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

```
In [2]: df = pd.read_csv("D:\data science\Data scientist\Projects\Project 2\loan_data.
```

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

Out[3]:

	Loan_ID	Gender	Married	Dependents	Education	Self_Employed	ApplicantIncome	Coappl
0	LP001003	Male	Yes	1	Graduate	No	4583	
1	LP001005	Male	Yes	0	Graduate	Yes	3000	
2	LP001006	Male	Yes	0	Not Graduate	No	2583	
3	LP001008	Male	No	0	Graduate	No	6000	
4	LP001013	Male	Yes	0	Not Graduate	No	2333	

Data cleaning

```
In [4]: # loan ID is not required
        df = df.drop('Loan_ID',axis = 1)
```

```
In [5]: df.columns
```

```
Out[5]: Index(['Gender', 'Married', 'Dependents', 'Education', 'Self_Employed',
               'ApplicantIncome', 'CoapplicantIncome', 'LoanAmount',
               'Loan_Amount_Term', 'Credit_History', 'Property_Area', 'Loan_Status'],
              dtype='object')
```

```
In [6]: df.shape
```

```
Out[6]: (381, 12)
```

In [7]:

```
#Checking for missing data
df.isnull().sum()
```

Out[7]:

```
Gender                5
Married               0
Dependents            8
Education             0
Self_Employed        21
ApplicantIncome       0
CoapplicantIncome     0
LoanAmount            0
Loan_Amount_Term     11
Credit_History       30
Property_Area         0
Loan_Status           0
dtype: int64
```

In [8]:

```
df[df.isnull()]
```

Out[8]:

	Gender	Married	Dependents	Education	Self_Employed	ApplicantIncome	CoapplicantInco
0	NaN	NaN	NaN	NaN	NaN	NaN	N
1	NaN	NaN	NaN	NaN	NaN	NaN	N
2	NaN	NaN	NaN	NaN	NaN	NaN	N
3	NaN	NaN	NaN	NaN	NaN	NaN	N
4	NaN	NaN	NaN	NaN	NaN	NaN	N
...	...	...	...	...	...	...	
376	NaN	NaN	NaN	NaN	NaN	NaN	N
377	NaN	NaN	NaN	NaN	NaN	NaN	N
378	NaN	NaN	NaN	NaN	NaN	NaN	N
379	NaN	NaN	NaN	NaN	NaN	NaN	N
380	NaN	NaN	NaN	NaN	NaN	NaN	N

