! This class has been made inactive. No posts will be allowed until an instructor reactivates the class.

private note @115 2 views

HW5_2017310936_Md_Shirajum_Munir

I) Use K-means with following parameters:

n_clusters=3,

init='k-means++',

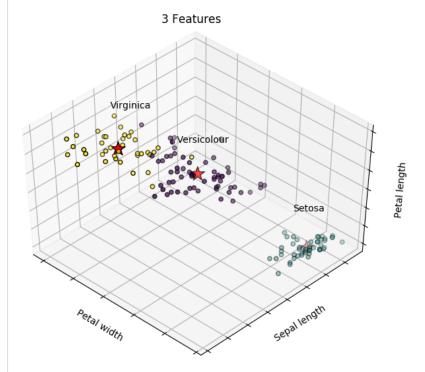
n_init=10,

max_iter=300, tol=1e-04,

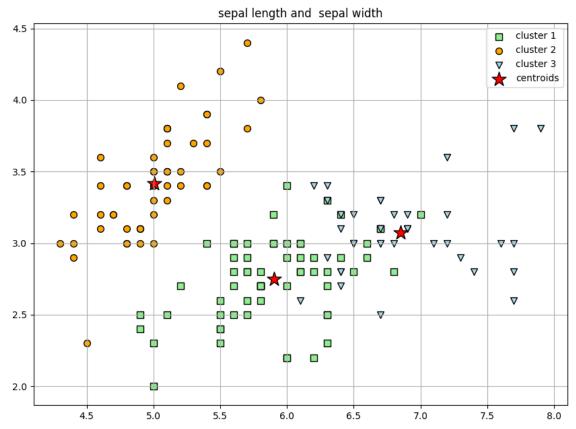
random_state=0,

a) Plot the clusters in 3-D plot with 3 features and 2-D plot with 2 features (similar to input [6] of this notebook, you can choose any combination that shows clear clusters)

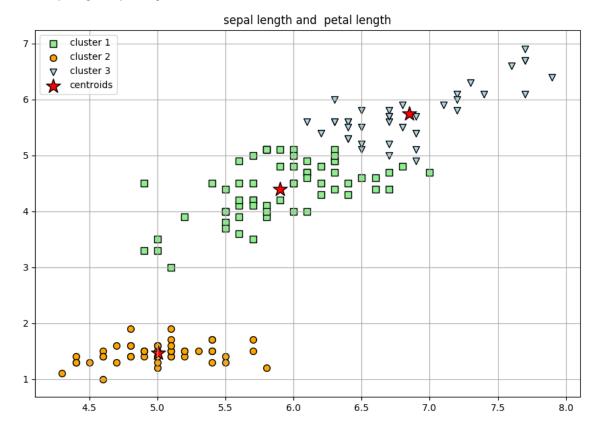
- 1. sepal length in cm
- 2. sepal width in cm
- 3. petal length in cm
- 4. petal width in cm



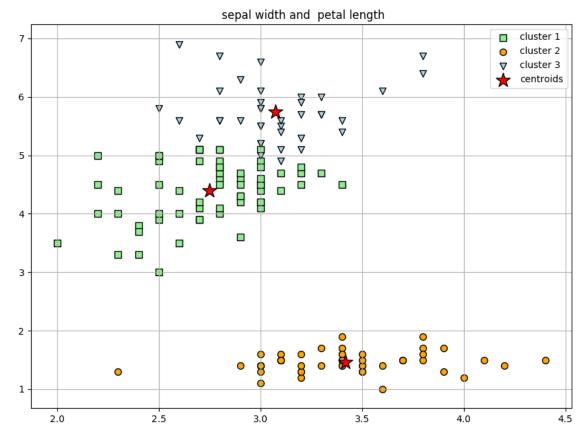
Features : sepal length and sepal width



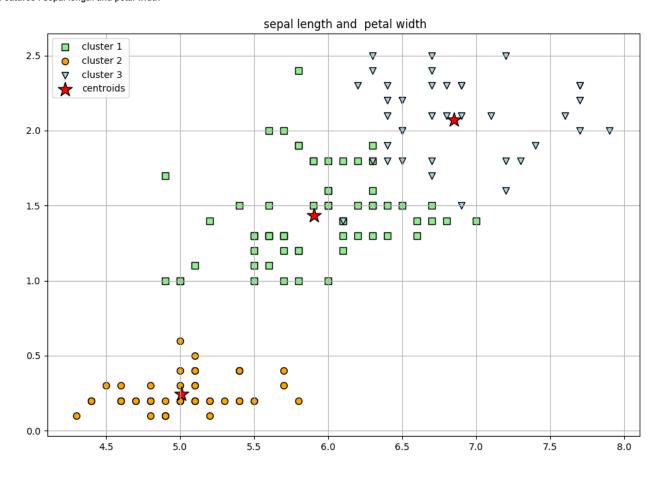
Features: sepal length and petal length



Features : sepal width and petal length



Features : sepal length and petal width

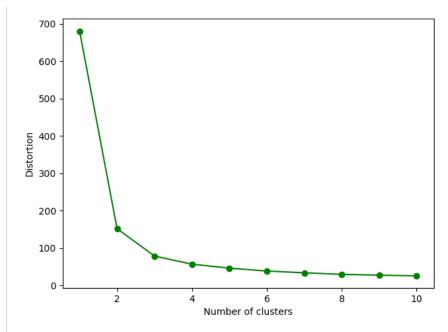


import numpy as np
import matplotlib.pyplot as plt

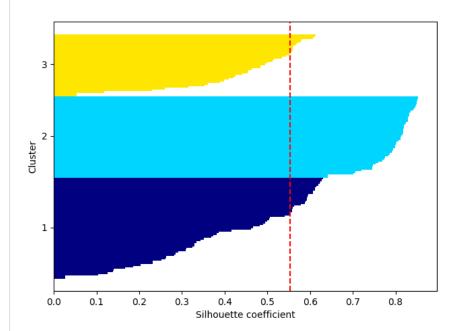
```
from mpl_toolkits.mplot3d import Axes3D
from sklearn.cluster import KMeans
from sklearn import datasets
np.random.seed(5)
iris = datasets.load_iris()
X = iris.data
y = iris.target
print(len(X))
km = KMeans(n_clusters=3,
            init='k-means++',
            n_init=10,
            max iter=300,
            tol=1e-04,
            random state=0)
y_km = km.fit_predict(X)
titles = ['3 clusters']
fig = plt.figure( figsize=(8, 6))
ax = Axes3D(fig, rect=[0, 0, .95, 1], elev=48, azim=134)
labels = km.labels_
('Virginica', 2)]:
    ax.text3D(X[y == label, 3].mean(),
              X[y == label, 0].mean(),
X[y == label, 2].mean() + 2, name,
              horizontalalignment='center',
              bbox=dict(alpha=.2, edgecolor='w', facecolor='w'))
ax.scatter(km.cluster_centers_[:, 3],
            km.cluster_centers_[:, 0],
            km.cluster_centers_[:, 2],
            s=250, marker='*'
            c='red', edgecolor='black',
label='centroids')
ax.w_xaxis.set_ticklabels([])
ax.w_yaxis.set_ticklabels([])
ax.w_zaxis.set_ticklabels([])
ax.set xlabel('Petal width')
ax.set_ylabel('Sepal length')
ax.set_zlabel('Petal length')
ax.set_title('3 Features')
ax.dist = 12
plt.show()
plt.scatter(X[y_km == 0, 0],
            X[y_{km} == 0, 1],
            s=50, c='lightgreen',
            marker='s', edgecolor='black',
            label='cluster 1')
plt.scatter(X[y_km == 1, 0],
            X[y_{km} == 1, 1],
            s=50, c='orange',
            marker='o', edgecolor='black',
            label='cluster 2')
plt.scatter(X[y_km == 2, 0],
            X[y_km == 2, 1],
            s=50, c='lightblue',
            marker='v', edgecolor='black',
            label='cluster 3')
plt.scatter(km.cluster_centers_[:, 0],
            km.cluster_centers_[:, 1],
            s=250, marker='*',
c='red', edgecolor='black',
label='centroids')
plt.legend(scatterpoints=1)
plt.grid()
plt.tight_layout()
plt.title('sepal length and sepal width')
#plt.savefig('images/11_02.png', dpi=300)
plt.show()
plt.scatter(X[y_km == 0, 0],
            X[y_{km} == 0, 2],
            s=50, c='lightgreen',
            marker='s', edgecolor='black',
            label='cluster 1')
plt.scatter(X[y_km == 1, 0],
            X[y_{km} == 1, 2],
            s=50, c='orange',
            marker='o', edgecolor='black',
            label='cluster 2')
plt.scatter(X[y_km == 2, 0],
```

```
X[y_km == 2, 2],
s=50, c='lightblue',
marker='v', edgecolor='black',
             label='cluster 3')
plt.scatter(km.cluster_centers_[:, 0],
              km.cluster_centers_[:, 2],
              s=250, marker='*',
              c='red', edgecolor='black',
              label='centroids')
plt.legend(scatterpoints=1)
plt.grid()
plt.tight_layout()
#plt.savefig('images/11 02.png', dpi=300)
plt.title('sepal length and petal length')
plt.show()
s=50, c='lightgreen',
              marker='s', edgecolor='black',
             label='cluster 1')
plt.scatter(X[y_km == 1, 1],
             X[y_{km} == 1, 2],
              s=50, c='orange'
              marker='o', edgecolor='black',
              label='cluster 2')
plt.scatter(X[y_km == 2, 1],
              X[y_{km} == 2, 2],
             s=50, c='lightblue',
              marker='v', edgecolor='black',
             label='cluster 3')
plt.scatter(km.cluster_centers_[:, 1], km.cluster_centers_[:, 2],
             s=250, marker='*',
c='red', edgecolor='black',
label='centroids')
plt.legend(scatterpoints=1)
plt.grid()
plt.tight_layout()
#plt.savefig('images/11_02.png', dpi=300)
plt.title(' sepal width and petal length')
plt.scatter(X[y_km == 0, 0],
              X[y \ km == 0, 3],
              s=50, c='lightgreen',
              marker='s', edgecolor='black',
              label='cluster 1')
plt.scatter(X[y_km == 1, 0],
              X[y_{km} == 1, 3],
             s=50, c='orange',
marker='o', edgecolor='black',
             label='cluster 2')
plt.scatter(X[y_km == 2, 0],
             X[y_{km} == 2, 3],
              s=50, c='lightblue',
              marker='v', edgecolor='black',
             label='cluster 3')
plt.scatter(km.cluster_centers_[:, 0],
              km.cluster_centers_[:, 3],
              s=250, marker='*',
             c='red', edgecolor='black',
label='centroids')
plt.legend(scatterpoints=1)
plt.grid()
plt.tight_layout()
#plt.savefig('images/11_02.png', dpi=300)
plt.title(' sepal length and petal width')
plt.show()
```

