Import require libraries function

In [1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn import svm
```

Loding dataset

In [2]:
```
dataset = pd.read_excel(r"C:\Users\shank\Downloads\Copy of loan.xlsx",sheet_name="loan")
```

Printing the first five rows of the DataFrame

In [3]:
```
dataset.head()
```

Out[3]:

	Loan_ID	Gender	Married	Dependents	Education	Self_Employed	ApplicantIncome	CoapplicantIncome	Lo
0	LP001002	Male	No	0	Graduate	No	5849	0.0	
1	LP001003	Male	Yes	1	Graduate	No	4583	1508.0	
2	LP001005	Male	Yes	0	Graduate	Yes	3000	0.0	
3	LP001006	Male	Yes	0	Not Graduate	No	2583	2358.0	
4	LP001008	Male	No	0	Graduate	No	6000	0.0	

Dataset size checking

In [4]:
```
dataset.shape
```

Out[4]:
```
(614, 13)
```

Summary information about dataset

In [5]:
```
dataset.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 614 entries, 0 to 613
Data columns (total 13 columns):
 #   Column             Non-Null Count  Dtype  
---  ------             --------------  -----  
 0   Loan_ID            614 non-null    object 
 1   Gender             601 non-null    object 
 2   Married            611 non-null    object 
 3   Dependents         599 non-null    object 
 4   Education          614 non-null    object 
 5   Self_Employed      582 non-null    object 
 6   ApplicantIncome    614 non-null    int64  
 7   CoapplicantIncome  614 non-null    float64
 8   LoanAmount         592 non-null    float64
 9   Loan_Amount_Term   600 non-null    float64
 10  Credit_History     564 non-null    float64
 11  Property_Area      614 non-null    object 
 12  Loan_Status        614 non-null    object 
dtypes: float64(4), int64(1), object(8)
memory usage: 62.5+ KB
```

Five-number summary

In [6]:
```
dataset.describe()
```

Out[6]:

	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

Checking duplicate values

In [7]:
```
dataset.duplicated().sum()
```

Out[7]:
```
0
```

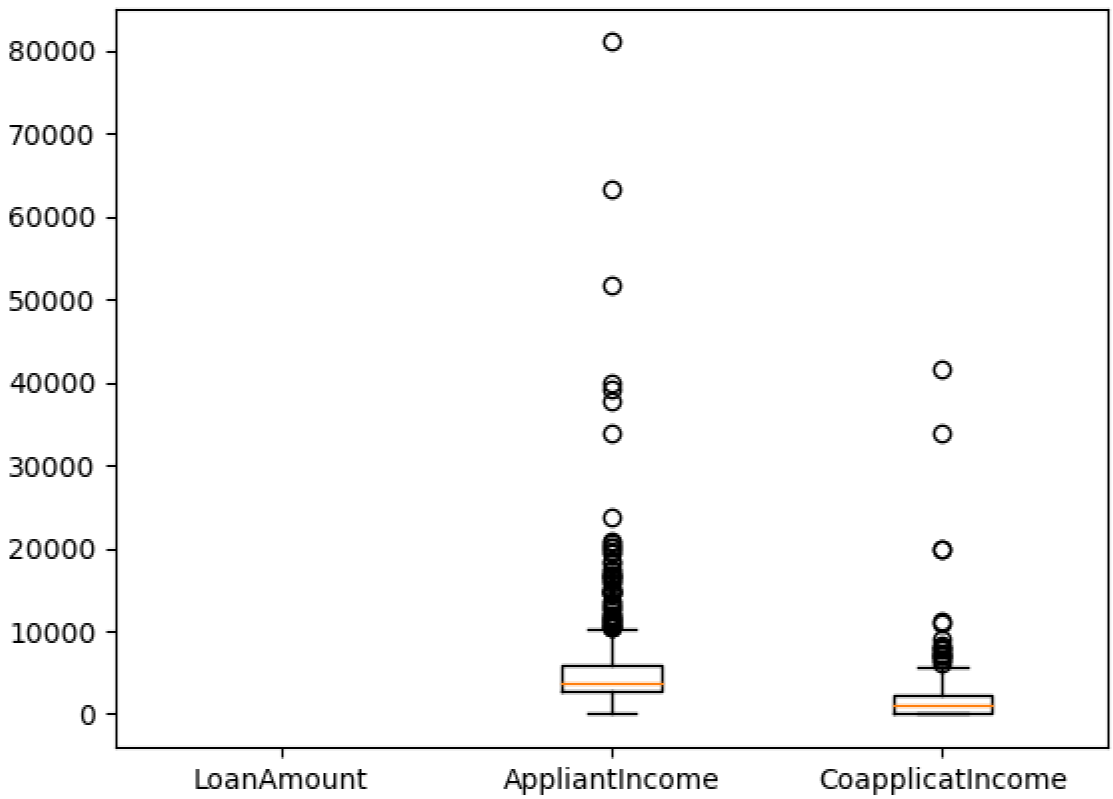
Number of missing values in each columns

In [8]:
```
