Project : K -MEAN CLUSTERING

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DataSet : Mall_Customer DataSet (Available on Kaggle)

Description : This algorithm have been Implemented from Scratch

In [1]:

```
#import libraries
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
import random
from itertools import islice
import math
import random
from scipy.spatial import distance
from copy import deepcopy
import warnings
warnings.filterwarnings("ignore")
```

In [2]:

```
df= pd.read_csv("Mall_Customers.csv")
```

In [3]:

```
df.tail()
```

Out[3]:

	CustomerID	Genre	Age	AnnualIncome	SpendingScore
195	196	Female	35	120	79
196	197	Female	45	126	28
197	198	Male	32	126	74
198	199	Male	32	137	18
199	200	Male	30	137	83

In [4]:

```
# keeping only the desired column
col = ['Genre', 'Age', 'AnnualIncome', 'SpendingScore']
customer_features = df[col]
```

In [5]:

```
customer_features.head()
```

Out[5]:

	Genre	Age	AnnualIncome	SpendingScore
0	Male	19	15	39
1	Male	21	15	81

	Genre	Age	AnnualIncome	SpendingScore
2	Female	20	16	6
3	Female	23	16	77
4	Female	31	17	40

In [6]:

```
customer_features = pd.get_dummies(customer_features,
                                   columns= ['Genre'])
```

In [7]:

```
customer_features['cluster'] = 0
```

In [8]:

```
customer_features
```

Out[8]:

	Age	AnnualIncome	SpendingScore	Genre_Female	Genre_Male	cluster
0	19	15	39	0	1	0
1	21	15	81	0	1	0
2	20	16	6	1	0	0
3	23	16	77	1	0	0
4	31	17	40	1	0	0
...	...	...	...	...	...	...
195	35	120	79	1	0	0
196	45	126	28	1	0	0
197	32	126	74	0	1	0
198	32	137	18	0	1	0
199	30	137	83	0	1	0

200 rows × 6 columns

This function initializes centroids from within the Data Set

In [9]:

```
def initialize_centroids(customer_features, k):
        centroids = customer_features.sample(n = k)
        return centroids
```

This function will calculate the Euclidean distance of Data Points from Centroids and return that distance

In [10]:

```
def euclidean_distance(customer_features, centroids):
    labels = {}
    euclidean_dist = {}
    for point in customer_features.itertuples():
        for centroid in centroids.itertuples():
            euclidean_dist[(point[0],centroid[0])] = distance.euclidean(list(point)[1:],
list(centroid)[1:])
    return euclidean_dist
```

This function will use selected centroids and Euclidean

distance to check, Data Point belongs to which cluster, and assigns the label of that cluster.

In [11]:

```
def label_cluster(customer_features, centroids, euclidean_dist):
    i,j = 0,0
    distances = []
    label = []
    for point in range(len(euclidean_dist)):
        if(len(distances) < 4):
            distances.append(euclidean_dist[list(euclidean_dist.keys())[point]])
            if(len(distances) == 3):
                label.append(distances.index(min(distances)))
                distances.clear()
                i = 0
            i += 1
    customer_features["cluster"] = pd.DataFrame(label)
    return customer_features
```

This function is to visualize the clusters, made by this algorithm.

In [12]:

```
def cluster_visualization(clusters):

    LABEL_COLOR_MAP = {
                       0 : 'r',
                       1 : 'y',
                       2 : 'g'
                       }

    label_color = [LABEL_COLOR_MAP[m] for m in clusters['cluster']]
    label_color
    plt.scatter(clusters.values[:,0],clusters.values[:,1],clusters.values[:,2], color =
label_color)
    plt.pause(0.01)
    plt.show()
```

This function will check, Once algorithm is done with clustering of Data Points, it'll start updating centroids and make clusters agian and again, untill algorithm will converge.