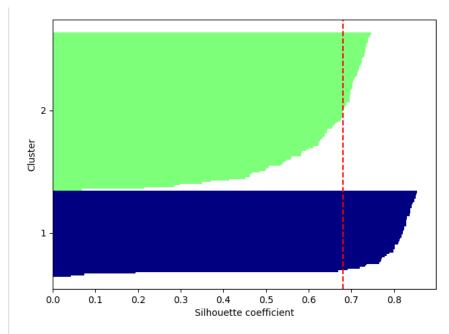
b) Use elbow method to plot and choose the best "k", similar to inputs [7] and [8] of this notebook.



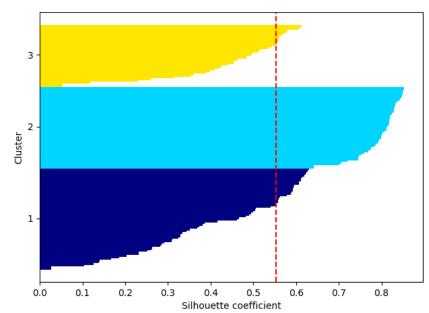
c) Show the silhouette plots of these clusters similar to input $\ [9]$ of this $\ notebook.$



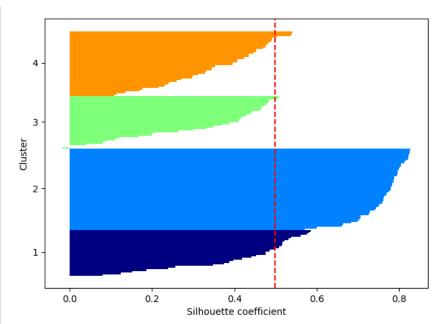
d) Show the silhouette plots of K-means with $n_clusters$ =2, 3, and 4. $n_clusters$ =2



n_clusters=3



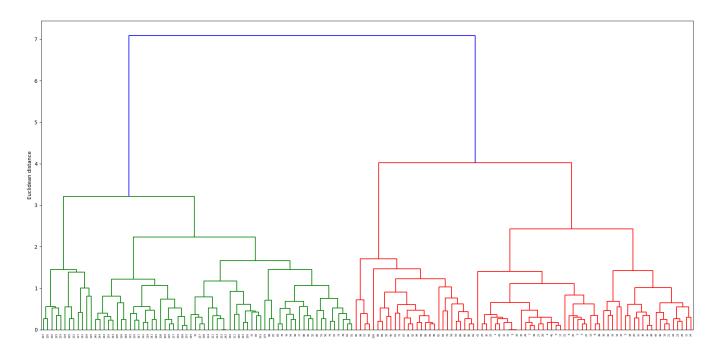
n_clusters=4



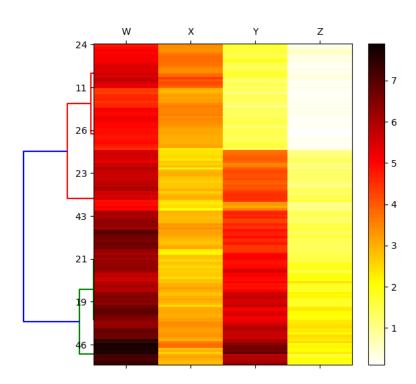
```
print('Distortion: %.2f' % km.inertia_)
distortions = []
for i in range(1, 11):
   km = KMeans(n_clusters=i,
               init='k-means++',
               n_init=10,
               max_iter=300,
               random_state=0)
   km.fit(X)
   {\tt distortions.append(km.inertia\_)}
plt.plot(range(1, 11), distortions, marker='o', c='g')
plt.xlabel('Number of clusters')
plt.ylabel('Distortion')
plt.tight_layout()
plt.show()
# c) Show the silhouette plots of these clusters similar to input [9] of this notebook.
from sklearn.metrics import silhouette_samples
from matplotlib import cm
km = KMeans(n_clusters=3,
           init='k-means++',
           n_init=10,
           max_iter=300,
           tol=1e-04.
           random_state=0)
y_{km} = km.fit_predict(X)
cluster_labels = np.unique(y_km)
n_clusters = cluster_labels.shape[0]
silhouette_vals = silhouette_samples(X, y_km, metric='euclidean')
y_ax_lower, y_ax_upper = 0, 0
yticks = []
for i, c in enumerate(cluster_labels):
   c_silhouette_vals = silhouette_vals[y_km == c]
   c_silhouette_vals.sort()
   y_ax_upper += len(c_silhouette_vals)
   color = cm.jet(float(i) / n_clusters)
   \verb|yticks.append|(y_ax_lower + y_ax_upper) / 2.)|
   y_ax_lower += len(c_silhouette_vals)
silhouette_avg = np.mean(silhouette_vals)
plt.axvline(silhouette_avg, color="red", linestyle="--")
plt.yticks(yticks, cluster_labels + 1)
plt.ylabel('Cluster')
plt.xlabel('Silhouette coefficient')
plt.tight_layout()
plt.show()
\# d) Show the silhouette plots of K-means with n_clusters=2, 3, and 4.
```

```
from sklearn.metrics import silhouette samples
from matplotlib import cm
km = KMeans(n_clusters=2,
            init='k-means++',
            n_init=10,
            max_iter=300,
            tol=1e-04,
            random_state=0)
y_km = km.fit_predict(X)
cluster_labels = np.unique(y_km)
n clusters = cluster labels.shape[0]
silhouette_vals = silhouette_samples(X, y_km, metric='euclidean')
y_ax_lower, y_ax_upper = 0, 0
vticks = []
for i, c in enumerate(cluster_labels):
    c_silhouette_vals = silhouette_vals[y_km == c]
    c_silhouette_vals.sort()
    y_ax_upper += len(c_silhouette_vals)
    color = cm.jet(float(i) / n_clusters)
    yticks.append((y_ax_lower + y_ax_upper) / 2.)
    y_ax_lower += len(c_silhouette_vals)
silhouette_avg = np.mean(silhouette_vals)
plt.axvline(silhouette_avg, color="red", linestyle="--")
plt.yticks(yticks, cluster_labels + 1)
plt.ylabel('Cluster')
plt.xlabel('Silhouette coefficient')
plt.tight_layout()
plt.show()
from sklearn.metrics import silhouette_samples
from matplotlib import cm
km = KMeans(n_clusters=3,
            init='k-means++',
            n init=10,
            max_iter=300,
            tol=1e-04,
            random_state=0)
y km = km.fit predict(X)
cluster_labels = np.unique(y_km)
n_clusters = cluster_labels.shape[0]
silhouette_vals = silhouette_samples(X, y_km, metric='euclidean')
y_ax_lower, y_ax_upper = 0, 0
yticks = []
for i, c in enumerate(cluster_labels):
    c_silhouette_vals = silhouette_vals[y_km == c]
    c_silhouette_vals.sort()
    y_ax_upper += len(c_silhouette_vals)
    color = cm.jet(float(i) / n_clusters)
    plt.barh(range(y_ax_lower, y_ax_upper), c_silhouette_vals, height=1.0,
             edgecolor='none', color=color)
    yticks.append((y_ax_lower + y_ax_upper) / 2.)
    y_ax_lower += len(c_silhouette_vals)
silhouette_avg = np.mean(silhouette_vals)
plt.axvline(silhouette_avg, color="red", linestyle="--")
plt.yticks(yticks, cluster_labels + 1)
plt.ylabel('Cluster')
plt.xlabel('Silhouette coefficient')
plt.tight_layout()
plt.show()
from sklearn.metrics import silhouette_samples
from matplotlib import cm
km = KMeans(n_clusters=4,
            init='k-means++',
            n_init=10,
            max iter=300
            tol=1e-04,
            random_state=0)
y_km = km.fit_predict(X)
cluster labels = np.unique(y km)
n_clusters = cluster_labels.shape[0]
silhouette_vals = silhouette_samples(X, y_km, metric='euclidean')
y_ax_lower, y_ax_upper = 0, 0
yticks = []
for i, c in enumerate(cluster_labels):
```

II) Performing the hierarchical clustering on a distance matrix, similar to inputs [14] to [19] of this notebook.



