Machine Learning Fundamentals Lab-9

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Aim:

a) To implement K Means Clustering Algorithm on given dataset and predict the outcomes without support of classes or labels.
b) To implement, find the centroids of clusters and to plot them.

Software Required:

a) Jupyter Notebook
b) Anaconda Navigator

Libraries Required: Numpy, Matplotlib, Seaborn, Sci-kit Learn, Pandas

Code and Outputs:

a) Train Ticket Dataset K Means

In [1]:
```
# Dependencies
import pandas as pd
import numpy as np
from sklearn.cluster import KMeans
from sklearn.preprocessing import LabelEncoder
from sklearn.preprocessing import MinMaxScaler
import seaborn as sns
import matplotlib.pyplot as plt
%matplotlib inline
```

In [2]:
```
# Load the train and test datasets to create two DataFrames

train_url = "train.csv"
train = pd.read_csv(train_url)
test_url = "test.csv"
test = pd.read_csv(test_url)
```

In [3]:
```
print("***** Train_Set *****")
print(train.head())
print("\n")
print("***** Test_Set *****")
print(test.head())
```

```
***** Train_Set *****
   PassengerId  Survived  Pclass  \
0            1         0       3
1            2         1       1
2            3         1       3
3            4         1       1
4            5         0       3

                                                Name     Sex   Age  SibSp  \
0                            Braund, Mr. Owen Harris    male  22.0      1
1  Cumings, Mrs. John Bradley (Florence Briggs Th...  female  38.0      1
2                             Heikkinen, Miss. Laina  female  26.0      0
3       Futrelle, Mrs. Jacques Heath (Lily May Peel)  female  35.0      1
4                           Allen, Mr. William Henry    male  35.0      0

   Parch            Ticket     Fare Cabin Embarked
0      0         A/5 21171   7.2500   NaN        S
1      0          PC 17599  71.2833   C85        C
2      0  STON/O2. 3101282   7.9250   NaN        S
3      0            113803  53.1000  C123        S
4      0            373450   8.0500   NaN        S


***** Test_Set *****
   PassengerId  Pclass                                          Name     Sex  \
0          892       3                              Kelly, Mr. James    male
1          893       3              Wilkes, Mrs. James (Ellen Needs)  female
2          894       2                     Myles, Mr. Thomas Francis    male
3          895       3                              Wirz, Mr. Albert    male
4          896       3  Hirvonen, Mrs. Alexander (Helga E Lindqvist)  female

    Age  SibSp  Parch   Ticket     Fare Cabin Embarked
0  34.5      0      0   330911   7.8292   NaN        Q
1  47.0      1      0   363272   7.0000   NaN        S
2  62.0      0      0   240276   9.6875   NaN        Q
3  27.0      0      0   315154   8.6625   NaN        S
4  22.0      1      1  3101298  12.2875   NaN        S
```

In [4]:
```
print("***** Train_Set *****")
print(train.describe())
print("\n")
print("***** Test_Set *****")
print(test.describe())
```

```
***** Train_Set *****
       PassengerId    Survived      Pclass         Age       SibSp  \
count   891.000000  891.000000  891.000000  714.000000  891.000000
mean    446.000000    0.383838    2.308642   29.699118    0.523008
std     257.353842    0.486592    0.836071   14.526497    1.102743
min       1.000000    0.000000    1.000000    0.420000    0.000000
25%     223.500000    0.000000    2.000000   20.125000    0.000000
50%     446.000000    0.000000    3.000000   28.000000    0.000000
75%     668.500000    1.000000    3.000000   38.000000    1.000000
max     891.000000    1.000000    3.000000   80.000000    8.000000

            Parch        Fare
count  891.000000  891.000000
mean     0.381594   32.204208
std      0.806057   49.693429
min      0.000000    0.000000
25%      0.000000    7.910400
50%      0.000000   14.454200
75%      0.000000   31.000000
max      6.000000  512.329200


***** Test_Set *****
       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 [5]:
```
print(train.columns.values)
```

```
['PassengerId' 'Survived' 'Pclass' 'Name' 'Sex' 'Age' 'SibSp' 'Parch'
 'Ticket' 'Fare' 'Cabin' 'Embarked']
```

In [6]:
```
# For the train set
train.isna().head()
```

Out[6]:

	PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare	Cabin	Embarked
0	False	False	False	False	False	False	False	False	False	False	True	False
1	False	False	False	False	False	False	False	False	False	False	False	False
2	False	False	False	False	False	False	False	False	False	False	True	False
3	False	False	False	False	False	False	False	False	False	False	False	False
4	False	False	False	False	False	False	False	False	False	False	True	False

In [7]:
```
# For the test set
test.isna().head()
```

Out[7]:

	PassengerId	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare	Cabin	Embarked
0	False	False	False	False	False	False	False	False	False	True	False
1	False	False	False	False	False	False	False	False	False	True	False
2	False	False	False	False	False	False	False	False	False	True	False
3	False	False	False	False	False	False	False	False	False	True	False
4	False	False	False	False	False	False	False	False	False	True	False

In [8]:
```
print("*****In the train set*****")
print(train.isna().sum())
print("\n")
print("*****In the test set*****")
print(test.isna().sum())
```

