In [1]:
```python
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
sns.set_style("darkgrid")

from sklearn.model_selection import train_test_split, cross_val_score
from sklearn.metrics import classification_report as cr , accuracy_score as acc , confusion_matrix as cm

import warnings
warnings.filterwarnings("ignore")
```

Importing Data set

In [2]:
```python
df=pd.read_csv("titanic_train.csv")
df.head()
```

Out[2]:

	PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare	Cabin	Embarked
0	1	0	3	Braund, Mr. Owen Harris	male	22.0	1	0	A/5 21171	7.2500	NaN	S
1	2	1	1	Cumings, Mrs. John Bradley (Florence Briggs Th...	female	38.0	1	0	PC 17599	71.2833	C85	C
2	3	1	3	Heikkinen, Miss. Laina	female	26.0	0	0	STON/O2. 3101282	7.9250	NaN	S
3	4	1	1	Futrelle, Mrs. Jacques Heath (Lily May Peel)	female	35.0	1	0	113803	53.1000	C123	S
4	5	0	3	Allen, Mr. William Henry	male	35.0	0	0	373450	8.0500	NaN	S

EDA

In [3]:
```python
df.describe()
```

Out[3]:

	PassengerId	Survived	Pclass	Age	SibSp	Parch	Fare
count	891.000000	891.000000	891.000000	714.000000	891.000000	891.000000	891.000000
mean	446.000000	0.383838	2.308642	29.699118	0.523008	0.381594	32.204208
std	257.353842	0.486592	0.836071	14.526497	1.102743	0.806057	49.693429
min	1.000000	0.000000	1.000000	0.420000	0.000000	0.000000	0.000000
25%	223.500000	0.000000	2.000000	20.125000	0.000000	0.000000	7.910400
50%	446.000000	0.000000	3.000000	28.000000	0.000000	0.000000	14.454200
75%	668.500000	1.000000	3.000000	38.000000	1.000000	0.000000	31.000000
max	891.000000	1.000000	3.000000	80.000000	8.000000	6.000000	512.329200

In [4]:
```python
df["Survived"].value_counts() # Data is unbalanced
```

Out[4]:
```
0    549
1    342
Name: Survived, dtype: int64
```

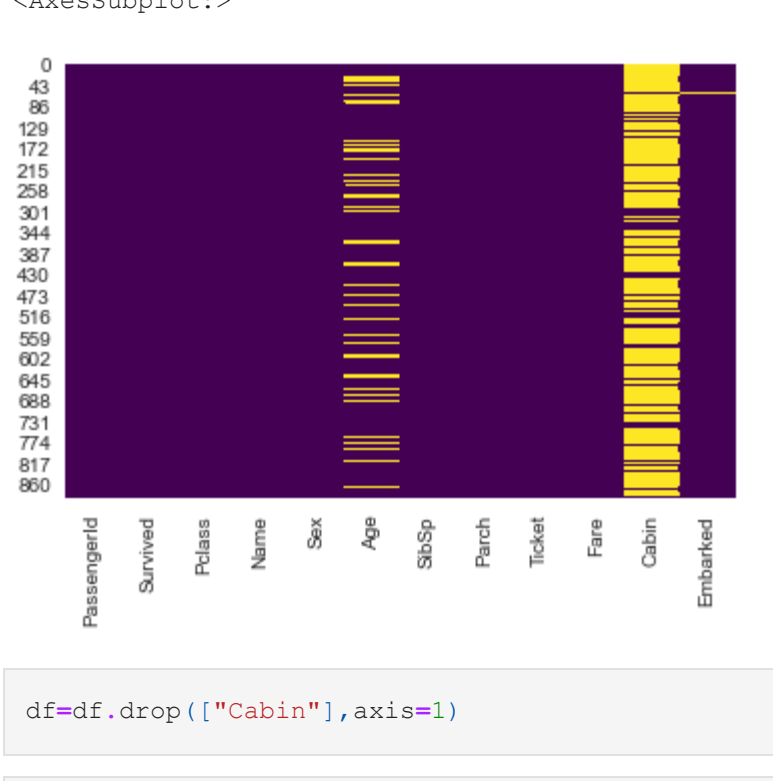
In [5]:
```python
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 891 entries, 0 to 890
Data columns (total 12 columns):
 #   Column       Non-Null Count  Dtype
---  ------       --------------  -----
 0   PassengerId  891 non-null    int64
 1   Survived     891 non-null    int64
 2   Pclass       891 non-null    int64
 3   Name         891 non-null    object
 4   Sex          891 non-null    object
 5   Age          714 non-null    float64
 6   SibSp        891 non-null    int64
 7   Parch        891 non-null    int64
 8   Ticket       891 non-null    object
 9   Fare         891 non-null    float64
 10  Cabin        204 non-null    object
 11  Embarked     889 non-null    object
dtypes: float64(2), int64(5), object(5)
memory usage: 66.2+ KB
```

From above we observed that, there are some missing values in Age,Cabin, Embarked columns, If there are more numbers of missing values (<50%) we should drop that feature otherwise replace/ impute mean values.

