```
In [267]: import numpy as np
          import pandas as pd
          import seaborn as sns
          from matplotlib import pyplot as plt
          %matplotlib inline
```

Load the data

```
In [268]: traindf = pd.read_csv("train.csv", encoding="utf-8")
          traindf.head()
          # sibsp: siblings / spouses aboard the Titanic
          # parch: parents / children aboard the Titanic
```

Out[268]:

	PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare	Ca
0	1	0	3	Braund, Mr. Owen Harris	male	22.0	1	0	A/5 21171	7.2500	N
1	2	1	1	Cumings, Mrs. John Bradley (Florence Briggs Th...	female	38.0	1	0	PC 17599	71.2833	C
2	3	1	3	Heikkinen, Miss. Laina	female	26.0	0	0	STON/O2. 3101282	7.9250	N
3	4	1	1	Futrelle, Mrs. Jacques Heath (Lily May Peel)	female	35.0	1	0	113803	53.1000	C1
4	5	0	3	Allen, Mr. William Henry	male	35.0	0	0	373450	8.0500	N

```
In [269]: testdf = pd.read_csv("test.csv", encoding="utf-8")
          testdf.head()
```

Out[269]:

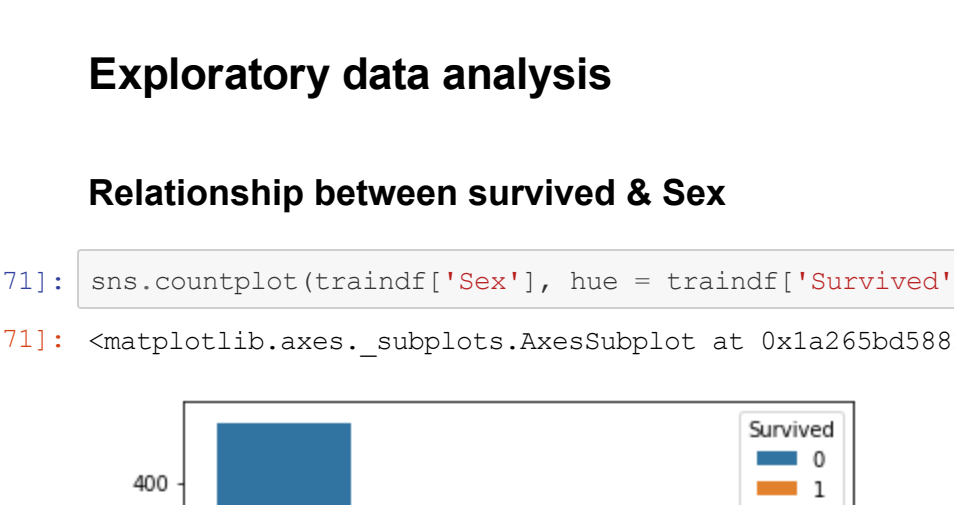
	PassengerId	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare	Cabin	Embark
0	892	3	Kelly, Mr. James	male	34.5	0	0	330911	7.8292	NaN	
1	893	3	Wilkes, Mrs. James (Ellen Needs)	female	47.0	1	0	363272	7.0000	NaN	
2	894	2	Myles, Mr. Thomas Francis	male	62.0	0	0	240276	9.6875	NaN	
3	895	3	Wirz, Mr. Albert	male	27.0	0	0	315154	8.6625	NaN	
4	896	3	Hirvonen, Mrs. Alexander (Helga E Lindqvist)	female	22.0	1	1	3101298	12.2875	NaN	

```
In [270]: print(traindf.shape)
          print(testdf.shape)

(891, 12)
(418, 11)
```

