In [1]:
```
import numpy as np # linear algebra
import pandas as pd # data processing, CSV file I/O (e.g. pd.read_csv)
import matplotlib.pyplot as plt
import seaborn as sns
import plotly as py
import plotly.graph_objs as go
from sklearn.cluster import KMeans
import warnings
import os
warnings.filterwarnings("ignore")
py.offline.init_notebook_mode(connected = True)
#print(os.listdir("../input"))
```

In [2]:
```
df = pd.read_csv(r'Mall_Customers.csv')
df.head()
```

Out[2]:

	CustomerID	Gender	Age	Annual Income (k$)	Spending Score (1-100)
0	1	Male	19	15	39
1	2	Male	21	15	81
2	3	Female	20	16	6
3	4	Female	23	16	77
4	5	Female	31	17	40

In [3]:
```
df.shape
```

Out[3]: (200, 5)

In [4]:
```
df.describe()
```

Out[4]:

	CustomerID	Age	Annual Income (k$)	Spending Score (1-100)
count	200.000000	200.000000	200.000000	200.000000
mean	100.500000	38.850000	60.560000	50.200000
std	57.879185	13.969007	26.264721	25.823522
min	1.000000	18.000000	15.000000	1.000000
25%	50.750000	28.750000	41.500000	34.750000
50%	100.500000	36.000000	61.500000	50.000000
75%	150.250000	49.000000	78.000000	73.000000
max	200.000000	70.000000	137.000000	99.000000

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

Out[5]:

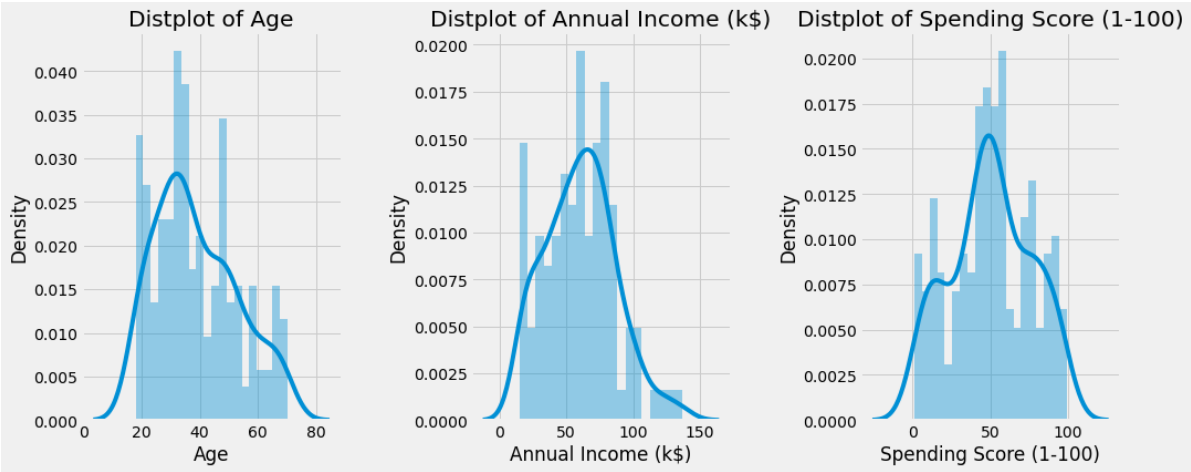
```
CustomerID                int64
Gender                   object
```

In [6]:
```
1 df.isnull().sum()
```

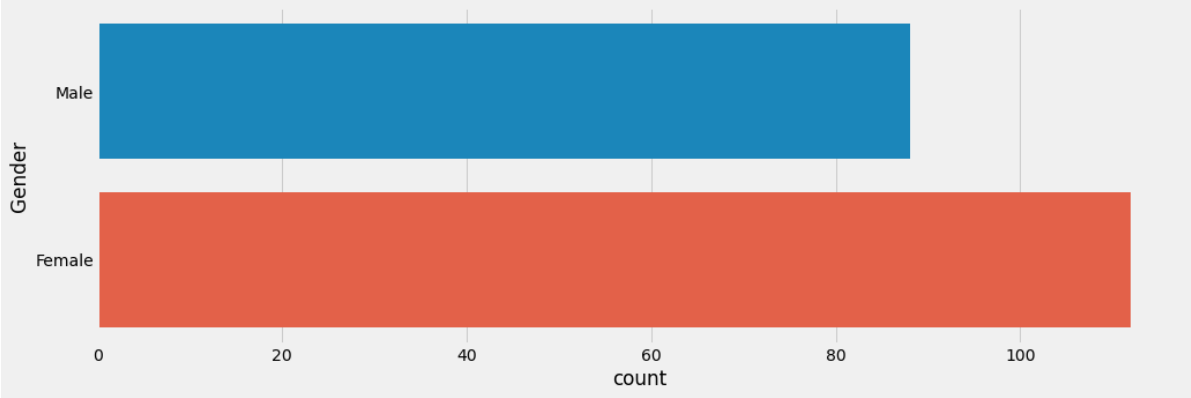
Out[6]:
```
CustomerID                0
Gender                    0
Age                       0
Annual Income (k$)        0
Spending Score (1-100)    0
dtype: int64
```

