Titanic Survival Classification

In [ ]:
```
import warnings
warnings.filterwarnings('ignore')

import pandas as pd
import numpy as np

import matplotlib.pyplot as plt
import seaborn as sns
import missingno

from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score
from sklearn.preprocessing import OneHotEncoder, LabelEncoder, StandardScaler
from sklearn.svm import SVC
from sklearn.ensemble import RandomForestClassifier
from xgboost import XGBClassifier
```

In [ ]:
```
train_data = pd.read_csv('train.csv')
test_data = pd.read_csv('test.csv')
```

In [ ]:
```
train_data.head(10)
```

Out[ ]:

	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
5	6	0	3	Moran, Mr. James	male	NaN	0	0	330877	8.4583	NaN	Q
6	7	0	1	McCarthy, Mr. Timothy J	male	54.0	0	0	17463	51.8625	E46	S
7	8	0	3	Palsson, Master. Gosta Leonard	male	2.0	3	1	349909	21.0750	NaN	S
8	9	1	3	Johnson, Mrs. Oscar W (Elisabeth Vilhelmina Berg)	female	27.0	0	2	347742	11.1333	NaN	S
9	10	1	2	Nasser, Mrs. Nicholas (Adele Achem)	female	14.0	1	0	237736	30.0708	NaN	C

In [ ]:
```
test_data.head(10)
```

Out[ ]:

	PassengerId	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare	Cabin	Embarked
0	892	3	Kelly, Mr. James	male	34.5	0	0	330911	7.8292	NaN	Q
1	893	3	Wilkes, Mrs. James (Ellen Needs)	female	47.0	1	0	363272	7.0000	NaN	S
2	894	2	Myles, Mr. Thomas Francis	male	62.0	0	0	240276	9.6875	NaN	Q
3	895	3	Wirz, Mr. Albert	male	27.0	0	0	315154	8.6625	NaN	S
4	896	3	Hirvonen, Mrs. Alexander (Helga E Lindqvist)	female	22.0	1	1	3101298	12.2875	NaN	S
5	897	3	Svensson, Mr. Johan Cervin	male	14.0	0	0	7538	9.2250	NaN	S
6	898	3	Connolly, Miss. Kate	female	30.0	0	0	330972	7.6292	NaN	Q
7	899	2	Caldwell, Mr. Albert Francis	male	26.0	1	1	248738	29.0000	NaN	S
8	900	3	Abrahim, Mrs. Joseph (Sophie Halaut Easu)	female	18.0	0	0	2657	7.2292	NaN	C
9	901	3	Davies, Mr. John Samuel	male	21.0	2	0	A/4 48871	24.1500	NaN	S

In [ ]:
```
print(f'Training Data\nnumber of rows: {train_data.shape[0]}\nnumber of columns: {train_data.shape[1]}')
print(f'Testing Data\nnumber of rows: {test_data.shape[0]}\nnumber of columns: {test_data.shape[1]}')
```

```
Training Data
number of rows: 891
number of columns: 12
Testing Data
number of rows: 418
number of columns: 11
```

Exploratory Data Analysis

In [ ]:
```
train_data.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: 83.7+ KB
```

In [ ]:
```
train_data.describe()
```

Out[ ]:

	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 [ ]:
```
test_data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 418 entries, 0 to 417
Data columns (total 11 columns):
 #   Column       Non-Null Count  Dtype  
---  ------       --------------  -----  
 0   PassengerId  418 non-null    int64  
 1   Pclass       418 non-null    int64  
 2   Name         418 non-null    object 
 3   Sex          418 non-null    object 
 4   Age          332 non-null    float64
 5   SibSp        418 non-null    int64  
 6   Parch        418 non-null    int64  
 7   Ticket       418 non-null    object 
 8   Fare         417 non-null    float64
 9   Cabin        91 non-null     object 
 10  Embarked     418 non-null    object 
dtypes: float64(2), int64(4), object(5)
memory usage: 36.0+ KB
```

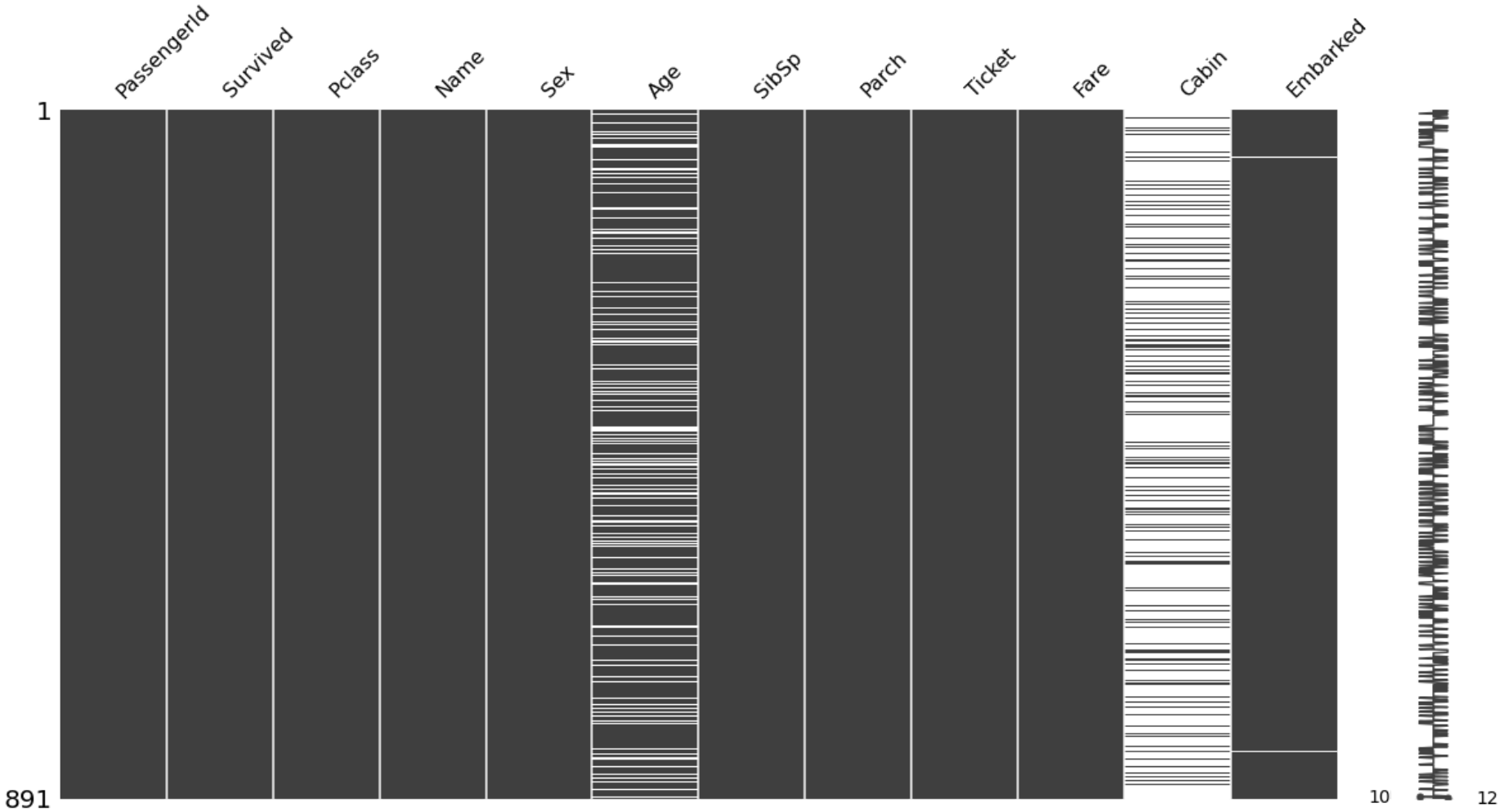
In [ ]:
```
test_data.describe()
```

Out[ ]:

	PassengerId	Pclass	Age	SibSp	Parch	Fare
count	418.000000	418.000000	332.000000	418.000000	418.000000	417.000000
mean	1100.500000	2.265550	30.272590	0.447368	0.392344	35.627188
std	120.810458	0.841838	14.181209	0.896760	0.981429	55.907576
min	892.000000	1.000000	0.170000	0.000000	0.000000	0.000000
25%	996.250000	1.000000	21.000000	0.000000	0.000000	7.895800
50%	1100.500000	3.000000	27.000000	0.000000	0.000000	14.454200
75%	1204.750000	3.000000	39.000000	1.000000	0.000000	31.500000
max	1309.000000	3.000000	76.000000	8.000000	9.000000	512.329200

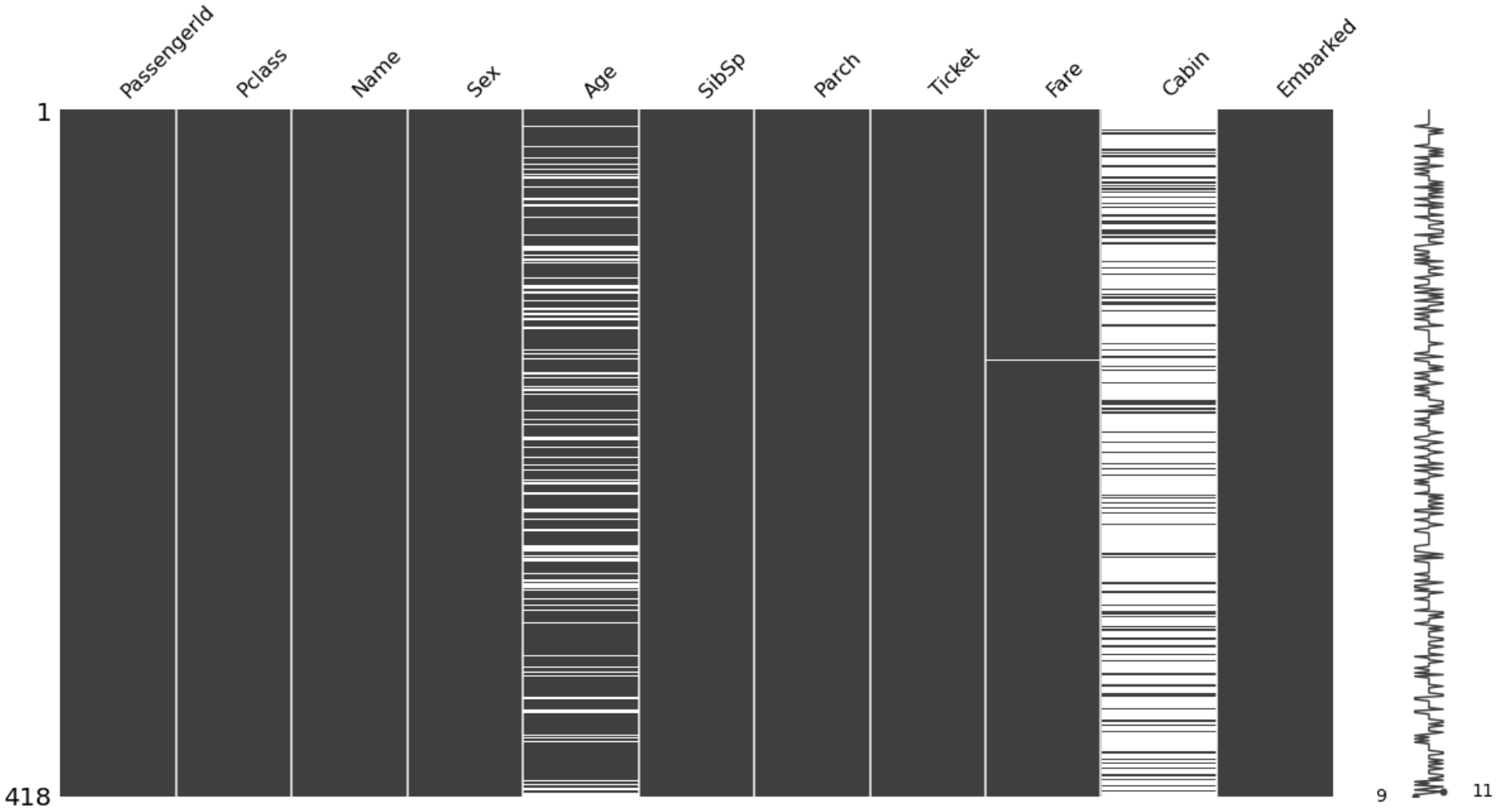
In [ ]:
```
missingno.matrix(train_data, figsize=(20,10))
```

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



In [ ]:
```
missingno.matrix(test_data, figsize=(20,10))
```

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



In [ ]:
```
cols_to_exclude = ['PassengerId', 'Name', 'Ticket', 'Cabin']

df_train = train_data.drop(cols_to_exclude, axis=1)
df_test = test_data.drop(cols_to_exclude, axis=1)
```

In [ ]:
```
df_train.head()
```

Out[ ]:

	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

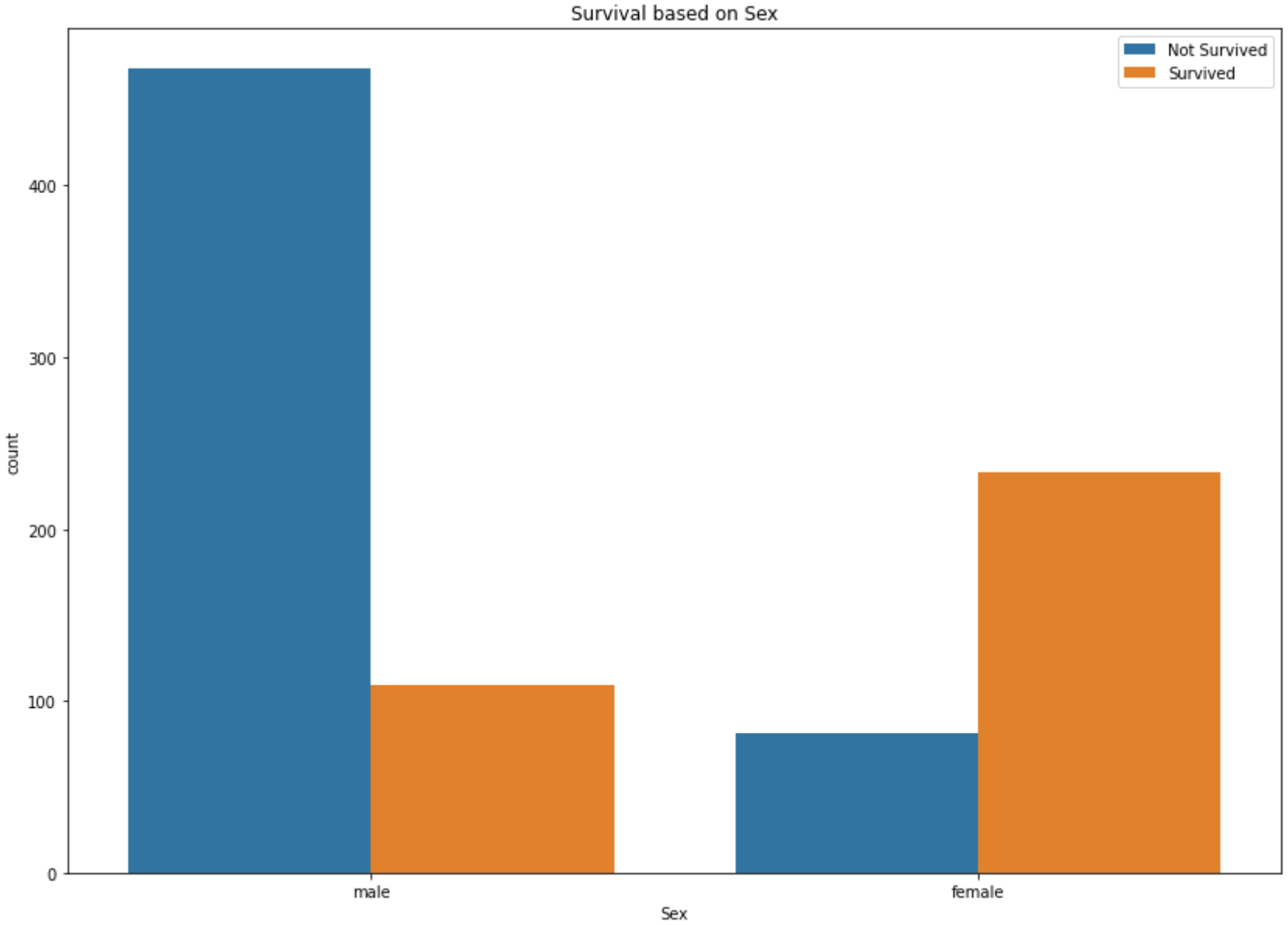
In [ ]:
```
df_test.head()
```

Out[ ]:

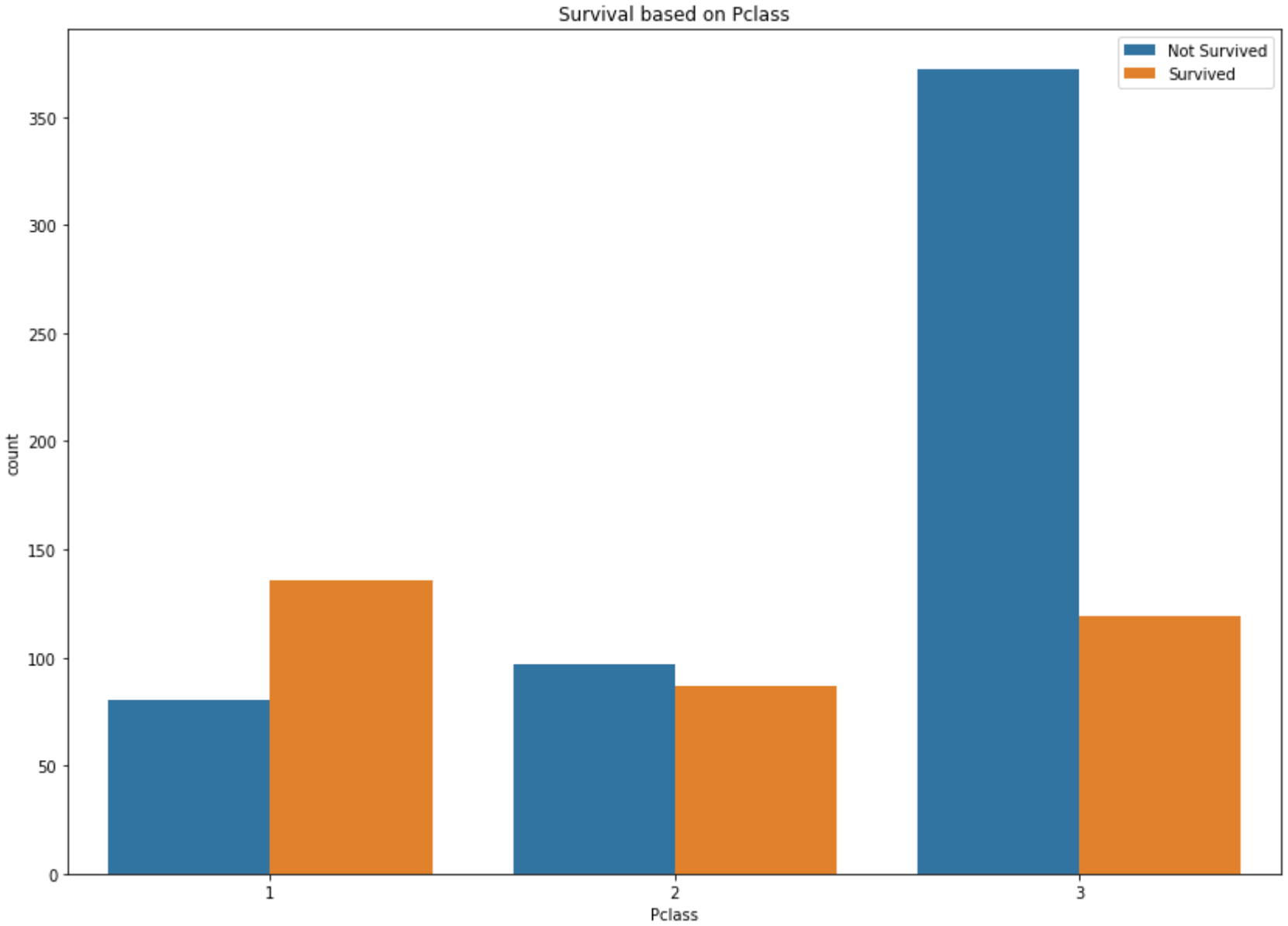
	Pclass	Sex	Age	SibSp	Parch	Fare	Embarked
0	3	male	34.5	0	0	7.8292	Q
1	3	female	47.0	1	0	7.0000	S
2	2	male	62.0	0	0	9.6875	Q
3	3	male	27.0	0	0	8.6625	S
4	3	female	22.0	1	1	12.2875	S

In [ ]:
```
# For categorical variables
def count_plot(col):

    plt.figure(figsize=(14,10))
    sns.countplot(x=col, hue='Survived', data=df_train)
    plt.legend(['Not Survived', 'Survived'], loc='upper right')
    plt.title(f'Survival based on {col}')
    plt.show()
```