Exploratory data analysis

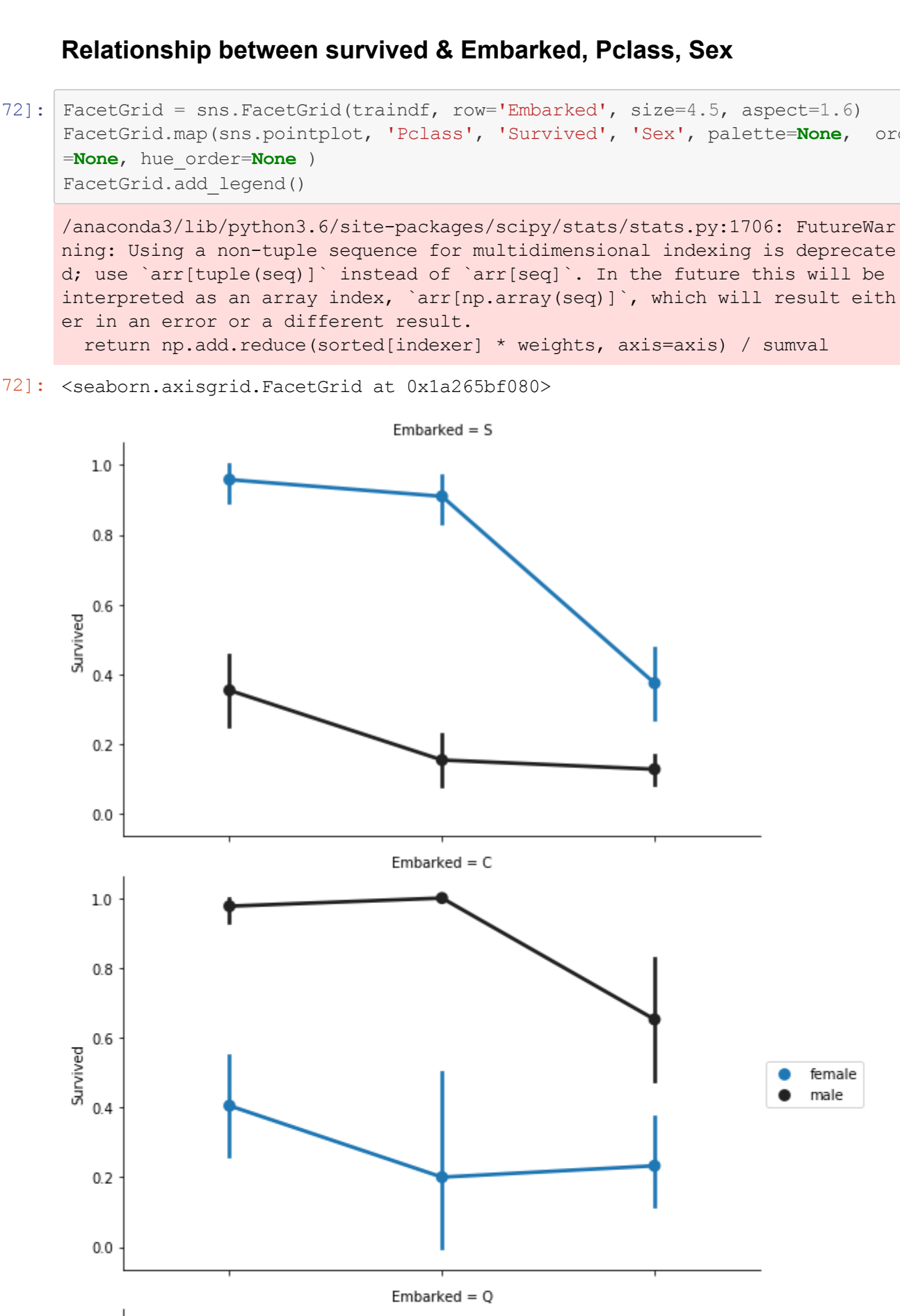
Relationship between survived & Sex

```
In [271]: sns.countplot(traindf['Sex'], hue = traindf['Survived'])

Out[271]: <matplotlib.axes._subplots.AxesSubplot at 0x1a265bd588>
```



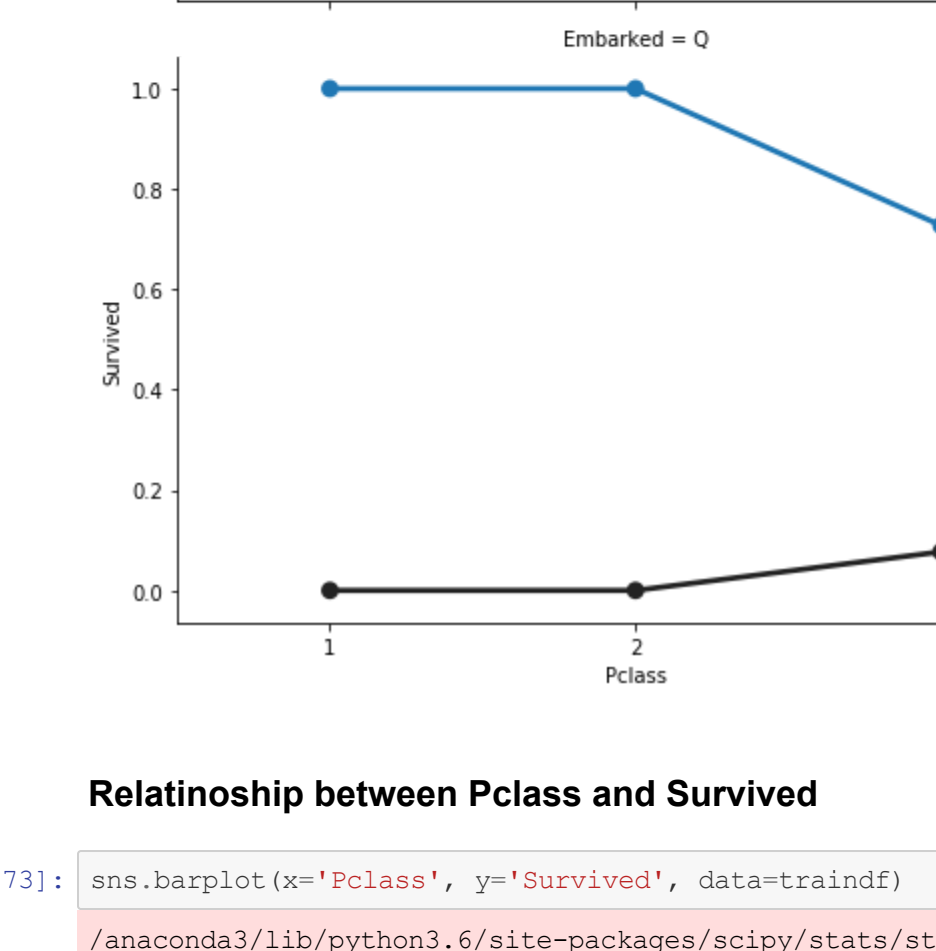
Relationship between survived & Embarked, Pclass, Sex

```
In [272]: FacetGrid = sns.FacetGrid(traindf, row="Embarked", size=4.5, aspect=1.6)
          FacetGrid.map(sns.pointplot, 'Pclass', 'Survived', 'Sex', palette=None, order
          =None, hue_order=None )
          FacetGrid.add_legend()

/anaconda3/lib/python3.6/site-packages/scipy/stats/stats.py:1706: FutureWarning: Using a non-tuple sequence for multidimensional indexing is deprecated; use `arr[tuple(seq)]` instead of `arr[seq]`. In the future this will be interpreted as an array index, `arr[np.array(seq)]`, which will result either in an error or a different result.
  return np.add.reduce(sorted[indexer] * weights, axis=axis) / sumval

Out[272]: <seaborn.axisgrid.FacetGrid at 0x1a265bf080>
```