In [6]:
```python
sns.heatmap(df.isnull(),xticklabels=True,cbar=False,cmap="viridis")
```

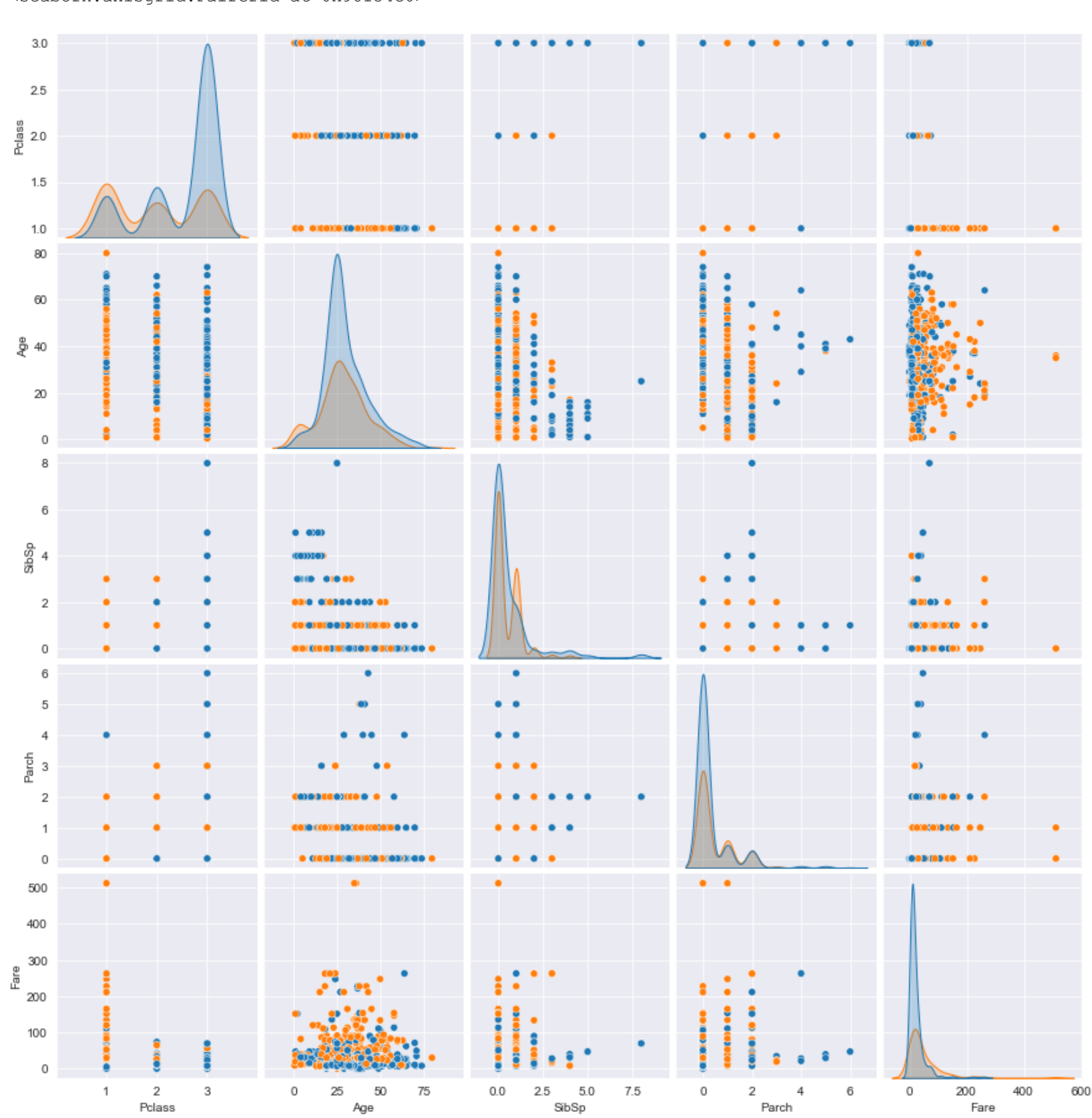
Out[6]:
```
<AxesSubplot:>
```



In [7]:
```python
df=df.drop(["Cabin"],axis=1)
```

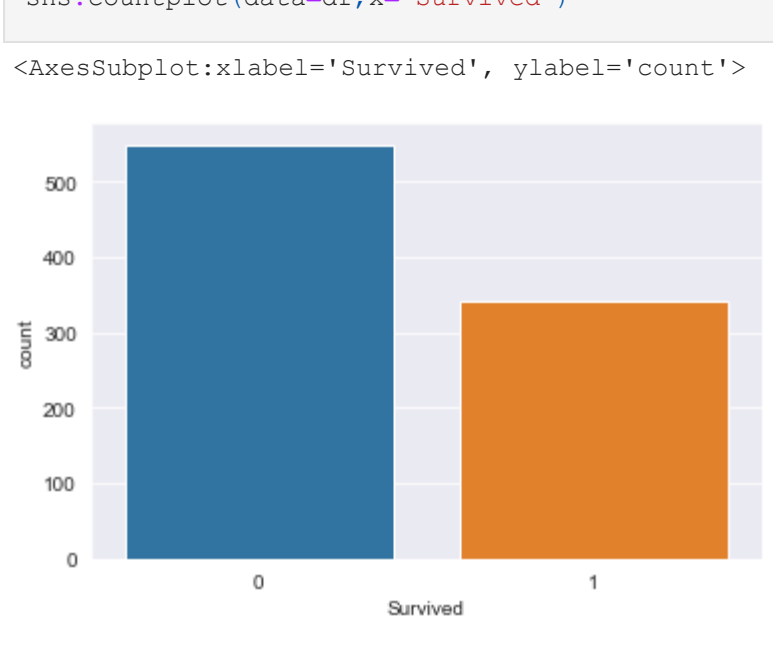
In [43]:
```python
sns.pairplot(df,hue="Survived")
```