dataset.isnull().sum()
```

Out[8]:
```
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
dtype: int64
```

Outliers checking

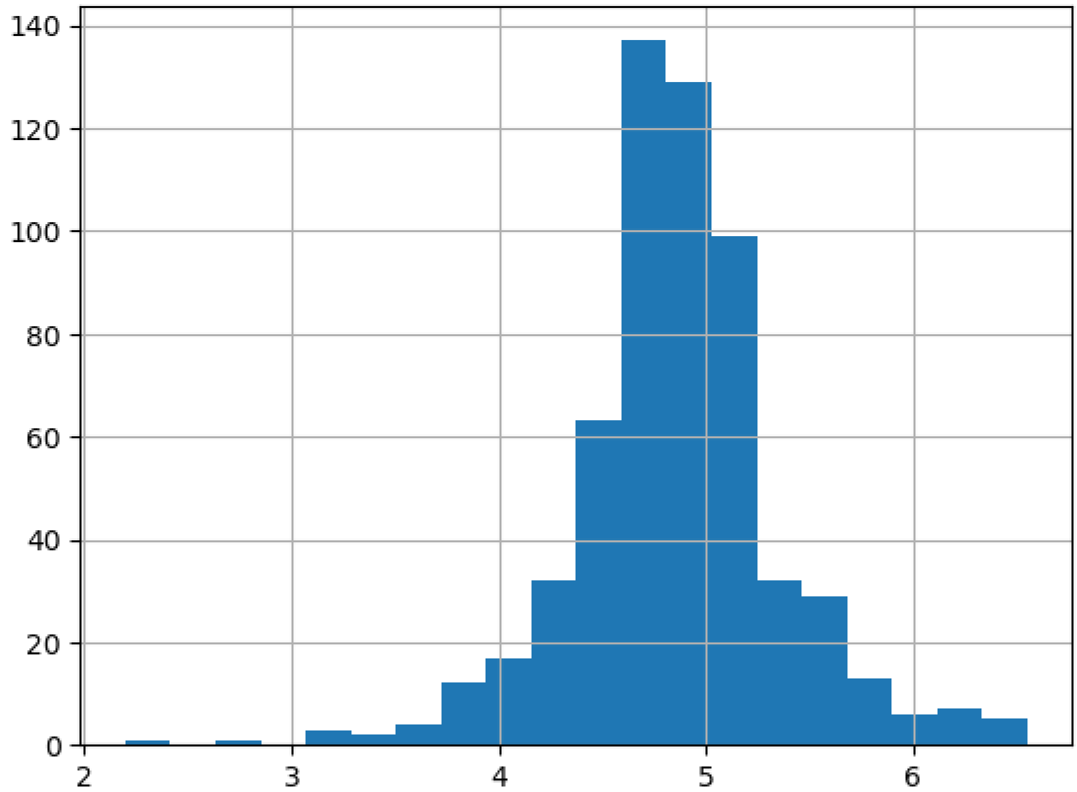
In [9]:
```
plt.boxplot([dataset['LoanAmount'],dataset['ApplicantIncome'],dataset['CoapplicantIncome
plt.xticks([1,2,3],['LoanAmount','AppliantIncome','CoapplicatIncome'])
plt.show()
```



Plotting histogram on LoanAmount column

In [10]:
```
dataset['LoanAmount_log']=np.log(dataset['LoanAmount'])
dataset['LoanAmount_log'].hist(bins=20)
```

Out[10]: <Axes: >



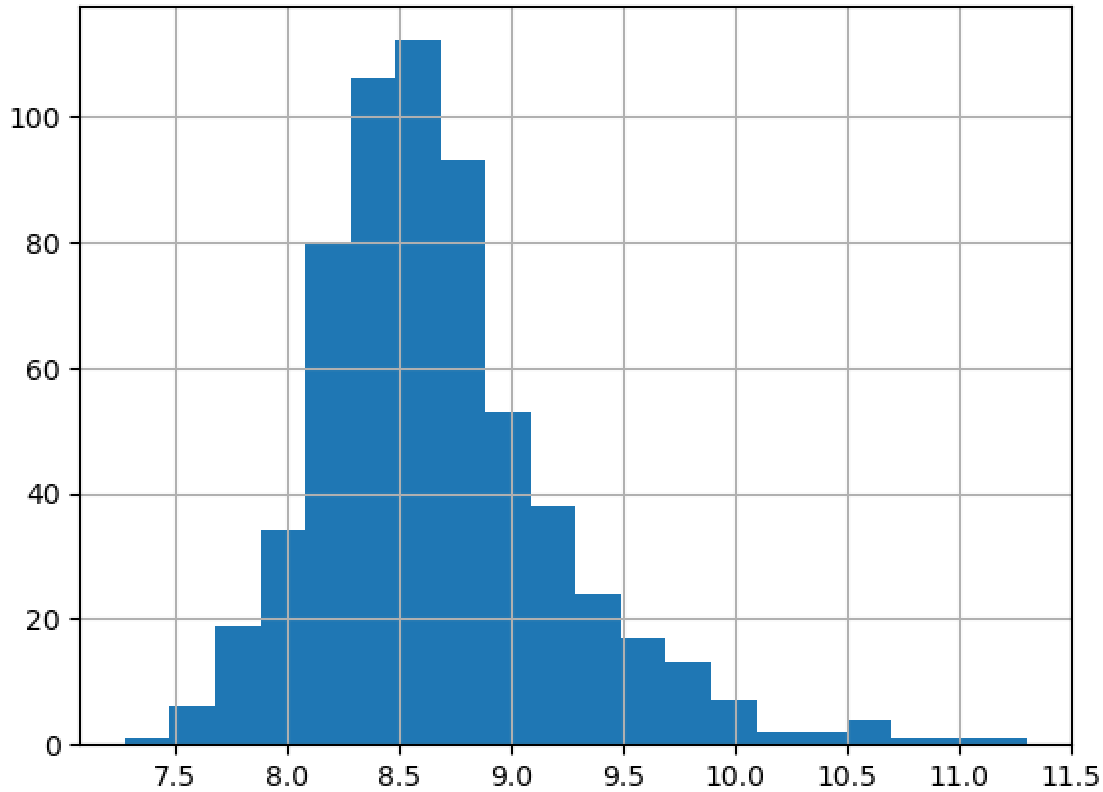
In [11]:
```
dataset.isnull().sum()
```

Out[11]:
```
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
```

In [11]:
```
dataset['Totalincome']=dataset['ApplicantIncome']+dataset['CoapplicantIncome']
dataset['Totalincome_log']=np.log(dataset['Totalincome'])
dataset['Totalincome_log'].hist(bins=20)
```

Out[11]:
```
<Axes: >
```

Loading [MathJax]/extensions/Safe.js



Replacing null values with mode and mean

In [12]:
```
dataset['Gender'].fillna(dataset['Gender'].mode()[0],inplace=True)
dataset['Married'].fillna(dataset['Married'].mode()[0],inplace=True)
dataset['Self_Employed'].fillna(dataset['Self_Employed'].mode()[0],inplace=True)
dataset['Dependents'].fillna(dataset['Dependents'].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()
```

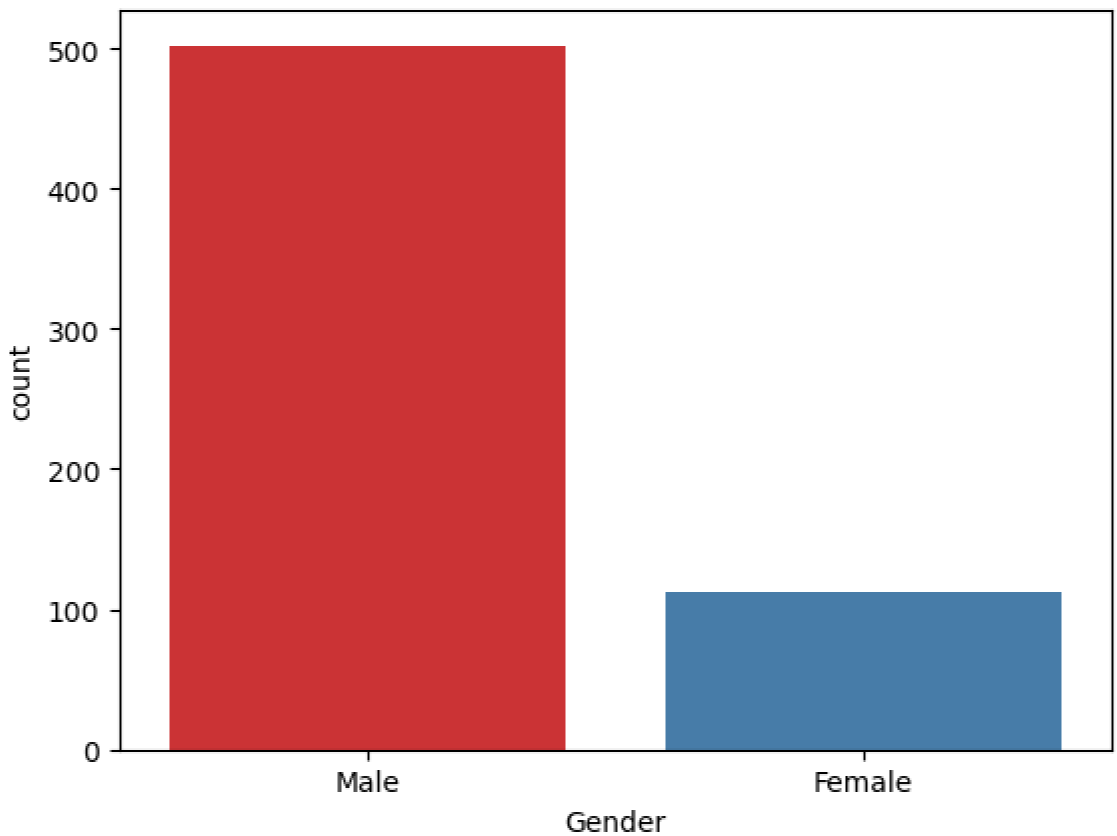
Out[12]:
```
Loan_ID              0
Gender               0
Married              0
Dependents           0
Education            0
Self_Employed        0
ApplicantIncome      0
CoapplicantIncome    0
LoanAmount           0
Loan_Amount_Term     0
Credit_History       0
Property_Area        0
Loan_Status          0
LoanAmount_log       0
Totalincome          0
Totalincome_log      0
dtype: int64
```

Number of people who takes loan as group by gender

In [13]:
```
print("Number of people who takes loan as group by gender: ")
print(dataset['Gender'].value_counts())
sns.countplot(data=dataset,x="Gender",palette= 'Set1')
```