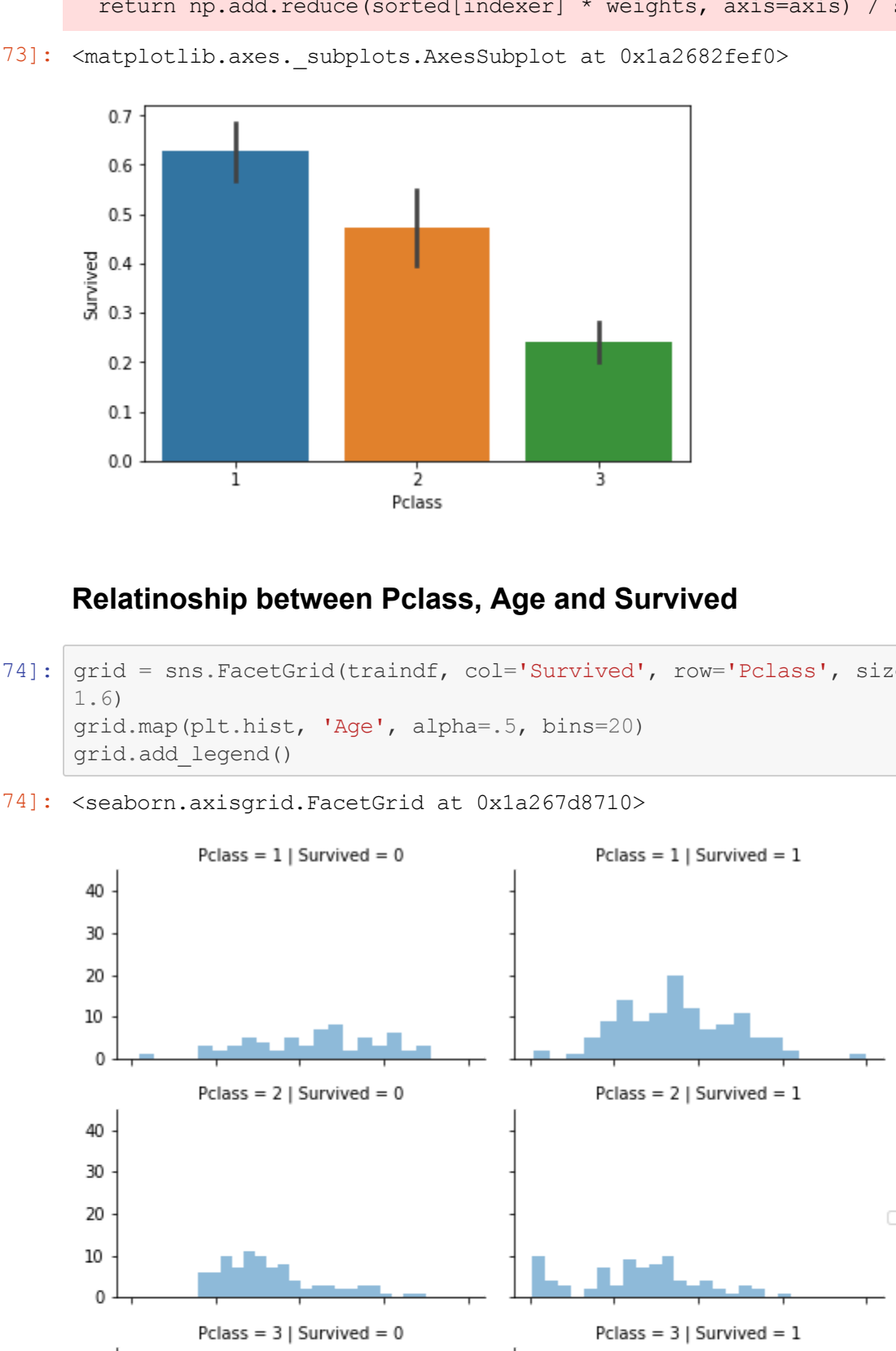
Relationship between Pclass and Survived

```
In [273]: sns.barplot(x='Pclass', y='Survived', data=traindf)

/anaconda3/lib/python3.6/site-packages/scipy/stats/stats.py:1706: FutureWarning: Using a non-tuple sequence for multidimensional indexing is deprecated; use `arr[tuple(seq)]` instead of `arr[seq]`. In the future this will be interpreted as an array index, `arr[np.array(seq)]`, which will result either in an error or a different result.
  return np.add.reduce(sorted[indexer] * weights, axis=axis) / sumval

Out[273]: <matplotlib.axes._subplots.AxesSubplot at 0x1a2682fef0>
```



