```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
```

```
import warnings
warnings.simplefilter("ignore")
```

```
colnames=['sepal_length', 'sepal_width', 'petal_length', 'petal_width']
print(len(colnames))
```

```
4
```

```
iris_data=pd.read_csv('/content/drive/MyDrive/iris.txt', sep=" ", names=colnames,header=None)
```

```
iris_data.head()
```

	sepal_length	sepal_width	petal_length	petal_width
0	5.7	4.4	1.5	0.4
1	5.5	4.2	1.4	0.2
2	5.2	4.1	1.5	0.1
3	5.8	4.0	1.2	0.2
4	5.4	3.9	1.7	0.4

```
iris_data.shape
```

```
(150, 4)
```

```
def euclidean_distance(point1, point2):
  dist = np.linalg.norm(point1 - point2)
```

```
  return dist
```

```
def manhattan_distance(point1, point2):
    return np.sum([abs(value1 - value2) for value1, value2 in zip(point1, point2)])
```

```
def cosine_similarity(point1,point2):
  return np.dot(point1, point2) / (np.linalg.norm(point1) * np.linalg.norm(point2))
```

```
def sse_k(data,cluster,centroids,K,metric):
  sse = []
  count = [0]*K
  dist1 = 0
  dist2 = 0
  dist3 = 0
  for i in range(data.shape[0]):
    if cluster[i] == 1:
      dist1+= (euclidean_distance(data[i],centroids[0])**2)
      count[0]+=1
    elif cluster[i] == 2:
      dist2+= (euclidean_distance(data[i],centroids[1])**2)
      count[1]+=1
    elif cluster[i] == 3:
      dist3+= (euclidean_distance(data[i],centroids[2])**2)
      count[2]+=1
  # print(count[0])
  # print(count[1])
  # print(count[2])
  # print(dist1)
  # print(dist2)
  # print(dist3)
  #sse_1 = (dist1/count1)+(dist2/count2)+(dist3/count3)
  #sse.append(sse_1)
  sse_1 = dist1+dist2+dist3

  #sse_total = np.array(sse)
  return sse_1,count
```

```
def ssb(data,count,centroids,K):
  cent_1 = [0]*len(centroids[0])
  for i in range(K):
    cent_1 += centroids[i]

  cent_1 /= K


  print(cent_1)
  value = 0
  for i in range(K):
    print((euclidean_distance(centroids[i],cent_1)**2))
    value+= count[i]*(euclidean_distance(centroids[i],cent_1)**2)
    print(value,i)
  return value
```

```
import random
from collections import defaultdict
def K_Means_predict_man(data,K,max_iter,rand_seed):
  centroids = defaultdict(int)
  cluster = [0]*iris_data1.shape[0]
  random.seed(rand_seed)
  mylist = np.arange(data.shape[0])
  list1 = mylist.tolist()
  x = random.sample(list1,K)
  #print(x)
  for i in range(K):
  #initializing 1st cluster center
    num1 = x[i]
    #print(data[num1])
    centroids[i] = data[num1]

  iter=0
  #print(2)

  for iteration in range(max_iter):
    iter+=1
    labels=defaultdict(list)
    #print(data.shape)
```

```
#print(centroids)

for keys in range(K):
  labels[keys]=[]

for datapoint1 in range(len(data)):
  distance=[]
  for datapoint2 in range(K):
    dist=manhattan_distance(data[datapoint1],centroids[datapoint2])
    #print("Dp",data[i])
    #print("Cent",centroids[j])
    #print(dist)
    distance.append(dist)
  min_distance=min(distance)
  index=distance.index(min_distance)
  labels[index].append(data[datapoint1])
  cluster[datapoint1] = index+1
  centroid_old=dict(centroids)

for i in range(K):
  label=labels[i]

  centroid_new=np.mean(label,axis=0)
  centroids[i]=centroid_new
  flag=1

for i in range(K):
  a=centroids[i]
  b=centroid_old[i]
  temp = 0
  for i in range(len(a)):
    d = abs(a[i] - b[i])
    temp+=d
  if temp !=0:
    flag = 0


if flag==1:
  break
```

```
  #print(iter)
  return labels,centroids,cluster,iter