In [13]:

```
def update_centroids(clusters, centroids):

    print("Centroids")
    print(centroids)
    cluster_visualization(clusters)
    new_centroids = pd.DataFrame()

    cluster1 =  clusters[clusters["cluster"] == 0]
    cluster2 =  clusters[clusters["cluster"] == 1]
    cluster3 =  clusters[clusters["cluster"] == 2]

    centroid1 = cluster1.mean(axis=0).astype(int)
    centroid2 = cluster2.mean(axis=0).astype(int)
    centroid3 = cluster3.mean(axis=0).astype(int)

    new_centroids = pd.concat([centroid1, centroid2, centroid3], ignore_index = True, ax
is = 1).T
```

```
    if(([number for number in list(centroid1)] == list(centroids.iloc[0])) and ([number
for number in list(centroid2)] == list(centroids.iloc[1])) and ([number for number in li
st(centroid3)] == list(centroids.iloc[2]))):
        return clusters

    else:
        euclidean_dist = euclidean_distance(clusters, new_centroids)
        new_clusters = label_cluster(clusters, new_centroids, euclidean_dist)
        update_centroids(new_clusters, new_centroids)
```

Initialize Centroids (from within a DataSet)

In [14]:

```
centroids = initialize_centroids(customer_features, 3)
centroids
```

Out[14]:

	Age	AnnualIncome	SpendingScore	Genre_Female	Genre_Male	cluster
74	59	54	47	0	1	0
119	50	67	57	1	0	0
7	23	18	94	1	0	0

Euclidean Distance of Data Points from Centroids

In [15]:

```
euclidean_dist = euclidean_distance(customer_features, centroids)
```

After selecting some random centroids and calculating Euclidean Distance, Now calcualte labels of DataPoints.

In [16]:

```
clusters = label_cluster(customer_features, centroids, euclidean_dist)
clusters
```

Out[16]:

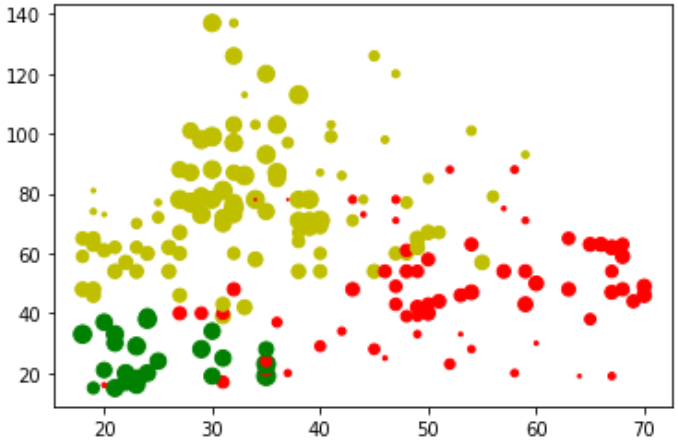
	Age	AnnualIncome	SpendingScore	Genre_Female	Genre_Male	cluster
0	19	15	39	0	1	2
1	21	15	81	0	1	2
2	20	16	6	1	0	0
3	23	16	77	1	0	2
4	31	17	40	1	0	0
...	...	...	...	...	...	...
195	35	120	79	1	0	1
196	45	126	28	1	0	1
197	32	126	74	0	1	1
198	32	137	18	0	1	1
199	30	137	83	0	1	1

200 rows × 6 columns

Plot Cluster

In [17]:

```
cluster_visualization(clusters)
```

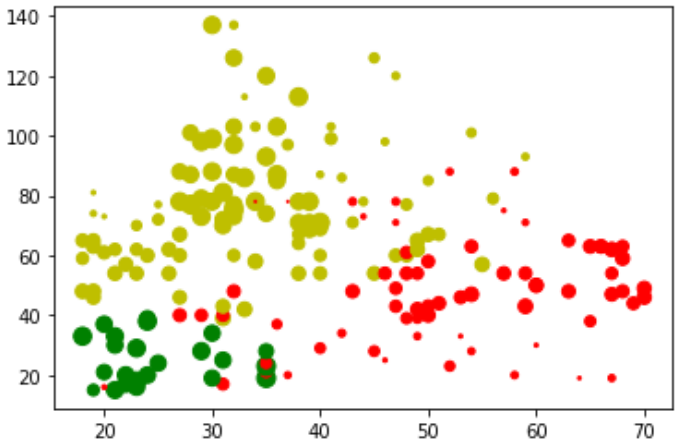


Now, calculate mean of DataPoints in separate clusters, and update centroids on the basis of mean. Plot cluster again and again untill centroids and clusters stop updating, and the algorithm has converged.