```
Number of people who takes loan as group by gender:
Male      502
Female    112
Name: Gender, dtype: int64
```

Out[13]:
```
<Axes: xlabel='Gender', ylabel='count'>
```

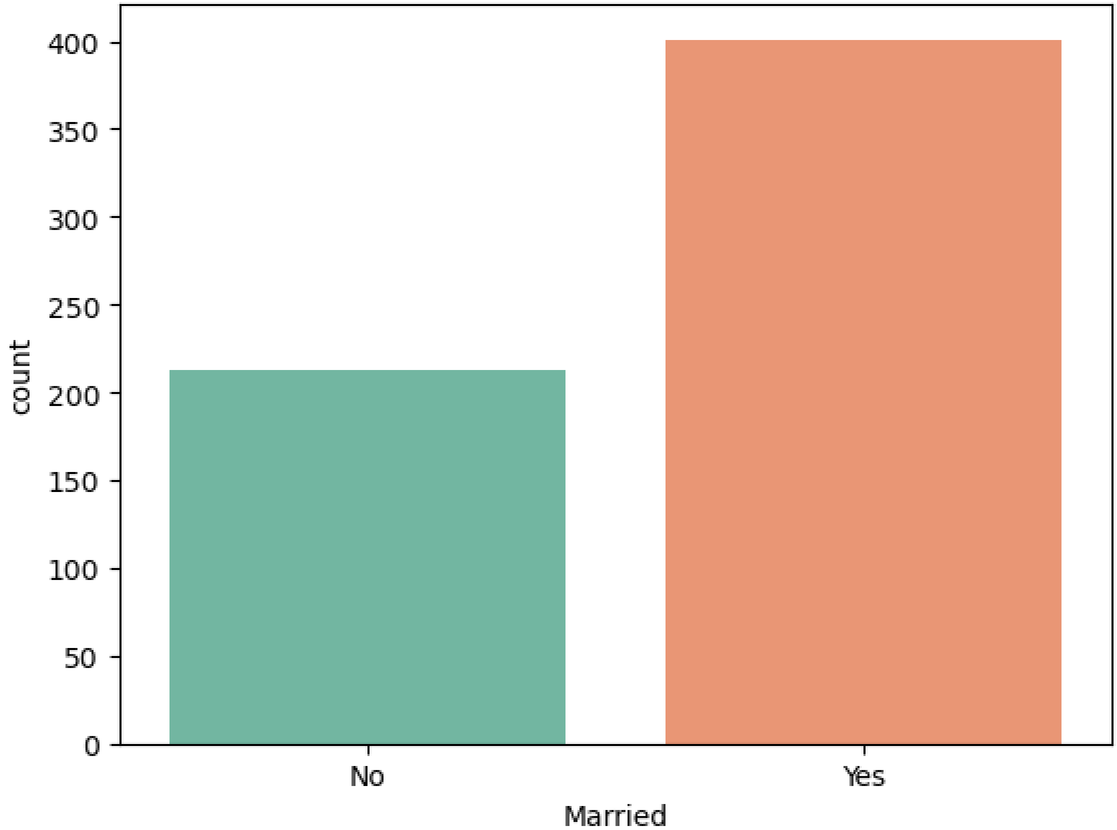


Number of people who takes loan as group by marital status

In [14]:
```
print("Number of people who takes loan as group by marital status: ")
print(dataset['Married'].value_counts())
sns.countplot(data=dataset,x="Married",palette= 'Set2')
```