```

```
import random
from collections import defaultdict
def K_Means_predict(data,K,max_iter,rand_seed):
  centroids = defaultdict(int)
  cluster = [0]*iris_data1.shape[0]
  random.seed(rand_seed)
  mylist = np.arange(data.shape[0])
  list1 = mylist.tolist()
  x = random.sample(list1,K)
  print("Initial Cluster Center Indices \n",x)
  print("Initial Cluster Centers\n")
  for i in range(K):
  #initializing 1st cluster center
    num1 = x[i]
    print(data[num1])
    centroids[i] = data[num1]

  iter=0
  #print(2)

  for iteration in range(max_iter):
    iter+=1
    labels=defaultdict(list)
    #print(data.shape)
    #print(centroids)

    for keys in range(K):
      labels[keys]=[]

    for datapoint1 in range(len(data)):
      distance=[]
      for datapoint2 in range(K):
        dist=euclidean_distance(data[datapoint1],centroids[datapoint2])
        #print("Dp",data[i])
```

```
        #print("Cent",centroids[j])
        #print(dist)
        distance.append(dist)
      min_distance=min(distance)
      index=distance.index(min_distance)
      labels[index].append(data[datapoint1])
      cluster[datapoint1] = index+1
      centroid_old=dict(centroids)

    for i in range(K):
      label=labels[i]

      centroid_new=np.mean(label,axis=0)
      centroids[i]=centroid_new
      flag=1

    for i in range(K):
      a=centroids[i]
      b=centroid_old[i]
      temp = 0
      for i in range(len(a)):
        d = abs(a[i] - b[i])
        temp+=d
      if temp !=0:
        flag = 0


    if flag==1:
      break
  #print(iter)
  return labels,centroids,cluster,iter

```

```
import random
from collections import defaultdict
def K_Means_predict_man1(data,K,max_iter,rand_seed):
  centroids = defaultdict(int)
  cluster = [0]*iris_data1.shape[0]
  random.seed(rand_seed)
```

```
mylist = np.arange(data.shape[0])
list1 = mylist.tolist()
x = random.sample(list1,K)
#print(x)
for i in range(K):
#initializing 1st cluster center
  num1 = x[i]
  #print(data[num1])
  centroids[i] = data[num1]

iter=0
#print(2)

for iteration in range(max_iter):
  iter+=1
  labels=defaultdict(list)
  #print(data.shape)
  #print(centroids)

  for keys in range(K):
    labels[keys]=[]

  for datapoint1 in range(len(data)):
    distance=[]
    for datapoint2 in range(K):
      dist=manhattan_distance(data[datapoint1],centroids[datapoint2])
      #print("Dp",data[i])
      #print("Cent",centroids[j])
      #print(dist)
      distance.append(dist)
    min_distance=min(distance)
    index=distance.index(min_distance)
    labels[index].append(data[datapoint1])
    cluster[datapoint1] = index+1
    centroid_old=dict(centroids)

  for i in range(K):
    label=labels[i]

```

```
      centroid_new=np.median(label,axis=0)
      centroids[i]=centroid_new
      flag=1

    for i in range(K):
      a=centroids[i]
      b=centroid_old[i]
      temp = 0
      for i in range(len(a)):
        d = abs(a[i] - b[i])
        temp+=d
      if temp !=0:
        flag = 0


    if flag==1:
      break
  #print(iter)
  return labels,centroids,cluster,iter

```

```
import random
from collections import defaultdict
def K_Means_predict1(data,K,max_iter,rand_seed):
  centroids = defaultdict(int)
  cluster = [0]*iris_data1.shape[0]
  random.seed(rand_seed)
  mylist = np.arange(data.shape[0])
  list1 = mylist.tolist()
  x = random.sample(list1,K)
  #print(x)
  for i in range(K):
  #initializing 1st cluster center
    num1 = x[i]
    centroids[i] = data[num1]

  iter=0
  #print(2)