In [7]:
```
1 plt.style.use('fivethirtyeight')
```

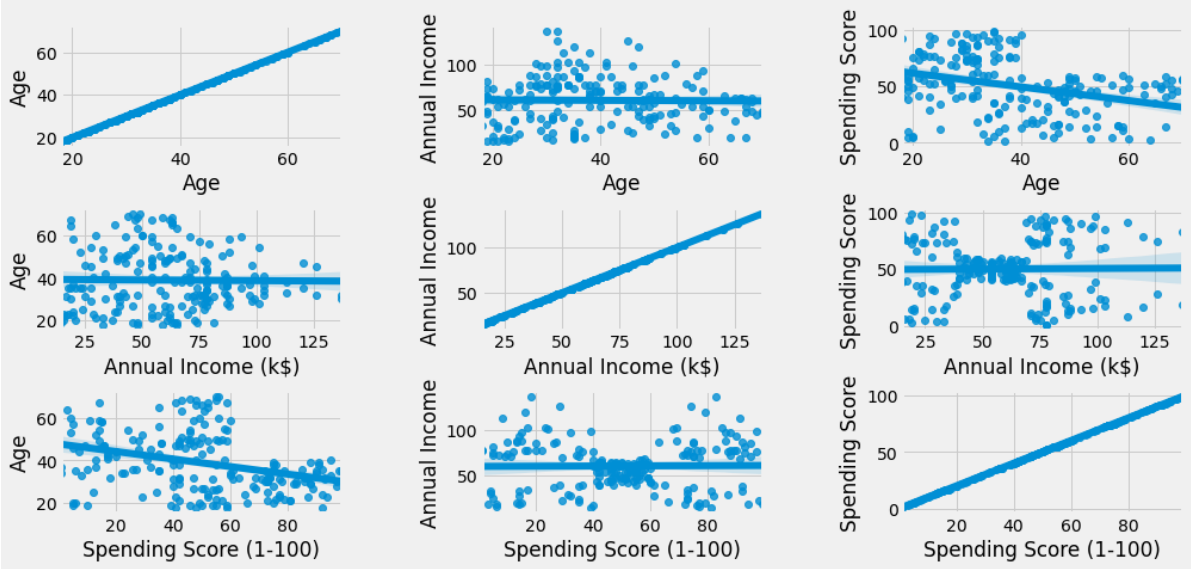
In [8]:
```
1 plt.figure(1 , figsize = (15 , 6))
2 n = 0
3 for x in ['Age' , 'Annual Income (k$)' , 'Spending Score (1-100)']:
4     n += 1
5     plt.subplot(1 , 3 , n)
6     plt.subplots_adjust(hspace =0.5 , wspace = 0.5)
7     sns.distplot(df[x] , bins = 20)
8     plt.title('Distplot of {}'.format(x))
9 plt.show()
```



