, 124],
       [1, 1, 2, ..., 1.0, 6800, 251],
       ...,
       [1, 0, 0, ..., 1.0, 5243, 174],
       [1, 1, 0, ..., 1.0, 7393, 268],
       [1, 0, 0, ..., 1.0, 9200, 311]], dtype=object)
```

In [119…
```
test=ss.fit_transform(test)
```

In [121…
```
pred=NBClassifier.predict(test)
```

In [122…
```
pred
```

Out[122]:
```
array([1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 0, 1, 1, 1, 1, 0, 1, 1,
       0, 0, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 0, 0, 1, 0, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 0, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 0, 0, 0, 1, 1, 1, 0, 0, 1, 0, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 0, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 0,
       1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 0, 0, 1, 0, 1, 1, 1, 1, 0, 0, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 0, 1, 1, 0, 1,
       0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 0, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 0, 0, 1, 1, 1, 1, 0,
       1, 0, 1, 0, 1, 1, 1, 1, 0, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 0, 1, 0, 1, 1, 1, 1, 0, 0, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 0, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1,
       1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1])
```

1 represents the customer is eligible for the loan and 0 represents the customer is not eligible for the loan