```
Number of people who takes loan as group by marital status:
Yes    401
No     213
Name: Married, dtype: int64
```

Out[14]:
```
<Axes: xlabel='Married', ylabel='count'>
```



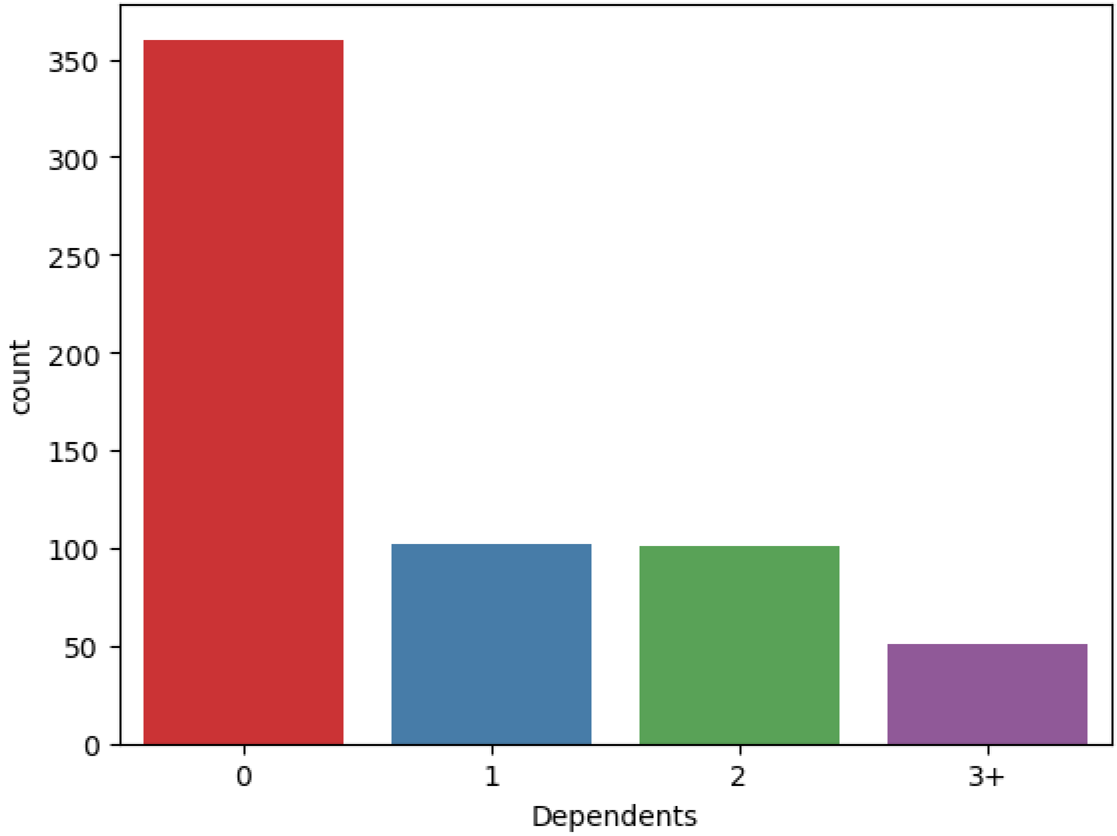
Number of people who takes loan as group by Dependents

In [15]:
```
print("Number of people who takes loan as group by Dependents: ")
print(dataset['Dependents'].value_counts())
sns.countplot(data=dataset,x="Dependents",palette= 'Set1')
```