Relationship between Pclass, Age and Survived

```
In [274]: grid = sns.FacetGrid(traindf, col='Survived', row='Pclass', size=2.2, aspect=1.6)
          grid.map(plt.hist, 'Age', alpha=.5, bins=20)
          grid.add_legend()

Out[274]: <seaborn.axisgrid.FacetGrid at 0x1a267d8710>
```



Handle Missing Values

Concat traindf & testdf

```
In [275]: df = traindf.append(testdf)
          df = df.drop('Survived',axis=1)
          print(df.shape)

(1309, 11)
```

```
In [276]: df.info()

<class 'pandas.core.frame.DataFrame'>
Int64Index: 1309 entries, 0 to 417
Data columns (total 11 columns):
Age            1046 non-null float64
Cabin          295 non-null object
Embarked       1307 non-null object
Fare           1308 non-null float64
Name           1309 non-null object
Parch          1309 non-null int64
PassengerId    1309 non-null int64
Pclass         1309 non-null int64
Sex            1309 non-null object
SibSp          1309 non-null int64
Ticket         1309 non-null object
dtypes: float64(2), int64(4), object(5)
memory usage: 122.7+ KB
```

```
In [277]: df.describe(include = 'all')
```

Out[277]:

	Age	Cabin	Embarked	Fare	Name	Parch	PassengerId	
count	1046.000000	295	1307	1308.000000	1309	1309.000000	1309.000000	1309.
unique	NaN	186	3	NaN	1307	NaN	NaN	
top	NaN	C23 C25 C27	S	NaN	Connolly, Miss. Kate	NaN	NaN	
freq	NaN	6	914	NaN	2	NaN	NaN	
mean	29.881138	NaN	NaN	33.295479	NaN	0.385027	655.000000	2.
std	14.413493	NaN	NaN	51.758668	NaN	0.865560	378.020061	0.
min	0.170000	NaN	NaN	0.000000	NaN	0.000000	1.000000	1.
25%	21.000000	NaN	NaN	7.895800	NaN	0.000000	328.000000	2.
50%	28.000000	NaN	NaN	14.454200	NaN	0.000000	655.000000	3.
75%	39.000000	NaN	NaN	31.275000	NaN	0.000000	982.000000	3.
max	80.000000	NaN	NaN	512.329200	NaN	9.000000	1309.000000	3.

```
In [278]: df.isna().sum()

Out[278]: Age             263
          Cabin          1014
          Embarked          2
          Fare              1
          Name              0
          Parch             0
          PassengerId       0
          Pclass            0
          Sex               0
          SibSp             0
          Ticket            0
          dtype: int64
```

```
In [279]: total = df.isna().sum().sort_values(ascending=False)
          percent_1 = df.isna().sum()/df.isna().count()*100
          percent_2 = (round(percent_1, 1))
```

```
In [280]: missing_data = pd.concat([total, percent_2], axis=1, keys=['Total', '%'])
          missing_data
```

Out[280]:

	Total	%
Age	263	20.09
Cabin	1014	77.46
Embarked	2	0.15
Fare	1	0.08
Name	0	0.00
Parch	0	0.00
PassengerId	0	0.00
Pclass	0	0.00
Sex	0	0.00
SibSp	0	0.00
Ticket	0	0.00

Fill missing value- numerical

```
In [281]: # fill numerica missing values with median
```

```
In [282]: med = df.median()
          df = df.fillna(med) # Only apply to columns belong to numerical type
          df.isna().sum()

Out[282]: Age               0
          Cabin          1014
          Embarked          2
          Fare              0
          Name              0
          Parch             0
          PassengerId       0
          Pclass            0
          Sex               0
          SibSp             0
          Ticket            0
          dtype: int64
```

Fill missing value- categorical

```
In [283]: # fill missing value(Embarked) with the most common one
```

```
In [284]: df["Embarked"].value_counts()

Out[284]: S    914
          C    270
          Q    123
          Name: Embarked, dtype: int64
```

```
In [285]: most = df["Embarked"].value_counts().idxmax()
          most

Out[285]: 'S'
```

```
In [286]: df["Embarked"] = df["Embarked"].fillna(most)
          df.isna().sum()

Out[286]: Age               0
          Cabin          1014
          Embarked          0
          Fare              0
          Name              0
          Parch             0
          PassengerId       0
          Pclass            0
          Sex               0
          SibSp             0
          Ticket            0
          dtype: int64
```

