```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
%matplotlib inline
```

```
dataset = pd.read_csv("loantrain.csv")
```

```
dataset.head()
```

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

```
dataset.shape
```

```
(614, 13)
```

```
dataset.info
```

```
<bound method DataFrame.info of       Loan_ID  Gender Married Dependents     Education
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]>
```

```
dataset.describe()
```

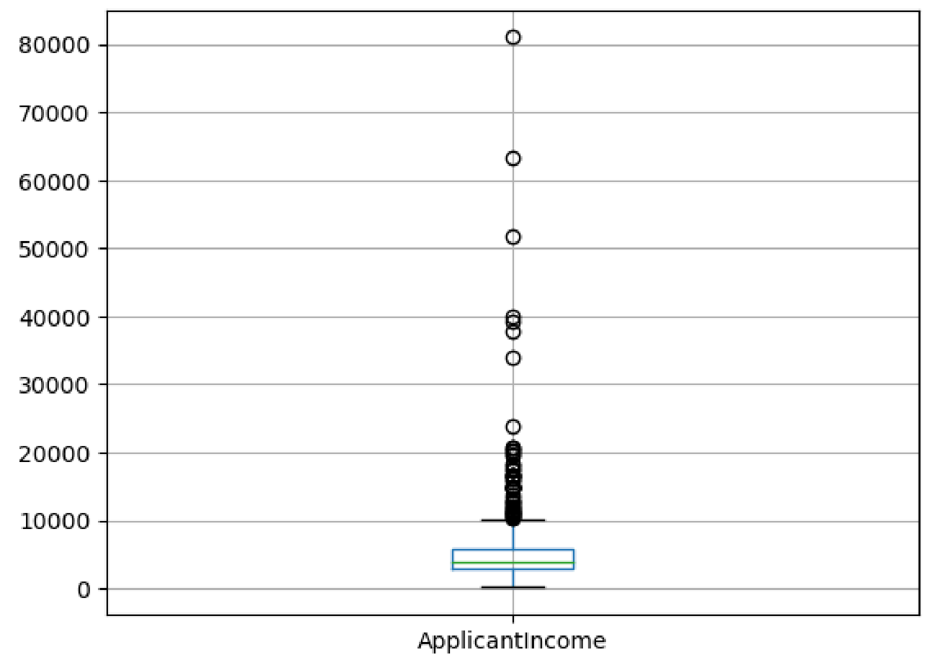
	ApplicantIncome	CoapplicantIncome	LoanAmount	Loan_Amount_Term	Credit_History
count	614.000000	614.000000	592.000000	600.00000	564.000000
mean	5403.459283	1621.245798	146.412162	342.00000	0.842199
std	6109.041673	2926.248369	85.587325	65.12041	0.364878
min	150.000000	0.000000	9.000000	12.00000	0.000000
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

```
pd.crosstab(dataset['Credit_History'],dataset['Loan_Status'],margins=True)
```