Out[43]:
```
<seaborn.axisgrid.PairGrid at 0x98134c0>
```



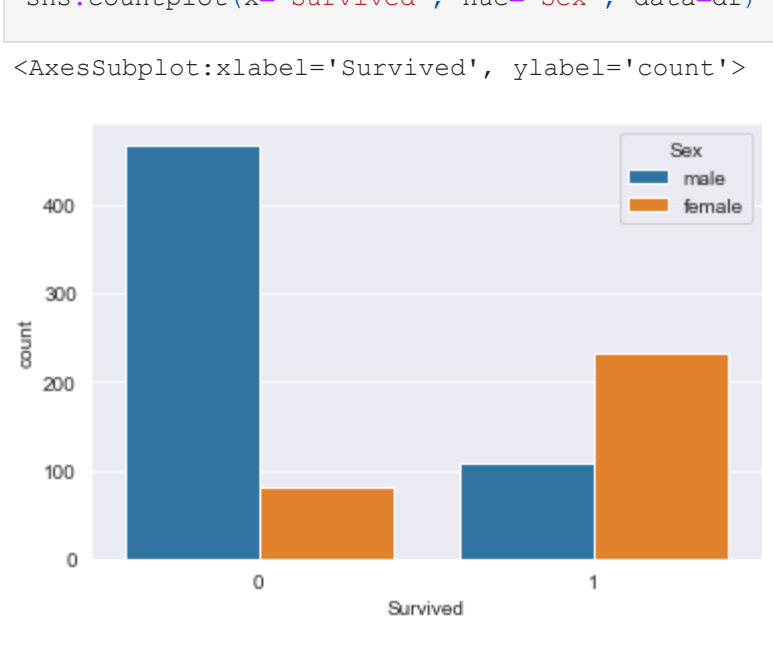
In [7]:
```python
sns.countplot(data=df,x="Survived")
```

Out[7]:
```
<AxesSubplot:xlabel='Survived', ylabel='count'>
```



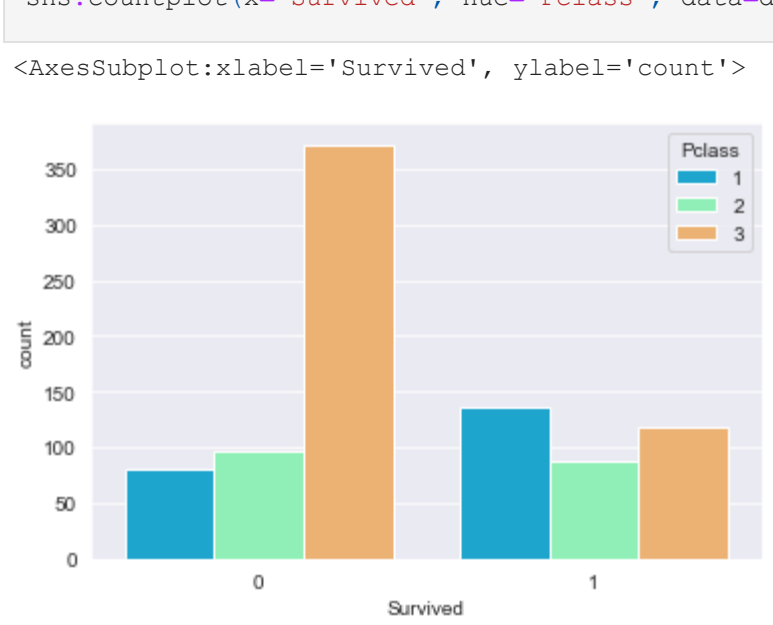
In [8]:
```python
sns.countplot(x='Survived', hue='Sex', data=df)
```

Out[8]:
```
<AxesSubplot:xlabel='Survived', ylabel='count'>
```



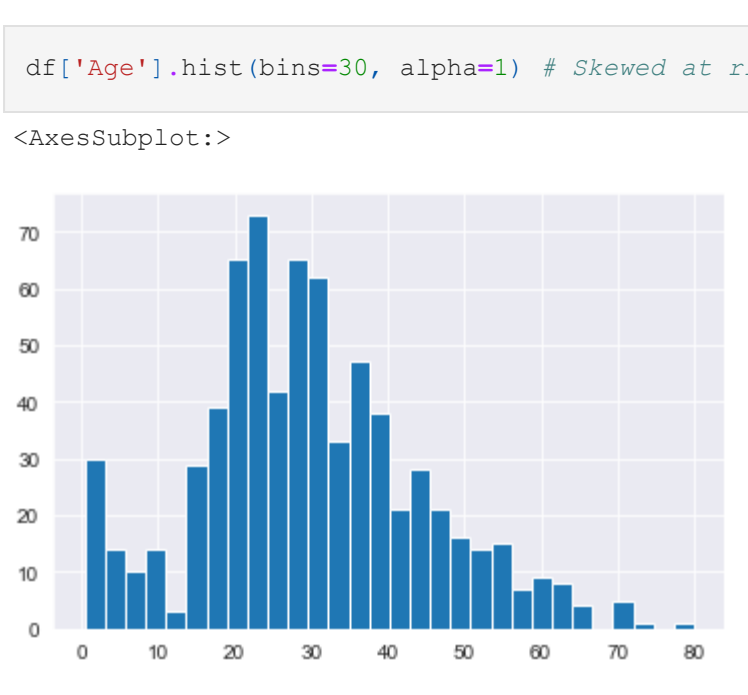
In [9]:
```python
sns.countplot(x='Survived', hue='Pclass', data=df, palette='rainbow')
```