Attaching dendrograms to a heat map



```
Output:
150
    5.1 3.5 1.4
1
    4.9
        3.0
            1.4
                 0.2
2
    4.7
        3.2 1.3
                 0.2
3
    4.6 3.1 1.5
                0.2
4
5
6
7
    5.0 3.6 1.4
                 0.2
    5.4 3.9 1.7
                 0.4
    4.6 3.4 1.4 0.3
    5.0 3.4 1.5 0.2
8
9
10
    4.4 2.9 1.4 0.2
    4.9 3.1 1.5
                0.1
    5.4 3.7 1.5
                 0.2
11
    4.8 3.4 1.6
                0.2
12
    4.8 3.0 1.4
                 0.1
13
    4.3 3.0 1.1
                 0.1
14
    5.8 4.0 1.2
15
    5.7 4.4 1.5
                 0.4
    5.4 3.9 1.3 0.4
17
    5.1 3.5 1.4
18
    5.7 3.8 1.7
19
    5.1 3.8 1.5
20
    5.4 3.4 1.7 0.2
21
    5.1 3.7 1.5
                0.4
22
    4.6 3.6 1.0
                0.2
23
    5.1 3.3 1.7
                 0.5
24
    4.8 3.4 1.9 0.2
25
    5.0 3.0 1.6 0.2
26
27
    5.0 3.4 1.6
                0.4
    5.2 3.5 1.5 0.2
28
    5.2 3.4 1.4 0.2
29
    4.7 3.2 1.6 0.2
120 6.9 3.2 5.7
121
    5.6 2.8 4.9
                2.0
122 7.7 2.8 6.7 2.0
123 6.3 2.7 4.9
                1.8
124 6.7 3.3 5.7 2.1
125
   7.2 3.2 6.0
                1.8
126 6.2 2.8 4.8 1.8
127 6.1 3.0 4.9 1.8
128 6.4 2.8 5.6 2.1
129 7.2 3.0 5.8 1.6
130 7.4 2.8 6.1 1.9
131 7.9 3.8 6.4 2.0
132 6.4 2.8 5.6 2.2
133 6.3 2.8 5.1 1.5
134 6.1 2.6 5.6 1.4
135 7.7 3.0 6.1 2.3
136
   6.3 3.4 5.6
                2.4
137 6.4 3.1 5.5 1.8
138
   6.0 3.0 4.8 1.8
139 6.9 3.1 5.4 2.1
```

```
140 6.7 3.1 5.6 2.4
141 6.9 3.1 5.1 2.3
142 5.8 2.7 5.1 1.9
143 6.8 3.2 5.9
                  2.3
144 6.7 3.3 5.7 2.5
145 6.7 3.0
                  2.3
146 6.3 2.5 5.0 1.9
147 6.5 3.0
             5.2 2.0
148 6.2 3.4 5.4 2.3
    5.9 3.0
             5.1 1.8
[150 rows x 4 columns]
    0.000000 0.538516 0.509902 0.648074 0.141421 0.616441 0.519615
                                                  1.090871
    0.538516 0.000000 0.300000 0.331662
                                         0.608276
                                                             0.509902
1
    0.509902 0.300000 0.000000 0.244949
                                         0.509902 1.086278
                                                             0.264575
    0.648074 0.331662 0.244949 0.000000
3
                                         0.648074 1.166190
                                                             0.331662
    0.141421 0.608276 0.509902 0.648074
                                         0.000000 0.616441
                                                             0.458258
             1.090871 1.086278 1.166190
                                         0.616441 0.000000
                                                             0.994987
5
    0.616441
              0.509902 0.264575 0.331662
6
    0.519615
                                         0.458258 0.994987
                                                             0.000000
                                                   0.700000
7
    0.173205 0.424264 0.412311 0.500000
                                         0.223607
                                                             0.424264
8
    0.921954 0.509902 0.435890 0.300000
                                         0.921954 1.459452
                                                             0.547723
9
    0.469042 0.173205 0.316228 0.316228
                                         0.529150 1.009950
                                                             0.479583
10
    0.374166
             0.866025 0.883176 1.000000
                                         0.424264 0.346410
                                                             0.866025
    0.374166 0.458258 0.374166 0.374166 0.346410 0.812404
                                                             0.300000
    0.591608
             0.141421 0.264575 0.264575
                                          0.640312 1.161895
12
                                                             0.489898
    0.994987 0.678233 0.500000 0.519615
                                         0.974679 1.571623
14
    0.883176
             1.360147
                       1.363818 1.529706
                                          0.916515
                                                   0.678233
                                         1.086278 0.616441
15
    1.104536 1.627882 1.587451 1.714643
16
    0.547723 1.053565
                      1.009950 1.166190
                                         0.547723 0.400000
    0.100000 0.547723 0.519615 0.655744 0.173205 0.591608
                                                             0.509902
17
    0.741620
             1.174734
                      1.236932 1.322876
                                         0.793725 0.331662
                                                             1,208305
18
19
    0.331662 0.836660 0.754983 0.866025
                                         0.264575 0.387298
                                                             0.648074
             0.707107 0.830662 0.877496
                                         0.538516 0.538516
                                                             0.860233
20
    0.435890
    0.300000 0.761577 0.700000 0.806226
                                                             0.600000
21
                                         0.264575 0.412311
    0.648074 0.781025 0.509902 0.707107
                                         0.565685 1.122497
                                                             0.458258
22
                      0.648074 0.648074
    0.469042
23
             0.556776
                                         0.529150 0.678233
                                                             0.624500
    0.591608 0.648074 0.640312 0.538516 0.574456 0.830662
24
                                                             0.547723
25
    0.547723 0.223607 0.469042 0.424264
                                         0.632456 1.009950
                                                             0.608276
26
    0.316228 0.500000 0.509902 0.547723
                                         0.346410 0.648074
                                                             0.458258
27
    0.141421 0.591608 0.616441 0.721110
                                         0.244949 0.529150
                                                             0.624500
    0.141421
              0.500000 0.547723 0.678233
                                         0.282843 0.648074
                                                             0.608276
28
    0.538516
29
              0.346410
                       0.300000 0.173205
                                          0.538516 1.014889
                                                             0.316228
    5.121523
              5.190376
                       5.348832 5.229723
                                         5.164301 4.727579
                                                             5,274467
121
    4.028647
              4.002499
                       4.143670 3.986226
                                         4.060788
                                                   3.748333