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

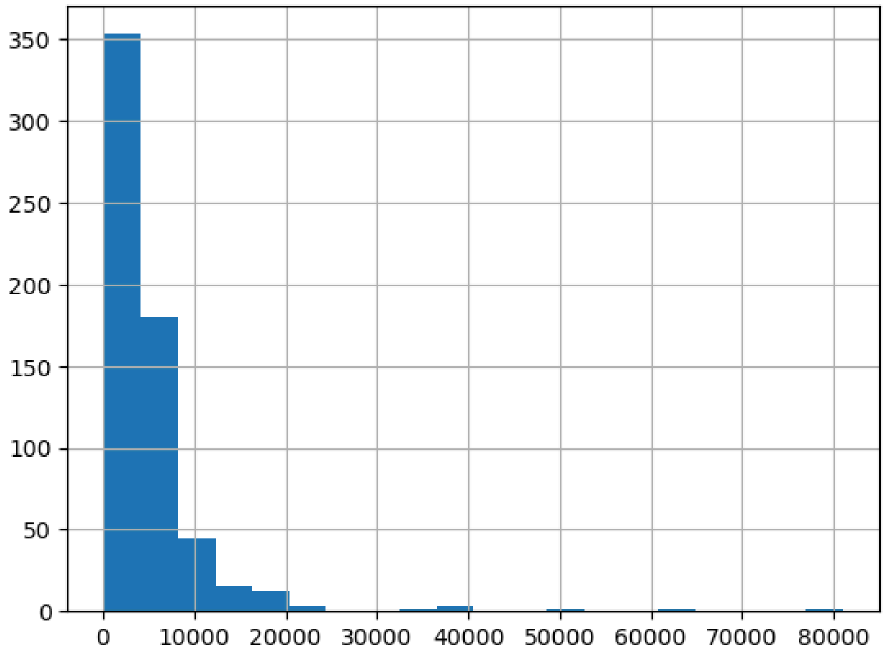
```
dataset.boxplot(column='ApplicantIncome')
```

```
<Axes: >
```



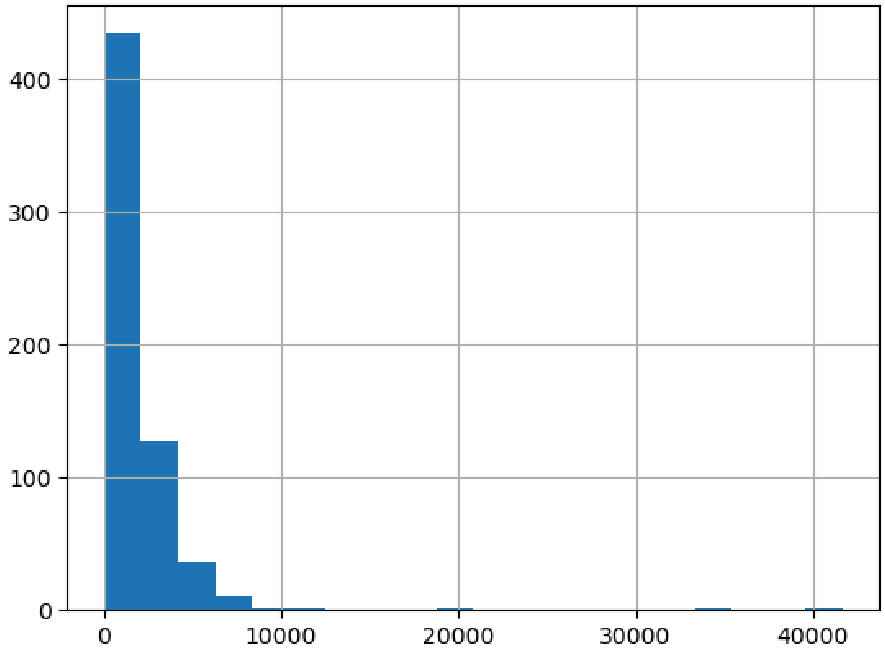
```
dataset['ApplicantIncome'].hist(bins=20)
```

```
<Axes: >
```