One-Hot Encoding

```
In [287]: dummy = pd.get_dummies(df["Embarked"])
          df = pd.concat([df, dummy], axis=1)
          df.head()
```

Out[287]:

	Age	Cabin	Embarked	Fare	Name	Parch	PassengerId	Pclass	Sex	SibSp	Ti
0	22.0	NaN	S	7.2500	Braund, Mr. Owen Harris	0	1	3	male	1	2
1	38.0	C85	C	71.2833	Cumings, Mrs. John Bradley (Florence Briggs Th...	0	2	1	female	1	PC 1
2	26.0	NaN	S	7.9250	Heikkinen, Miss. Laina	0	3	3	female	0	STON 310
3	35.0	C123	S	53.1000	Futrelle, Mrs. Jacques Heath (Lily May Peel)	0	4	1	female	1	113
4	35.0	NaN	S	8.0500	Allen, Mr. William Henry	0	5	3	male	0	373

```
In [288]: dummy = pd.get_dummies(df["Sex"])
          df = pd.concat([df, dummy], axis=1)
          df.head()
```

Out[288]:

	Age	Cabin	Embarked	Fare	Name	Parch	PassengerId	Pclass	Sex	SibSp	Ti
0	22.0	NaN	S	7.2500	Braund, Mr. Owen Harris	0	1	3	male	1	2
1	38.0	C85	C	71.2833	Cumings, Mrs. John Bradley (Florence Briggs Th...	0	2	1	female	1	PC 1
2	26.0	NaN	S	7.9250	Heikkinen, Miss. Laina	0	3	3	female	0	STON 310
3	35.0	C123	S	53.1000	Futrelle, Mrs. Jacques Heath (Lily May Peel)	0	4	1	female	1	113
4	35.0	NaN	S	8.0500	Allen, Mr. William Henry	0	5	3	male	0	373

```
In [289]: # Name -> title
```

```
In [290]: def nameflow(s):
              return s.split(",")[-1].split(".")[0].replace(" ", "")

          df["title"] = df["Name"].apply(nameflow)
          df.head()
```

Out[290]:

	Age	Cabin	Embarked	Fare	Name	Parch	PassengerId	Pclass	Sex	SibSp	Ti
0	22.0	NaN	S	7.2500	Braund, Mr. Owen Harris	0	1	3	male	1	2
1	38.0	C85	C	71.2833	Cumings, Mrs. John Bradley (Florence Briggs Th...	0	2	1	female	1	PC 1
2	26.0	NaN	S	7.9250	Heikkinen, Miss. Laina	0	3	3	female	0	STON 310
3	35.0	C123	S	53.1000	Futrelle, Mrs. Jacques Heath (Lily May Peel)	0	4	1	female	1	113
4	35.0	NaN	S	8.0500	Allen, Mr. William Henry	0	5	3	male	0	373

```
In [291]: df["title"].value_counts()

Out[291]: Mr             757
          Miss           260
          Mrs            197
          Master          61
          Dr               8
          Rev              8
          Col              4
          Ms               2
          Major            2
          Mlle             2
          Capt             1
          Lady             1
          theCountess      1
          Jonkheer         1
          Mme              1
          Dona             1
          Sir              1
          Don              1
          Name: title, dtype: int64
```

```
In [292]: # pd.crosstab(df["Survived"], traindf["Name"].apply(nameflow))
```

```
In [293]: def nameflow(s):
              s = s.split(",")[-1].split(".")[0].replace(" ", "")
              saved = ["Mr", "Mrs","Miss"]
              if s in saved:
                  return s
              else:
                  return "X"
          s = df["Name"].apply(nameflow)
          s.head(10)

Out[293]: 0      Mr
          1     Mrs
          2    Miss
          3     Mrs
          4      Mr
          5      Mr
          6      Mr
          7       X
          8     Mrs
          9     Mrs
          Name: Name, dtype: object
```

```
In [294]: pd.set_option('display.max_columns', 50)
```

```
In [295]: dummy = pd.get_dummies(s)
          df = pd.concat([df, dummy], axis=1)
          df.head()
```

Out[295]:

	Age	Cabin	Embarked	Fare	Name	Parch	PassengerId	Pclass	Sex	SibSp	Ti
0	22.0	NaN	S	7.2500	Braund, Mr. Owen Harris	0	1	3	male	1	2
1	38.0	C85	C	71.2833	Cumings, Mrs. John Bradley (Florence Briggs Th...	0	2	1	female	1	PC 1
2	26.0	NaN	S	7.9250	Heikkinen, Miss. Laina	0	3	3	female	0	STON 310
3	35.0	C123	S	53.1000	Futrelle, Mrs. Jacques Heath (Lily May Peel)	0	4	1	female	1	113
4	35.0	NaN	S	8.0500	Allen, Mr. William Henry	0	5	3	male	0	373