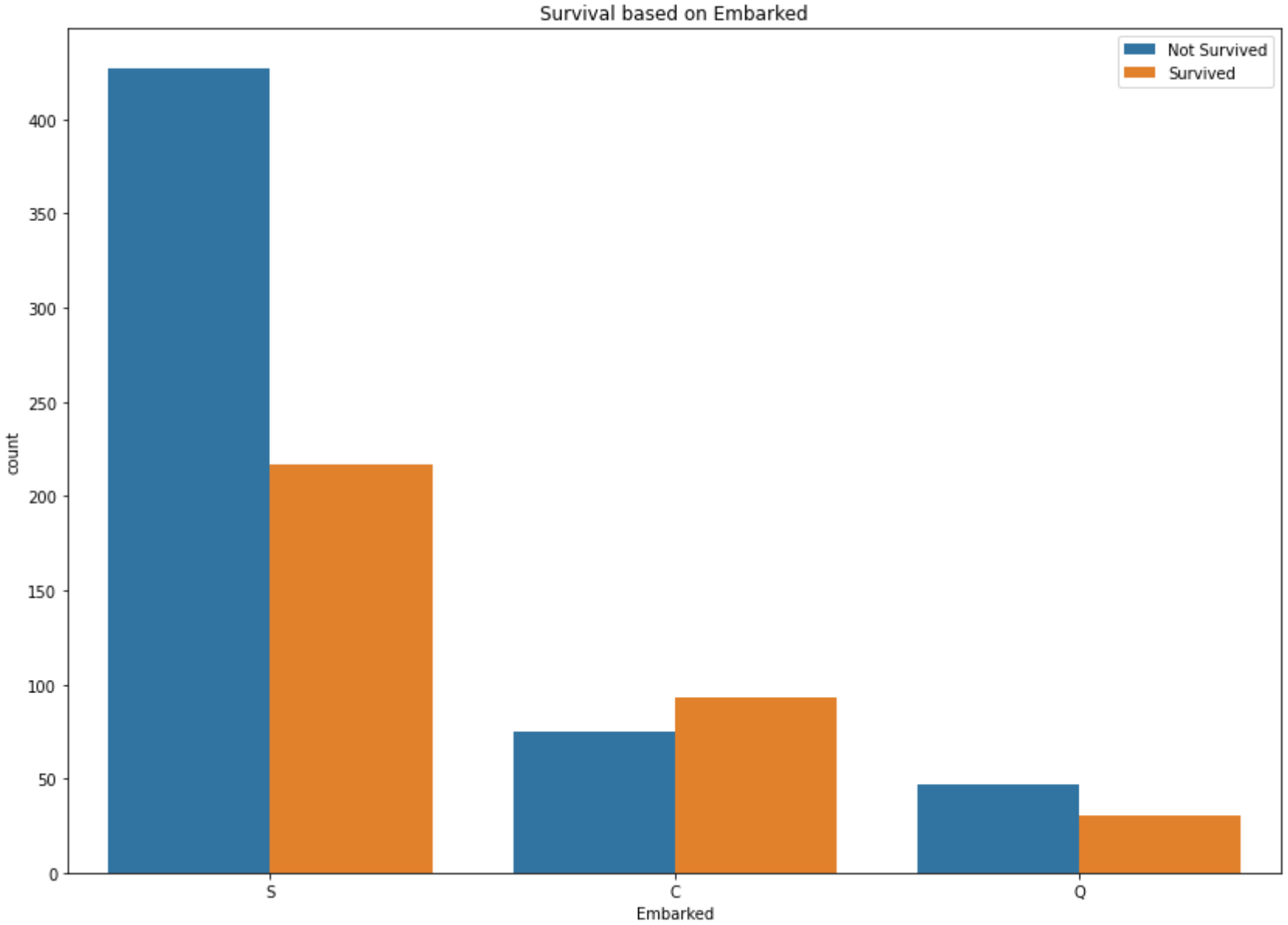
In [ ]:
```
categorical_features = ['Sex', 'Pclass', 'Embarked']

for i in categorical_features:
    count_plot(i)
    print('==========\n==========')
```


Survival based on Sex
Not Survived
Survived
400
300
200
100
0
count
male
female
Sex

==========
==========


Survival based on Pclass
Not Survived
Survived
count
0
50
100
150
200
250
300
350
1
2
3
Pclass