    6.211280
              6.261789
                       6.446705 6.322974
                                         6.265780
                                                   5.836095
                                                             6.399219
   4.109745
             4.106093 4.281355 4.143670
                                         4.160529 3.801316
    4.969909
              5.042817
                       5.194228 5.069517
                                          5.007994 4.576024
                                                             5,113707
124
                                         5.359104 4.917316
    5.312250
              5.389805
                       5.558777
                                5.438750
                                                             5.496362
125
    3.977436
              3.981206 4.149699 4.012481 4.024922 3.663332
                                                             4.090232
126
   4.007493 4.031129
                      4.185690 4.047221 4.047221 3.674235 4.112177
127
128 4.840455 4.851804 5.014978 4.873397
                                         4.883646 4.506662
                                                             4.947727
    5.097058
                                         5.149757 4.722288
129
              5.158488
                       5.338539 5.217279
                                                             5,288667
130 5.546170 5.591959
                      5.777543 5.655086 5.601785 5.178803
                                                             5.731492
131 6.014150
             6.154673
                      6.312686 6.215304 6.057227 5.559676
                                                             6.240192
132 4.880574 4.891830 5.053712 4.913247
                                         4.923413 4.545327
                                                             4.984977
    4.160529
             4.168933
                      4.341659 4.198809
                                         4.208325 3.845777
                                                             4,287190
133
    4.570558 4.547527
                      4.716991 4.555217
                                         4.614109 4.288356
                                                             4,662617
                                                             5.988322
135
    5.788782
              5.860034
                      6.040695 5.932116
                                         5.843800 5.391660
    4.891830 4.959839 5.092151 4.962862 4.920366 4.502222 4.993996
              4.650806
                      4.806246 4.669047
                                         4.645428
    4.606517
                                                   4.247352
138
    3.896152 3.915354 4.066940 3.926831 3.934463 3.569314
    4.796874
             4.860041 5.026927 4.910193
                                         4.844585 4.412482
   5.019960 5.072475
                      5.228767 5.104900 5.061620 4.641121
                                                             5.152669
140
    4.636809
             4.702127
                      4.868265 4.760252
                                         4.686150 4.249706
                                                             4.803124
141
142 4.208325 4.180909
                      4.334743 4.177320
                                         4.246175 3.925557
                                                             4.263801
143
    5.257376 5.320714 5.475400 5.349766
                                         5.297169 4.868265
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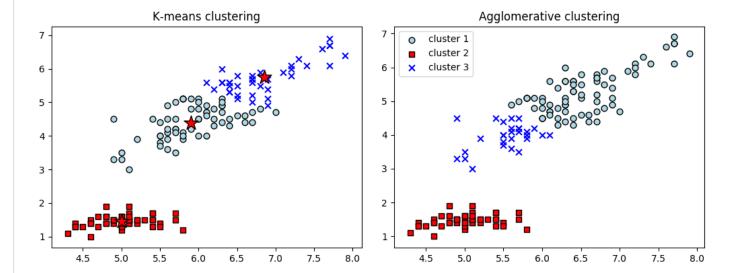
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	6 7 8 9 10 11 12 13 14 15 16 17 18 19	5.397222 5.200961 5.523586 5.274467 5.097058 5.190376 5.397222 5.845511 5.304715 5.061620 5.217279 4.817676 5.158488	5.267827 5.082322 5.406478 5.165269 4.977951 5.071489 5.286776 5.724509 5.180734 4.925444 5.081338 4.700000 5.028916	4.796874 4.598913 4.914265 4.666905 4.593332 4.597826 4.784349 5.235456 4.713809 4.501111 4.617359 4.609772 4.229657 4.570558	4.384062 4.200000 4.429447 4.220190 4.170132 4.184495 4.324350 4.764452 4.453089 4.297674 4.325506 4.237924 3.937004 4.235564	4.593474 4.397727 4.701064 4.457578 4.316248 4.387482 4.576024 5.025933 4.553021 4.341659 4.448595 4.420407 4.052160 4.379498	4.749737 4.589118 4.888763 4.672259 4.511097 4.561798 4.791659 5.205766 4.750789 4.479955 4.616276 4.606517 4.254409 4.536518	4.217819 4.060788 4.302325 4.106093 4.032369 4.022437 4.217819 4.631414 4.333590 4.113393 4.178516 4.102438 3.806573 4.060788
	6 7 8 9 10 11 12 13 14 15 16 17 18 19 20	5.397222 5.200961 5.523586 5.274467 5.097058 5.190376 5.397222 5.845511 5.061620 5.217279 5.218237 4.81767 4.817678 4.904080	5.267827 5.082322 5.406478 5.165269 4.977951 5.071489 5.286776 5.724509 5.180734 4.925444 5.081338 5.092151 4.700000 6.028916 4.794789	4.796874 4.598913 4.914265 4.666905 4.593332 4.597826 4.784349 5.235456 4.713809 4.501111 4.617359 4.609772 4.229657 4.2570558 4.302325	4.384062 4.200000 4.429447 4.220190 4.170132 4.184495 4.324350 4.764452 4.453089 4.297674 4.325506 4.237924 4.935564 3.924283	4.593474 4.397727 4.701064 4.457578 4.316248 4.387482 4.576024 5.025933 4.553021 4.341659 4.448595 4.420407 4.052160 4.379498 4.106093	4.749737 4.589118 4.888763 4.672259 4.511097 4.561798 4.791659 5.205766 4.750789 4.479955 4.616276 4.606517 4.254409 4.536518 4.328972	4.217819 4.060788 4.302325 4.106093 4.032369 4.022437 4.217819 4.631414 4.333590 4.113393 4.178516 4.102438 3.806573 4.060788 3.811824
	6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21	5.397222 5.200961 5.523586 5.274467 5.097058 5.190376 5.397222 5.845511 5.061620 5.217279 5.218237 4.817676 4.817676 4.94088 5.109795	5.267827 5.082322 5.406478 5.165269 4.977951 5.071489 5.286776 5.724509 4.925444 5.081338 5.092151 4.700000 4.794789 4.976947	4.796874 4.598913 4.914265 4.666905 4.503332 4.597826 4.784349 5.235456 4.713809 4.501111 4.617359 4.609772 4.229657 4.570558 4.302325 4.511097	4.384062 4.200000 4.429447 4.220190 4.170132 4.184495 4.324350 4.764452 4.453089 4.297674 4.325506 4.237924 3.937004 4.235564 4.235564 4.235564 4.24283 4.168933	4.593474 4.397727 4.701064 4.457578 4.316248 4.387482 4.576024 5.025933 4.553021 4.341659 4.448595 4.420407 4.052160 4.379498 4.106093 4.324350	4.749737 4.589118 4.888763 4.672259 4.511097 4.561798 4.791659 5.205766 4.750789 4.479955 4.616276 4.606517 4.254409 4.536518 4.328972 4.485532	4.217819 4.060788 4.302325 4.106093 4.032369 4.022437 4.217819 4.631414 4.333590 4.113393 4.178516 4.102438 3.806573 4.060788 3.811824 4.006245