Drop Columns

```
In [296]: df.columns

Out[296]: Index(['Age', 'Cabin', 'Embarked', 'Fare', 'Name', 'Parch', 'PassengerId',
                 'Pclass', 'Sex', 'SibSp', 'Ticket', 'C', 'Q', 'S', 'female', 'male',
                 'title', 'Miss', 'Mr', 'Mrs', 'X'],
                dtype='object')
```

```
In [297]: df = df.drop(['PassengerId', 'Name', 'Sex', 'Ticket', 'Cabin', 'Embarked', 'X'
          ,'title'], axis=1)
          df.head()
```

Out[297]:

	Age	Fare	Parch	Pclass	SibSp	C	Q	S	female	male	Miss	Mr	Mrs
0	22.0	7.2500	0	3	1	0	0	1	0	1	0	1	0
1	38.0	71.2833	0	1	1	1	0	0	1	0	0	0	1
2	26.0	7.9250	0	3	0	0	0	1	1	0	1	0	0
3	35.0	53.1000	0	1	1	0	0	1	1	0	0	0	1
4	35.0	8.0500	0	3	0	0	0	1	0	1	0	1	0

create new feature

```
In [298]: # Combine SibSp and Parch as a new feature called "relatives"
          #df['relatives'] = df['SibSp'] + df['Parch']
          #df.loc[df['relatives'] > 0, 'not_alone'] = 0
          #df.loc[df['relatives'] == 0, 'not_alone'] = 1
          #df['not_alone'] = df['not_alone'].astype(int)
```

```
In [299]: # To show people who have relatives
          # 1 : Have relatives
          # 0 : Not have relatives

          #df['not_alone'].value_counts()
```

```
In [300]: df.head()
```

Out[300]:

	Age	Fare	Parch	Pclass	SibSp	C	Q	S	female	male	Miss	Mr	Mrs
0	22.0	7.2500	0	3	1	0	0	1	0	1	0	1	0
1	38.0	71.2833	0	1	1	1	0	0	1	0	0	0	1
2	26.0	7.9250	0	3	0	0	0	1	1	0	1	0	0
3	35.0	53.1000	0	1	1	0	0	1	1	0	0	0	1
4	35.0	8.0500	0	3	0	0	0	1	0	1	0	1	0

Split df into train_df and test_df

```
In [301]: df_train = df[:len(traindf)]
          df_test = df[len(traindf):]
```

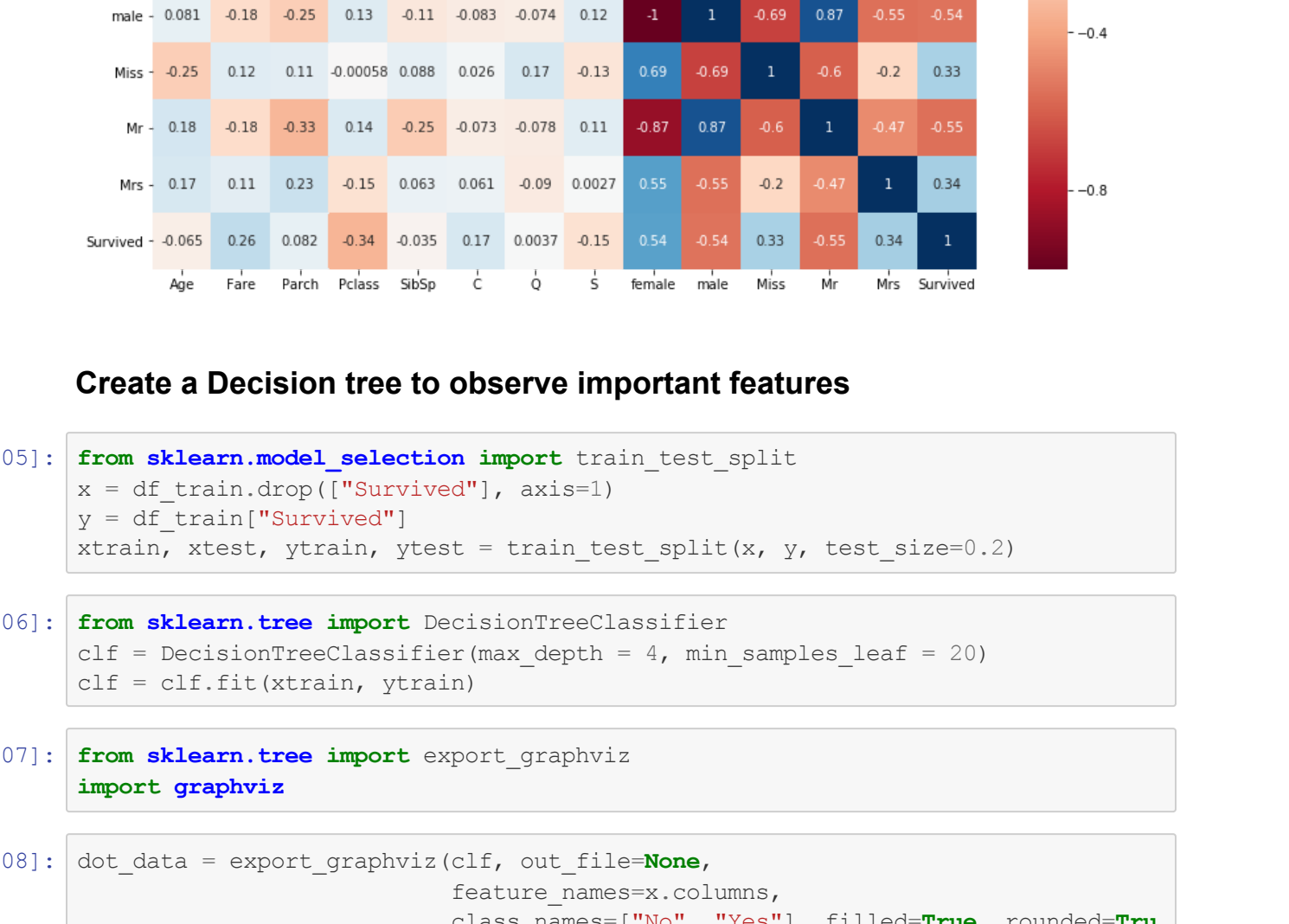
```
In [302]: df_train['Survived'] = traindf['Survived']
          df_train.head()

/anaconda3/lib/python3.6/site-packages/ipykernel_launcher.py:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/stable/indexing.html#indexing-view-versus-copy
  """Entry point for launching an IPython kernel.
```