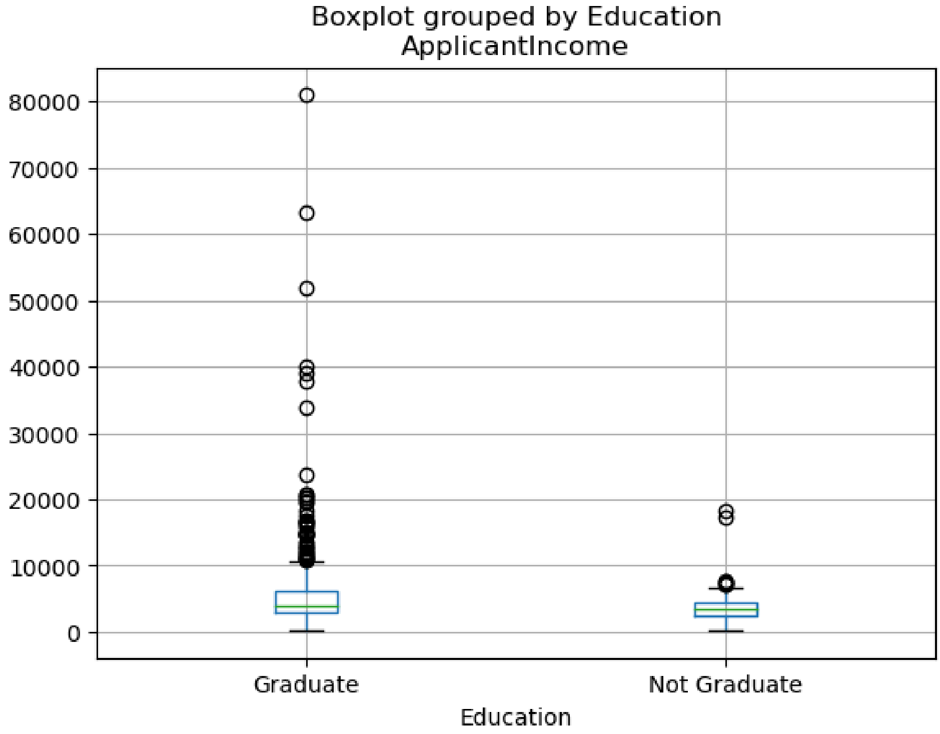
```
dataset['CoapplicantIncome'].hist(bins=20)
```

```
<Axes: >
```



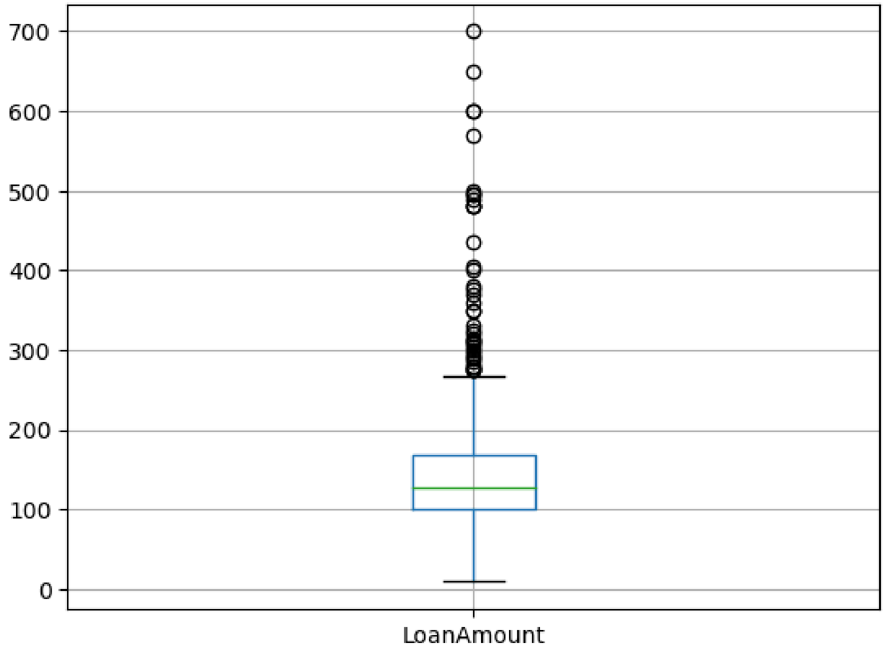
```
dataset.boxplot(column='ApplicantIncome', by= 'Education')
```

```
<Axes: title={'center': 'ApplicantIncome'}, xlabel='Education'>
```