```
Number of people who takes loan as group by Dependents:
0     360
1     102
2     101
3+     51
Name: Dependents, dtype: int64
```

Out[15]:
```
<Axes: xlabel='Dependents', ylabel='count'>
```

Loading [MathJax]/extensions/Safe.js

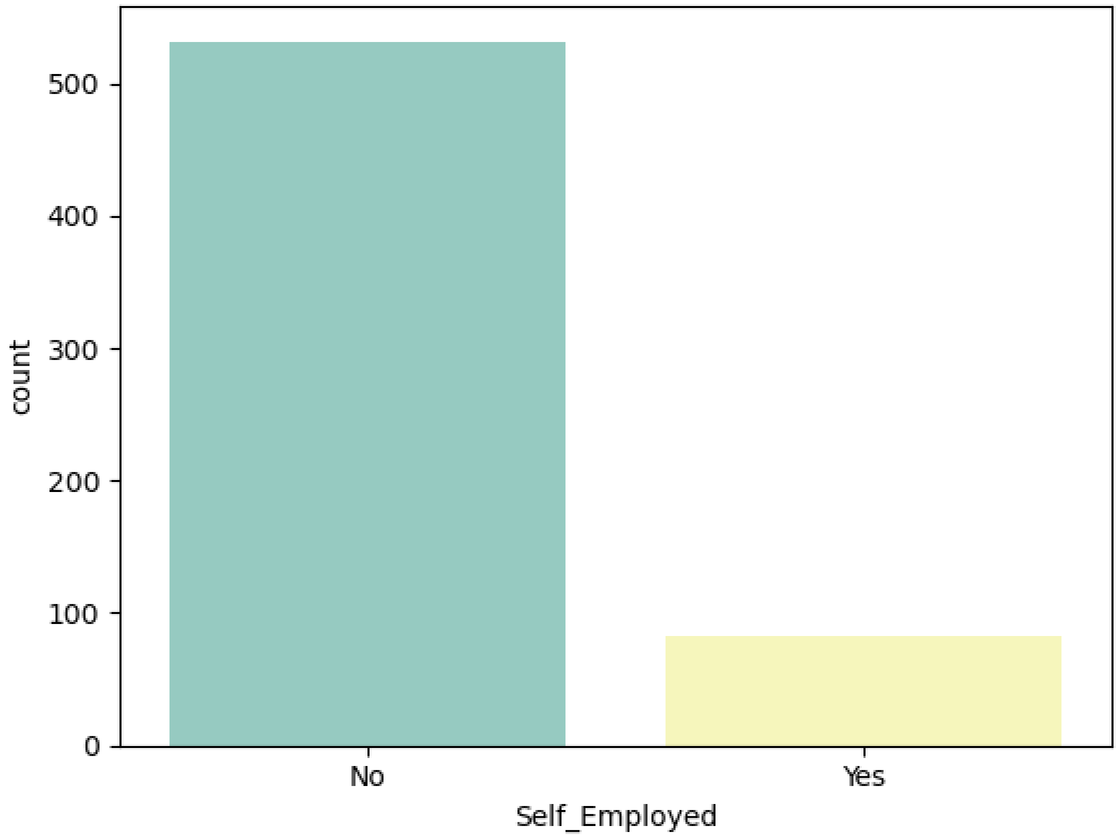


Number of people who takes loan as group by Self_Employed

In [16]:
```
print("Number of people who takes loan as group by Self_Employed: ")
print(dataset['Self_Employed'].value_counts())
sns.countplot(data=dataset,x="Self_Employed",palette= 'Set3')
```

```
Number of people who takes loan as group by Self_Employed:
No     532
Yes     82
Name: Self_Employed, dtype: int64
```

Out[16]:
```
<Axes: xlabel='Self_Employed', ylabel='count'>
```



Number of people who takes loan as group by LoanAmount

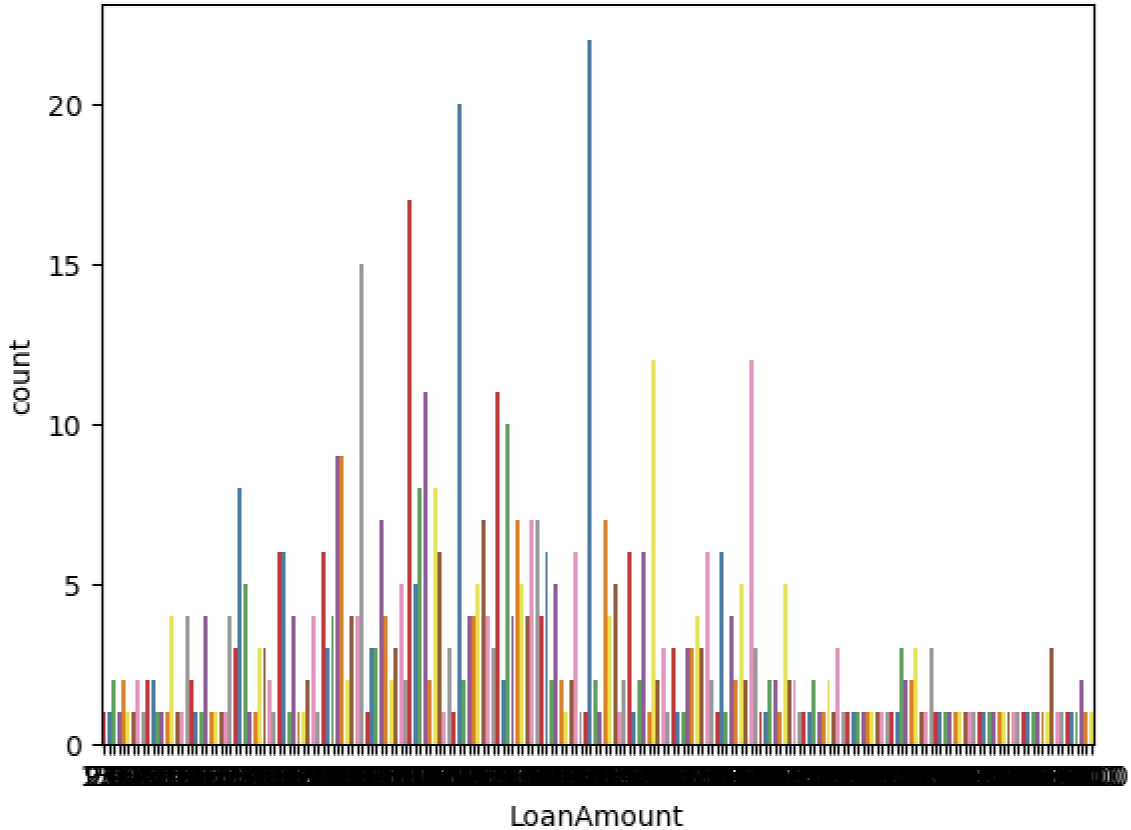
In [17]:

```
print("Number of people who takes loan as group by LoanAmount: ")
print(dataset['LoanAmount'].value_counts())
sns.countplot(data=dataset,x="LoanAmount",palette= 'Set1')
```

```
Number of people who takes loan as group by LoanAmount:
146.412162    22
120.000000    20
110.000000    17
100.000000    15
160.000000    12
              ..
240.000000     1
214.000000     1
59.000000      1
166.000000     1
253.000000     1
Name: LoanAmount, Length: 204, dtype: int64
```

Out[17]:

```
<Axes: xlabel='LoanAmount', ylabel='count'>
```

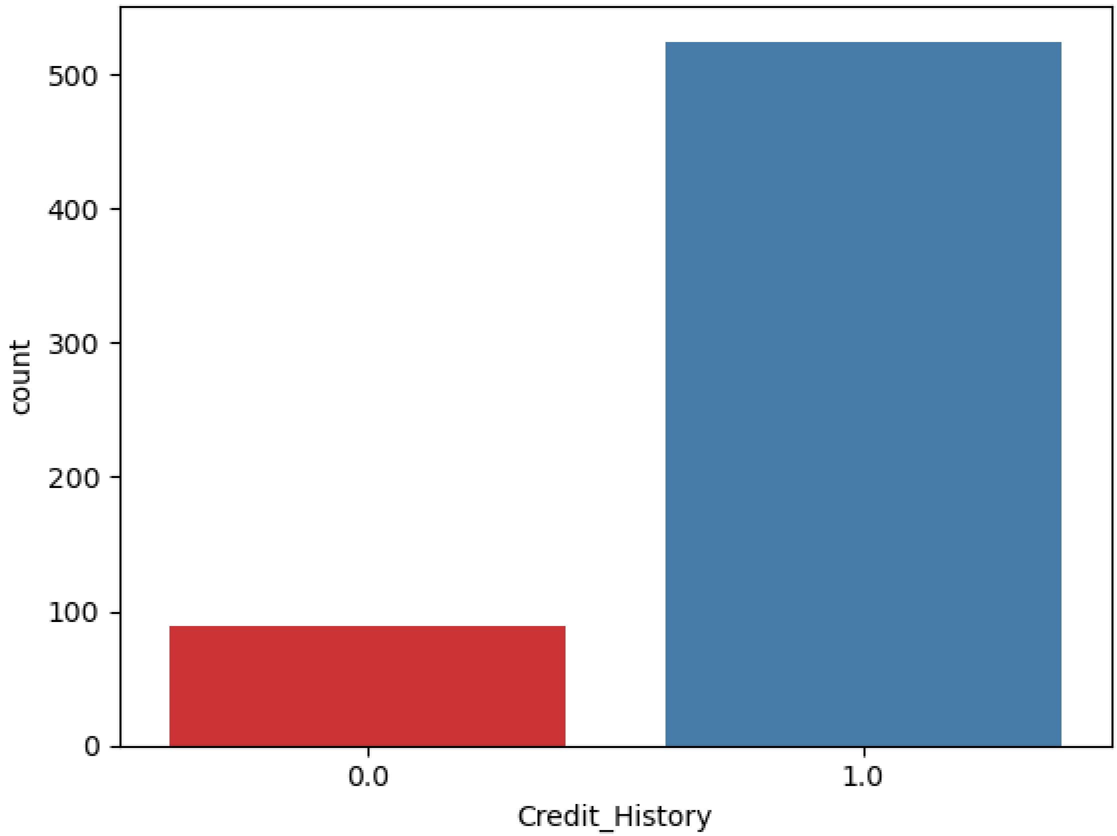


Number of people who takes loan as group by Credit_History

In [18]:
```
print("Number of people who takes loan as group by Credit_History: ")
print(dataset['Credit_History'].value_counts())
sns.countplot(data=dataset,x="Credit_History",palette= 'Set1')
```