```

```
for iteration in range(max_iter):
  iter+=1
  labels=defaultdict(list)
  #print(data.shape)
  #print(centroids)

  for keys in range(K):
    labels[keys]=[]

  for datapoint1 in range(len(data)):
    distance=[]
    for datapoint2 in range(K):
      dist=euclidean_distance(data[datapoint1],centroids[datapoint2])
      #print("Dp",data[i])
      #print("Cent",centroids[j])
      #print(dist)
      distance.append(dist)
    min_distance=min(distance)
    index=distance.index(min_distance)
    labels[index].append(data[datapoint1])
    cluster[datapoint1] = index+1
    centroid_old=dict(centroids)

  for i in range(K):
    label=labels[i]

    centroid_new=np.median(label,axis=0)
    centroids[i]=centroid_new
    flag=1

  for i in range(K):
    a=centroids[i]
    b=centroid_old[i]
    temp = 0
    for i in range(len(a)):
      d = abs(a[i] - b[i])
      temp+=d
    if temp !=0:
      flag = 0
```

```


    if flag==1:
      break
  #print(iter)
  return labels,centroids,cluster,iter

```

```
import random
from collections import defaultdict
def K_Means_predict_cos(data,K,max_iter,rand_seed):
  centroids = defaultdict(int)
  cluster = [0]*iris_data1.shape[0]
  random.seed(rand_seed)
  mylist = np.arange(data.shape[0])
  list1 = mylist.tolist()
  x = random.sample(list1,K)
  #print(x)
  for i in range(K):
  #initializing 1st cluster center
    num1 = x[i]
    centroids[i] = data[num1]

  iter=0
  #print(2)

  for iteration in range(max_iter):
    iter+=1
    labels=defaultdict(list)
    #print(data.shape)
    #print(centroids)

    for keys in range(K):
      labels[keys]=[]

    for datapoint1 in range(len(data)):
      distance=[]
      for datapoint2 in range(K):
        dist=cosine_similarity(data[datapoint1],centroids[datapoint2])
```

```
        #print("Dp",data[i])
        #print("Cent",centroids[j])
        #print(dist)
        distance.append(dist)
      min_distance=max(distance)
      index=distance.index(min_distance)
      labels[index].append(data[datapoint1])
      cluster[datapoint1] = index+1
      centroid_old=dict(centroids)

    for i in range(K):
      label=labels[i]

      centroid_new=np.mean(label,axis=0)
      #print(centroid_new)
      centroids[i]=centroid_new
      flag=1

    for i in range(K):
      a=centroids[i]
      b=centroid_old[i]
      temp = 0
      #print(a)
      #print(b)
      for i in range(len(a)):
        d = abs(a[i] - b[i])
        temp+=d
      if temp !=0:
        flag = 0


    if flag==1:
      break
  #print(iter)
  return labels,centroids,cluster,iter

```

```
import random
from collections import defaultdict
```

```
def K_Means_predict_cos1(data,K,max_iter,rand_seed):
  centroids = defaultdict(int)
  cluster = [0]*iris_data1.shape[0]
  random.seed(rand_seed)
  mylist = np.arange(data.shape[0])
  list1 = mylist.tolist()
  x = random.sample(list1,K)
  #print(x)
  for i in range(K):
  #initializing 1st cluster center
    num1 = x[i]
    centroids[i] = data[num1]

  iter=0
  #print(2)

  for iteration in range(max_iter):
    iter+=1
    labels=defaultdict(list)
    #print(data.shape)
    #print(centroids)

    for keys in range(K):
      labels[keys]=[]

    for datapoint1 in range(len(data)):
      distance=[]
      for datapoint2 in range(K):
        dist=cosine_similarity(data[datapoint1],centroids[datapoint2])
        #print("Dp",data[i])
        #print("Cent",centroids[j])
        #print(dist)
        distance.append(dist)
      min_distance=max(distance)
      index=distance.index(min_distance)
      labels[index].append(data[datapoint1])
      cluster[datapoint1] = index+1
      centroid_old=dict(centroids)
```

```
    for i in range(K):
      label=labels[i]

      centroid_new=np.median(label,axis=0)
      centroids[i]=centroid_new
      flag=1

    for i in range(K):
      a=centroids[i]
      b=centroid_old[i]
      temp = 0
      for i in range(len(a)):
        d = abs(a[i] - b[i])
        temp+=d
      if temp !=0:
        flag = 0


    if flag==1:
      break
  #print(iter)
  return labels,centroids,cluster,iter