381 rows × 12 columns

In [9]:

```
#Dropped all missing data
df = df.dropna()
```

In [10]:

```
df.shape
```

Out[10]:

```
(308, 12)
```

In [11]:

```
df.duplicated().sum()
```

Out[11]:

```
0
```

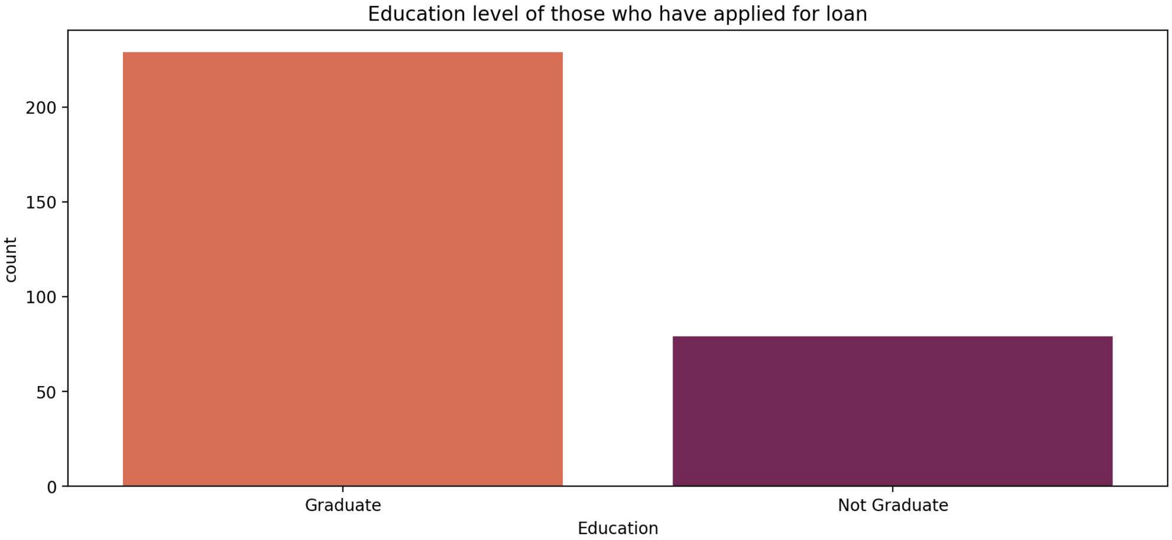
EDA and Data Visualization

In [12]:

```
plt.figure(figsize = (12,5),dpi = 200)
sns.countplot(data = df,x = "Education",palette="rocket_r",)
plt.title("Education level of those who have applied for loan")
```

Out[12]:

```
Text(0.5, 1.0, 'Education level of those who have applied for loan')
```

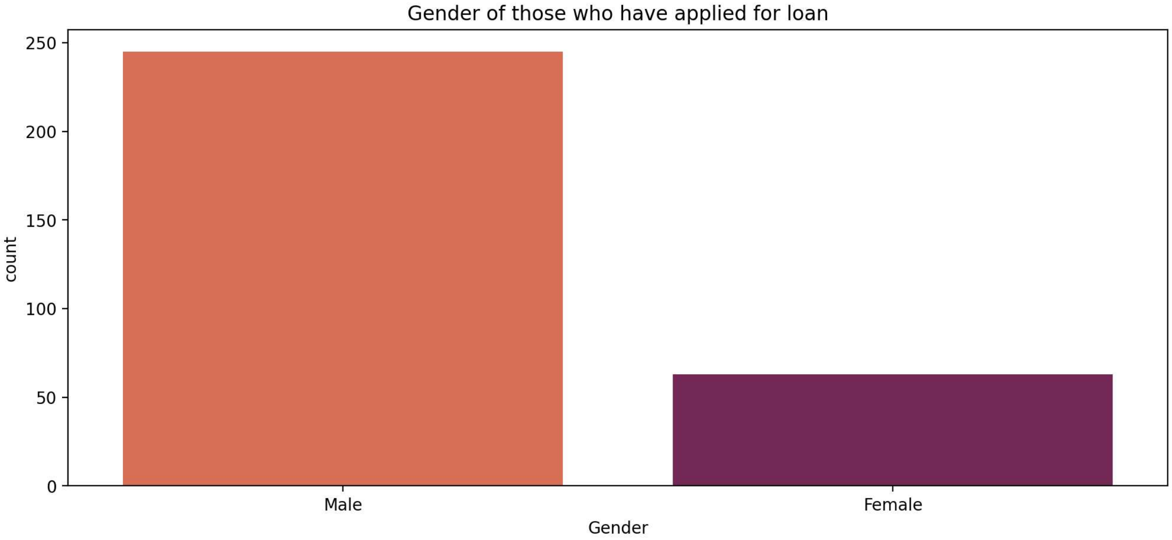


In [13]:

```
plt.figure(figsize = (12,5),dpi = 200)
sns.countplot(data = df,x = "Gender",palette="rocket_r",)
plt.title("Gender of those who have applied for loan")
```