==========
==========

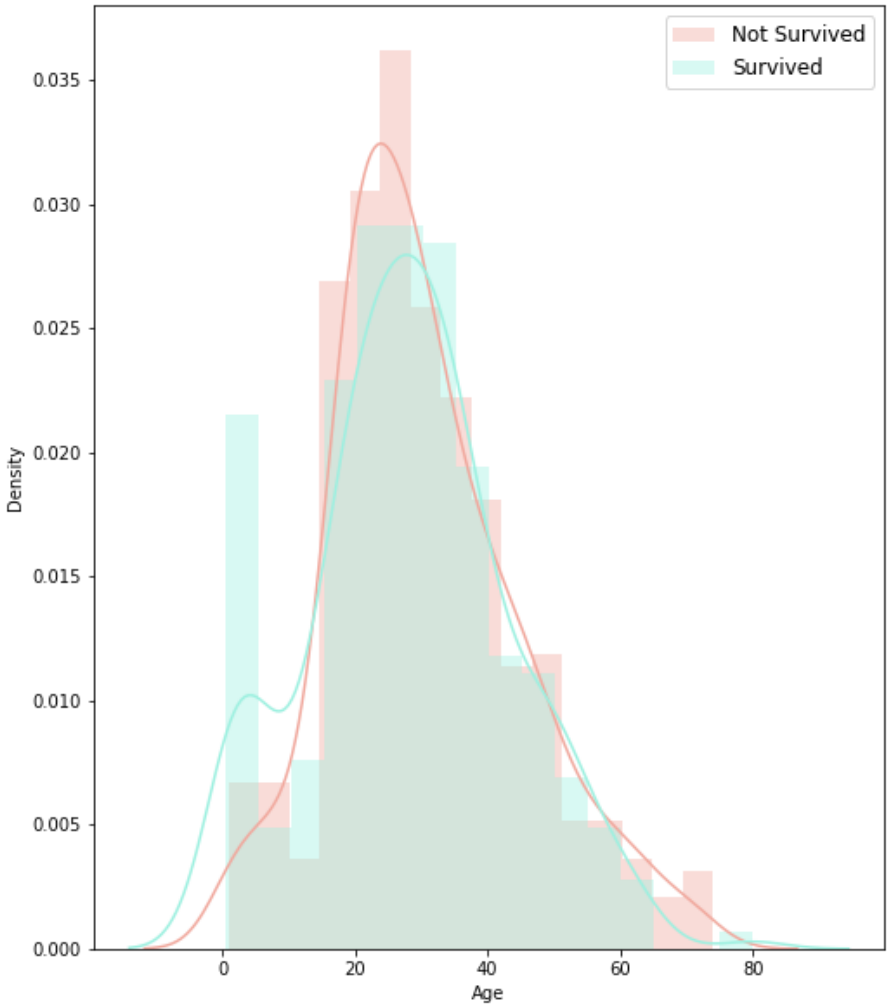


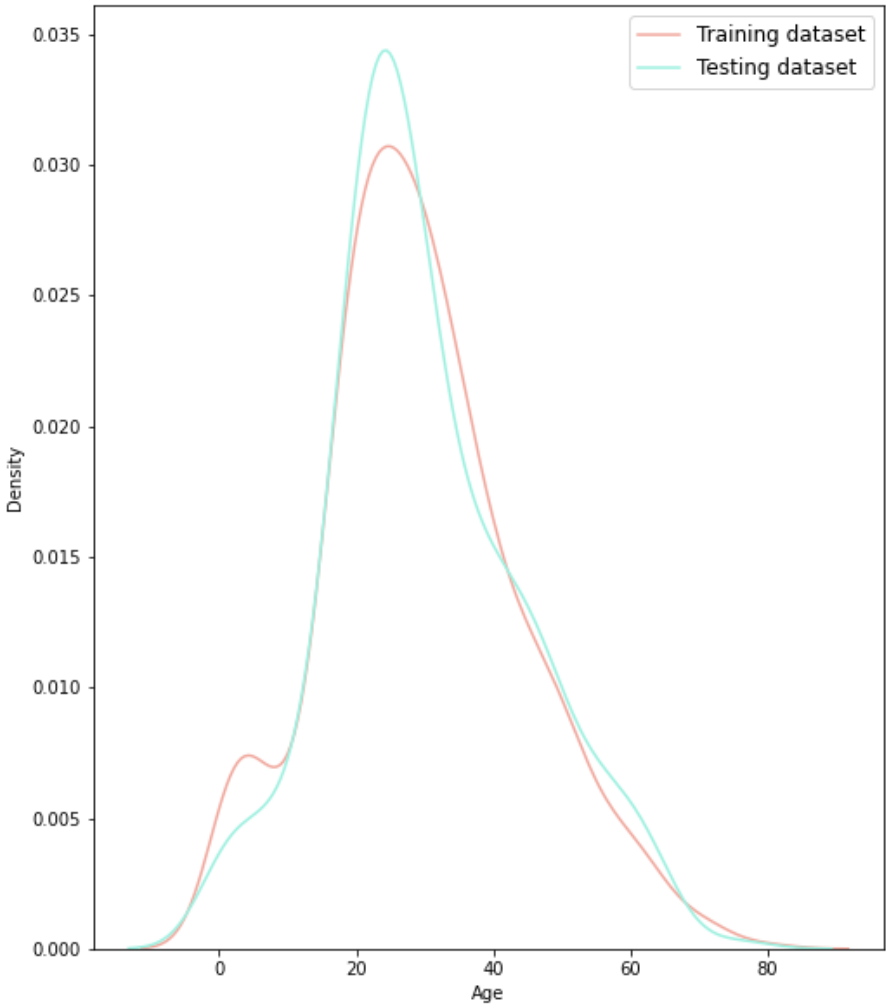
==========
==========

In [ ]:
```
def continuous_plot(col):

    fig, axs = plt.subplots(ncols=2, nrows=1, figsize=(18,10))
```

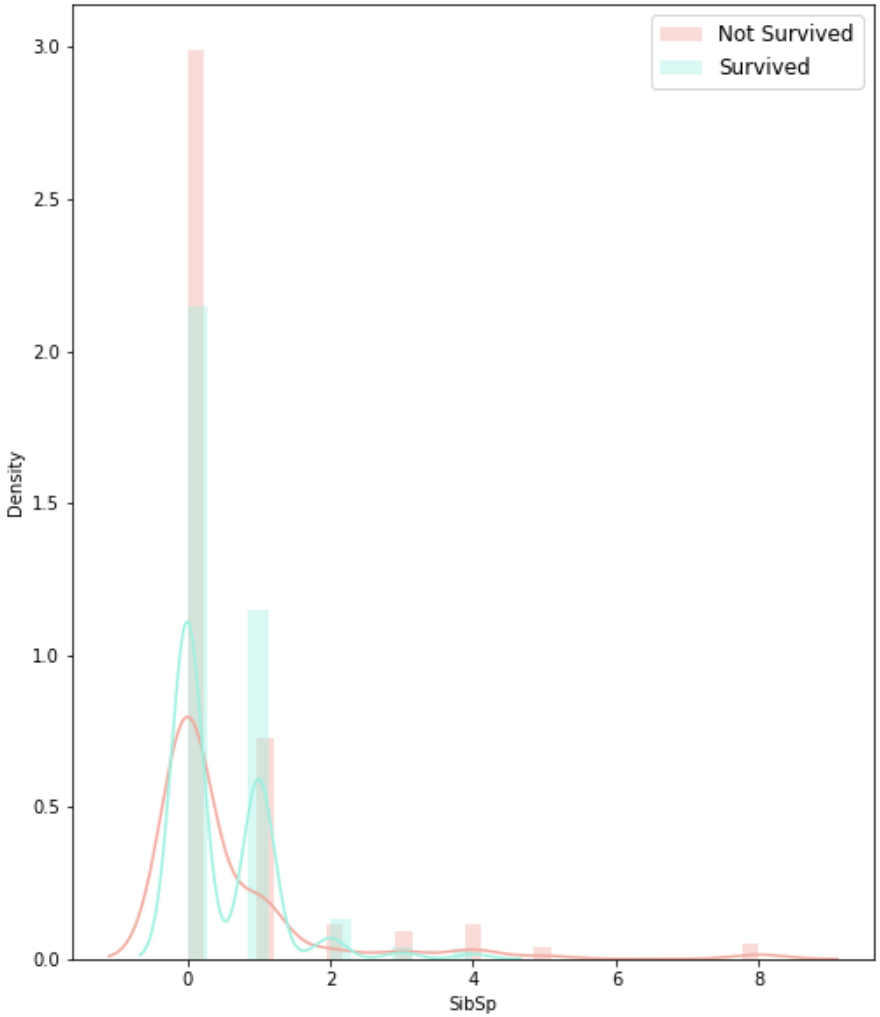
```
    sns.distplot(df_train[df_train.Survived==0][col], label='Not Survived', hist=True, color='#F1A99E', ax=axs[0])
    sns.distplot(df_train[df_train.Survived==1][col], label='Survived', hist=True, color='#9EF1E1', ax=axs[0])

    sns.distplot(df_train[col], label='Training dataset', hist=False, color='#F1A99E', ax=axs[1])
    sns.distplot(df_test[col], label='Testing dataset', hist=False, color='#9EF1E1', ax=axs[1])

    axs[0].legend(loc='upper right', prop={'size': 12})
    axs[1].legend(loc='upper right', prop={'size': 12})

    plt.show()
```

