```
import math
def euclidean_distance(l1,l2):
  return math.sqrt(pow((l1[0]-l2[0]),2)+pow((l1[1]-l2[1]),2))


def calculate_a(que,k):
  a=[]
  for i in range(0,k):
     for j in range(0,len(que[i])):
        a.append([])
        for k in range(0,len(que[i])):
           if j!=k:
              a[-1].append(round(euclidean_distance(que[i][j],que[i][k]),2))
  for i in a:
      if len(i)==0:
        i.append(0)
  l2=[]
  for i in a:
    avg=0
    for j in i:
      avg+=j
    avg=avg/len(i)
    l2.append(round(avg,2))
  return l2



def calculate_b(que,k):
  b=[]
  for i in range(0,len(que)):
     for j in range(0,len(que[i])):
       b.append([])
       for y in range(0,len(que)):
         if i!=y:
           b[-1].append([])
           for z in range(0,len(que[y])):
              b[-1][-1].append(round(euclidean_distance(que[i][j],que[y][z]),2))
  ll=[]
  for i in b:
    ll.append([])
    for j in i:
      avg=0.0
      for y in j:
        avg+=y
      avg=avg/len(j)
      ll[-1].append(round(avg,2))
  l5=[]
  for i in ll:
    mi=i[0]
    for j in i:
      if mi > j:
         mi=j
    l5.append(mi)
  return l5



def calculate_s(l2,l3):
  s=[]
  avg=0
  for i in range(0,len(l2)):
     x=(l3[i]-l2[i])/max(l2[i],l3[i])
     s.append(round(x,2))
     avg+=s[-1]
  avg=avg/len(l2)
  return (s,round(avg,3))



que=[[[0, 0], [0, 1], [2, 3]], [[3, 3],[3, 4]]]
k=2
a_l=calculate_a(que,k)
b_l=calculate_b(que,k)
print('Cohesion(a) is:  ',a_l)
print('Separation(b) is:  ',b_l)
ans= calculate_s(a_l,b_l)
my_dict={}
```

```
my_dict[k]=ans[1]
print('S values are: ',ans[0])
print('Silhoutte coefficient for k=2 is: ',ans[1])
```

```
     Cohesion(a) is:   [2.3, 1.92, 3.22, 1.0, 1.0]
     Separation(b) is:   [4.62, 3.92, 1.21, 2.95, 3.55]
     S values are:  [0.5, 0.51, -0.62, 0.66, 0.72]
     Silhoutte coefficient for k=2 is:  0.354
```

```
que=[[[0, 0], [0, 1], [2, 3]], [[3, 3]],[[3, 4]]]
k=3
a_l=calculate_a(que,k)
b_l=calculate_b(que,k)
print('Cohesion(a) is:  ',a_l)
print('Separation(b) is:  ',b_l)
ans= calculate_s(a_l,b_l)
my_dict[k]=ans[1]
print('S values are: ',ans[0])
print('Silhoutte coefficient for k=2 is: ',ans[1])
```

```
     Cohesion(a) is:   [2.3, 1.92, 3.22, 0.0, 0.0]
     Separation(b) is:   [4.24, 3.61, 1.0, 1.0, 1.0]
     S values are:  [0.46, 0.47, -0.69, 1.0, 1.0]
     Silhoutte coefficient for k=2 is:  0.448
```

```
print(my_dict)
```

```
     {2: 0.354, 3: 0.448}
```

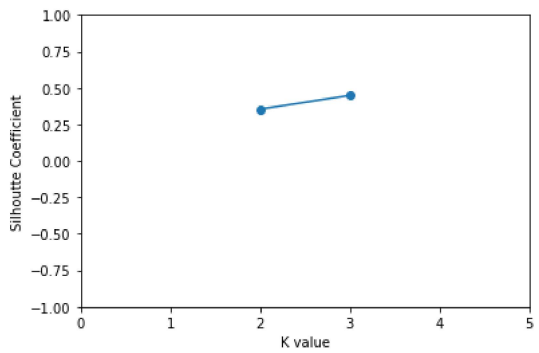
```
print(max(my_dict.values()))
optimal_k = [i for i,j in my_dict.items() if j==max(my_dict.values())]
for i in optimal_k:
  print('optimal k value is:',i)
```

```
     0.448
     optimal k value is: 3
```

```
x=[]
y=[]
for i,j in my_dict.items():
  x.append(i)
  y.append(j)
print(x,y)
```

```
     [2, 3] [0.354, 0.448]
```

```
import matplotlib.pyplot as plt
import numpy as np
x_p = np.array(x)
y_p = np.array(y)
plt.xlim(0,5)
plt.ylim(-1,1)
plt.plot(x_p,y_p,marker='o')
plt.xlabel('K value')
plt.ylabel('Silhoutte Coefficient')
plt.show()
```



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