Out[13]:

```
Text(0.5, 1.0, 'Gender of those who have applied for loan')
```

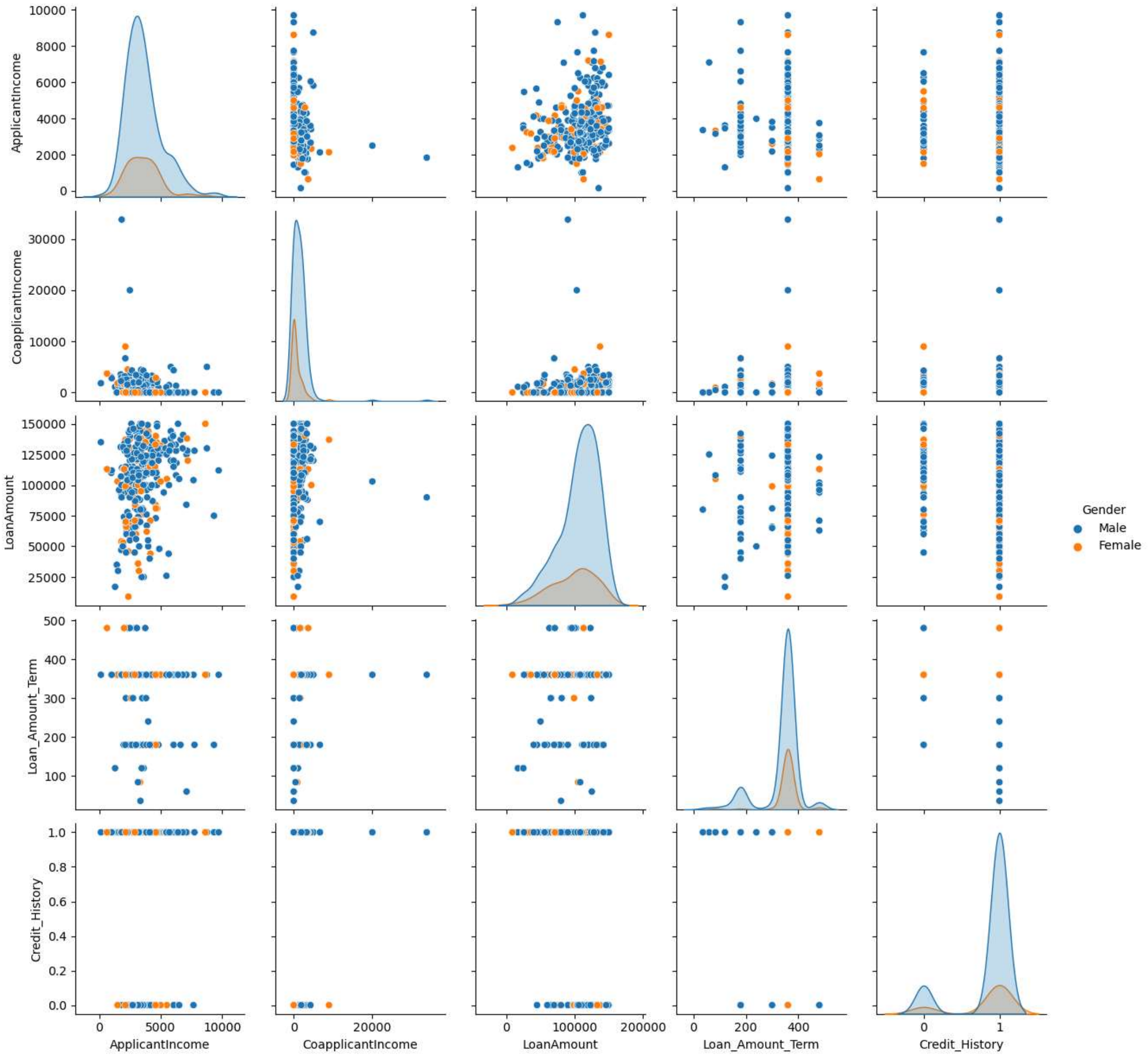


In [14]:

```
df["LoanAmount"] = df["LoanAmount"]*1000
```

```
In [15]: sns.pairplot(data = df,hue="Gender");
```

```
D:\program files\Anaconda\Lib\site-packages\seaborn\axisgrid.py:118: UserWarn
ing: The figure layout has changed to tight
  self._figure.tight_layout(*args, **kwargs)
```



Feature Engineering

```
In [16]: dfcopy = df
         dfcopy2 = df
         dfcopy3 = df
```