Out[9]:
```
<AxesSubplot:xlabel='Survived', ylabel='count'>
```



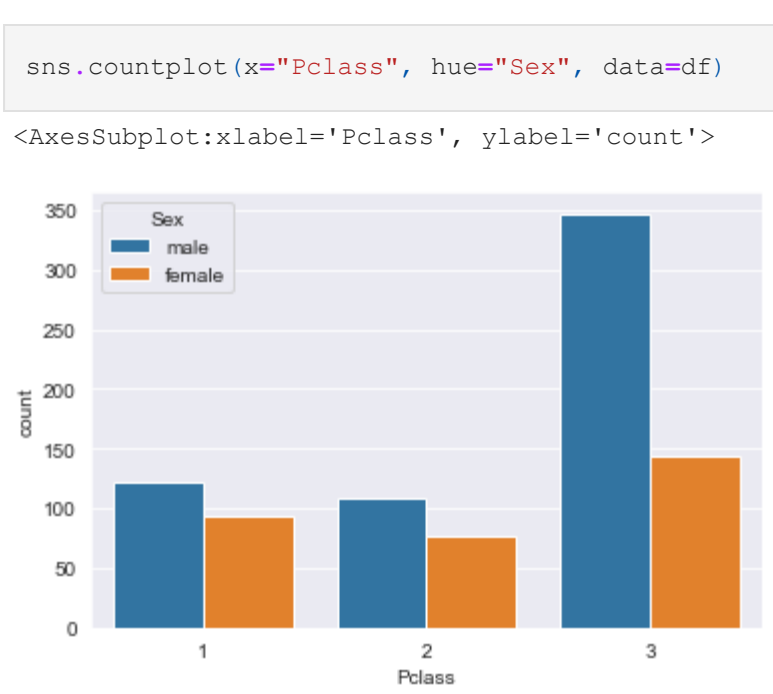
In [33]:
```python
df['Age'].hist(bins=30, alpha=1) # Skewed at right
```

Out[33]:
```
<AxesSubplot:>
```



In [21]:
```python
sns.countplot(x="Pclass", hue="Sex", data=df)
```

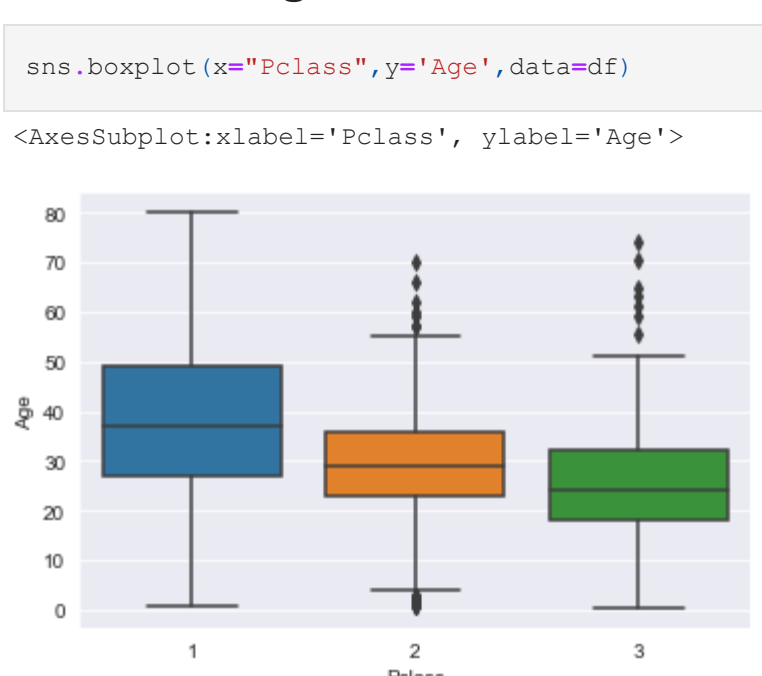
Out[21]:
```
<AxesSubplot:xlabel='Pclass', ylabel='count'>
```



Data Cleaning

In [8]:
```python
sns.boxplot(x="Pclass",y='Age',data=df)
```

Out[8]:
```
<AxesSubplot:xlabel='Pclass', ylabel='Age'>
```

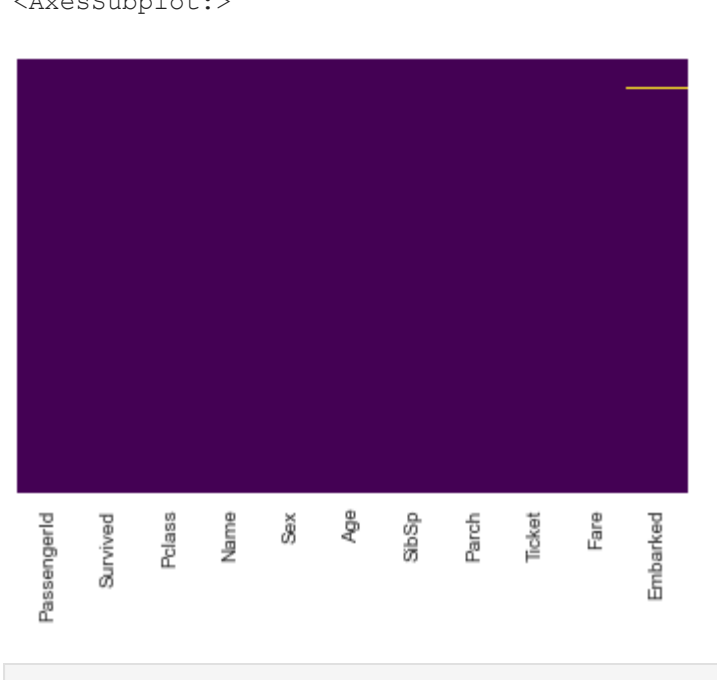


In [9]:
```python
def imputeage(cls):
    Age=cls[0]
    Pclass=cls[1]

    if pd.isnull(Age):
        if Pclass==1:
            return 37
        elif Pclass==2:
            return 29
        else:
            return 25
    else:

        return Age
```

In [10]:
```python
df["Age"]=df[["Age","Pclass"]].apply(imputeage,axis=1)
```

In [11]:
```python
sns.heatmap(df.isnull(), yticklabels=False, cbar = False, cmap='viridis')
```

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



In [12]:
```python
df.drop(['PassengerId','Name','Ticket'], axis=1, inplace=True)
```

In [13]:
```python
df.head()
```

Out[13]:

	Survived	Pclass	Sex	Age	SibSp	Parch	Fare	Embarked
0	0	3	male	22.0	1	0	7.2500	S
1	1	1	female	38.0	1	0	71.2833	C
2	1	3	female	26.0	0	0	7.9250	S
3	1	1	female	35.0	1	0	53.1000	S
4	0	3	male	35.0	0	0	8.0500	S

