Experiment No. – 2.1

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Subject Name:	**Machine Learning Lab**	**Subject Code:**	**23 CSH 651**

Aim of the Experiment:

Implementing K-Means Algorithm using Python.

Theory:

K-Means Clustering is an Unsupervised Machine Learning algorithm, which groups the unlabeled dataset into different clusters. The goal of clustering is to divide the population or set of data points into a number of groups so that the data points within each group are more comparable to one another and different from the data points within the other groups.

K-Means Clustering works well with numerical data, where the concept of distance between data points is meaningful. It's commonly applied to continuous variables. It does not predict labels for new data; it assigns them to existing clusters based on similarity. It is a centroid based algorithm, where each cluster is associated with a centroid.

Here K defines the number of pre-defined clusters that need to be created in the process, as if K=2, there will be two clusters, and for K=3, there will be three clusters, and so on.

Steps for K-Means Clustering Algorithm:

1) Select the number K to decide the number of clusters.
2) Select k random points from the data as centroids.
3) Calculate the distance of all observations to each of the k centroids.
4) Assign the observations to the closest centroid.
5) Find the new location of the centroid by taking the mean of all the observations in each cluster.
6) Repeat Steps 3-5 until the centroids do not change position..

Example:

Customer segmentation in marketing: K-means groups customers based on purchasing behavior, allowing businesses to tailor marketing strategies for different segments.

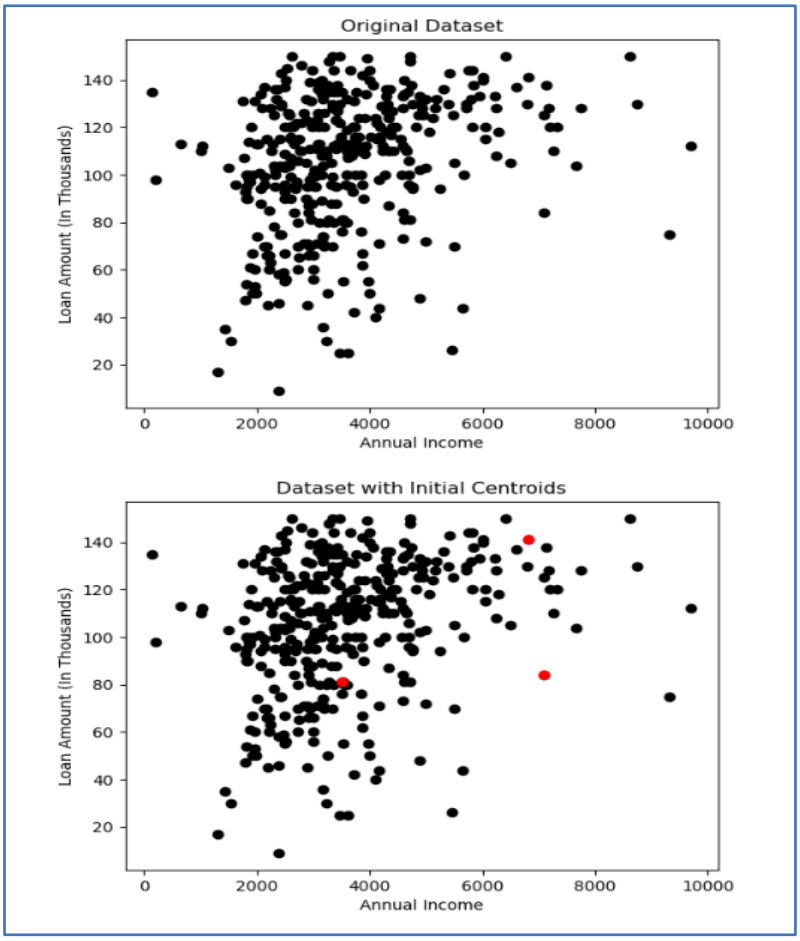
Code:

```
# Importing libraries
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt

# Load the dataset
data = pd.read_csv('C:/Users/milan/OneDrive/Desktop/Clustering.csv')
data.head()

# Read the features
X = data[["LoanAmount","ApplicantIncome"]]
# Visualise data points
plt.scatter(X["ApplicantIncome"],X["LoanAmount"],c='black')
plt.xlabel('Annual Income')
plt.ylabel('Loan Amount (In Thousands)')
plt.title('Original Dataset')
plt.show()

# Step1 - Choose the Number of Clusters (K)
K=3
# Step2 - Select Random Centroid for each Cluster
Centroids = (X.sample(n=K))

# Plot the Centroids
plt.scatter(X["ApplicantIncome"],X["LoanAmount"],c='black')
plt.scatter(Centroids["ApplicantIncome"],Centroids["LoanAmount"],c='red')
plt.xlabel('Annual Income')
plt.ylabel('Loan Amount (In Thousands)')
plt.title('Dataset with Initial Centroids')
plt.show()

print('Initial Centroids: \n',Centroids)
# Step3 - Assign all the points to the closest cluster centroid
# Step4 - Recompute centroids of newly formed clusters
# Step5 - Repeat step 3 and 4

diff = 1
j=0
p=1
print("\nDifference between Previous and Current Centroids:")
while(diff != 0):
    # XD will contain distance of each point from each cluster
```