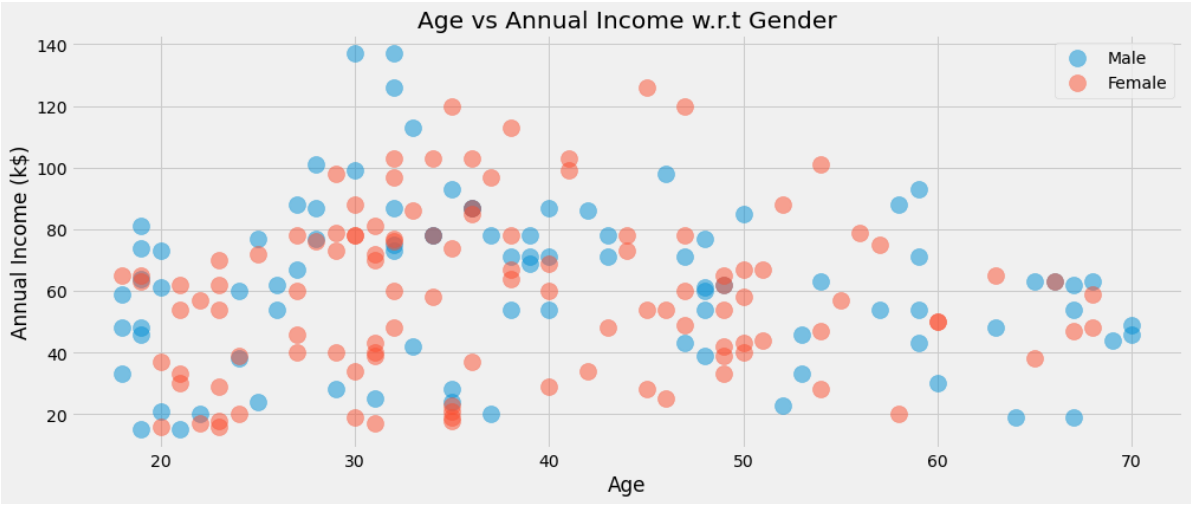
In [9]:
```
1 plt.figure(1 , figsize = (15 , 5))
2 sns.countplot(y = 'Gender' , data = df)
3 plt.show()
```



In [10]:
```
plt.figure(1 , figsize = (15 , 7))
n = 0
for x in ['Age' , 'Annual Income (k$)' , 'Spending Score (1-100)']:
    for y in ['Age' , 'Annual Income (k$)' , 'Spending Score (1-100)']:
        n += 1
        plt.subplot(3 , 3 , n)
        plt.subplots_adjust(hspace = 0.5 , wspace = 0.5)
        sns.regplot(x = x , y = y , data = df)
        plt.ylabel(y.split()[0]+' '+y.split()[1] if len(y.split()) > 1 els
plt.show()
```

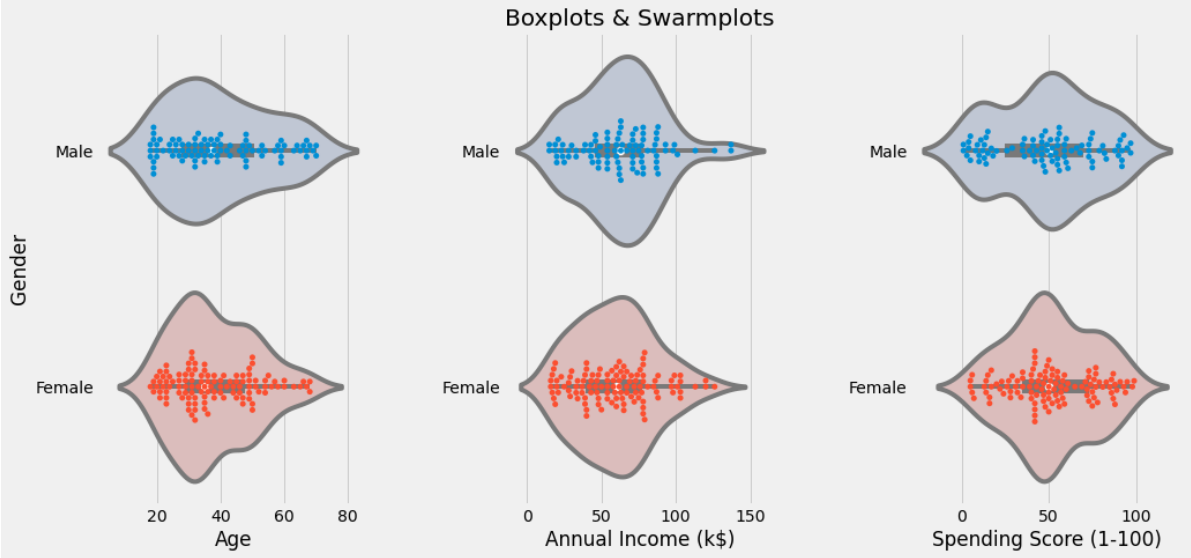


In [11]:
```
plt.figure(1 , figsize = (15 , 6))
for gender in ['Male' , 'Female']:
    plt.scatter(x = 'Age' , y = 'Annual Income (k$)' , data = df[df['Gende
                s = 200 , alpha = 0.5 , label = gender)
plt.xlabel('Age'), plt.ylabel('Annual Income (k$)')
plt.title('Age vs Annual Income w.r.t Gender')
plt.legend()
plt.show()
```