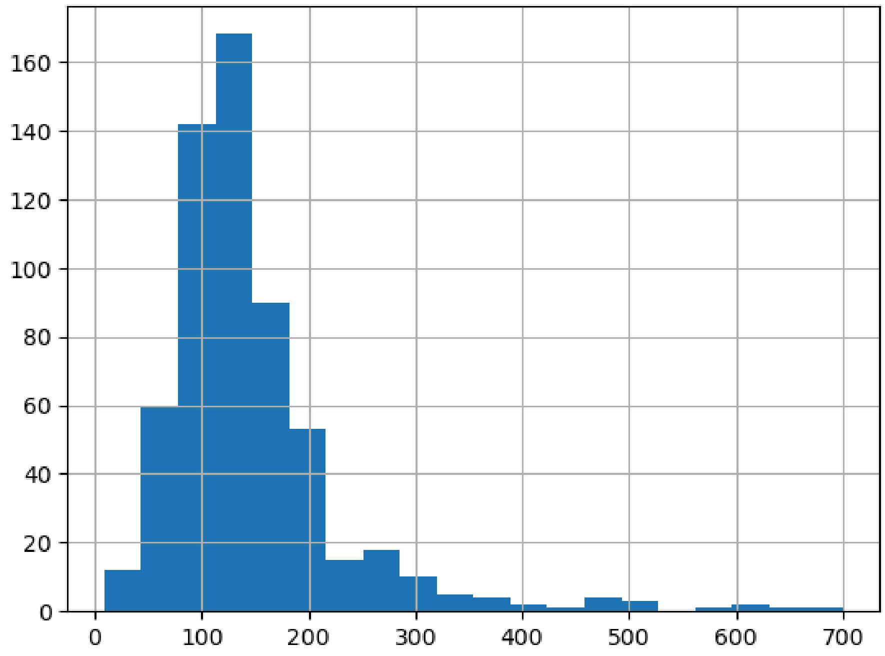
```
dataset.boxplot(column ='LoanAmount')
```

```
<Axes: >
```



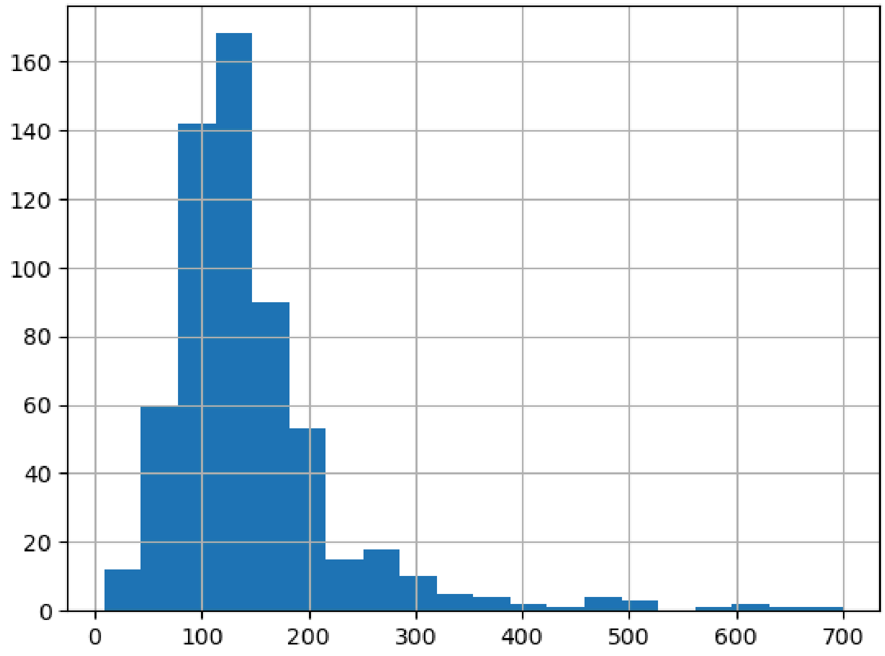
```
dataset['LoanAmount'].hist(bins=20)
```

```
<Axes: >
```



```
dataset['LoanAmount_log']=np.log(dataset['LoanAmount'])
dataset['LoanAmount'].hist(bins=20)
```

```
<Axes: >
```



```
dataset.isnull().sum()
```

```
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
```