```

```
sse_1 = []
sse_2 = []
sse_3 = []
count11 = []
ssb_k = []
tss_k = []
from collections import defaultdict
iris_data1 = iris_data.to_numpy()
for rand_seed in range(20):
  classes,centroids,cluster,iter=K_Means_predict(iris_data1,3,10000,rand_seed)
  classes1,centroids1,cluster1,iter1=K_Means_predict1(iris_data1,3,10000,rand_seed)
  classes2,centroids2,cluster2,iter2=K_Means_predict_man(iris_data1,3,10000,rand_seed)
  classes3,centroids3,cluster3,iter3=K_Means_predict_man1(iris_data1,3,10000,rand_seed)
  classes4,centroids4,cluster4,iter4=K_Means_predict_cos(iris_data1,3,10000,rand_seed)
  classes5,centroids5,cluster5,iter5=K_Means_predict_cos1(iris_data1,3,10000,rand_seed)
```

```
for i in range(0,3):
  classes[i]=np.array(classes[i]).tolist()
for i in range(0,3):
  classes1[i]=np.array(classes1[i]).tolist()
print("Iteration=%d \n"%rand_seed)
print("Euclidean")
print("Mean \n")
print("Max Iteratins Run=%d \n"%iter)
print("Final Centroids:",centroids)
SSE,count = sse_k(iris_data1,cluster,centroids,3,1)
sse_1.append(SSE)
SSB = ssb(iris_data1,count,centroids,3)
ssb_k.append(SSB)
count11.append(count)
ssb_k.append(SSB)
count11.append(count)
print("Total SSE =%f"%SSE)
print("Total SSB =%2f \n"%SSB)
print("\n")
for i in range(0,3):
  print("Cluster %d"%i,len(classes[i]))
print("Median \n")
print("Max Iteratins Run=%d \n"%iter1)
print("Final Centroids:",centroids1)
SSE,count = sse_k(iris_data1,cluster1,centroids1,3,1)
print("Total SSE =%2f"%SSE)
#print("Total SSB =%2f \n"%SSB)
print("\n")
for i in range(0,3):
  print("Cluster %d"%i,len(classes1[i]))
print("\n")
print("Manhattan")
print("Mean \n")
print("Max Iteratins Run=%d \n"%iter2)
print("Final Centroids:",centroids2)
SSE,count = sse_k(iris_data1,cluster2,centroids2,3,2)
print("Total SSE =%2f"%SSE)
print("\n")
for i in range(0,3):
```

```
  print("Cluster %d"%i,len(classes2[i]))
print("Median \n")
print("Max Iteratins Run=%d \n"%iter3)
print("Final Centroids:",centroids3)
SSE,count = sse_k(iris_data1,cluster3,centroids3,3,2)
print("Total SSE =%2f"%SSE)
print("\n")
for i in range(0,3):
  print("Cluster %d"%i,len(classes3[i]))
print("\n")
print("Cosine")
print("Mean \n")
print("Max Iteratins Run=%d \n"%iter4)
print("Final Centroids:",centroids4)
SSE,count = sse_k(iris_data1,cluster4,centroids4,3,3)
print("Total SSE =%2f"%SSE)
print("\n")
for i in range(0,3):
  print("Cluster %d"%i,len(classes4[i]))
print("Median \n")
print("Max Iteratins Run=%d \n"%iter5)
print("Final Centroids:",centroids5)
SSE,count = sse_k(iris_data1,cluster5,centroids5,3,3)
sse_3.append(SSE)
print("Total SSE =%2f"%SSE)
print("\n")
for i in range(0,3):
  print("Cluster %d"%i,len(classes5[i]))
print("\n")
print("*********XXXXX********")
#print(centroids)
```