In [14]:
```python
df.isna().sum()
```

Out[14]:
```
Survived    0
Pclass      0
Sex         0
Age         0
SibSp       0
Parch       0
Fare        0
Embarked    2
dtype: int64
```

In [15]:
```python
df=df.dropna()
```

In [16]:
```python
df.isna().sum()
```

Out[16]:
```
Survived    0
Pclass      0
Sex         0
Age         0
SibSp       0
Parch       0
Fare        0
Embarked    0
dtype: int64
```

Splitting Data in x and y

In [17]:
```python
x = df.iloc[:,1:]
y = df.iloc[:,0]
```

In [18]:
```python
x
```

Out[18]:

	Pclass	Sex	Age	SibSp	Parch	Fare	Embarked
0	3	male	22.0	1	0	7.2500	S
1	1	female	38.0	1	0	71.2833	C
2	3	female	26.0	0	0	7.9250	S
3	1	female	35.0	1	0	53.1000	S
4	3	male	35.0	0	0	8.0500	S
...	...	...	...	...	...	...	...
886	2	male	27.0	0	0	13.0000	S
887	1	female	19.0	0	0	30.0000	S
888	3	female	25.0	1	2	23.4500	S
889	1	male	26.0	0	0	30.0000	C
890	3	male	32.0	0	0	7.7500	Q

889 rows × 7 columns

In [19]:
```python
y
```

Out[19]:
```
0      0
1      1
2      1
3      1
4      0
      ..
886    0
887    1
888    0
889    1
890    0
Name: Survived, Length: 889, dtype: int64
```

Encoding of Categorical data

In [20]:
```python
from sklearn.compose import ColumnTransformer
from sklearn.preprocessing import OneHotEncoder
```

In [21]:
```python
ct=ColumnTransformer(transformers=[("encoder",OneHotEncoder(),["Sex","Embarked"])],remainder="passthrough")
x = np.array(ct.fit_transform(x))
```

In [22]:
```python
x
```

Out[22]:
```
array([[ 0.    ,  1.    ,  0.    , ...,  1.    ,  0.    ,  7.25  ],
       [ 1.    ,  0.    ,  1.    , ...,  1.    ,  0.    , 71.2833],
       [ 1.    ,  0.    ,  0.    , ...,  0.    ,  0.    ,  7.925 ],
       ...,
       [ 1.    ,  0.    ,  0.    , ...,  1.    ,  2.    , 23.45  ],
       [ 0.    ,  1.    ,  1.    , ...,  0.    ,  0.    , 30.    ],
       [ 0.    ,  1.    ,  0.    , ...,  0.    ,  0.    ,  7.75  ]])
```

ML Model training & Creating

In [23]:
```python
from sklearn.model_selection import train_test_split

xtrain, xtest, ytrain, ytest = train_test_split(x,y, test_size=0.25, random_state=1)
```

In [24]:
```python
from sklearn.linear_model import LogisticRegression
```

In [25]:
```python
from sklearn.tree import DecisionTreeClassifier

def cr_m(model):
    model.fit(xtrain, ytrain)
    ypred= model.predict(xtest)
    print( f"Classification Report -:\n {cr(ytest, ypred)}")
    return model
```

Hyper Parameter tunning

In [26]:
```python
logreg=LogisticRegression()
cr_m(logreg)
```

```
Classification Report -:
               precision    recall  f1-score   support

           0       0.88      0.88      0.88       138
           1       0.80      0.80      0.80        85

    accuracy                           0.85       223
   macro avg       0.84      0.84      0.84       223
weighted avg       0.85      0.85      0.85       223
```