```
*****In the train set*****
PassengerId      0
Survived         0
Pclass           0
Name             0
Sex              0
Age            177
SibSp            0
Parch            0
Ticket           0
Fare             0
Cabin          687
Embarked         2
dtype: int64


*****In the test set*****
PassengerId      0
Pclass           0
Name             0
Sex              0
Age             86
SibSp            0
Parch            0
Ticket           0
Fare             1
Cabin          327
Embarked         0
dtype: int64
```

In [9]:
```
# Fill missing values with mean column values in the train set
train.fillna(train.mean(), inplace=True)
# Fill missing values with mean column values in the test set
test.fillna(test.mean(), inplace=True)
```

In [10]:
```
print(train.isna().sum())
print(test.isna().sum())
```

```
PassengerId      0
Survived         0
Pclass           0
Name             0
Sex              0
Age              0
SibSp            0
Parch            0
Ticket           0
Fare             0
Cabin          687
Embarked         2
dtype: int64
PassengerId      0
Pclass           0
Name             0
Sex              0
Age              0
SibSp            0
Parch            0
Ticket           0
Fare             0
Cabin          327
```

In [11]:
```
train['Ticket'].head()
```

Out[11]:
```
0           A/5 21171
1            PC 17599
2    STON/O2. 3101282
3              113803
4              373450
Name: Ticket, dtype: object
```

In [12]:
```
train['Cabin'].head()
```

Out[12]:
```
0     NaN
1     C85
2     NaN
3    C123
4     NaN
Name: Cabin, dtype: object
```

In [13]:
```
train[['Pclass', 'Survived']].groupby(['Pclass'], as_index=False).mean().sort_values(by='Survived', ascending=False)
```

Out[13]:

	Pclass	Survived
0	1	0.629630
1	2	0.472826
2	3	0.242363

In [14]:
```
train[["Sex", "Survived"]].groupby(['Sex'], as_index=False).mean().sort_values(by='Survived', ascending=False)
```

Out[14]:

	Sex	Survived
0	female	0.742038
1	male	0.188908

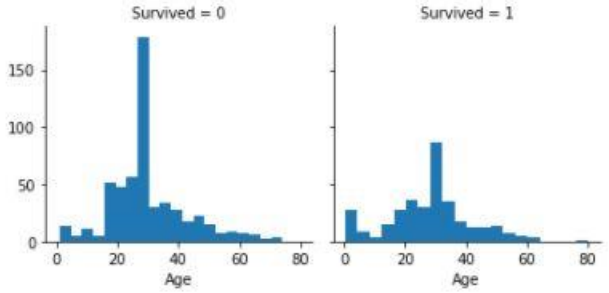
In [15]:
```
train[["SibSp", "Survived"]].groupby(['SibSp'], as_index=False).mean().sort_values(by='Survived', ascending=False)
```

Out[15]:

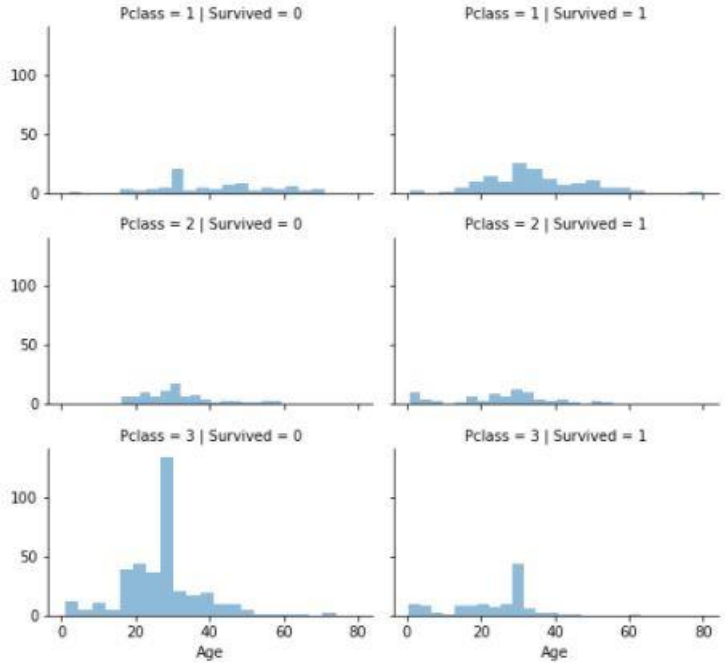
	SibSp	Survived
1	1	0.535885
2	2	0.464286
0	0	0.345395
3	3	0.250000
4	4	0.166667
5	5	0.000000
6	8	0.000000

In [16]:
```
g = sns.FacetGrid(train, col='Survived')
g.map(plt.hist, 'Age', bins=20)
```

Out[16]: <seaborn.axisgrid.FacetGrid at 0x187eef29160>



In [17]:
```
grid = sns.FacetGrid(train, col='Survived', row='Pclass', height=2.2, aspect=1.6)
grid.map(plt.hist, 'Age', alpha=.5, bins=20)
grid.add_legend();
```



In [18]:
```
train.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          891 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 [19]:
```
train = train.drop(['Name','Ticket', 'Cabin','Embarked'], axis=1)
test = test.drop(['Name','Ticket', 'Cabin','Embarked'], axis=1)
```