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

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

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

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

```
dataset.LoanAmount = dataset.LoanAmount.fillna(dataset.LoanAmount.mean())
dataset.LoanAmount_log = dataset.LoanAmount_log.fillna(dataset.LoanAmount_log.mean())
```

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

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

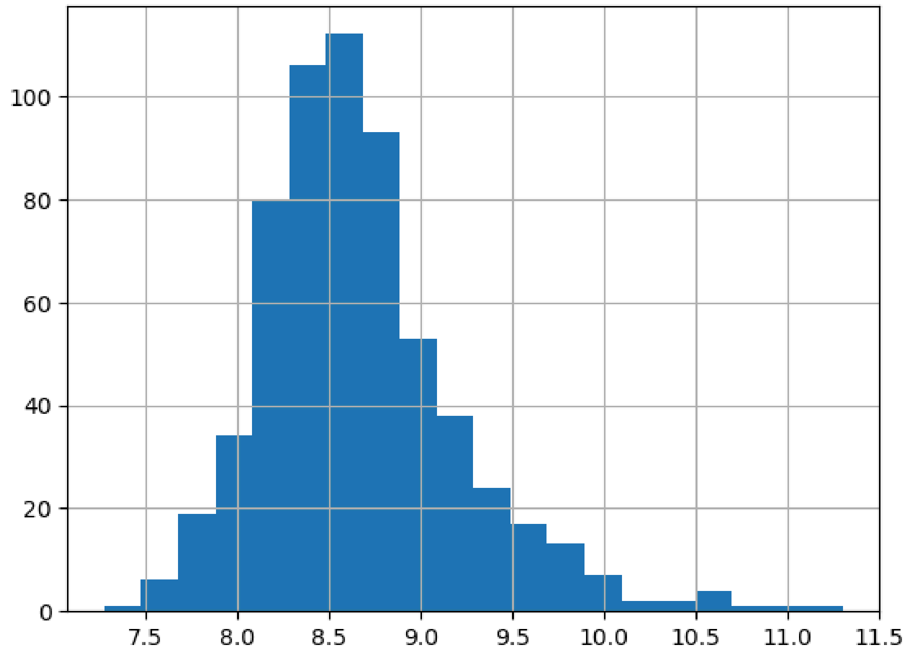
```
dataset.isnull().sum()
```

```
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
```

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

```
dataset['TotalIncome_log'].hist(bins=20)
```

```
<Axes: >
```



```
dataset.head()
```

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

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

```
x
```

```
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)
```

```
y
```

```
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', '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', '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', 'N', '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', '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', 'N', 'Y', '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)
```

```
from sklearn.model_selection import train_test_split

x_loantrain, x_loantest, y_loantrain, y_loantest = train_test_split(x, y, test_size=0.2, random_s
```

```
print(x_loantrain)
```

```
[['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]]
```

```
from sklearn.preprocessing import LabelEncoder
labelencoder_x = LabelEncoder()
```

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

```
x_loantrain[:,7]=labelencoder_x.fit_transform(x_loantrain[:,7])
```

```
x_loantrain
```

```
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)
```

```
labelencoder_y = LabelEncoder()
y_loantrain = labelencoder_y.fit_transform(y_loantrain)
```

```
y_loantrain
```

```
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, 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])
```