Distribution of values in Age , Annual Income and Spending Score according to Gender

In [12]:
```
plt.figure(1 , figsize = (15 , 7))
n = 0
for cols in ['Age' , 'Annual Income (k$)' , 'Spending Score (1-100)']:
    n += 1
    plt.subplot(1 , 3 , n)
    plt.subplots_adjust(hspace = 0.5 , wspace = 0.5)
    sns.violinplot(x = cols , y = 'Gender' , data = df , palette = 'vlag')
    sns.swarmplot(x = cols , y = 'Gender' , data = df)
    plt.ylabel('Gender' if n == 1 else '')
    plt.title('Boxplots & Swarmplots' if n == 2 else '')
plt.show()
```

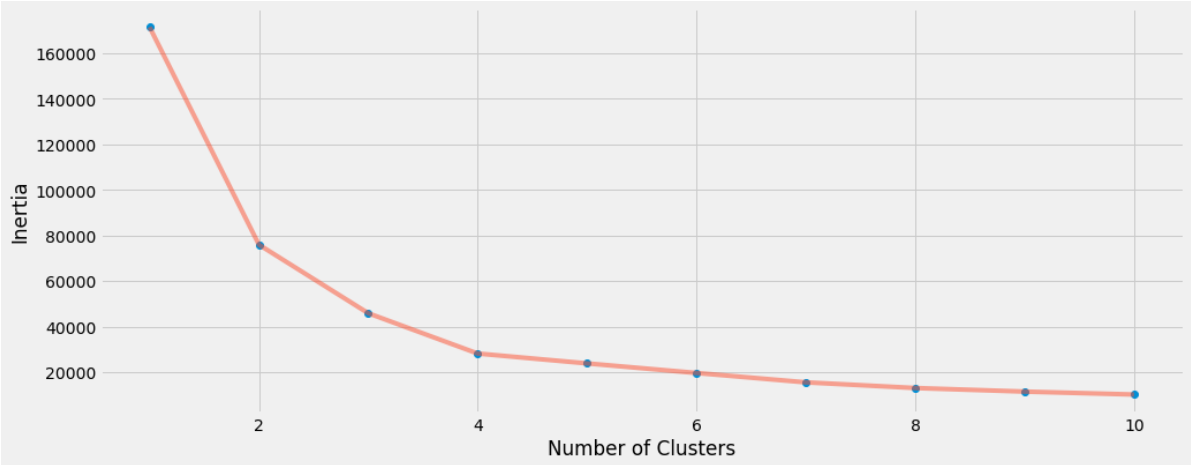


Clustering using K- means 1.Segmentation using Age and Spending Score

In [13]:
```
X1 = df[['Age' , 'Spending Score (1-100)']].iloc[: , :].values
inertia = []
for n in range(1 , 11):
    algorithm = (KMeans(n_clusters = n ,init='k-means++', n_init = 10 ,max
                        tol=0.0001,  random_state= 111  , algorithm='elkar
    algorithm.fit(X1)
    inertia.append(algorithm.inertia_)
```

In [14]:

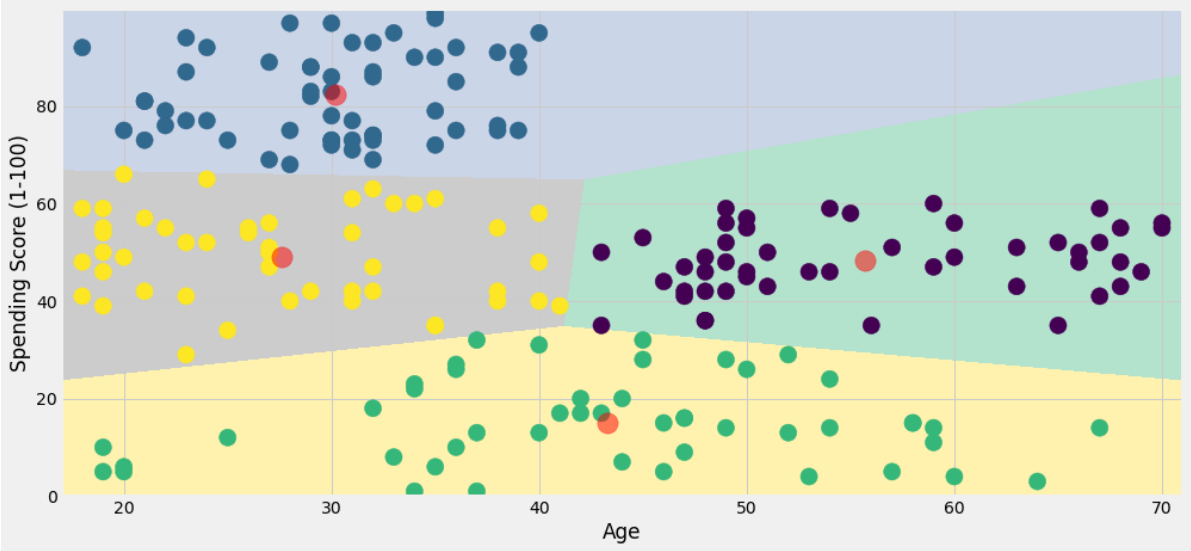
```
1 plt.figure(1 , figsize = (15 ,6))
2 plt.plot(np.arange(1 , 11) , inertia , 'o')
3 plt.plot(np.arange(1 , 11) , inertia , '-' , alpha = 0.5)
4 plt.xlabel('Number of Clusters') , plt.ylabel('Inertia')
5 plt.show()
```