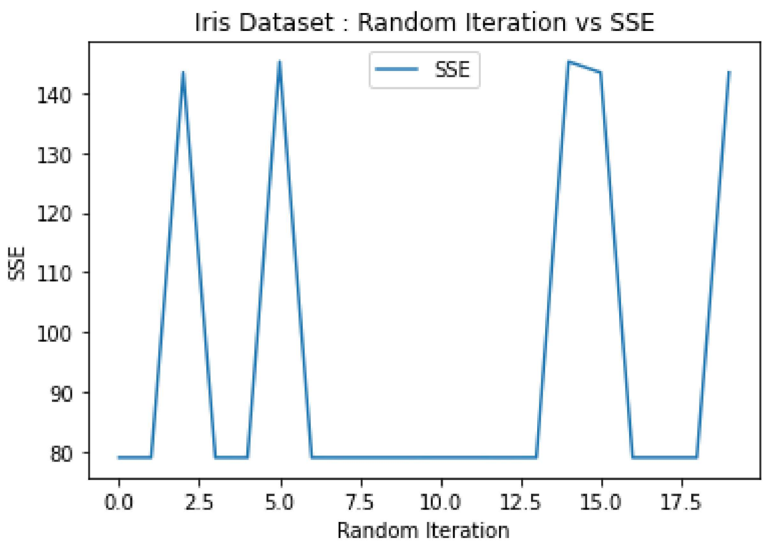
```
*********XXXXX********
Initial Cluster Center Indices
 [14, 23, 21]
Initial Cluster Centers

[5.3 3.7 1.5 0.2]
[5.5 3.5 1.3 0.2]
```

```
[5.1 3.5 1.4 0.2]
Iteration=2

Euclidean
Mean

Max Iteratins Run=5

Final Centroids: defaultdict(<class 'int'>, {0: array([6.30103093, 2.88659794, 4.95876289, 1.69587629]), 1: array([5.28333333, 3.70833
97
24
29
123.79587628865977
3.8495833333333342
15.808275862068967
[5.45340878 3.22244835 2.69037307 0.75719823]
6.857967680295207
665.2228649886351 0
1.9304210810745257
711.5529709344238 1
1.8379977178688256
764.8549047526197 2
Total SSE =143.453735
Total SSB =764.854905



Cluster 0 97
Cluster 1 24
Cluster 2 29
Median

Max Iteratins Run=3

Final Centroids: defaultdict(<class 'int'>, {0: array([6.3, 2.9, 4.9, 1.6]), 1: array([5.4, 3.8, 1.5, 0.2]), 2: array([4.9, 3.2, 1.4,
98
17
35
130.01000000000002
2.7500000000000013
14.420000000000003
Total SSE =147.180000
```

```
Cluster 0 98
Cluster 1 17
Cluster 2 35
```