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

```
x_loantest[:,7]=labelencoder_x.fit_transform(x_loantest[:,7])
```

```
labelencoder_y = LabelEncoder()
y_loantest = labelencoder_y.fit_transform(y_loantest)
```

```
x_loantest
```

```
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, 4.6821312271242, 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],
```

```
y_loantest
```

```
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])
```

```
from sklearn.preprocessing import StandardScaler
ss = StandardScaler()
x_loantrain = ss.fit_transform(x_loantrain)
x_loantest = ss.fit_transform(x_loantest)
```

```
from sklearn.tree import DecisionTreeClassifier
DTClassifier = DecisionTreeClassifier(criterion = 'entropy', random_state = 0)
DTClassifier.fit(x_loantrain, y_loantrain)
```

```
▾                    DecisionTreeClassifier
DecisionTreeClassifier(criterion='entropy', random_state=0)
```

```
y_pred = DTClassifier.predict(x_loantest)
y_pred
```

```
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, 0, 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])
```

```
from sklearn import metrics
print('The accuracy of decision tree is: ', metrics.accuracy_score(y_pred,y_loantest))
```

```
The accuracy of decision tree is:  0.7073170731707317
```

```
from sklearn.naive_bayes import GaussianNB
NBClassifier = GaussianNB()
NBClassifier.fit(x_loantrain,y_loantrain)
```

```
▾ GaussianNB
GaussianNB()
```

```
y_pred = NBClassifier.predict(x_loantest)
```

```
y_pred
```

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

```
print('The accuracy of Naive Bayes is: ' ,metrics.accuracy_score(y_pred,y_loantest))
```

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

```
testdata = pd.read_csv("loantest.csv")
```

```
testdata.head()
```

	Unnamed: 0	Gender	Married	Dependents	Education	Self_Employed	ApplicantIncome	CoapplicantIn
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	

```
testdata.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 367 entries, 0 to 366
Data columns (total 12 columns):
 #   Column             Non-Null Count  Dtype  
---  ------             --------------  -----  
 0   Unnamed: 0         367 non-null    object 
 1   Gender             356 non-null    object 
 2   Married            367 non-null    object 
 3   Dependents         357 non-null    object 
 4   Education          367 non-null    object 
 5   Self_Employed      344 non-null    object 
 6   ApplicantIncome    367 non-null    int64  
 7   CoapplicantIncome  367 non-null    int64  
 8   LoanAmount         362 non-null    float64
 9   Loan_Amount_Term   361 non-null    float64
 10  Credit_History     338 non-null    float64
 11  Property_Area      367 non-null    object 
```

```
dtypes: float64(3), int64(2), object(7)
memory usage: 34.5+ KB
```

```
testdata.isnull().sum()
```

```
Unnamed: 0            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
```

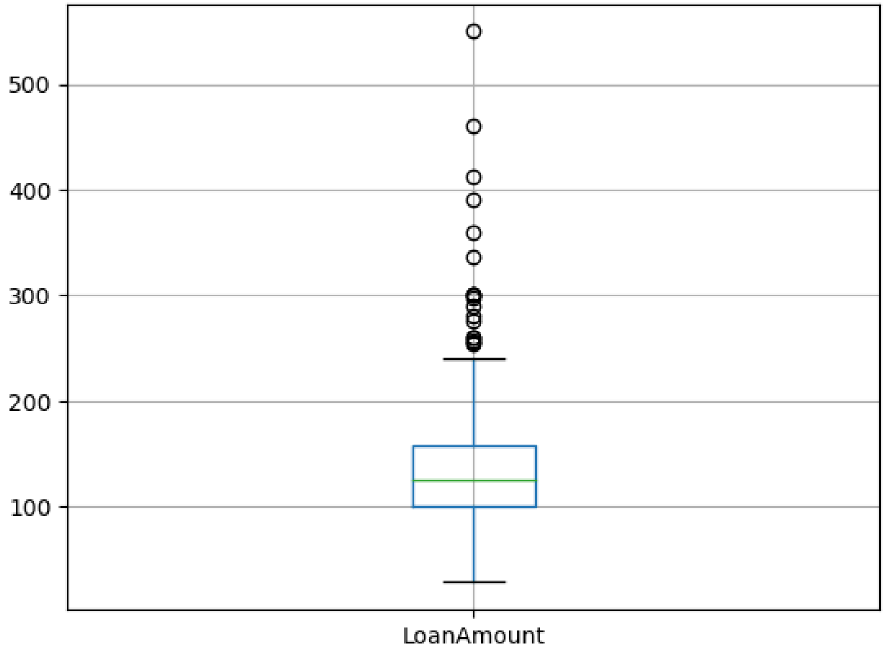
```
testdata['Gender'].fillna(testdata['Gender'].mode()[0],inplace=True)
testdata['Dependents'].fillna(testdata['Dependents'].mode()[0],inplace=True)
testdata['Self_Employed'].fillna(testdata['Self_Employed'].mode()[0],inplace=True)
testdata['Loan_Amount_Term'].fillna(testdata['Loan_Amount_Term'].mode()[0],inplace=True)
testdata['Credit_History'].fillna(testdata['Credit_History'].mode()[0],inplace=True)
```

```
testdata.isnull().sum()
```

```
Unnamed: 0           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
```