In [15]:
```
algorithm = (KMeans(n_clusters = 4 ,init='k-means++', n_init = 10 ,max_ite
                    tol=0.0001,  random_state= 111  , algorithm='elkar
algorithm.fit(X1)
labels1 = algorithm.labels_
centroids1 = algorithm.cluster_centers_
h = 0.02
x_min, x_max = X1[:, 0].min() - 1, X1[:, 0].max() + 1
y_min, y_max = X1[:, 1].min() - 1, X1[:, 1].max() + 1
xx, yy = np.meshgrid(np.arange(x_min, x_max, h), np.arange(y_min, y_max, h
Z = algorithm.predict(np.c_[xx.ravel(), yy.ravel()])

plt.figure(1 , figsize = (15 , 7) )
plt.clf()
Z = Z.reshape(xx.shape)
plt.imshow(Z , interpolation='nearest',
           extent=(xx.min(), xx.max(), yy.min(), yy.max()),
           cmap = plt.cm.Pastel2, aspect = 'auto', origin='lower')

plt.scatter( x = 'Age' ,y = 'Spending Score (1-100)' , data = df , c = lab
            s = 200 )
plt.scatter(x = centroids1[: , 0] , y =  centroids1[: , 1] , s = 300 , c =
plt.ylabel('Spending Score (1-100)') , plt.xlabel('Age')
plt.show()
```



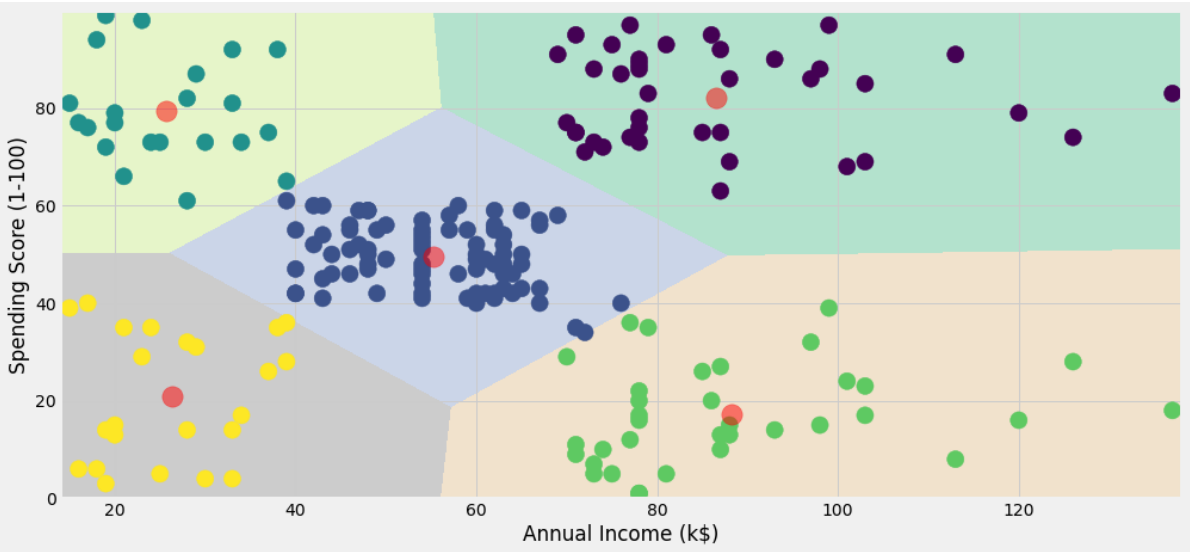
2. Segmentation using Annual Income and Spending Score