```
Number of people who takes loan as group by Credit_History:
1.0    525
0.0     89
Name: Credit_History, dtype: int64
```

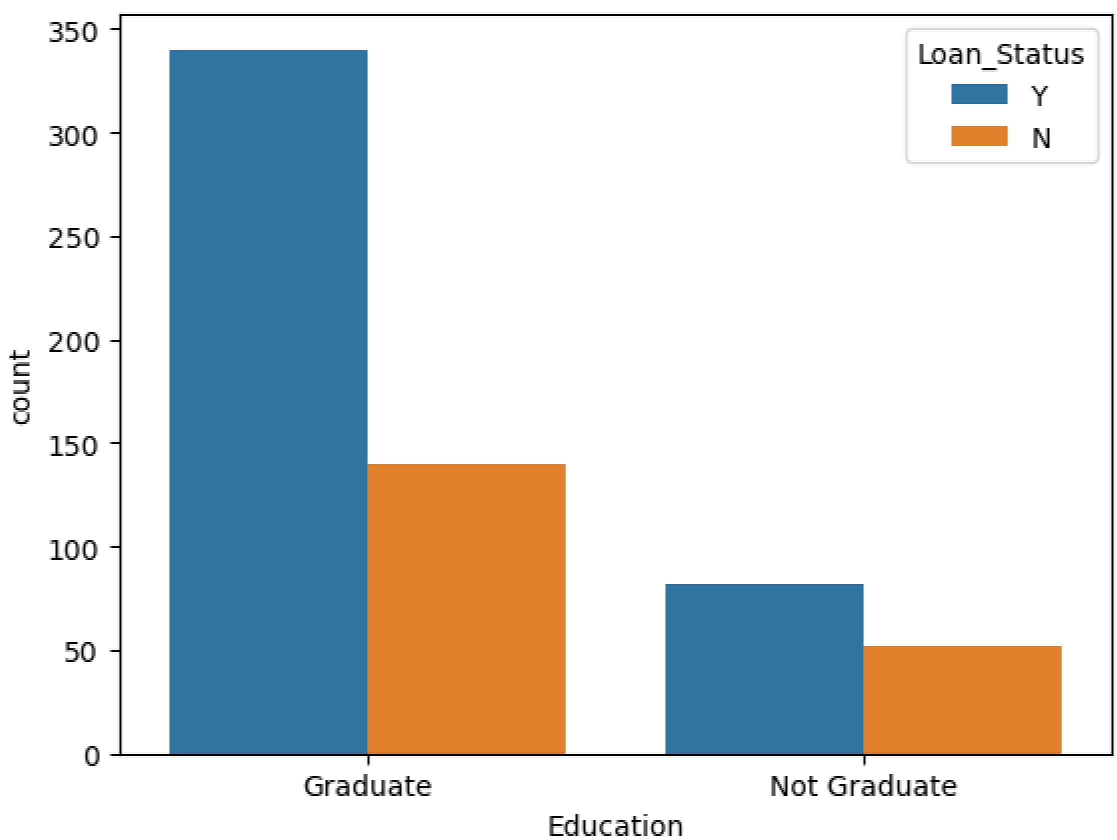
Out[18]:
```
<Axes: xlabel='Credit_History', ylabel='count'>
```



Education vs Loan_Status

In [19]:
```
sns.countplot(data=dataset,x="Education",hue="Loan_Status")
```

Out[19]:
```
<Axes: xlabel='Education', ylabel='count'>
```

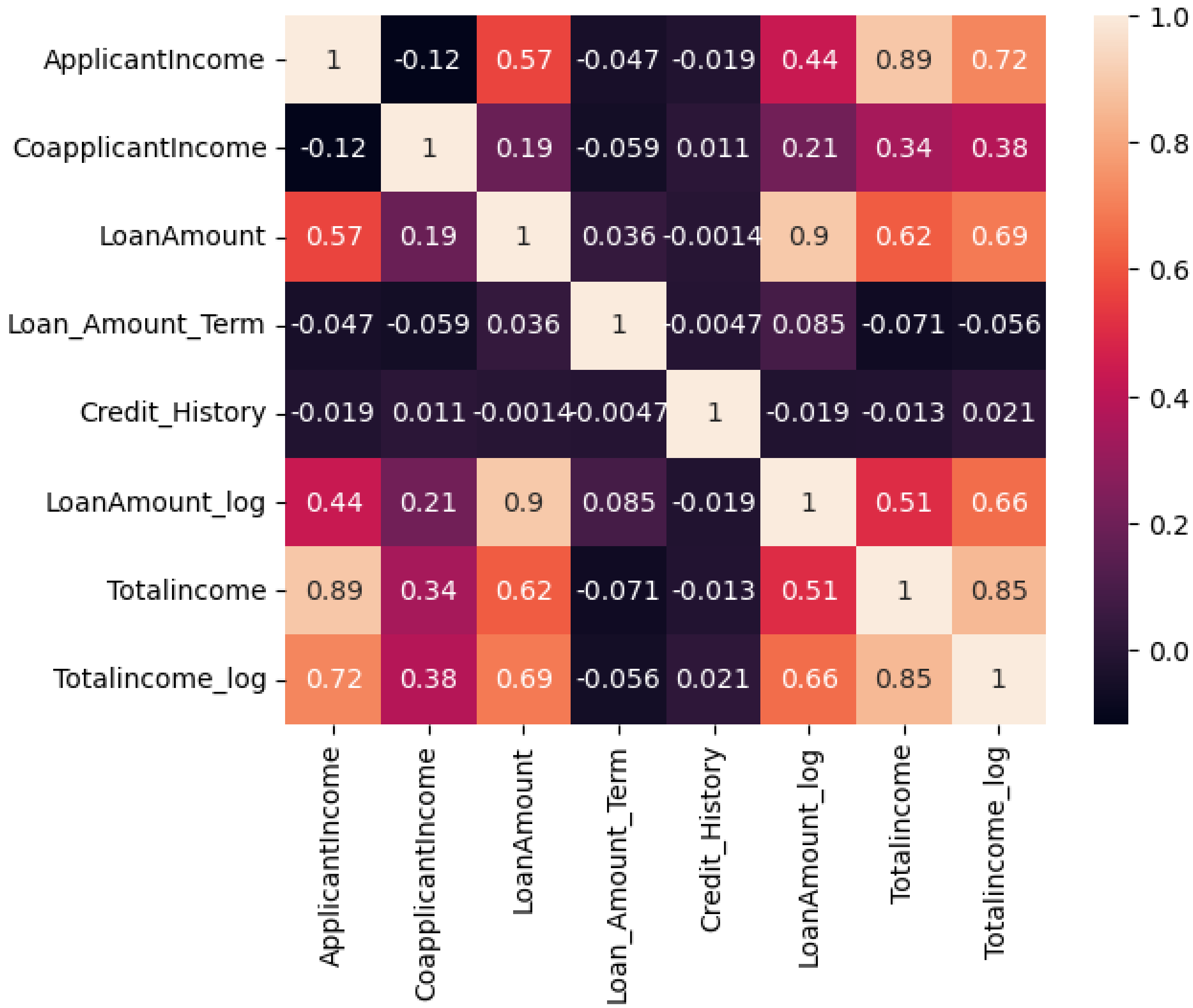


Correlation matrix

In [20]:
```
sns.heatmap(dataset.corr(),annot=True)
```