In [20]:
```
labelEncoder = LabelEncoder()
labelEncoder.fit(train['Sex'])
labelEncoder.fit(test['Sex'])
train['Sex'] = labelEncoder.transform(train['Sex'])
test['Sex'] = labelEncoder.transform(test['Sex'])
```

In [21]:
```
train.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 891 entries, 0 to 890
Data columns (total 8 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   Sex          891 non-null    int32
 4   Age          891 non-null    float64
 5   SibSp        891 non-null    int64
 6   Parch        891 non-null    int64
 7   Fare         891 non-null    float64
dtypes: float64(2), int32(1), int64(5)
memory usage: 52.3 KB
```

In [22]:
```
test.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 418 entries, 0 to 417
Data columns (total 7 columns):
 #   Column       Non-Null Count  Dtype
---  ------       --------------  -----
 0   PassengerId  418 non-null    int64
 1   Pclass       418 non-null    int64
 2   Sex          418 non-null    int32
 3   Age          418 non-null    float64
 4   SibSp        418 non-null    int64
 5   Parch        418 non-null    int64
 6   Fare         418 non-null    float64
```

In [23]:
```
X = np.array(train.drop(['Survived'], 1).astype(float))
y = np.array(train['Survived'])
```

In [24]:
```
train.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 891 entries, 0 to 890
Data columns (total 8 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   Sex          891 non-null    int32
 4   Age          891 non-null    float64
 5   SibSp        891 non-null    int64
 6   Parch        891 non-null    int64
 7   Fare         891 non-null    float64
dtypes: float64(2), int32(1), int64(5)
memory usage: 52.3 KB
```

In [25]:
```
kmeans = KMeans(n_clusters=2) # You want cluster the passenger records into 2: Survived or Not survived
kmeans.fit(X)
```

Out[25]:
```
KMeans(n_clusters=2)
```

In [26]:
```
correct = 0
for i in range(len(X)):
    predict_me = np.array(X[i].astype(float))
    predict_me = predict_me.reshape(-1, len(predict_me))
    prediction = kmeans.predict(predict_me)
    if prediction[0] == y[i]:
        correct += 1

print(correct/len(X))
```

```
0.5084175084175084
```

In [27]:
```
kmeans = KMeans(n_clusters=2, max_iter=600, algorithm = 'auto')
kmeans.fit(X)
```

Out[27]:
```
KMeans(max_iter=600, n_clusters=2)
```

In [28]:
```
correct = 0
for i in range(len(X)):
    predict_me = np.array(X[i].astype(float))
    predict_me = predict_me.reshape(-1, len(predict_me))
    prediction = kmeans.predict(predict_me)
    if prediction[0] == y[i]:
        correct += 1

print(correct/len(X))
```

```
0.49158249158249157
```

In [29]:
```
scaler = MinMaxScaler()
X_scaled = scaler.fit_transform(X)
kmeans.fit(X_scaled)
```

Out[29]:
```
KMeans(max_iter=600, n_clusters=2)
```

In [30]:
```
correct = 0
for i in range(len(X)):
    predict_me = np.array(X[i].astype(float))
    predict_me = predict_me.reshape(-1, len(predict_me))
    prediction = kmeans.predict(predict_me)
    if prediction[0] == y[i]:
        correct += 1

print(correct/len(X))
```