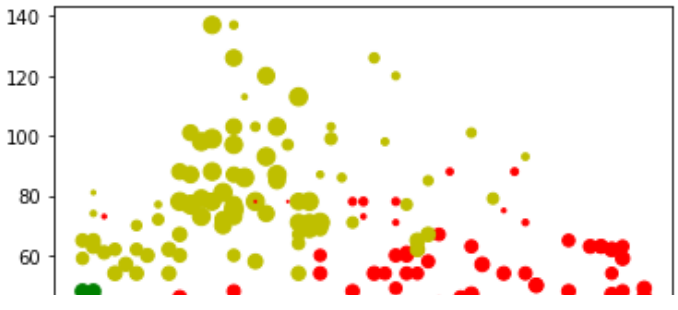
In [18]:

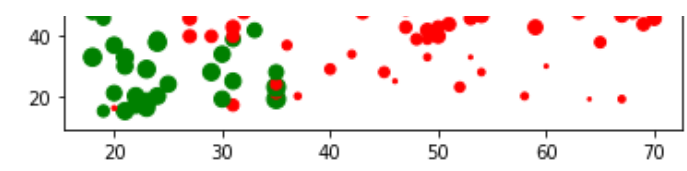
```
final_clustering = update_centroids(clusters, centroids)
```

```
Centroids
     Age  AnnualIncome  SpendingScore  Genre_Female  Genre_Male  cluster
74    59            54             47             0           1        0
119   50            67             57             1           0        0
7     23            18             94             1           0        0
```



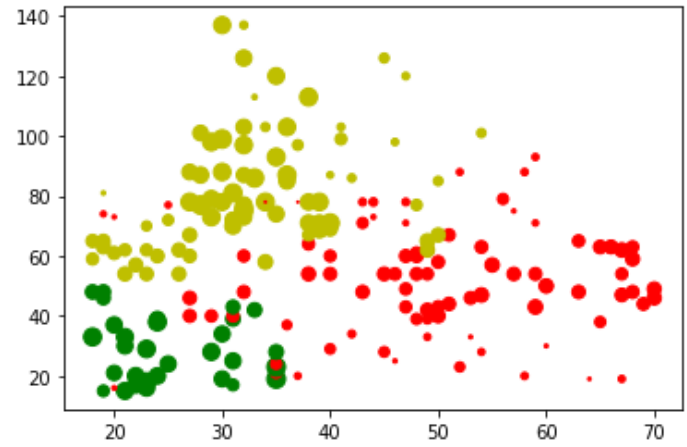

```
Centroids
   Age  AnnualIncome  SpendingScore  Genre_Female  Genre_Male  cluster
0   51            47             34             0           0        0
1   33            76             54             0           0        1
2   25            25             77             0           0        2
```





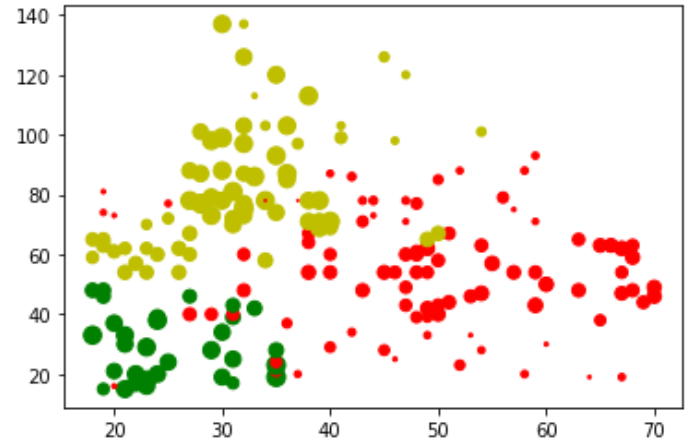
Centroids

	Age	AnnualIncome	SpendingScore	Genre_Female	Genre_Male	cluster
0	49	49	35	0	0	0
1	33	80	56	0	0	1
2	24	28	74	0	0	2