	6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24	5.397222 5.200961 5.523586 5.274467 5.097058 5.190376 5.397222 5.845511 5.061620 5.217279 5.218237 4.817676 5.158488 4.904080 5.109795 5.217820 4.876474 4.944694	5.267827 5.082322 5.406478 5.165269 4.977951 5.071489 5.286776 5.724509 5.180734 4.925444 5.081338 5.092151 4.704000 5.028916 4.794789 4.976947 5.646238 4.749737 4.832184	4.796874 4.598913 4.914265 4.666905 4.503332 4.597826 4.784349 5.235456 4.713809 4.501111 4.617359 4.609772 4.229657 4.570558 4.302325 4.511097 5.78803 4.259108 4.366921	4.384062 4.200000 4.429447 4.220190 4.170132 4.184495 4.324350 4.764452 4.453089 4.297674 4.325506 4.237924 4.235564 3.937004 4.235564 3.924283 4.168933 4.794789 3.863936 3.944617	4.593474 4.397727 4.701064 4.457578 4.316248 4.387482 4.576024 5.025933 4.553021 4.341659 4.448595 4.420407 4.052160 4.379498 4.106093 4.324350 4.984977 4.068169 4.144876	4.749737 4.589118 4.888763 4.672259 4.511097 4.561798 4.791659 5.205766 4.750789 4.479955 4.616276 4.606517 4.254409 4.536518 4.328972 4.485532 5.460282 4.315090	4.217819 4.060788 4.302325 4.106093 4.032369 4.022437 4.217819 4.631414 4.333590 4.113393 4.178516 4.102438 3.806573 4.060788 3.811824 4.006245 4.628175 3.78984 3.764306
	6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25	5.397222 5.200961 5.523586 5.274467 5.097058 5.190376 5.397222 5.845511 5.061620 5.217279 5.218237 4.815678 4.904080 5.109795 5.781003 5.781003 5.781003 5.781003 5.781004 5.78104 5.781004 5.78	5.267827 5.082322 5.406478 5.165269 4.977951 5.071489 5.286776 5.724509 5.180734 4.925444 5.081338 5.092151 4.700000 6.028916 4.794789 4.976947 5.646238 4.749737 4.832184 5.007994	4.796874 4.598913 4.914265 4.666905 4.593332 4.597826 4.784349 5.235456 4.713809 4.501111 4.617359 4.609772 4.229657 4.570558 4.302325 4.511097 5.178803 4.259108 4.366921 4.5011111	4.384062 4.200000 4.429447 4.220190 4.170132 4.184495 4.324350 4.764452 4.453089 4.297674 4.325506 4.237924 3.935564 3.924283 4.168933 4.794789 3.863936 3.944617 4.048456	4.593474 4.397727 4.701064 4.457578 4.316248 4.387482 4.576024 5.025933 4.553021 4.341659 4.420407 4.052160 4.379498 4.106093 4.324350 4.984977 4.068169 4.144876 4.295346	4.749737 4.589118 4.888763 4.672259 4.511097 4.561798 4.791659 5.205766 4.750789 4.479955 4.616276 4.606517 4.254409 4.536518 4.328972 4.485532 5.135173 4.260282 4.315090 4.522168	4.217819 4.060788 4.302325 4.106093 4.032369 4.022437 4.217819 4.631414 4.3335590 4.113393 4.178516 4.102438 3.806573 4.060788 3.811824 4.006245 4.628175 4.738984 3.764306 3.952215
	6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26	5.397222 5.200961 5.523586 5.274467 5.097058 5.190376 5.397222 5.845511 5.061620 5.217279 5.218237 4.817676 5.19795 5.781003 4.876474 4.944694 5.116640 5.037857	5.267827 5.082322 5.406478 5.165269 4.977951 5.071489 5.286776 5.724509 5.081338 5.092151 4.700000 4.794789 4.976947 5.646238 4.749737 4.832184 5.007994 4.911212	4.796874 4.598913 4.914265 4.666905 4.503332 4.597826 4.784349 5.235456 4.713809 4.501111 4.617359 4.609772 4.229657 4.570558 4.302325 4.511097 5.178803 4.259108 4.366921 4.366921 4.429447	4.384062 4.200000 4.429447 4.220190 4.170132 4.184495 4.324350 4.764452 4.453089 4.297674 4.325506 4.237924 3.937004 4.235564 3.924283 4.168933 4.794789 3.863936 3.944617 4.048456 4.038564	4.593474 4.397727 4.701064 4.457578 4.316248 4.387482 4.576024 5.025933 4.553021 4.341659 4.448595 4.420407 4.052160 4.379498 4.106093 4.324350 4.984977 4.068169 4.144876 4.295346 4.295346	4.749737 4.589118 4.888763 4.672259 4.511097 4.561798 4.791659 5.205766 4.750789 4.479955 4.616276 4.606517 4.254409 4.536518 4.328972 4.485532 5.135173 4.260282 4.315090 4.522168 4.414748	4.217819 4.060788 4.302325 4.106093 4.032369 4.022437 4.217819 4.631414 4.333590 4.113393 4.178516 4.102438 3.806573 4.060788 3.811824 4.06245 4.628175 3.738984 3.764306 3.952215 3.896152
	6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27	5.397222 5.200961 5.523586 5.274467 5.097058 5.190376 5.397222 5.845511 5.304715 5.061620 5.217279 5.218237 4.817676 5.158488 4.904080 5.109795 5.781003 4.876474 4.944694 5.116640 5.1037857 5.140039	5.267827 5.082322 5.406478 5.165269 4.977951 5.071489 5.286776 5.724509 5.180734 4.925444 5.081338 5.092151 4.700000 5.028916 4.794789 4.976947 5.646238 4.749737 4.832184 5.007994 4.911212 5.021952	4.796874 4.598913 4.914265 4.666905 4.593332 4.597826 4.784349 5.235456 4.713809 4.591111 4.617359 4.609772 4.229657 4.570558 4.3902325 4.511097 5.178803 4.259108 4.366921 4.366921 4.591111 4.429447 4.538722	4.384062 4.200000 4.429447 4.220190 4.170132 4.184495 4.324350 4.764452 4.453089 4.297674 4.325506 4.237924 3.937004 4.235564 3.924283 4.168933 4.794789 3.863936 3.944617 4.048456 4.038564 4.165333	4.593474 4.397727 4.701064 4.457578 4.316248 4.387482 4.576024 5.025933 4.553021 4.341659 4.448595 4.420407 4.052160 4.379498 4.106093 4.324350 4.984977 4.068169 4.144876 4.295346 4.295346 4.295346	4.749737 4.589118 4.888763 4.672259 4.511097 4.561798 4.791659 5.205766 4.750789 4.479955 4.616276 4.606517 4.254409 4.536518 4.328972 4.485532 5.135173 4.260282 4.315090 4.522168 4.414748 4.542026	4.217819 4.060788 4.302325 4.106093 4.032369 4.022437 4.217819 4.631414 4.333590 4.113393 4.178516 4.102438 3.806573 4.060788 3.811824 4.006245 4.628175 3.738984 3.764306 3.952215 3.896152 4.032369
	6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28	5.397222 5.209961 5.523586 5.274467 5.097058 5.190376 5.397222 5.845511 5.304715 5.061620 5.217279 4.817676 5.158488 4.904080 5.109795 5.781003 4.876474 4.944694 5.116640 5.034639 5.221111	5.267827 5.082322 5.406478 5.165269 4.977951 5.071489 5.286776 5.724509 5.180734 4.925444 5.081338 5.092151 4.704000 5.028916 4.794789 4.976947 5.646238 4.749737 4.832184 5.007994 4.911212 5.021952 5.102940	4.796874 4.598913 4.914265 4.666905 4.503332 4.597826 4.784349 4.501111 4.617359 4.609772 4.229657 4.570558 4.302325 4.511097 5.178803 4.259108 4.366921 4.501111 4.429447 4.538722 4.610857	4.384062 4.200000 4.429447 4.220190 4.170132 4.184495 4.324350 4.764452 4.453089 4.297674 4.325506 4.237924 3.937004 4.235564 3.924283 4.168933 4.794789 3.863936 3.944617 4.048456 4.038564 4.165333 4.227292	4.593474 4.397727 4.701064 4.457578 4.316248 4.387482 4.576024 5.025933 4.553021 4.341659 4.420407 4.052160 4.379498 4.106093 4.324350 4.984977 4.068169 4.144876 4.295346 4.295346 4.295346 4.295346 4.295346 4.243483 4.343961 4.419276	4.749737 4.589118 4.888763 4.672259 4.511097 4.561798 4.791659 5.205766 4.750789 4.479955 4.616276 4.606517 4.254409 4.536518 4.328972 4.485532 5.135173 4.260282 4.315090 4.522168 4.414748 4.542026 4.627094	4.217819 4.060788 4.302325 4.106093 4.032369 4.022437 4.217819 4.631414 4.333590 4.113393 4.178516 4.102438 3.806573 4.060788 3.811824 4.006245 4.006245 3.738984 3.764306 3.952215 3.496325 4.032369 4.110961
	6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29	5.397222 5.200961 5.523586 5.274467 5.097058 5.397222 5.845511 5.061620 5.217279 5.218237 6.158488 4.904080 5.109795 7.781003 4.876474 4.944694 5.116640 5.037857 5.21111 5.225897	5.267827 5.082322 5.406478 5.165269 4.977951 5.071489 5.286776 5.724509 5.180734 4.925444 5.081338 5.092151 4.704000 5.028916 4.794789 4.976947 5.646238 4.749737 4.832184 5.007994 4.911212 5.021952 5.102940 5.109795	4.796874 4.598913 4.914265 4.666905 4.503332 4.597826 4.784349 5.235456 4.713809 4.501111 4.617359 4.609772 4.229657 4.570558 4.302325 4.511097 4.259108 4.366921 4.501111 4.429447 4.538722 4.610857 4.627094	4.384062 4.200000 4.429447 4.220190 4.170132 4.184495 4.324350 4.764452 4.453089 4.297674 4.325506 4.237924 3.937004 4.235564 3.937004 4.235564 3.94283 4.168933 4.794789 3.863936 3.944617 4.048456 4.038564 4.165333 4.227292 4.183300	4.593474 4.397727 4.701064 4.457578 4.316248 4.387482 4.576024 5.025933 4.553021 4.341659 4.420407 4.052160 4.379498 4.106093 4.324350 4.984977 4.068169 4.144876 4.295346	4.749737 4.589118 4.888763 4.672259 4.511097 4.561798 4.791659 5.205766 4.750789 4.479955 4.616276 4.606517 4.254409 4.536518 4.328972 4.485532 5.2158 4.315090 4.522168 4.414748 4.542026 4.627094 4.597826	4.217819 4.060788 4.302325 4.106093 4.032369 4.022437 4.217819 4.631414 4.333590 4.113393 4.178516 4.102438 3.806573 4.060245 4.006245 4.006245 3.738984 3.764306 3.952215 3.896152 4.032369 4.110961 4.036087