Out[302]:

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

Correlation of Features

```
In [304]: plt.figure(figsize=(14, 11))
          sns.heatmap(df_train.corr(), annot=True, cmap="RdBu")
          plt.title('Correlation of Features', y=1.05, size=15)

Out[304]: Text(0.5,1.05,'Correlation of Features')
```



Create a Decision tree to observe important features

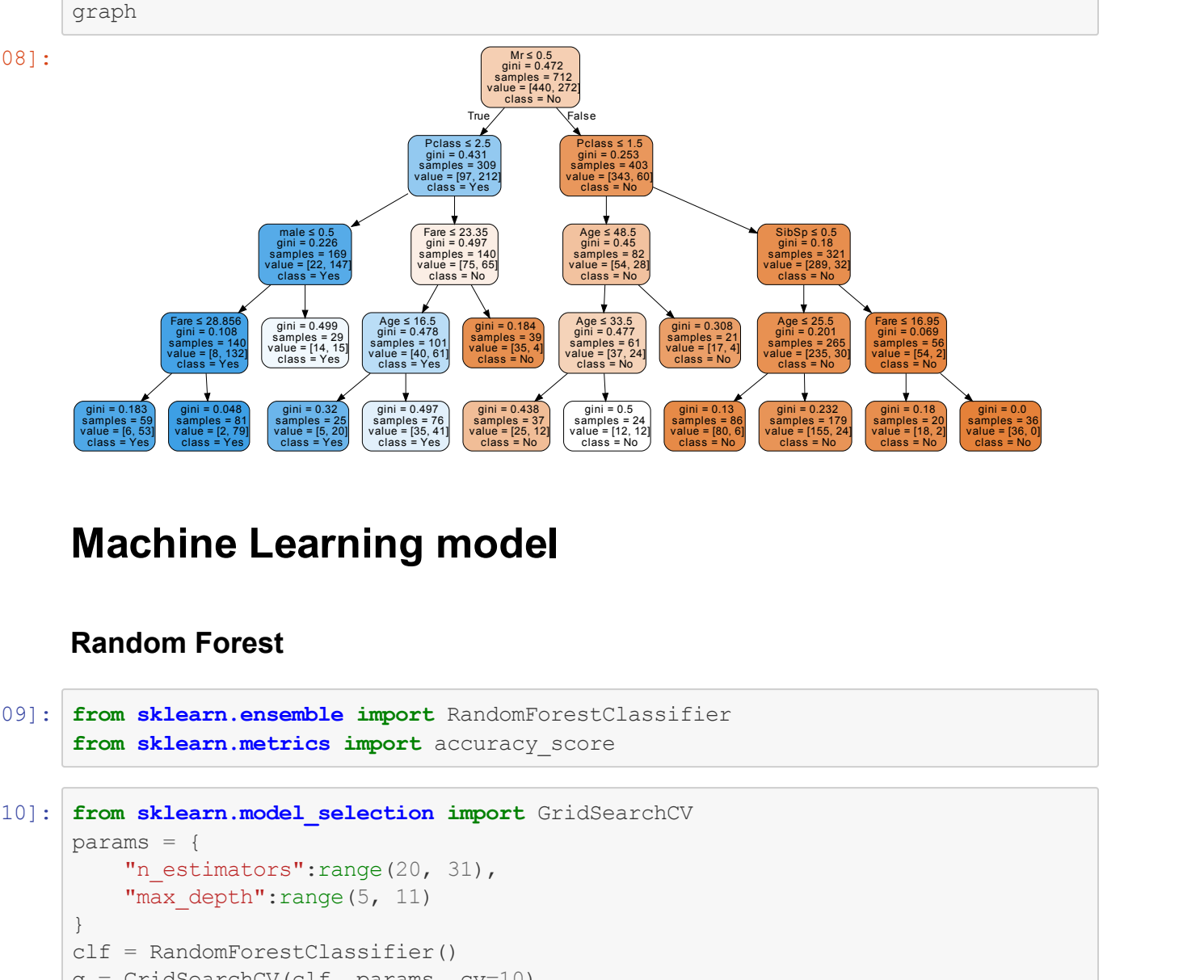
```
In [305]: from sklearn.model_selection import train_test_split
          x = df_train.drop(["Survived"], axis=1)
          y = df_train["Survived"]
          xtrain, xtest, ytrain, ytest = train_test_split(x, y, test_size=0.2)
```

```
In [306]: from sklearn.tree import DecisionTreeClassifier
          clf = DecisionTreeClassifier(max_depth = 4, min_samples_leaf = 20)
          clf = clf.fit(xtrain, ytrain)
```

```
In [307]: from sklearn.tree import export_graphviz
          import graphviz
```

```
In [308]: dot_data = export_graphviz(clf, out_file=None,
                                     feature_names=x.columns,
                                     class_names=["No", "Yes"], filled=True, rounded=Tru
          e, special_characters=True)
          graph = graphviz.Source(dot_data)
          graph
```