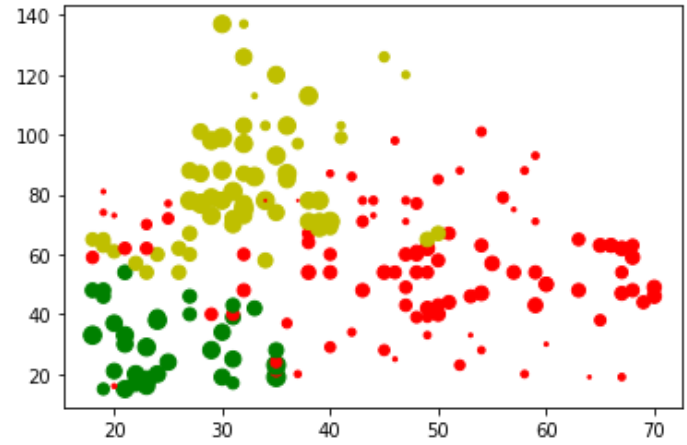
Centroids

	Age	AnnualIncome	SpendingScore	Genre_Female	Genre_Male	cluster
0	49	51	34	0	0	0
1	32	81	58	0	0	1
2	25	28	72	0	0	2



Centroids

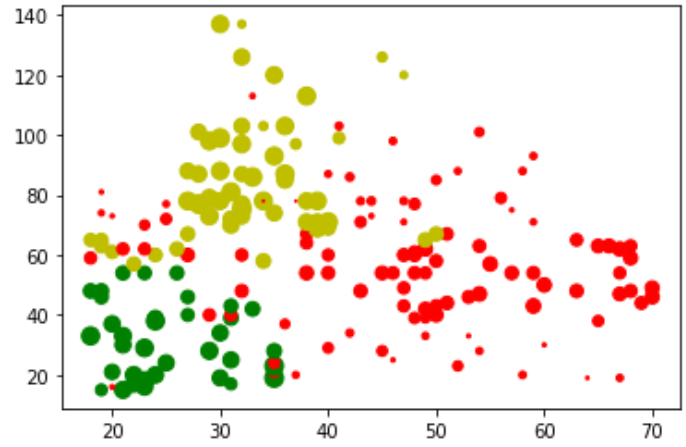
	Age	AnnualIncome	SpendingScore	Genre_Female	Genre_Male	cluster
0	48	54	33	0	0	0
1	31	82	62	0	0	1
2	25	29	71	0	0	2



Centroids

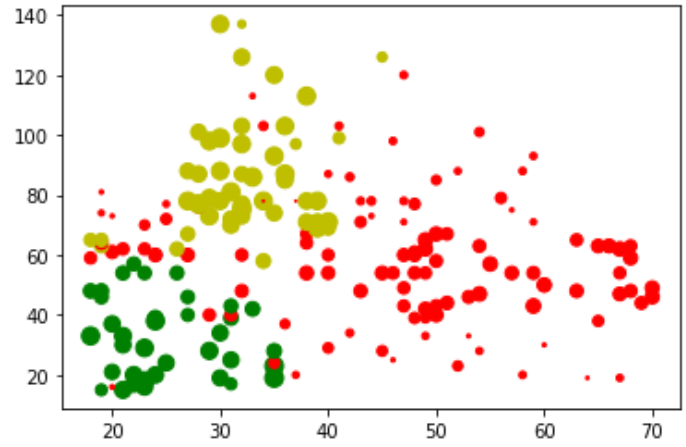
	Age	AnnualIncome	SpendingScore	Genre_Female	Genre_Male	cluster