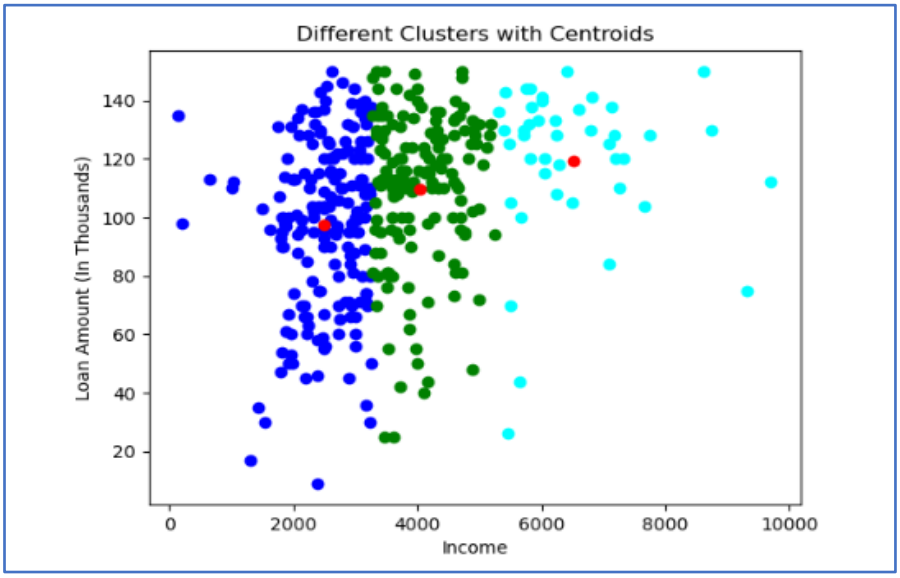
```
    XD=X.copy()
    i=1
    for index1,row_c in Centroids.iterrows():
        ED=[]
        for index2,row_d in X.iterrows():
            # Calculate distance of each point to centroid
            d1=(row_c["ApplicantIncome"]-row_d["ApplicantIncome"])**2
            d2=(row_c["LoanAmount"]-row_d["LoanAmount"])**2
            d=np.sqrt(d1+d2)
            ED.append(d)
        XD[i]=ED
        i=i+1

    # Store the Cluster number for each point
    C=[]

    for index,row in XD.iterrows():
        min_dist=row[1]
        pos=1
        for i in range(K):
            if row[i+1] < min_dist:
                min_dist = row[i+1]
                pos=i+1
        C.append(pos)

    XD["Cluster"]=C
    Centroids_new = XD.groupby(["Cluster"]).mean()[["LoanAmount","ApplicantIncome"]]
    if j == 0:
        diff=1
        j=j+1
    else:
        diff = (Centroids_new['LoanAmount'] - Centroids['LoanAmount']).sum() +
                                        (Centroids_new['ApplicantIncome'] -
Centroids['ApplicantIncome']).sum()
        print("Round",p,": ",diff.sum())
        p=p+1
    Centroids = XD.groupby(["Cluster"]).mean()[["LoanAmount","ApplicantIncome"]]

# Plot Clusters with differnt colors
color=['blue','green','cyan']
for k in range(K):
    data=XD[XD["Cluster"]==k+1]
    plt.scatter(data["ApplicantIncome"],data["LoanAmount"],c=color[k])
plt.scatter(Centroids["ApplicantIncome"],Centroids["LoanAmount"],c='red')
```

```
plt.xlabel('Income')
plt.ylabel('Loan Amount (In Thousands)')
plt.title('Different Clusters with Centroids')
plt.show()
```

Output:




```
Initial Centroids:
      LoanAmount  ApplicantIncome
52          81.0             3500
228        141.0             6822
290         84.0             7085

Difference between Previous and Current Centroids:
Round 1 :  -771.5883930907939
Round 2 :  -647.9837866169579
Round 3 :  -338.9363434386782
Round 4 :  -425.35196156288947
Round 5 :  -370.8474076920054
Round 6 :  -308.8462063935142
Round 7 :  -330.54482458691956
Round 8 :  -133.3283885143341
Round 9 :  -163.2283919837503
Round 10 :  -144.67450430112757
Round 11 :  -93.32770782368112
Round 12 :  -65.06691416725587
Round 13 :  -55.03495831127759
Round 14 :  -9.190752402517077
Round 15 :  -9.19844100901777
Round 16 :  -9.237706177129652
Round 17 :  0.0
```



Learning Outcomes:

1. **I learnt about various python libraries like pandas, matplotlib and numpy.**
2. **I learnt about the concept of K-Means Clustering Algorithm.**
3. **I learnt about how to select the value of K to determine clusters.**
4. **I learnt about how to assign data points to different clusters.**
5. **I learnt about how to calculate the Euclidean Distance.**