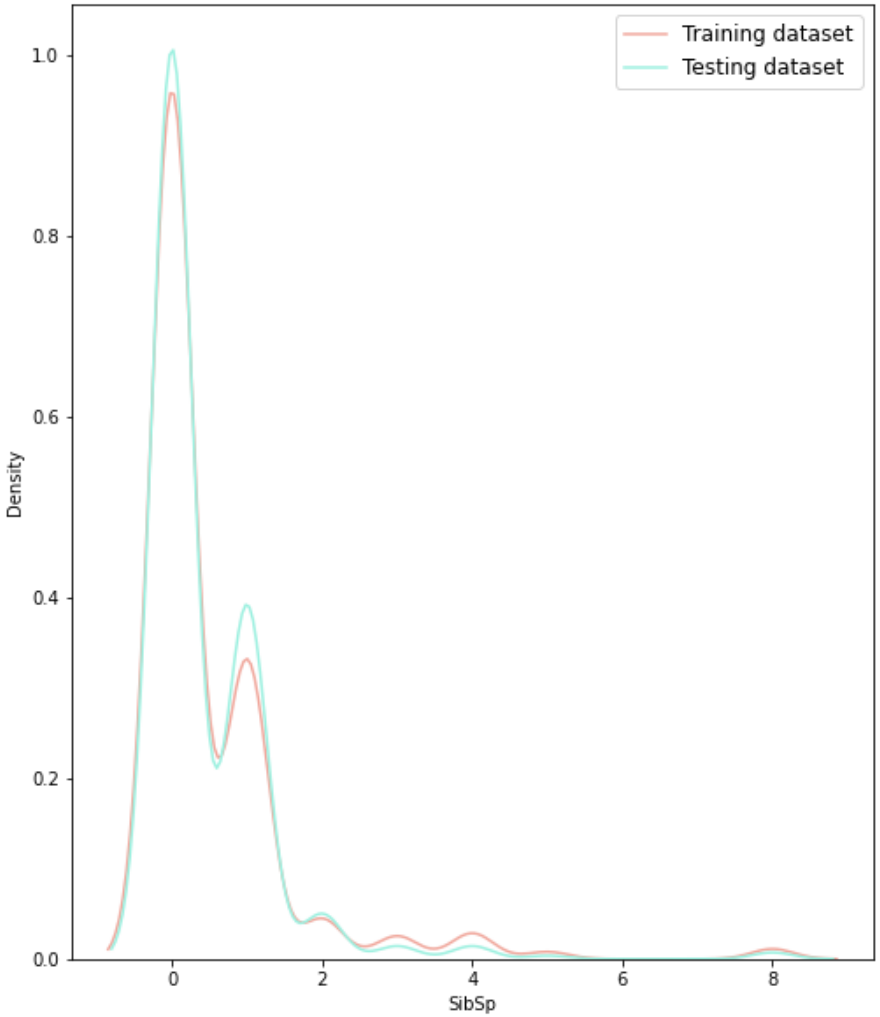
In [ ]:
```
continuous_features = ['Age', 'SibSp', 'Parch', 'Fare']

for i in continuous_features:
    continuous_plot(i)
    print('==========\n==========')
```


Not Survived
Survived
Density
Age
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.000
0
20
40
60
80

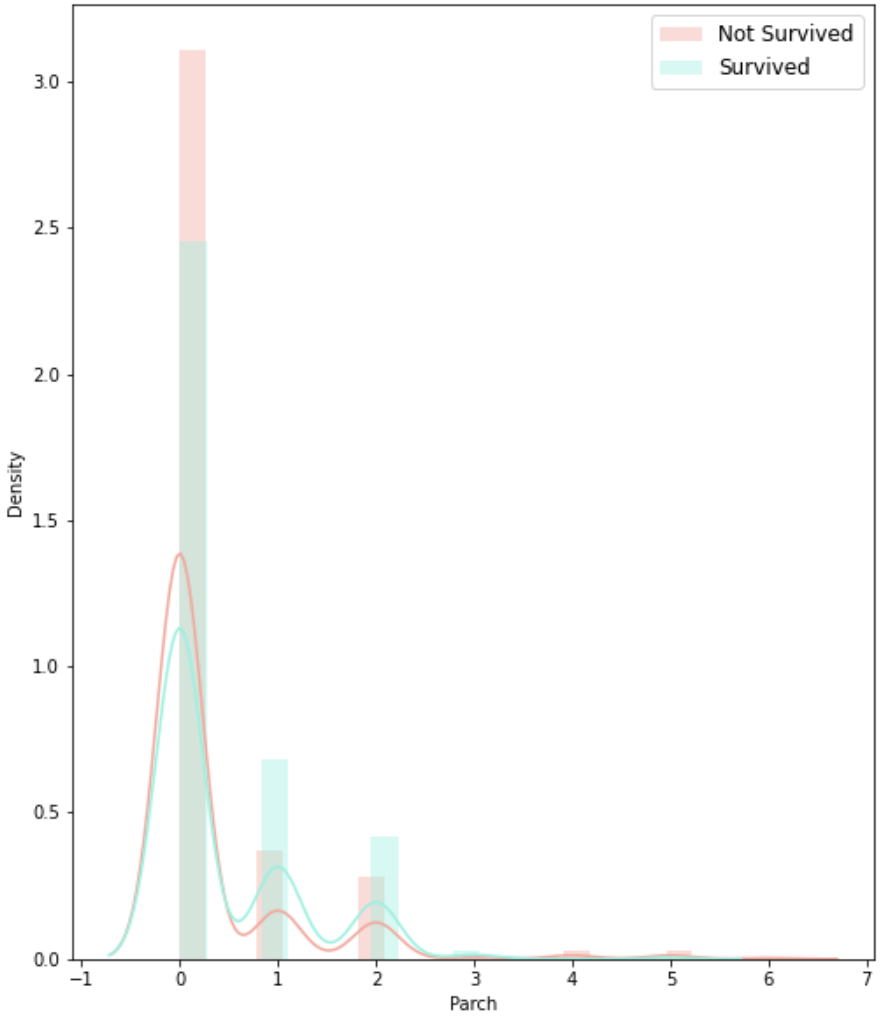

Training dataset
Testing dataset
Density
Age
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.000
0
20
40
60
80