Out[308]:



Machine Learning model

Random Forest

```
In [309]: from sklearn.ensemble import RandomForestClassifier
          from sklearn.metrics import accuracy_score
```

```
In [310]: from sklearn.model_selection import GridSearchCV
          params = {
              "n_estimators":range(20, 31),
              "max_depth":range(5, 11)
          }
          clf = RandomForestClassifier()
          g = GridSearchCV(clf, params, cv=10)
          g.fit(x, y)
          print(g.best_params_)
          print(g.best_score_)

{'max_depth': 6, 'n_estimators': 26}
0.8383838383838383
```

```
In [312]: clf = RandomForestClassifier(max_depth= 6, n_estimators= 26)
          clf.fit(x, y)

Out[312]: RandomForestClassifier(bootstrap=True, class_weight=None, criterion='gini',
                      max_depth=6, max_features='auto', max_leaf_nodes=None,
                      min_impurity_decrease=0.0, min_impurity_split=None,
                      min_samples_leaf=1, min_samples_split=2,
                      min_weight_fraction_leaf=0.0, n_estimators=26, n_jobs=1,
                      oob_score=False, random_state=None, verbose=0,
                      warm_start=False)
```

```
In [313]: df_test.head()
```

Out[313]:

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

```
In [314]: pre = clf.predict(df_test)
          pre

Out[314]: array([0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0, 1, 0, 1, 1, 0, 0, 0, 1, 0, 1,
                 1, 0, 1, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1,
                 1, 0, 0, 0, 1, 1, 0, 0, 1, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 1, 1,
                 1, 0, 0, 1, 1, 0, 0, 0, 1, 0, 0, 1, 0, 1, 1, 0, 0, 0, 0, 0, 1, 0,
                 1, 1, 1, 0, 1, 0, 0, 0, 1, 0, 1, 0, 1, 0, 0, 0, 1, 0, 0, 0, 0, 0,
                 0, 1, 1, 1, 1, 0, 0, 1, 0, 1, 1, 0, 1, 0, 0, 1, 0, 1, 0, 0, 0, 1,
                 0, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1,
                 0, 0, 1, 1, 0, 1, 1, 1, 1, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1,
                 1, 0, 1, 1, 0, 0, 1, 0, 1, 0, 1, 0, 0, 0, 0, 0, 1, 0, 1, 0, 1, 1,
                 0, 1, 1, 1, 1, 1, 0, 0, 1, 0, 1, 0, 0, 0, 0, 1, 0, 0, 1, 0, 1, 0,
                 1, 0, 1, 0, 1, 1, 0, 1, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 1, 1, 1,
                 0, 0, 0, 0, 1, 0, 1, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 1, 1,
                 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 1, 0, 0, 0, 0, 1, 1, 1, 1, 1, 0,
                 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 1,
                 0, 0, 0, 0, 0, 1, 1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0,
                 1, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0, 1, 0, 1, 0, 1, 1, 0,
                 0, 0, 1, 0, 1, 0, 0, 1, 0, 1, 1, 0, 1, 0, 0, 1, 1, 0, 0, 1, 0, 0,
                 1, 1, 0, 0, 0, 0, 0, 0, 1, 1, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1,
                 0, 1, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0, 1, 1, 1, 1, 1, 0, 1, 0, 0, 1])
```

```
In [315]: resultdf = pd.DataFrame()
          resultdf["PassengerId"] = testdf["PassengerId"]
          resultdf["Survived"] = pre
```

```
In [316]: resultdf.head()
```

Out[316]:

	PassengerId	Survived
0	892	0
1	893	0
2	894	0
3	895	0
4	896	1

```
In [317]: resultdf.to_csv("result.csv", encoding="utf-8", index=False)
```

```
In [318]: # ls
```