In [38]:

```python
from sklearn.ensemble import RandomForestClassifier
from sklearn.svm import SVC
from sklearn.neighbors import KNeighborsClassifier
from xgboost import XGBClassifier

from sklearn.model_selection import train_test_split
from sklearn.model_selection import RandomizedSearchCV, GridSearchCV


from sklearn.preprocessing import LabelEncoder
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import accuracy_score, classification_report
from sklearn.metrics import accuracy_score
```

In [18]:

```python
label = LabelEncoder()
columns = ['Gender','Married','Dependents','Education','Self_Employed','Proper

for val in columns:
    df[f'encode_{val}'] = label.fit_transform(df[val])

df.drop(['Gender','Married','Dependents','Education','Self_Employed','Property
```

In [19]:

```python
X = df.drop(['encode_Loan_Status'],axis = 1)
y = df['encode_Loan_Status']
```

In [21]:

```python
#Scaling data

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3, rando

scaler = StandardScaler()
X_train_scaled = scaler.fit_transform(X_train)
X_test_scaled = scaler.transform(X_test)
```

Model Building

SVM

In [60]:

```
model_svm = SVC(kernel='rbf')
model_svm.fit(X_train_scaled,y_train)

y_pred = model_svm.predict(X_test_scaled)

accuracy = accuracy_score(y_test, y_pred)

print("Accuracy:", accuracy*100,"%")
report = classification_report(y_test, y_pred,output_dict = True)
dfreport = pd.DataFrame(report).transpose()
dfreport
```

```
Accuracy: 81.72043010752688 %
```

Out[60]:

	precision	recall	f1-score	support
0	0.928571	0.448276	0.604651	29.000000
1	0.797468	0.984375	0.881119	64.000000
accuracy	0.817204	0.817204	0.817204	0.817204
macro avg	0.863020	0.716325	0.742885	93.000000
weighted avg	0.838350	0.817204	0.794909	93.000000

XGBoost

In [48]:

```
xgb = XGBClassifier()
xgb.fit(X_train_scaled,y_train)


y_predxgb = xgb.predict(X_test_scaled)

accuracyxgb = accuracy_score(y_test, y_predxgb)

reportxgb = classification_report(y_test, y_predxgb,output_dict = True)
print("Accuracy:", accuracyxgb*100,"%")
dfreportxg = pd.DataFrame(reportxgb).transpose()
dfreportxg
```

```
Accuracy: 74.19354838709677 %
```

Out[48]:

	precision	recall	f1-score	support
0	0.600000	0.517241	0.555556	29.000000
1	0.794118	0.843750	0.818182	64.000000
accuracy	0.741935	0.741935	0.741935	0.741935
macro avg	0.697059	0.680496	0.686869	93.000000
weighted avg	0.733586	0.741935	0.736288	93.000000

Random Forest Classifier

In [56]:

```
rfc = RandomForestClassifier()

param_grid = {
    'n_estimators': [100, 200, 300],
    'max_depth': [None, 10, 20],
}

grid_search = GridSearchCV(rfc, param_grid, cv=5, error_score='raise')

grid_search.fit(X_train_scaled,y_train)

y_predrfc = grid_search.predict(X_test_scaled)

accuracyrfc = accuracy_score(y_test, y_predrfc)

print("Accuracy:", accuracyrfc*100,"%")
reportrfc = classification_report(y_test, y_predrfc,output_dict = True)
dfreportrfc = pd.DataFrame(reportrfc).transpose()
dfreportrfc
```

```
Accuracy: 80.64516129032258 %
```

Out[56]:

	precision	recall	f1-score	support
0	0.789474	0.517241	0.625000	29.000000
1	0.810811	0.937500	0.869565	64.000000
accuracy	0.806452	0.806452	0.806452	0.806452
macro avg	0.800142	0.727371	0.747283	93.000000
weighted avg	0.804157	0.806452	0.793303	93.000000

In [58]:

```
grid_search.best_params_
```

Out[58]:

```
{'max_depth': 20, 'n_estimators': 100}
```

Result : SVM - Accuracy = 81.72% and F1 score = 0.88