	6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 	5.397222 5.200961 5.523586 5.274467 5.097058 5.190376 5.397222 5.845511 5.061620 5.217279 5.218237 4.817676 5.158488 4.904080 5.109795 5.781003 4.876474 4.944694 5.116640 5.037857 5.140039 5.221111 5.225897	5.267827 5.082322 5.406478 5.165269 4.977951 5.071489 5.286776 5.724509 5.180734 4.925444 5.081338 5.092151 4.700000 4.794789 4.976947 5.646238 4.749737 4.832184 5.007994 4.911212 5.021952 5.102940 5.102940 5.109795	4.796874 4.598913 4.914265 4.666905 4.593332 4.597826 4.784349 5.235456 4.713809 4.501111 4.617359 4.609772 4.229657 4.570558 4.302325 4.511097 5.178803 4.259108 4.366921 4.501111 4.429447 4.538722 4.610857 4.610857 4.627094	4.384062 4.200000 4.429447 4.220190 4.170132 4.184495 4.324350 4.764452 4.453089 4.297674 4.325506 4.237924 4.335564 3.924283 4.168933 4.794789 3.863936 3.944617 4.048456 4.038564 4.165333 4.227292 4.183300	4.593474 4.397727 4.701064 4.457578 4.316248 4.387482 4.576024 5.025933 4.5553021 4.341659 4.448595 4.420407 4.052160 4.379498 4.106093 4.324350 4.984977 4.068169 4.144876 4.295346 4.234383 4.343961 4.419276 4.419276 4.419276	4.749737 4.589118 4.888763 4.672259 4.511097 4.561798 4.791659 5.205766 4.750789 4.479955 4.616276 4.636518 4.328972 4.485532 5.135173 4.260282 4.315090 4.52168 4.414748 4.542026 4.627094 4.627094 4.57826	4.217819 4.060788 4.302325 4.106093 4.032369 4.022437 4.217819 4.631414 4.3335590 4.113393 4.178516 4.102438 3.806573 3.811824 4.006245 4.628175 3.764306 3.952215 3.896152 4.032369 4.110961 4.036087
	6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 	5.397222 5.200961 5.523586 5.274467 5.097058 5.190376 5.397222 5.845511 5.061620 5.217279 5.218237 4.817676 5.18237 4.876474 4.944694 5.116640 5.164640 5.037857 5.140039 5.221111 5.225807	5.267827 5.082322 5.406478 5.165269 4.977951 5.071489 5.286776 5.724509 5.081338 5.092151 4.700000 4.794789 4.976947 5.646238 4.794789 4.976947 5.646238 4.794789 4.976947 5.646238 4.7947937 5.646238 4.794793 5.021952 5.102940 5.102940 5.102940 6.3000000	4.796874 4.598913 4.914265 4.666905 4.503332 4.597826 4.784349 5.235456 4.713809 4.501111 4.617359 4.609772 4.229657 4.570558 4.302325 4.511097 5.178803 4.259108 4.366921 4.501111 4.429447 4.538722 4.610857 4.610857 4.627094	4.384062 4.200000 4.429447 4.220190 4.170132 4.184495 4.324350 4.764452 4.453089 4.297674 4.325506 4.237924 3.937004 4.235564 3.924283 4.168933 4.794789 3.863936 4.048456 4.038564 4.165333 4.227292 4.183300 1.224745	4.593474 4.397727 4.701064 4.457578 4.316248 4.387482 4.576024 5.025933 4.553021 4.341659 4.448595 4.420407 4.052160 4.379498 4.1066093 4.324350 4.984977 4.068169 4.295346 4.295346 4.295346 4.295346 4.295346 4.295346 4.34383 4.343961 4.419276 4.413615	4.749737 4.589118 4.888763 4.672259 4.511097 4.561798 4.791659 5.205766 4.750789 4.479955 4.616276 4.606517 4.254409 4.536518 4.328972 4.485532 5.135173 4.260282 4.315090 4.52168 4.414748 4.542026 4.627094 4.597826	4.217819 4.060788 4.302325 4.106093 4.032369 4.022437 4.217819 4.631414 4.333590 4.178516 4.102438 3.806573 4.060788 3.811824 4.06245 4.628175 3.738984 4.06245 4.628175 3.738984 4.032369 4.110961 4.032369 4.110961 4.036087
	6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 	5.397222 5.200961 5.523586 5.274467 5.097058 5.190376 5.397222 5.217279 5.218237 4.817676 5.158488 4.904080 5.109795 5.781003 4.876474 4.944694 5.116640 5.037857 5.140039 5.221111 5.225897 0.223607 1.640122	5.267827 5.082322 5.406478 5.165269 4.977951 5.071489 5.286776 5.724509 5.180734 4.925444 5.081338 6.092151 4.704789 4.976947 5.646238 4.749737 4.832184 5.007994 4.911212 5.021952 5.102940 5.109795 0.3000000 1.532971	4.796874 4.598913 4.914265 4.666905 4.593332 4.597826 4.784349 5.235456 4.713809 4.591111 4.617359 4.609772 4.229657 4.570558 4.3902325 4.511097 5.178803 4.259108 4.366921 4.591111 4.429447 4.538722 4.610857 4.627094	4.384062 4.200000 4.429447 4.220190 4.170132 4.184495 4.324350 4.764452 4.453089 4.297674 4.325506 4.237924 3.937004 4.235564 3.924283 4.168933 4.794789 3.863936 3.944617 4.048456 4.038564 4.165333 4.227292 4.183300 1.224745 0.774597	4.593474 4.397727 4.701064 4.457578 4.316248 4.387482 4.576024 5.025933 4.553021 4.341659 4.448595 4.420407 4.052160 4.379498 4.106093 4.324350 4.984977 4.068169 4.144876 4.295346 4.295346 4.295346 4.295346 4.295346 4.295346 4.2134383 4.343961 4.419276 4.413615 0.734847	4.749737 4.589118 4.888763 4.672259 4.511097 4.561798 4.791659 5.205766 4.750789 4.479955 4.616276 4.606517 4.254409 4.536518 4.328972 4.485532 5.135173 4.260282 4.315090 4.522168 4.414748 4.542026 4.627094 4.597826 6.7874401 1.029563	4.217819 4.060788 4.302325 4.106093 4.032369 4.022437 4.217819 4.631414 4.333590 4.113393 4.178516 4.102438 3.806573 4.060788 3.811824 4.006245 3.738984 3.764306 3.952215 4.032369 4.110961 4.036087 1.284523 0.458258
	6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 22 23 24 25 26 27 28 29 120 121 122	5.397222 5.200961 5.523586 5.274467 5.097058 5.397222 5.845511 5.061620 5.217279 5.218237 4.817676 5.158488 4.904080 5.109795 5.1781003 4.876474 4.944694 5.116640 5.037857 5.140039 5.221111 5.225897 0.223607 1.640122 1.303840	5.267827 5.082322 5.406478 5.165269 4.977951 5.071489 5.286776 5.724509 5.180734 4.925444 5.081338 5.092151 4.704000 5.028916 4.794789 4.976947 5.646238 4.749737 4.832184 5.007994 4.911212 5.021952 5.102940 5.109795 0.300000 1.532971 1.581139	4.796874 4.598913 4.914265 4.666905 4.503332 4.597826 4.784349 5.235456 4.713809 4.501111 4.617359 4.609772 4.229657 4.570558 4.302325 4.511097 5.178803 4.259108 4.366921 4.501111 4.429447 4.538722 4.610857 4.627094 0.574456 1.195826 1.838478	4.384062 4.200000 4.429447 4.220190 4.170132 4.184495 4.324350 4.764452 4.453089 4.297674 4.325506 4.237924 3.937904 4.235564 3.937004 4.235564 3.94283 4.168933 4.794789 3.863936 3.944617 4.048456 4.038564 4.165533 4.227292 4.183300 1.224745 0.774597 2.224860	4.593474 4.397727 4.701064 4.457578 4.316248 4.387482 4.576024 5.025933 4.553021 4.341659 4.448595 4.420407 4.052160 4.379498 4.106093 4.324350 4.984977 4.068169 4.144876 4.295346 4.295346 4.295346 4.295346 4.295346 4.295346 6.295346 6.419276 6.413615 0.734847 0.969536 1.931321	4.749737 4.589118 4.888763 4.672259 4.511097 4.561798 4.791659 4.479955 4.616276 4.666517 4.254409 4.536518 4.328972 4.485532 5.36518 4.328972 4.485532 4.315090 4.522168 4.414748 4.542026 4.627094 4.597826 0.787401 1.029563 2.095233	4.217819 4.060788 4.302325 4.106093 4.032369 4.022437 4.217819 4.631414 4.333590 4.113393 4.178516 4.102438 3.806573 4.060788 3.811824 4.006245 4.6028175 3.896452 4.4036087 1.284523 4.436871