	Age	AnnualIncome	SpendingScore	Genre_Female	Genre_Male	cluster
0	47	56	33	0	0	0
1	32	83	66	0	0	1
2	25	30	70	0	0	2



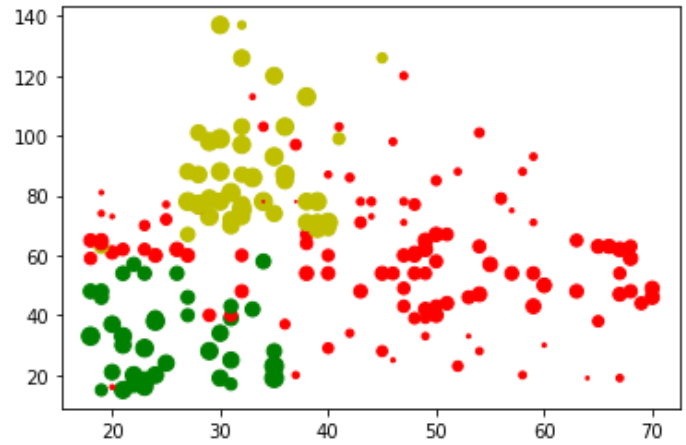
Centroids

	Age	AnnualIncome	SpendingScore	Genre_Female	Genre_Male	cluster
0	47	57	33	0	0	0
1	32	84	69	0	0	1
2	25	31	69	0	0	2



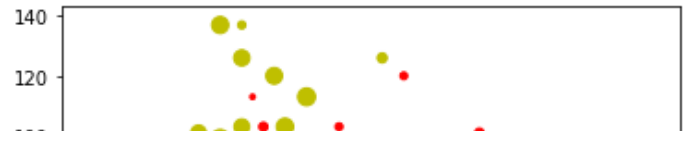
Centroids

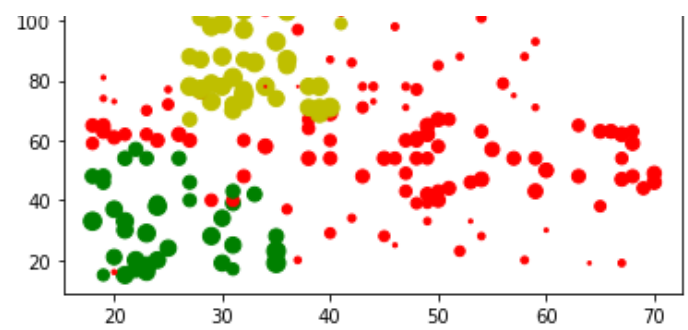
	Age	AnnualIncome	SpendingScore	Genre_Female	Genre_Male	cluster
0	46	58	33	0	0	0
1	32	85	74	0	0	1
2	25	32	68	0	0	2



Centroids

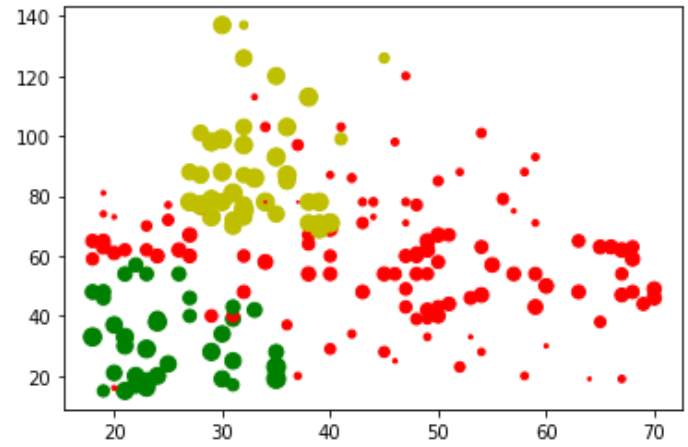
	Age	AnnualIncome	SpendingScore	Genre_Female	Genre_Male	cluster
0	45	59	34	0	0	0
1	32	87	76	0	0	1
2	25	32	67	0	0	2