Out[26]:
```
LogisticRegression()
```

In [27]:
```python
for i in range (2,100):
    dt2 = DecisionTreeClassifier(min_samples_leaf=i)
    print(i)
    cr_m(dt2)
```

```
weighted avg       0.85      0.81      0.79       223

84
Classification Report -:
              precision    recall  f1-score   support

           0       0.77      0.99      0.87       138
           1       0.98      0.52      0.68        85

    accuracy                           0.81       223
   macro avg       0.87      0.76      0.77       223
weighted avg       0.85      0.81      0.79       223

85
Classification Report -:
              precision    recall  f1-score   support

           0       0.77      0.99      0.87       138
           1       0.98      0.52      0.68        85

    accuracy                           0.81       223
   macro avg       0.87      0.76      0.77       223
weighted avg       0.85      0.81      0.79       223

86
Classification Report -:
              precision    recall  f1-score   support

           0       0.77      0.99      0.87       138
           1       0.98      0.52      0.68        85

    accuracy                           0.81       223
   macro avg       0.87      0.76      0.77       223
weighted avg       0.85      0.81      0.79       223

87
Classification Report -:
              precision    recall  f1-score   support

           0       0.77      0.99      0.87       138
           1       0.98      0.52      0.68        85

    accuracy                           0.81       223
   macro avg       0.87      0.76      0.77       223
weighted avg       0.85      0.81      0.79       223

88
Classification Report -:
              precision    recall  f1-score   support

           0       0.77      0.99      0.87       138
           1       0.98      0.52      0.68        85

    accuracy                           0.81       223
   macro avg       0.87      0.76      0.77       223
weighted avg       0.85      0.81      0.79       223

89
Classification Report -:
              precision    recall  f1-score   support

           0       0.77      0.99      0.87       138
           1       0.98      0.52      0.68        85

    accuracy                           0.81       223
   macro avg       0.87      0.76      0.77       223
weighted avg       0.85      0.81      0.79       223

90
Classification Report -:
              precision    recall  f1-score   support

           0       0.77      0.99      0.87       138
           1       0.98      0.52      0.68        85

    accuracy                           0.81       223
   macro avg       0.87      0.76      0.77       223
weighted avg       0.85      0.81      0.79       223

91
Classification Report -:
              precision    recall  f1-score   support

           0       0.77      0.99      0.87       138
           1       0.98      0.52      0.68        85

    accuracy                           0.81       223
   macro avg       0.87      0.76      0.77       223
weighted avg       0.85      0.81      0.79       223

92
Classification Report -:
              precision    recall  f1-score   support

           0       0.77      0.99      0.87       138
           1       0.98      0.52      0.68        85

    accuracy                           0.81       223
   macro avg       0.87      0.76      0.77       223
weighted avg       0.85      0.81      0.79       223

93
Classification Report -:
              precision    recall  f1-score   support

           0       0.77      0.99      0.87       138
           1       0.98      0.52      0.68        85

    accuracy                           0.81       223
   macro avg       0.87      0.76      0.77       223
weighted avg       0.85      0.81      0.79       223

94
Classification Report -:
              precision    recall  f1-score   support

           0       0.77      0.99      0.87       138
           1       0.98      0.52      0.68        85

    accuracy                           0.81       223
   macro avg       0.87      0.76      0.77       223
weighted avg       0.85      0.81      0.79       223

95
Classification Report -:
              precision    recall  f1-score   support

           0       0.77      0.99      0.87       138
           1       0.98      0.52      0.68        85

    accuracy                           0.81       223
   macro avg       0.87      0.76      0.77       223
weighted avg       0.85      0.81      0.79       223

96
Classification Report -:
              precision    recall  f1-score   support

           0       0.77      0.99      0.87       138
           1       0.98      0.52      0.68        85

    accuracy                           0.81       223
   macro avg       0.87      0.76      0.77       223
weighted avg       0.85      0.81      0.79       223

97
Classification Report -:
              precision    recall  f1-score   support

           0       0.77      0.99      0.87       138
           1       0.98      0.52      0.68        85

    accuracy                           0.81       223
   macro avg       0.87      0.76      0.77       223
weighted avg       0.85      0.81      0.79       223

98
Classification Report -:
              precision    recall  f1-score   support

           0       0.77      0.99      0.87       138
           1       0.98      0.52      0.68        85

    accuracy                           0.81       223
   macro avg       0.87      0.76      0.77       223
weighted avg       0.85      0.81      0.79       223

99
Classification Report -:
              precision    recall  f1-score   support

           0       0.77      0.99      0.87       138
           1       0.98      0.52      0.68        85

    accuracy                           0.81       223
   macro avg       0.87      0.76      0.77       223
weighted avg       0.85      0.81      0.79       223
```