	6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 120 121 122 120 121 121 121 131 142 151 162 17 182 183 184 185 185 185 185 185 185 185 185 185 185	5.397222 5.200961 5.523586 5.274467 5.097058 5.190376 5.397222 5.845511 5.061620 5.217279 5.218237 4.817676 5.158488 4.904080 5.109795 5.781003 4.876474 4.944694 5.116640 5.037857 5.140039 5.221111 5.225897 0.223607 1.640122 1.303840 1.322876	5.267827 5.082322 5.406478 5.165269 4.977951 5.071489 5.286776 5.724509 5.180734 4.925444 5.081338 5.092151 4.700000 6.028916 4.794789 4.976947 5.646238 4.749737 4.832184 5.007994 4.911212 5.021952 5.102940 5.102940 5.102940 5.102940 1.532971 1.581139 1.284523	4.796874 4.598913 4.914265 4.666905 4.503332 4.597826 4.784349 5.235456 4.713809 4.501111 4.617359 4.609772 4.229657 4.570558 4.302325 4.511097 5.178803 4.259108 4.366921 4.501111 4.429447 4.538722 4.610857 4.627094 0.574456 1.195826 1.195826 1.838478 0.768115	4.384062 4.204000 4.429447 4.220190 4.170132 4.184495 4.324350 4.764452 4.453089 4.297674 4.325506 4.237924 4.235564 3.924283 4.168933 4.794789 3.863936 3.944617 4.048456 4.038564 4.165333 4.227292 4.183300 1.224745 0.774597 2.224860 0.244949	4.593474 4.397727 4.701064 4.457578 4.316248 4.387482 4.576024 5.025933 4.553021 4.341659 4.448595 4.420407 4.052160 4.379498 4.106093 4.324350 4.984977 4.068169 4.144876 4.295346 4.234383 4.343961 4.419276 4.413615 0.7348477 0.969536 1.931321 0.509902	4.749737 4.589118 4.888763 4.672259 4.511097 4.561798 4.791659 5.205766 4.6750789 4.479955 4.616276 4.636518 4.328972 4.485532 5.135173 4.260282 4.315090 4.522168 4.414748 4.542026 4.627094 4.597826 0.787401 1.029563 2.095233 1.000000	4.217819 4.060788 4.302325 4.106093 4.032369 4.022437 4.217819 4.631414 4.3335590 4.113393 4.178516 4.102438 3.811824 4.006245 4.062875 3.738984 3.764306 3.952215 3.896152 4.032369 4.110961 4.036087 1.284523 0.458258 2.424871 0.538516
	6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 120 121 122 131 141 15 16 17 18 18 18 18 18 18 18 18 18 18 18 18 18	5.397222 5.200961 5.523586 5.274467 5.097058 5.190376 5.397222 5.845511 5.061620 5.217279 5.218237 4.815676 5.109795 5.781003 4.876474 4.944694 5.116640 5.037857 5.140039 5.221111 5.225897 6.223607 1.640122 1.303840 1.322876 0.316228	5.267827 5.082322 5.406478 5.165269 4.977951 5.071489 5.286776 5.724509 5.081338 5.092151 4.700000 4.976947 5.646238 4.794789 4.976947 5.646238 4.749737 4.832184 5.007994 4.911212 5.021952 5.102940 5.102940 5.102940 5.102940 5.10300000 1.532971 1.581139 1.284523 0.400000	4.796874 4.598913 4.914265 4.666905 4.503332 4.597826 4.784349 5.235456 4.713809 4.501111 4.617359 4.609772 4.229657 4.570558 4.302325 4.511097 5.178803 4.259108 4.366921 4.501111 4.429447 4.538722 4.610857 4.627094 0.574456 1.195826 1.838478 0.78415 0.616441	4.384062 4.200000 4.429447 4.220190 4.170132 4.184495 4.324350 4.764452 4.453089 4.297674 4.325506 4.237924 3.937004 4.235564 3.924283 4.168933 4.794789 3.863936 4.048456 4.038564 4.165333 4.227292 4.183300 1.224745 0.774597 2.224860 0.244949 1.153256	4.593474 4.397727 4.701064 4.457578 4.316248 4.387482 4.576024 5.025933 4.536021 4.341659 4.448595 4.420407 4.052160 4.379498 4.106093 4.324350 4.984977 4.068169 4.144876 4.295346 4.234383 4.343961 4.419276 4.413615 0.734847 0.969536 1.931321 0.509902 0.624500	4.749737 4.589118 4.888763 4.672259 4.511097 4.561798 4.791659 5.205766 4.750789 4.479955 4.616276 4.606517 4.254409 4.536518 4.328972 4.485532 5.135173 4.260282 4.315090 4.522168 4.414748 4.542026 4.627094 4.597826 4.627094 4.597826 0.787401 1.029563 1.000000 0.624500	4.217819 4.060788 4.302325 4.106093 4.022437 4.217819 4.631414 4.333590 4.113393 4.178516 4.102438 3.806573 3.806573 3.811824 4.006245 4.628175 3.738496 3.952215 3.896152 4.032369 4.110961 4.036087 1.284523 0.458258 2.424871 0.538516 1.086278
	6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 120 121 122 122 123 124 125 126 127 127 128 129 129 129 129 129 129 129 129 129 129	5.397222 5.200961 5.523586 5.274467 5.097058 5.190376 5.397222 5.845511 5.061620 5.217279 5.218237 4.817676 5.18237 4.817676 5.781003 4.876474 4.944694 5.116640 5.037857 5.140039 5.221111 5.225897 6.223607 1.640122 1.303840 1.322876 0.316228 0.648074	5.267827 5.082322 5.406478 5.165269 4.977951 5.071489 5.286776 5.724509 5.081338 5.092151 4.700000 4.794789 4.976947 5.646238 4.7749737 4.832184 5.007994 4.911212 5.021952 5.102940 5.102940 5.1029795 6.300000 1.532971 1.581139 1.284523 0.400000 0.916515	4.796874 4.598913 4.914265 4.666905 4.503332 4.597826 4.784349 5.235456 4.713809 4.501111 4.617359 4.609772 4.229657 4.570558 4.302325 4.511097 5.178803 4.259108 4.366921 4.501111 4.429447 4.538722 4.610857 4.627094 0.574456 1.195826 1.838478 0.616441 1.086278	4.384062 4.200000 4.429447 4.220190 4.170132 4.184495 4.324350 4.764452 4.453089 4.297674 4.325506 4.237924 3.937004 4.235564 3.924283 4.168933 4.794789 3.863936 4.048456 4.038564 4.165333 4.227292 4.183300 1.224745 0.774597 2.224745 0.774597 2.224869 1.153256 1.519868	4.593474 4.397727 4.701064 4.457578 4.316248 4.387482 4.576024 5.025933 4.553021 4.341659 4.448595 4.420407 4.052160 4.379498 4.106093 4.324350 4.984977 4.068169 4.144876 4.295346 4.295346 4.234383 4.343961 4.419276 4.413615 0.734847 0.969536 1.931321 0.624500 1.100000	4.749737 4.589118 4.888763 4.672259 4.511097 4.561798 4.791659 5.205766 4.750789 4.479955 4.616276 4.606517 4.254409 4.536518 4.328972 4.485532 5.135173 4.260282 4.315090 4.522168 4.414748 4.542026 4.627094 4.597826 0.787401 1.029563 2.095233 1.0000000 0.624500 1.284523	4.217819 4.060788 4.302325 4.106093 4.022437 4.217819 4.631414 4.333590 4.118516 4.102438 3.806573 4.060788 3.811824 4.006245 4.06245 4.628175 3.738984 3.764306 3.952215 3.896152 4.032369 4.110961 4.036087 1.284523 0.458258 2.424871 6.086278 1.593738
	6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 120 121 122 123 124 125 126 127 127 128 129 129 129 129 129 129 129 129 129 129	5.397222 5.209961 5.523586 5.274467 5.097058 5.190376 5.397222 5.845511 5.304715 5.061620 5.217279 5.218237 4.817676 5.158488 4.904080 5.109795 5.781003 4.876474 4.944694 5.116640 5.037857 5.140039 5.221111 5.225897 0.223607 1.640122 1.303840 1.322876 0.316228 0.648074 1.407125	5.267827 5.082322 5.406478 5.165269 4.977951 5.071489 5.286776 5.724509 5.180734 4.925444 5.081338 5.092151 4.704000 5.028916 4.794789 4.976947 5.646238 4.749737 4.832184 5.007994 4.911212 5.021952 5.102940 5.109795 0.300000 1.532971 1.581139 1.284523 0.400000 0.916515 1.341641	4.796874 4.598913 4.914265 4.666905 4.503332 4.597826 4.7484349 4.501111 4.617359 4.609772 4.229657 4.570558 4.302325 4.511097 5.178803 4.259108 4.366921 4.501111 4.429447 4.538722 4.610857 4.627094 0.574456 1.195826 1.838478 0.768115 0.616441 1.086278 0.836660	4.384062 4.200000 4.429447 4.220190 4.170132 4.184495 4.324350 4.764452 4.453089 4.297674 4.325506 4.237924 3.937004 4.235564 3.937004 4.235564 3.937004 4.235564 3.94283 4.794789 3.863936 3.944617 4.048456 4.165333 4.227292 4.183300 1.224745 0.774597 2.224860 0.244949 1.153256 0.387298	4.593474 4.397727 4.701064 4.457578 4.316248 4.387482 4.576024 5.025933 4.4553021 4.341659 4.448595 4.420407 4.052160 4.379498 4.106093 4.324350 4.94877 4.068169 4.144876 4.295346 4.295346 4.295346 4.295346 4.219276 4.413615 6.734847 6.969536 1.931321 6.509902 6.624500 6.574456	4.749737 4.589118 4.888763 4.672259 4.511097 4.561798 4.7791659 4.479955 4.616276 4.606517 4.254409 4.536518 4.328972 4.485532 4.315090 4.522168 4.414748 4.542026 4.627094 4.597826 0.7874401 1.029563 2.095233 1.000000 0.624500 0.624500 0.984886	4.217819 4.060788 4.302325 4.106093 4.032369 4.022437 4.217819 4.631414 4.333590 4.113393 4.178516 4.102438 3.806573 4.060788 3.811824 4.006245 3.764306 3.952215 3.896152 4.032369 4.110961 4.036087 1.284523 6.458258 2.424871 6.538516 1.086278 0.458258 2.424871 6.538516