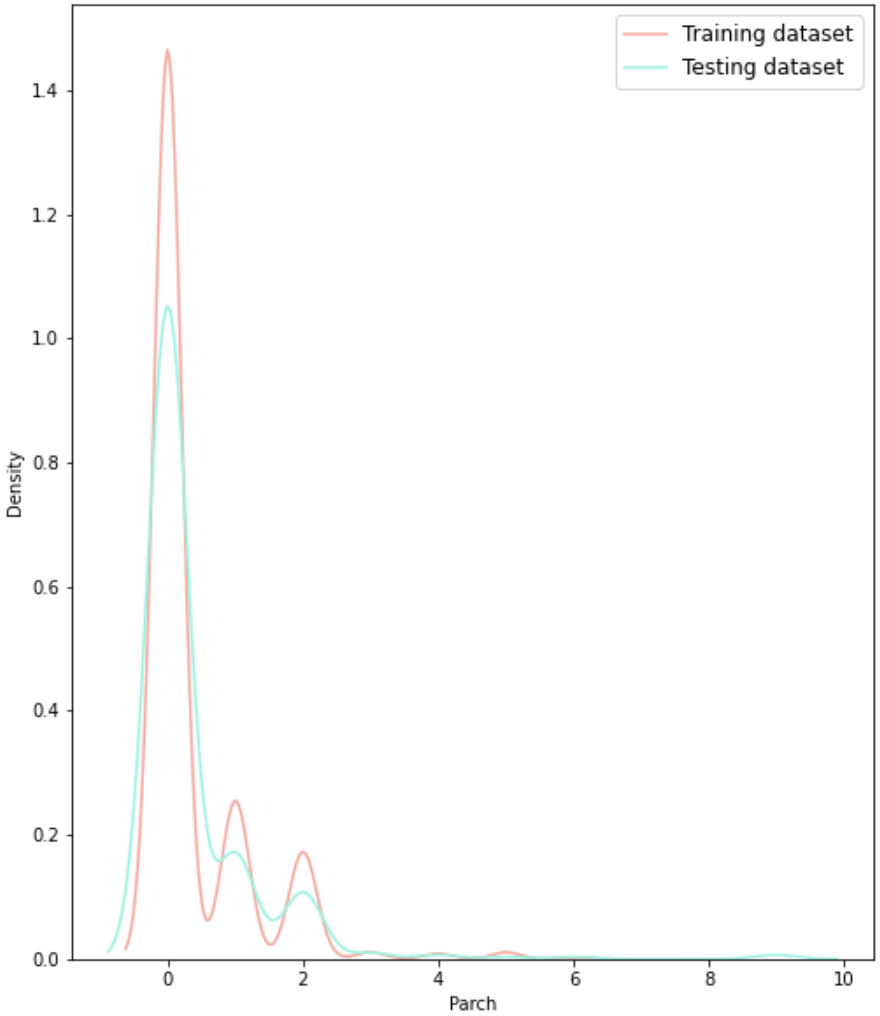
==========
==========


Not Survived
Survived
Density
SibSp
0.0
0.5
1.0
1.5
2.0
2.5
3.0
0
2
4
6
8

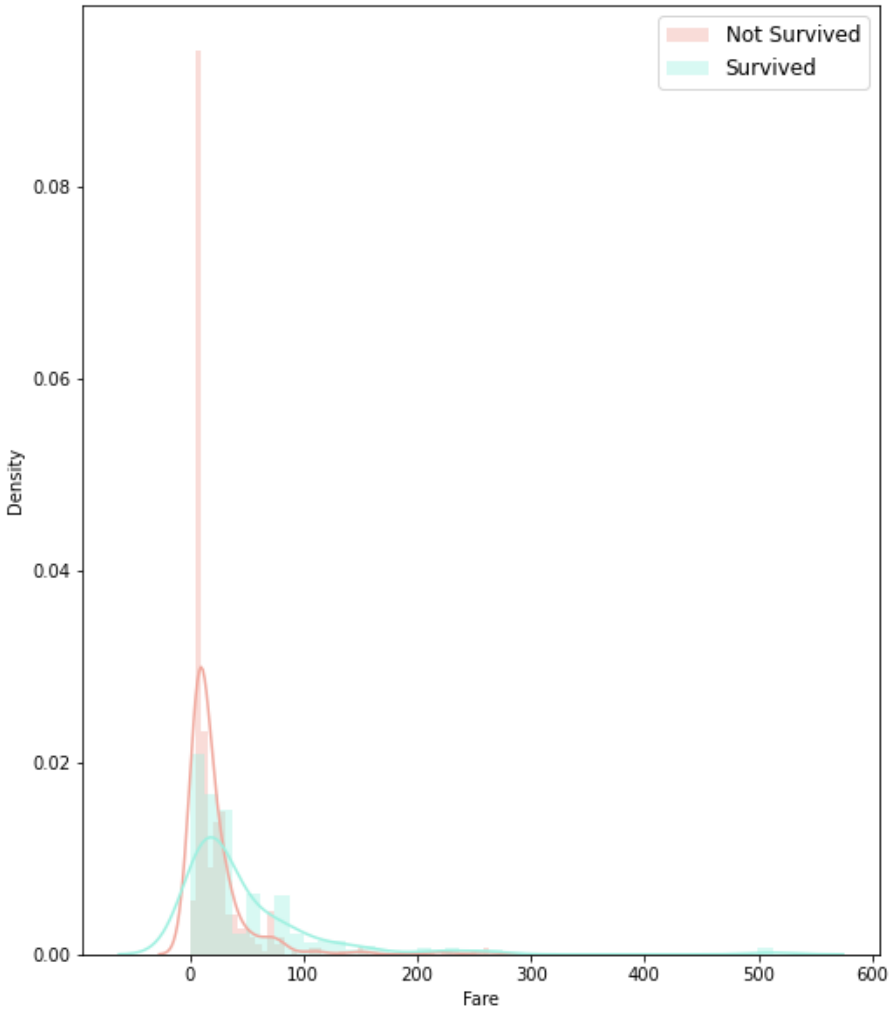

Training dataset
Testing dataset
Density
SibSp
0.0
0.2
0.4
0.6
0.8
1.0
0
2
4
6
8

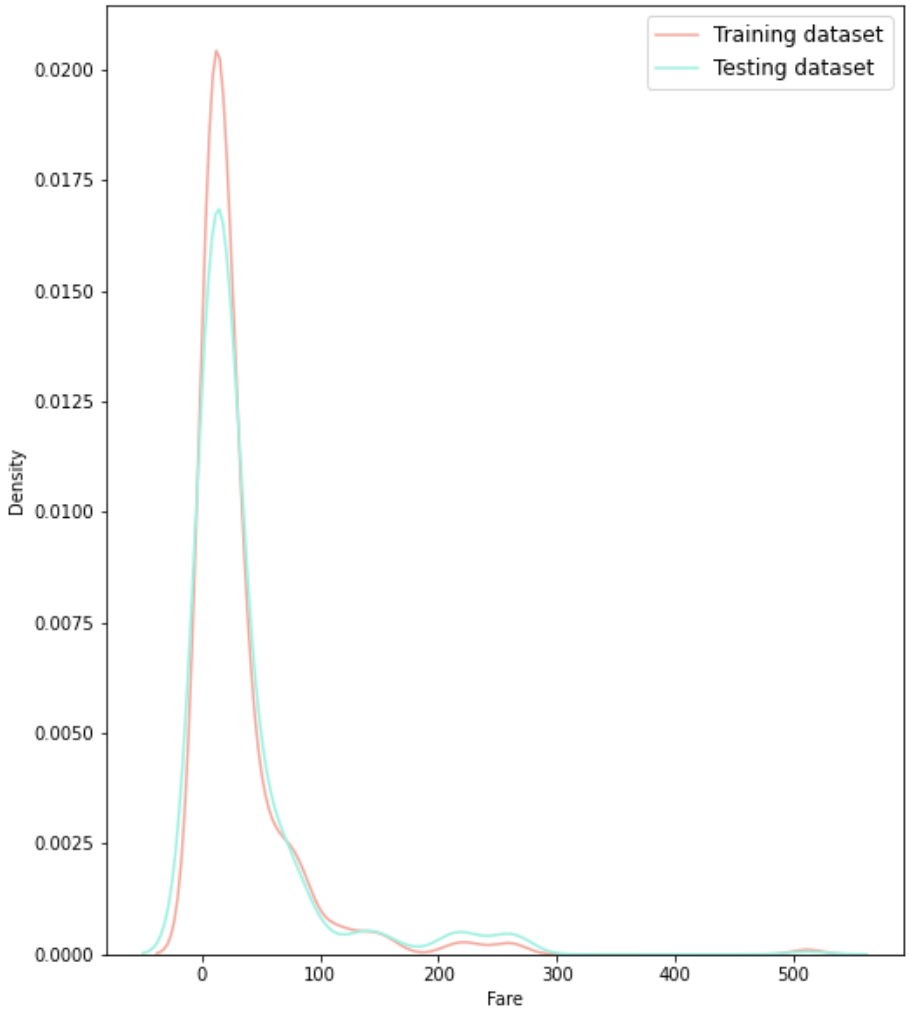
==========
==========


Not Survived
Survived
Density
Parch


Training dataset
Testing dataset
Density
Parch

==========
==========





==========
==========

Feature Engineering

Dealing with missing values

In [ ]:
```
age_without_na = df_train.Age[df_train.Age.notna()==True]
MEDIAN_AGE = np.median(age_without_na)
```

```
df_train.Age.fillna(MEDIAN_AGE, inplace=True)
df_test.Age.fillna(MEDIAN_AGE, inplace=True)
```