In [28]:

```
for i in range (1,50):
    dt = DecisionTreeClassifier(max_depth=i)
    print(i)
    cr_m(dt)
```

```
1
Classification Report -:
              precision    recall  f1-score   support

           0       0.85      0.88      0.87       138
           1       0.80      0.75      0.78        85

    accuracy                           0.83       223
   macro avg       0.83      0.82      0.82       223
weighted avg       0.83      0.83      0.83       223

2
Classification Report -:
              precision    recall  f1-score   support

           0       0.77      0.93      0.84       138
           1       0.82      0.54      0.65        85

    accuracy                           0.78       223
   macro avg       0.79      0.73      0.75       223
weighted avg       0.79      0.78      0.77       223

3
Classification Report -:
              precision    recall  f1-score   support

           0       0.82      0.96      0.88       138
           1       0.90      0.66      0.76        85

    accuracy                           0.84       223
   macro avg       0.86      0.81      0.82       223
weighted avg       0.85      0.84      0.84       223

4
Classification Report -:
              precision    recall  f1-score   support

           0       0.82      0.96      0.89       138
           1       0.90      0.67      0.77        85

    accuracy                           0.85       223
   macro avg       0.86      0.81      0.83       223
weighted avg       0.86      0.85      0.84       223

5
Classification Report -:
              precision    recall  f1-score   support

           0       0.84      0.94      0.89       138
           1       0.88      0.72      0.79        85

    accuracy                           0.86       223
   macro avg       0.86      0.83      0.84       223
weighted avg       0.86      0.86      0.85       223

6
Classification Report -:
              precision    recall  f1-score   support

           0       0.85      0.93      0.89       138
           1       0.87      0.73      0.79        85

    accuracy                           0.86       223
   macro avg       0.86      0.83      0.84       223
weighted avg       0.86      0.86      0.85       223

7
Classification Report -:
              precision    recall  f1-score   support

           0       0.86      0.91      0.88       138
           1       0.84      0.75      0.80        85

    accuracy                           0.85       223
   macro avg       0.85      0.83      0.84       223
weighted avg       0.85      0.85      0.85       223

8
Classification Report -:
              precision    recall  f1-score   support

           0       0.86      0.89      0.88       138
           1       0.81      0.76      0.79        85

    accuracy                           0.84       223
   macro avg       0.84      0.83      0.83       223
weighted avg       0.84      0.84      0.84       223

9
Classification Report -:
              precision    recall  f1-score   support

           0       0.86      0.91      0.88       138
           1       0.83      0.75      0.79        85

    accuracy                           0.85       223
   macro avg       0.84      0.83      0.84       223
weighted avg       0.85      0.85      0.85       223

10
Classification Report -:
              precision    recall  f1-score   support

           0       0.84      0.86      0.85       138
           1       0.77      0.74      0.75        85

    accuracy                           0.82       223
   macro avg       0.81      0.80      0.80       223
weighted avg       0.82      0.82      0.82       223

11
Classification Report -:
              precision    recall  f1-score   support

           0       0.85      0.88      0.87       138
           1       0.80      0.74      0.77        85

    accuracy                           0.83       223
   macro avg       0.82      0.81      0.82       223
weighted avg       0.83      0.83      0.83       223

12
Classification Report -:
              precision    recall  f1-score   support

           0       0.84      0.86      0.85       138
           1       0.77      0.74      0.75        85

    accuracy                           0.82       223
   macro avg       0.81      0.80      0.80       223
weighted avg       0.82      0.82      0.82       223

13
Classification Report -:
              precision    recall  f1-score   support

           0       0.83      0.85      0.84       138
           1       0.74      0.72      0.73        85

    accuracy                           0.80       223
   macro avg       0.79      0.78      0.78       223
weighted avg       0.80      0.80      0.80       223

14
Classification Report -:
              precision    recall  f1-score   support

           0       0.84      0.85      0.84       138
           1       0.75      0.74      0.75        85

    accuracy                           0.81       223
   macro avg       0.80      0.79      0.80       223
weighted avg       0.81      0.81      0.81       223

15
Classification Report -:
              precision    recall  f1-score   support

           0       0.86      0.83      0.85       138
           1       0.74      0.78      0.76        85

    accuracy                           0.81       223
   macro avg       0.80      0.80      0.80       223
weighted avg       0.81      0.81      0.81       223

16
Classification Report -:
              precision    recall  f1-score   support

           0       0.85      0.83      0.84       138
           1       0.73      0.76      0.75        85

    accuracy                           0.80       223
   macro avg       0.79      0.80      0.79       223
weighted avg       0.80      0.80      0.80       223

17
Classification Report -:
              precision    recall  f1-score   support

           0       0.85      0.84      0.85       138
           1       0.75      0.76      0.76        85

    accuracy                           0.81       223
   macro avg       0.80      0.80      0.80       223
weighted avg       0.81      0.81      0.81       223

18
Classification Report -:
              precision    recall  f1-score   support

           0       0.84      0.84      0.84       138
           1       0.74      0.74      0.74        85

    accuracy                           0.80       223
   macro avg       0.79      0.79      0.79       223
weighted avg       0.80      0.80      0.80       223

19
Classification Report -:
              precision    recall  f1-score   support

           0       0.84      0.83      0.84       138
           1       0.73      0.75      0.74        85

    accuracy                           0.80       223
   macro avg       0.79      0.79      0.79       223
weighted avg       0.80      0.80      0.80       223

20
Classification Report -:
              precision    recall  f1-score   support

           0       0.84      0.83      0.84       138
           1       0.73      0.75      0.74        85

    accuracy                           0.80       223
   macro avg       0.79      0.79      0.79       223
weighted avg       0.80      0.80      0.80       223

21
Classification Report -:
              precision    recall  f1-score   support

           0       0.85      0.84      0.84       138
           1       0.74      0.75      0.75        85

    accuracy                           0.81       223
   macro avg       0.80      0.80      0.80       223
weighted avg       0.81      0.81      0.81       223

22
Classification Report -:
              precision    recall  f1-score   support

           0       0.85      0.85      0.85       138
           1       0.75      0.75      0.75        85

    accuracy                           0.81       223
   macro avg       0.80      0.80      0.80       223
weighted avg       0.81      0.81      0.81       223

23
Classification Report -:
              precision    recall  f1-score   support

           0       0.85      0.83      0.84       138
           1       0.73      0.76      0.75        85

    accuracy                           0.80       223
   macro avg       0.79      0.80      0.79       223
weighted avg       0.80      0.80      0.80       223

24
Classification Report -:
              precision    recall  f1-score   support

           0       0.83      0.84      0.84       138
           1       0.74      0.73      0.73        85

    accuracy                           0.80       223
   macro avg       0.79      0.78      0.79       223
weighted avg       0.80      0.80      0.80       223

25
Classification Report -:
              precision    recall  f1-score   support

           0       0.84      0.84      0.84       138
           1       0.74      0.74      0.74        85

    accuracy                           0.80       223
   macro avg       0.79      0.79      0.79       223
weighted avg       0.80      0.80      0.80       223

26
Classification Report -:
              precision    recall  f1-score   support

           0       0.85      0.83      0.84       138
           1       0.74      0.76      0.75        85

    accuracy                           0.81       223
   macro avg       0.80      0.80      0.80       223