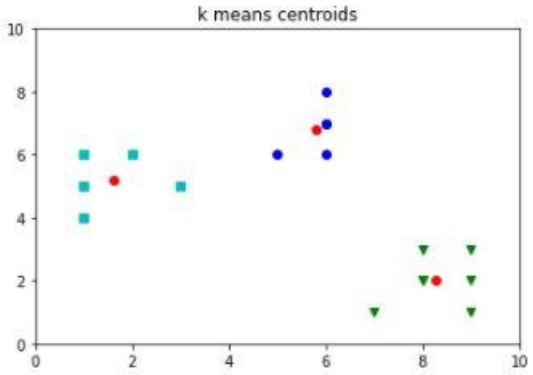
```
0.37373737373737376
```

b) Cluster Centroids

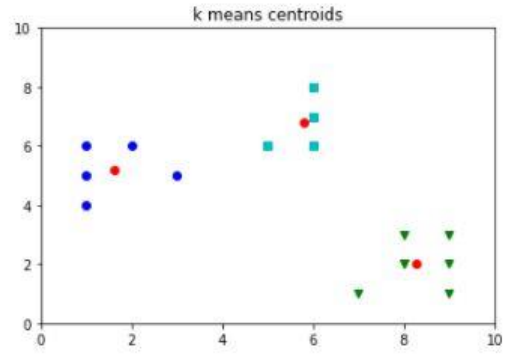
In [7]:
```
from sklearn.cluster import KMeans
from sklearn import metrics
import numpy as np
import matplotlib.pyplot as plt
```

In [16]:
```
x1 = np.array([3, 1, 1, 2, 1, 6, 6, 6, 5, 6, 7, 8, 9, 8, 9, 9, 8])
x2 = np.array([5, 4, 6, 6, 5, 8, 6, 7, 6, 7, 1, 2, 1, 2, 3, 2, 3])

for K in range(2,6,1):
    plt.plot()
    X = np.array(list(zip(x1, x2))).reshape(len(x1), 2)
    colors = ['b', 'g', 'c', 'r', 'y']
    markers = ['o', 'v', 's', '*', '+']

    K = 3
    kmeans_model = KMeans(n_clusters=K).fit(X)
    print(kmeans_model.cluster_centers_)
    centers = np.array(kmeans_model.cluster_centers_)
    plt.plot()
    plt.title('k means centroids')

    for i,l in enumerate(kmeans_model.labels_):
        plt.plot(x1[i], x2[i], color=colors[l], marker=markers[l], ls='None')
        plt.xlim([0, 10])
        plt.ylim([0, 10])

    plt.scatter(centers[:, 0], centers[:, 1], color='r')
    plt.show()
```

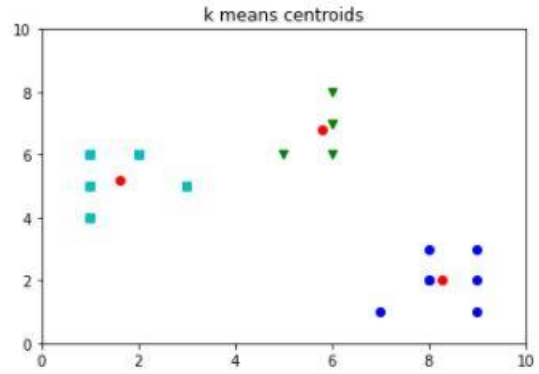
```
[[5.8        6.8       ]
 [8.28571429 2.        ]
 [1.6        5.2       ]]
```



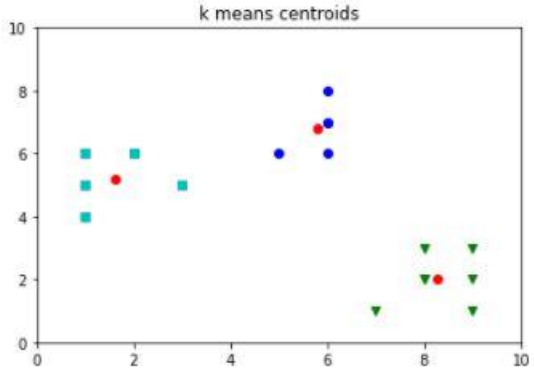

```
[[1.6        5.2       ]
 [8.28571429 2.        ]
 [5.8        6.8       ]]
```



```
[[8.28571429 2.        ]
 [5.8        6.8       ]
 [1.6        5.2       ]]
```




```
[[5.8        6.8       ]
 [8.28571429 2.        ]
 [1.6        5.2       ]]
```



Inference:

a) From the first one we infer that K means clustering is an unsupervised learning algorithm and it can be used in classifying the classes without labels by looking into the features, and even the prediction along with accuracy of predictions is given.
b) From second one we see the plot of centroids has the value of K changes from 2 to 6.

Result: K Means on train tickets dataset is implemented and the required plots are visualized using Jupyter notebook.