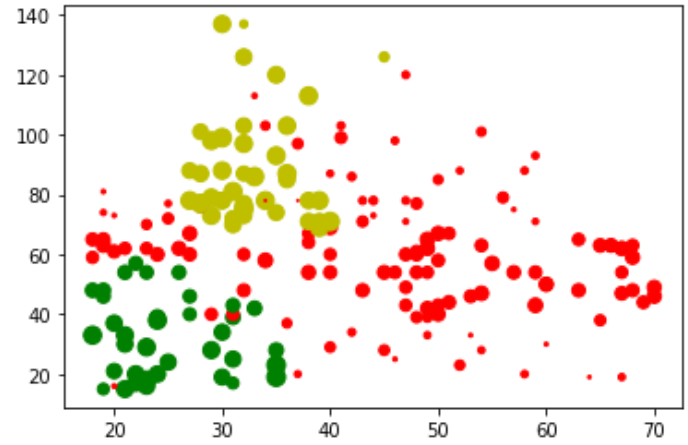
Centroids

	Age	AnnualIncome	SpendingScore	Genre_Female	Genre_Male	cluster
0	45	59	34	0	0	0
1	33	88	77	0	0	1
2	25	31	67	0	0	2



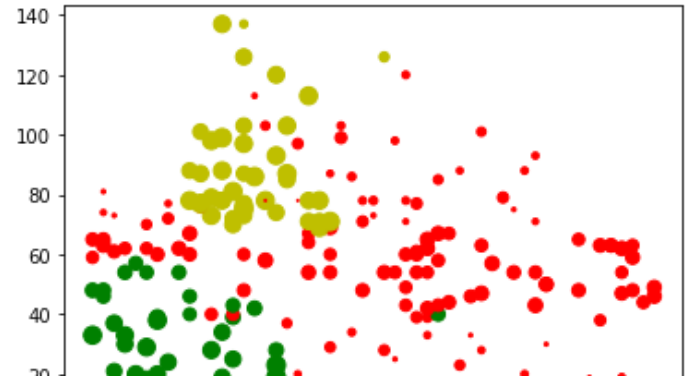
Centroids

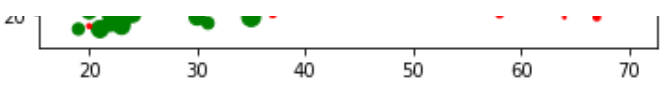
	Age	AnnualIncome	SpendingScore	Genre_Female	Genre_Male	cluster
0	45	59	34	0	0	0
1	33	88	78	0	0	1
2	25	31	67	0	0	2



Centroids

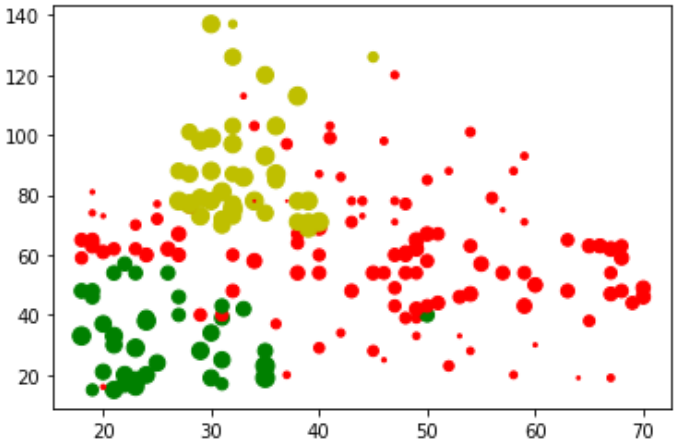
	Age	AnnualIncome	SpendingScore	Genre_Female	Genre_Male	cluster
0	45	60	34	0	0	0
1	32	88	79	0	0	1
2	25	31	67	0	0	2





Centroids

	Age	AnnualIncome	SpendingScore	Genre_Female	Genre_Male	cluster
0	44	60	34	0	0	0
1	32	88	79	0	0	1
2	26	32	67	0	0	2



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