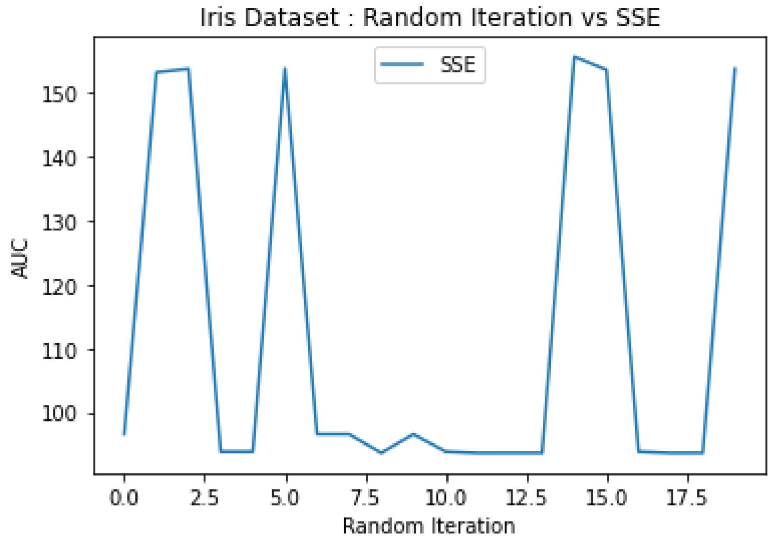
```
center = []
for i in range(len(centroids)):
  center.append(centroids[i])
cent = list(center)
cent_1 = np.array(cent)
```

```
iterations = np.arange(20)
#print(sse_1)
x = plt.subplot( )
x.plot(iterations, sse_1, label='SSE')
#x.plot(k_1, cv_auc, label='AUC CV')
plt.title('Iris Dataset : Random Iteration vs SSE')
plt.xlabel('Random Iteration')
plt.ylabel('SSE')
x.legend()
plt.show()
```



```
iterations = np.arange(20)
print(sse_3)
x = plt.subplot( )
x.plot(iterations, sse_3, label='SSE')
#x.plot(k_1, cv_auc, label='AUC CV')
plt.title('Iris Dataset : Random Iteration vs SSE')
plt.xlabel('Random Iteration')
plt.ylabel('AUC')
x.legend()
plt.show()
```

```
[96.56999999999998, 153.15000000000003, 153.70000000000002, 93.83999999999999, 93.83999999999999, 153.74, 96.57, 96.56999999999998, 93.61
```




```
import seaborn as sns
df_iris = pd.DataFrame(iris_data1, columns = colnames)
df_iris['cluster'] = cluster
sns.FacetGrid(df_iris, hue="cluster", size=5, hue_kws={"marker":["o", "o", "o", "x"]}).map(plt.scatter, "sepal_length", "sepal_width").add_l
```

```
plt.scatter(df_iris['sepal_length'], df_iris['sepal_width'],c=df_iris['cluster'], s=50, cmap='viridis')
centers = cent_1
plt.scatter(centers[:,0], centers[:,1], c='black', s=200, alpha=0.8);
```

```
plt.scatter(df_iris['petal_length'], df_iris['petal_width'],c=df_iris['cluster'], s=50, cmap='viridis')
centers = cent_1
plt.scatter(centers[:,2], centers[:,3], c='black', s=200, alpha=0.8);
```

```
print(classes)
```

```
print(cluster)
```

```
with open('cluster8.txt', 'w') as f:
  for i in cluster:
    f.write(str(i) +"\n")
```

```
sse = []
count1 = []
for rand_seed in range(1):
  classes,centroids,cluster,iter4=K_Means_predict(iris_data1,3,10000,rand_seed)
  SSE,count = sse_k(iris_data1,cluster,centroids,3)
  sse.append(SSE)
  count1.append(count)
  print("Total SSE =%2f"%SSE)
  #classes1,centroids1,cluster1,iter2=K_Means_predict_cos1(iris_data1,3,10000,rand_seed)
  for i in range(0,3):
    classes[i]=np.array(classes[i]).tolist()
  for i in range(0,3):
    classes1[i]=np.array(classes1[i]).tolist()

  print("Iteration=%d \n"%rand_seed)
  print("Mean \n")
  # for i in range(0,3):
  #   print(len(classes[i]))
  # print("Median \n")
  # for i in range(0,3):
  #   print(len(classes1[i]))
  # print("\n")
  #print(centroids)
```

```
# from collections import defaultdict
# iris_data1 = iris_data.to_numpy()
# for rand_seed in range(5):
#   classes,centroids,cluster=K_Means_predict(iris_data2,3,10000,rand_seed)
#   for i in range(0,3):
#     classes[i]=np.array(classes[i]).tolist()

#   for i in range(0,3):
#     print(len(classes[i]))
#   #print(centroids)

rand_seed = 0
classes,centroids,cluster,iter=K_Means_predict_cos1(iris_data1,3,10000,rand_seed)
for i in range(0,3):
  classes[i]=np.array(classes[i]).tolist()

for i in range(0,3):
  print(len(classes[i]))
```

```
print(cluster)
```

```
with open('cluster101.txt', 'w') as f:
  for i in cluster:
    f.write(str(i) +"\n")
```

```
SSE = sse_k(iris_data1,cluster,centroids,3)
```

```
print(SSE)
```