In [ ]:
```
df_train.isna().sum()
```

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

In [ ]:
```
df_test.isna().sum()
```

Out[ ]:
```
Pclass      0
Sex         0
Age         0
SibSp       0
Parch       0
Fare        1
Embarked    0
dtype: int64
```

In [ ]:
```
df_train.Embarked.value_counts()
```

Out[ ]:
```
S    644
C    168
Q     77
Name: Embarked, dtype: int64
```

In [ ]:
```
df_train.Embarked.fillna('S', inplace=True)
df_test.Fare.fillna(0, inplace=True)
```

Standardization and Encoding

In [ ]:
```
ss = StandardScaler()
def standardize(col):
    ss.fit(df_train[col].values.reshape(-1,1))
    df_train[col] = ss.transform(df_train[col].values.reshape(-1,1))
```

```
    df_test[col] = ss.transform(df_test[col].values.reshape(-1,1))

for i in continuous_features:
    standardize(i)

df_train.head()
```

Out[ ]:

	Survived	Pclass	Sex	Age	SibSp	Parch	Fare	Embarked
0	0	3	male	-0.565736	0.432793	-0.473674	-0.502445	S
1	1	1	female	0.663861	0.432793	-0.473674	0.786845	C
2	1	3	female	-0.258337	-0.474545	-0.473674	-0.488854	S
3	1	1	female	0.433312	0.432793	-0.473674	0.420730	S
4	0	3	male	0.433312	-0.474545	-0.473674	-0.486337	S

In [ ]:
```
le = LabelEncoder()
df_train['Embarked'] = le.fit_transform(df_train['Embarked'])
df_test['Embarked'] = le.fit_transform(df_test['Embarked'])
```

In [ ]:
```
ohe = OneHotEncoder()
ohe.fit(df_train[['Sex']])
transformed = ohe.transform(df_train[['Sex']]).toarray()
```

In [ ]:
```
df_train[['male', 'female']] = transformed
```

In [ ]:
```
test_transformed = ohe.transform(df_test[['Sex']]).toarray()
```

In [ ]:
```
df_test[['male','female']] = test_transformed
```

In [ ]:
```
df_train.drop(['Sex'], axis=1, inplace=True)
df_test.drop(['Sex'], axis=1, inplace=True)
```

Machine Learning

In [ ]:
```
X = df_train.iloc[:,1:9]
```

```
Y = df_train.iloc[:,0]

X_train, X_valid, Y_train, Y_valid = train_test_split(X, Y, test_size=0.20, random_state=1)
```

In [ ]:
```
print(X_train.shape, X_valid.shape, Y_train.shape, Y_valid.shape)
```

```
(712, 8) (179, 8) (712,) (179,)
```

In [ ]:
```
model = {'Model':[], 'Accuracy':[]}
```

Support Vector Classifier

In [ ]:
```
svc = SVC()
svc.fit(X_train, Y_train)
acc = svc.score(X_valid, Y_valid)
print(f"Accuracy with Support Vector Classifier: {acc*100:0.2f}%")
model['Model'].append('Support Vector Classifier')
model['Accuracy'].append(acc)
```

```
Accuracy with Support Vector Classifier: 79.33%
```

Random Forest Classifier

In [ ]:
```
rfc = RandomForestClassifier()
rfc.fit(X_train, Y_train)
acc = rfc.score(X_valid, Y_valid)
print(f"Accuracy with Random Forest Classifier: {acc*100:0.2f}%")
model['Model'].append('Random Forest Classifier')
model['Accuracy'].append(acc)
```

```
Accuracy with Random Forest Classifier: 78.77%
```

XGBoost Classifier

In [ ]:
```
xgb = XGBClassifier()
xgb.fit(X_train, Y_train)
acc = xgb.score(X_valid, Y_valid)
print(f"Accuracy with XGBoost Classifier: {acc*100:0.2f}%")
```

```
model['Model'].append('XGBoost Classifier')
model['Accuracy'].append(acc)
```

```
Accuracy with XGBoost Classifier: 77.65%
```

In [ ]:
```
model_df = pd.DataFrame(model)
model_df
```

Out[ ]:

	Model	Accuracy
0	Support Vector Classifier	0.793296
1	Random Forest Classifier	0.787709
2	XGBoost Classifier	0.776536

Support Vector Classifier produced the best score. So we will predict using SVC

In [ ]:
```
df_test.head(10)
```

Out[ ]:

	Pclass	Age	SibSp	Parch	Fare	Embarked	male	female
0	3	0.394887	-0.474545	-0.473674	-0.490783	1	0.0	1.0
1	3	1.355510	0.432793	-0.473674	-0.507479	2	1.0	0.0
2	2	2.508257	-0.474545	-0.473674	-0.453367	1	0.0	1.0
3	3	-0.181487	-0.474545	-0.473674	-0.474005	2	0.0	1.0
4	3	-0.565736	0.432793	0.767630	-0.401017	2	1.0	0.0
5	3	-1.180535	-0.474545	-0.473674	-0.462679	2	0.0	1.0
6	3	0.049062	-0.474545	-0.473674	-0.494810	1	1.0	0.0
7	2	-0.258337	0.432793	0.767630	-0.064516	2	0.0	1.0
8	3	-0.873136	-0.474545	-0.473674	-0.502864	0	1.0	0.0
9	3	-0.642586	1.340132	-0.473674	-0.162169	2	0.0	1.0

In [ ]:
```
predictions = svc.predict(df_test)
pd.Series(predictions).value_counts()
```

Out[ ]:
```
0    264
1    154
dtype: int64
```

In [ ]:
```
dummy_df_test = pd.read_csv('test.csv') # to get passenger ids for submission
pass_ids = dummy_df_test.iloc[:,0]
pass_ids
```

Out[ ]:
```
0       892
1       893
2       894
3       895
4       896
       ...
413    1305
414    1306
415    1307
416    1308
417    1309
Name: PassengerId, Length: 418, dtype: int64
```

In [ ]:
```
submission = pd.DataFrame({'PassengerId':pass_ids, 'Survived':predictions})
```

In [ ]:
```
# submission.to_csv('titanic_submission.csv', index=False)
```