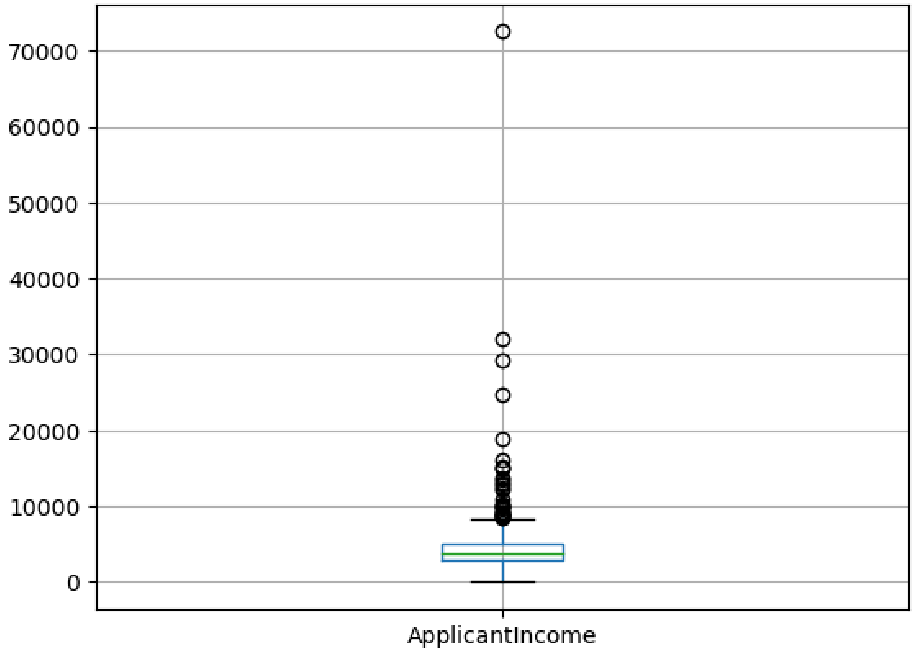
```
testdata.boxplot(column='LoanAmount')
```

```
<Axes: >
```



```
testdata.boxplot(column='ApplicantIncome')
```

```
<Axes: >
```



```
testdata.LoanAmount = testdata.LoanAmount.fillna(testdata.LoanAmount.mean())
```

```
testdata['LoanAmount_log']=np.log(testdata['LoanAmount'])
```

```
testdata.isnull().sum()
```

```
Unnamed: 0           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
```

```
testdata['TotalIncome'] = testdata['ApplicantIncome'] + testdata['CoapplicantIncome']
```

```
testdata['TotalIncome_log'] = np.log(testdata['TotalIncome'])
```

```
testdata.head()
```

	Unnamed: 0	Gender	Married	Dependents	Education	Self_Employed	ApplicantIncome	CoapplicantIn
1	LP001022	Male	Yes	1	Graduate	No	3076	
3	LP001035	Male	Yes	2	Graduate	No	2340	
					Graduate			

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

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

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