weighted avg       0.81      0.81      0.81       223

27
Classification Report -:
              precision    recall  f1-score   support

           0       0.84      0.85      0.84       138
           1       0.75      0.73      0.74        85

    accuracy                           0.80       223
   macro avg       0.79      0.79      0.79       223
weighted avg       0.80      0.80      0.80       223

28
Classification Report -:
              precision    recall  f1-score   support

           0       0.84      0.83      0.84       138
           1       0.73      0.75      0.74        85

    accuracy                           0.80       223
   macro avg       0.79      0.79      0.79       223
weighted avg       0.80      0.80      0.80       223

29
Classification Report -:
              precision    recall  f1-score   support

           0       0.85      0.85      0.85       138
           1       0.76      0.76      0.76        85

    accuracy                           0.82       223
   macro avg       0.80      0.81      0.81       223
weighted avg       0.82      0.82      0.82       223

30
Classification Report -:
              precision    recall  f1-score   support

           0       0.85      0.85      0.85       138
           1       0.76      0.76      0.76        85

    accuracy                           0.82       223
   macro avg       0.80      0.81      0.81       223
weighted avg       0.82      0.82      0.82       223

31
Classification Report -:
              precision    recall  f1-score   support

           0       0.85      0.83      0.84       138
           1       0.74      0.75      0.74        85

    accuracy                           0.80       223
   macro avg       0.79      0.79      0.79       223
weighted avg       0.80      0.80      0.80       223

32
Classification Report -:
              precision    recall  f1-score   support

           0       0.86      0.84      0.85       138
           1       0.75      0.78      0.76        85

    accuracy                           0.82       223
   macro avg       0.80      0.81      0.81       223
weighted avg       0.82      0.82      0.82       223

33
Classification Report -:
              precision    recall  f1-score   support

           0       0.86      0.84      0.85       138
           1       0.75      0.78      0.76        85

    accuracy                           0.82       223
   macro avg       0.80      0.81      0.81       223
weighted avg       0.82      0.82      0.82       223

34
Classification Report -:
              precision    recall  f1-score   support

           0       0.83      0.84      0.84       138
           1       0.74      0.73      0.73        85

    accuracy                           0.80       223
   macro avg       0.79      0.78      0.79       223
weighted avg       0.80      0.80      0.80       223

35
Classification Report -:
              precision    recall  f1-score   support

           0       0.84      0.85      0.84       138
           1       0.75      0.74      0.75        85

    accuracy                           0.81       223
   macro avg       0.80      0.79      0.80       223
weighted avg       0.81      0.81      0.81       223

36
Classification Report -:
              precision    recall  f1-score   support

           0       0.85      0.84      0.85       138
           1       0.75      0.76      0.76        85

    accuracy                           0.81       223
   macro avg       0.80      0.80      0.80       223
weighted avg       0.81      0.81      0.81       223

37
Classification Report -:
              precision    recall  f1-score   support

           0       0.86      0.85      0.85       138
           1       0.76      0.78      0.77        85

    accuracy                           0.82       223
   macro avg       0.81      0.81      0.81       223
weighted avg       0.82      0.82      0.82       223

38
Classification Report -:
              precision    recall  f1-score   support

           0       0.83      0.83      0.83       138
           1       0.72      0.73      0.73        85

    accuracy                           0.79       223
   macro avg       0.78      0.78      0.78       223
weighted avg       0.79      0.79      0.79       223

39
Classification Report -:
              precision    recall  f1-score   support

           0       0.84      0.85      0.84       138
           1       0.75      0.73      0.74        85

    accuracy                           0.80       223
   macro avg       0.79      0.79      0.79       223
weighted avg       0.80      0.80      0.80       223

40
Classification Report -:
              precision    recall  f1-score   support

           0       0.84      0.83      0.84       138
           1       0.73      0.75      0.74        85

    accuracy                           0.80       223
   macro avg       0.79      0.79      0.79       223
weighted avg       0.80      0.80      0.80       223

41
Classification Report -:
              precision    recall  f1-score   support

           0       0.84      0.83      0.84       138
           1       0.73      0.74      0.74        85

    accuracy                           0.80       223
   macro avg       0.79      0.79      0.79       223
weighted avg       0.80      0.80      0.80       223

42
Classification Report -:
              precision    recall  f1-score   support

           0       0.84      0.85      0.84       138
           1       0.75      0.73      0.74        85

    accuracy                           0.80       223
   macro avg       0.79      0.79      0.79       223
weighted avg       0.80      0.80      0.80       223

43
Classification Report -:
              precision    recall  f1-score   support

           0       0.85      0.85      0.85       138
           1       0.75      0.75      0.75        85

    accuracy                           0.81       223
   macro avg       0.80      0.80      0.80       223
weighted avg       0.81      0.81      0.81       223

44
Classification Report -:
              precision    recall  f1-score   support

           0       0.85      0.83      0.84       138
           1       0.74      0.76      0.75        85

    accuracy                           0.81       223
   macro avg       0.80      0.80      0.80       223
weighted avg       0.81      0.81      0.81       223

45
Classification Report -:
              precision    recall  f1-score   support

           0       0.85      0.85      0.85       138
           1       0.76      0.76      0.76        85

    accuracy                           0.82       223
   macro avg       0.80      0.81      0.81       223
weighted avg       0.82      0.82      0.82       223

46
Classification Report -:
              precision    recall  f1-score   support

           0       0.85      0.85      0.85       138
           1       0.75      0.75      0.75        85

    accuracy                           0.81       223
   macro avg       0.80      0.80      0.80       223
weighted avg       0.81      0.81      0.81       223

47
Classification Report -:
              precision    recall  f1-score   support

           0       0.84      0.83      0.83       138
           1       0.72      0.74      0.73        85

    accuracy                           0.79       223
   macro avg       0.78      0.78      0.78       223
weighted avg       0.79      0.79      0.79       223

48
Classification Report -:
              precision    recall  f1-score   support

           0       0.85      0.84      0.84       138
           1       0.74      0.75      0.75        85

    accuracy                           0.81       223
   macro avg       0.80      0.80      0.80       223
weighted avg       0.81      0.81      0.81       223

49
Classification Report -:
              precision    recall  f1-score   support

           0       0.84      0.84      0.84       138
           1       0.74      0.74      0.74        85

    accuracy                           0.80       223
   macro avg       0.79      0.79      0.79       223
weighted avg       0.80      0.80      0.80       223
```

Evaluation on best possible model

In [29]:

```
dt1 = DecisionTreeClassifier(max_depth=5)
dt1.fit(xtrain, ytrain)
ypred= dt1.predict(xtest)
```

In [31]:

```
print( f"Classification Report -:\n {cr(ytest, ypred)}")
print( f"Accuracy -: {acc(ytest, ypred)}")
print(f"Classification Report -:\n { cm(ytest, ypred)}")
```

```
Classification Report -:
              precision    recall  f1-score   support

           0       0.84      0.94      0.89       138
           1       0.88      0.72      0.79        85

    accuracy                           0.86       223
   macro avg       0.86      0.83      0.84       223
weighted avg       0.86      0.86      0.85       223

Accuracy -: 0.8565022421524664
Classification Report -:
 [[130   8]
 [ 24  61]]
```

Average Accuracy

In [32]:

```
cvs=cross_val_score(logreg,xtrain,ytrain,cv=5,scoring="accuracy")
print(f"Average accuracy -: {cvs.mean()*100}, \nStandard deviation-  {cvs.std()}")
```

```
Average accuracy -: 78.82616990236787,
Standard deviation-  0.021709372272727463
```