In [16]:
```
X2 = df[['Annual Income (k$)' , 'Spending Score (1-100)']].iloc[: , :].val
inertia = []
for n in range(1 , 11):
    algorithm = (KMeans(n_clusters = n ,init='k-means++', n_init = 10 ,max
                        tol=0.0001,  random_state= 111  , algorithm='elkar
    algorithm.fit(X2)
    inertia.append(algorithm.inertia_)
plt.figure(1 , figsize = (15 ,6))
plt.plot(np.arange(1 , 11) , inertia , 'o')
plt.plot(np.arange(1 , 11) , inertia , '-' , alpha = 0.5)
plt.xlabel('Number of Clusters') , plt.ylabel('Inertia')
```

```
12 plt.show()
```

In [17]:

```
 1 algorithm = (KMeans(n_clusters = 5 ,init='k-means++', n_init = 10 ,max_ite
 2                     tol=0.0001,  random_state= 111  , algorithm='elkar
 3 algorithm.fit(X2)
 4 labels2 = algorithm.labels_
 5 centroids2 = algorithm.cluster_centers_
 6 h = 0.02
 7 x_min, x_max = X2[:, 0].min() - 1, X2[:, 0].max() + 1
 8 y_min, y_max = X2[:, 1].min() - 1, X2[:, 1].max() + 1
 9 xx, yy = np.meshgrid(np.arange(x_min, x_max, h), np.arange(y_min, y_max, h
10 Z2 = algorithm.predict(np.c_[xx.ravel(), yy.ravel()])
11
12 plt.figure(1 , figsize = (15 , 7) )
13 plt.clf()
14 Z2 = Z2.reshape(xx.shape)
15 plt.imshow(Z2 , interpolation='nearest',
16            extent=(xx.min(), xx.max(), yy.min(), yy.max()),
17            cmap = plt.cm.Pastel2, aspect = 'auto', origin='lower')
18
19 plt.scatter( x = 'Annual Income (k$)' ,y = 'Spending Score (1-100)' , data
20              s = 200 )
21 plt.scatter(x = centroids2[: , 0] , y =  centroids2[: , 1] , s = 300 , c =
22 plt.ylabel('Spending Score (1-100)') , plt.xlabel('Annual Income (k$)')
23 plt.show()
```



In [18]:
```
X3 = df[['Age' , 'Annual Income (k$)' ,'Spending Score (1-100)']].iloc[: ,
inertia = []
for n in range(1 , 11):
    algorithm = (KMeans(n_clusters = n ,init='k-means++', n_init = 10 ,max
                        tol=0.0001,  random_state= 111  , algorithm='elkar
    algorithm.fit(X3)
    inertia.append(algorithm.inertia_)
plt.figure(1 , figsize = (15 ,6))
plt.plot(np.arange(1 , 11) , inertia , 'o')
plt.plot(np.arange(1 , 11) , inertia , '-' , alpha = 0.5)
plt.xlabel('Number of Clusters') , plt.ylabel('Inertia')
plt.show()
```

In [19]:
```
algorithm = (KMeans(n_clusters = 6 ,init='k-means++', n_init = 10 ,max_ite
                    tol=0.0001,  random_state= 111  , algorithm='elkar
algorithm.fit(X3)
labels3 = algorithm.labels_
centroids3 = algorithm.cluster_centers_
df['label3'] =  labels3
trace1 = go.Scatter3d(
    x= df['Age'],
    y= df['Spending Score (1-100)'],
    z= df['Annual Income (k$)'],
    mode='markers',
     marker=dict(
        color = df['label3'],
        size= 20,
        line=dict(
            color= df['label3'],
            width= 12
        ),
        opacity=0.8
     )
)

data = [trace1]
layout = go.Layout(
#     margin=dict(
#         l=0,
#         r=0,
```

```
#         b=0,
#         t=0
#     )
    title= 'Clusters',
    scene = dict(
            xaxis = dict(title  = 'Age'),
            yaxis = dict(title  = 'Spending Score'),
            zaxis = dict(title  = 'Annual Income')
        )
)
fig = go.Figure(data=data, layout=layout)
py.offline.iplot(fig)
```

In [ ]:
```
1
```