```
C:\Users\shank\AppData\Local\Temp\ipykernel_22232\3387572453.py:1: FutureWarning: The de
fault value of numeric_only in DataFrame.corr is deprecated. In a future version, it wil
l default to False. Select only valid columns or specify the value of numeric_only to si
lence this warning.
  sns.heatmap(dataset.corr(),annot=True)
```

Out[20]: <Axes: >



Using Lebel encoding for convert categorical to numerical data

In [21]:
```
dataset.replace({"Loan_Status":{'N':0,'Y':1}},inplace=True)
```

In [22]:
```
dataset.head(3)
```

Out[22]:

	Loan_ID	Gender	Married	Dependents	Education	Self_Employed	ApplicantIncome	CoapplicantIncome	Lo
0	LP001002	Male	No	0	Graduate	No	5849	0.0	
1	LP001003	Male	Yes	1	Graduate	No	4583	1508.0	
2	LP001005	Male	Yes	0	Graduate	Yes	3000	0.0	

In [23]:
```
dataset['Dependents'].value_counts()
```
Out[23]:
```
0     360
1     102
2     101
3+     51
Name: Dependents, dtype: int64
```
In [24]:
```
dataset['Dependents']=dataset['Dependents'].replace("3+",4)
```
In [25]:
```
dataset['Dependents'].value_counts()
```
Out[25]:
```
0    360
1    102
2    101
4     51
Name: Dependents, dtype: int64
```
In [26]:
```
dataset.replace({'Gender':{'Male':1,'Female':0},'Married':{'No':0,'Yes':1},'Education':{
                'Self_Employed':{'No':0,'Yes':1},'Property_Area':{'Rural':0,'Semiurban':
```

Printing first five rows after encoded

In [27]:
```
dataset.head()
```
Out[27]:

	Loan_ID	Gender	Married	Dependents	Education	Self_Employed	ApplicantIncome	CoapplicantIncome	Lo
0	LP001002	1	0	0	1	0	5849	0.0	
1	LP001003	1	1	1	1	0	4583	1508.0	
2	LP001005	1	1	0	1	1	3000	0.0	
3	LP001006	1	1	0	0	0	2583	2358.0	
4	LP001008	1	0	0	1	0	6000	0.0	

Separating dependent variable and independent variables

In [28]:
```
x = dataset.drop(columns=['Loan_ID','Loan_Status'],axis=1)
y = dataset['Loan_Status']
```

Printing first five rows of independent variables

In [29]:
```
x.head()
```

Out[29]:

	Gender	Married	Dependents	Education	Self_Employed	ApplicantIncome	CoapplicantIncome	LoanAmount
0	1	0	0	1	0	5849	0.0	146.412162
1	1	1	1	1	0	4583	1508.0	128.000000
2	1	1	0	1	1	3000	0.0	66.000000
3	1	1	0	0	0	2583	2358.0	120.000000
4	1	0	0	1	0	6000	0.0	141.000000

Printing first five rows of dependent variable

In [30]:
```
y.head()
```

Out[30]:
```
0    1
1    0
2    1
3    1
4    1
Name: Loan_Status, dtype: int64
```

Splitting train and test date

In [31]:
```
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
```

Standardizing train and test data

In [32]:
```
from sklearn.preprocessing import StandardScaler
ss = StandardScaler()

x_train = ss.fit_transform(x_train)
x_test = ss.fit_transform(x_test)
```

Prediction using classification algorithms

Applying RandomForestClassifier

In [33]:
```
from sklearn.ensemble import RandomForestClassifier
rf_clf = RandomForestClassifier()
rf_clf.fit(x_train, y_train)
```

Out[33]:
```
▼ RandomForestClassifier
RandomForestClassifier()
```

Accuracy score & Y_prediction

Loading [MathJax]/extensions/Safe.js

In [34]:
```
from sklearn import metrics
y_predict = rf_clf.predict(x_test)
print("Accuracy of random forest clf is: ", metrics.accuracy_score(y_predict,y_test))
y_predict
```

```
Accuracy of random forest clf is:  0.8130081300813008
```

Out[34]:
```
array([1, 1, 1, 1, 1, 0, 1, 1, 0, 1, 1, 0, 1, 1, 1, 1, 0, 1, 0, 0, 0, 1,
       1, 1, 1, 1, 1, 1, 0, 0, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 0, 0, 1,
       1, 0, 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, 0, 1, 1, 1, 1, 1, 0, 1, 0, 1, 1, 1, 1, 0, 1, 1, 1,
       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, 1, 0, 0, 1, 1, 1, 1, 1, 0, 0], dtype=int64)
```

Applying LogisticsRegression

In [35]:
```
from sklearn.linear_model import LogisticRegression
lg_reg = LogisticRegression()
lg_reg.fit(x_train,y_train)
```

Out[35]:
```
▼ LogisticRegression
LogisticRegression()
```

In [36]:
```
from sklearn import metrics
y_predict = lg_reg.predict(x_test)
print("Accuracy of logistics reg is: ", metrics.accuracy_score(y_predict,y_test))
y_predict
```

```
Accuracy of logistics reg is:  0.8373983739837398
```

Out[36]:
```
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, 0, 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], dtype=int64)
```

Applying DecisionTreeClassifier

In [37]:
```
from sklearn.tree import DecisionTreeClassifier
de_clf = DecisionTreeClassifier()
de_clf.fit(x_train, y_train)
```

Out[37]:
```
▼ DecisionTreeClassifier
DecisionTreeClassifier()
```

In [38]:
```
from sklearn import metrics
y_predict = de_clf.predict(x_test)
print("Accuracy of decisiontree clf is: ", metrics.accuracy_score(y_predict,y_test))
y_predict
```

```
Accuracy of decisiontree clf is:  0.5934959349593496
```

```
Out[38]: array([1, 1, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 1, 1, 1, 1, 0, 1, 1, 0, 0, 1,
                0, 1, 0, 1, 1, 1, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0, 0, 1,
                1, 1, 0, 1, 1, 1, 0, 1, 0, 1, 1, 0, 1, 1, 1, 1, 0, 1, 1, 0, 1, 1,
                1, 0, 0, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 0, 0, 1, 1,
                0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0,
                1, 0, 0, 1, 0, 0, 1, 1, 1, 1, 0, 0, 0], dtype=int64)
```