	6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 120 121 122 123 124 125 126 127 129 120 121 120 121 120 121 121 121 121 121	5.397222 5.200961 5.523586 5.274467 5.097058 5.190376 5.397222 5.845511 5.061620 5.217279 5.218237 6.158488 4.904080 5.109795 6.158488 4.904080 5.109795 6.158488 4.904080 5.109795 6.158488 4.904080 5.109795 6.158488 4.904080 5.109795 6.158488 4.904080 5.109795 6.158488 4.904080 6.109795 6.158488 4.904080 6.109795 6.130385 6.109795 6.130385 6.109795 6.130385 6.109795 6.130385 6.109795 6.1	5.267827 5.082322 5.406478 5.165269 4.977951 5.071489 5.286776 5.724509 5.180734 4.925444 5.081338 5.092151 4.700000 5.028916 4.794789 4.976947 5.646238 4.749737 4.832184 5.007994 4.911212 5.1021952 5.1021940 5.109795 0.300000 0.532971 1.581139 1.284523 0.400000 0.406505 1.341641 1.256981	4.796874 4.598913 4.914265 4.666905 4.503332 4.597826 4.784349 5.235456 4.713809 4.501111 4.617359 4.609772 4.229657 4.570558 4.302325 4.511097 5.178803 4.259108 4.366921 4.501111 4.429447 4.538722 4.610857 4.627094 0.574456 1.195826 1.838478 0.768115 0.616441 1.086278 0.836660 0.836660	4.384062 4.200000 4.429447 4.220190 4.170132 4.184495 4.324350 4.764452 4.453089 4.297674 4.325506 4.237924 3.924283 4.168933 4.794789 3.863936 3.944617 4.048456 4.038564 4.165333 4.227292 4.183300 1.224745 0.774597 2.224860 0.244949 1.153256 1.519868 0.387298 0.556776	4.593474 4.397727 4.701064 4.457578 4.316248 4.387482 4.576024 5.025933 4.553021 4.341659 4.448595 4.420407 4.052160 4.379498 4.106093 4.324350 4.984977 4.068169 4.144876 4.295346 4.234383 4.343961 4.419276 4.413615 0.734847 0.969536 1.931321 0.509902 0.624500 0.1000000 0.574456 0.538516	4.749737 4.589118 4.888763 4.672259 4.511097 4.561798 4.791659 5.205766 4.675789 4.479955 4.616276 4.566517 4.254409 4.536518 4.328972 4.485532 5.135173 4.260282 4.315090 4.522168 4.414748 4.542026 4.627094 4.597826 0.787401 1.029563 2.095233 1.000000 0.624500 0.1284523 0.984886 0.818535	4.217819 4.060788 4.302325 4.106093 4.022437 4.217819 4.631414 4.333590 4.113393 4.178516 4.102438 3.806573 4.060788 3.811824 4.006245 4.628175 3.738984 3.764306 3.952215 3.896152 4.110961 4.036087 1.224523 0.458258 2.424871 0.538516 1.086278 1.593738 0.469042 0.282843
	6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 120 121 122 122 123 124 125 126 127 128 129 129 129 129 129 129 129 129	5.397222 5.200961 5.523586 5.274467 5.097058 5.190376 5.397222 5.845511 5.061620 5.217279 5.218237 4.817676 5.19795 5.781003 4.876474 4.944694 5.116640 5.037857 5.140039 5.221111 5.225897 0.223607 1.640122 1.303840 1.322876 0.316228 0.648074 1.407125 1.344166 0.670820	5.267827 5.082322 5.406478 5.165269 4.977951 5.071489 5.286776 5.724509 5.180734 4.925444 5.081338 5.092151 4.700000 6.028916 4.794789 4.976947 5.646238 4.7947937 4.832184 5.007994 4.911212 5.021952 5.102940 5.102940 5.102940 1.532971 1.581139 1.284523 0.400000 0.916515 1.341641 1.256981 0.714143	4.796874 4.598913 4.914265 4.666905 4.503332 4.597826 4.784349 5.235456 4.713809 4.501111 4.617359 4.609772 4.229657 4.570558 4.302325 4.511097 5.178803 4.259108 4.366921 4.501111 4.429447 4.538722 4.610857 4.627094 0.574456 1.195826 1.195826 1.195826 1.195826 1.195826 1.195826 1.195826 1.195826 0.574456	4.384062 4.200000 4.429447 4.220190 4.170132 4.184495 4.324350 4.764452 4.453089 4.297674 4.325506 4.237924 3.937004 4.237564 3.924283 4.168933 4.794789 3.863936 3.863936 3.864936 4.165333 4.227292 4.183300 1.224745 0.774597 2.224860 0.244949 1.153256 1.519868 0.387298 0.387298 0.387298 0.707107	4.593474 4.397727 4.701064 4.457578 4.316248 4.387482 4.576024 5.025933 4.553021 4.341659 4.448595 4.420407 4.052160 4.379498 4.106093 4.324350 4.984977 4.068169 4.144876 4.295346 4.234383 4.343961 4.419276 4.413615 0.734847 0.969536 1.931321 0.509902 0.624500 1.100000 0.574456 0.538516 0.469042	4.749737 4.589118 4.888763 4.672259 4.511097 4.561798 4.791659 5.205766 4.6750789 4.479955 4.616276 4.656517 4.254409 4.536518 4.328972 4.485532 5.135173 4.260282 4.315090 4.522168 4.414748 4.542026 4.627094 4.597826 4.627094 4.597826 6.787401 1.029563 2.095233 1.000000 0.624500 1.284523 0.984886 0.818535 0.692820	4.217819 4.060788 4.302325 4.106093 4.022437 4.217819 4.631414 4.6333590 4.113393 4.178516 4.102438 3.806573 3.806573 3.811824 4.006245 4.06245 4.032369 4.110961 4.036087 1.284523 0.458253 0.458258 0.458258 0.458258 0.458258 0.458258 0.458258 0.458258
	6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 120 121 122 122 123 124 125 126 127 128 129 129 129 129 129 129 129 129 129 129	5.397222 5.200961 5.523586 5.274467 5.097058 5.190376 5.397222 5.845511 5.061620 5.217279 5.218237 4.817676 5.158488 4.904080 5.109795 5.781003 4.876474 4.944694 5.116640 5.037857 5.140039 5.221111 5.225897 6.223607 1.640122 1.303840 1.322876 0.316228 0.648074 1.407125 1.334166 0.670820 0.836660	5.267827 5.082322 5.406478 5.165269 4.977951 5.071489 5.286776 5.724509 5.081338 5.092151 4.700000 4.794789 4.976947 5.646238 4.749737 4.832184 5.007994 4.911212 5.021952 5.102940 5.109795 0.300000 1.532971 1.581139 1.284523 0.400000 0.916515 1.341641 1.256981 0.714143 1.077033	4.796874 4.598913 4.914265 4.666905 4.503332 4.597826 4.784349 5.235456 4.73809 4.501111 4.617359 4.609772 4.229657 4.570558 4.302325 4.511097 5.178803 4.259108 4.366921 4.501111 4.429447 4.538722 4.610857 4.627094 0.574456 1.195826 1.838478 0.616441 1.086278 0.836660 0.574456 1.048809	4.384062 4.200000 4.429447 4.220190 4.170132 4.184495 4.324350 4.764452 4.453089 4.297674 4.325506 4.237924 3.937004 4.235564 3.924283 4.168933 4.794789 3.863936 4.048456 4.038564 4.165333 4.227292 4.183300 5.1.224745 6.7774597 2.224860 6.244949 1.153256 1.519868 6.387298 6.7077107 1.337909	4.593474 4.397727 4.701064 4.457578 4.316248 4.387482 4.576024 5.025933 4.553021 4.341659 4.448595 4.420407 4.052160 4.379498 4.106093 4.324350 4.984977 4.068169 4.144876 4.295346 4.234383 4.343961 4.419276 4.413615 0.734847 0.969536 1.931321 0.509902 0.624500 1.100000 0.574456 0.538516 0.469042 1.004988	4.749737 4.589118 4.888763 4.672259 4.511097 4.561798 4.791659 5.205766 4.750789 4.479955 4.616276 4.606517 4.254409 4.536518 4.328972 4.485532 5.135173 4.260282 4.315090 4.522168 4.414748 4.542026 4.627094 4.597826 4.627094 4.597826 6.787401 1.029563 2.095233 1.000000 0.624500 1.284523 0.984886 0.692820 1.345362	4.217819 4.060788 4.302325 4.106093 4.022437 4.217819 4.631414 4.333590 4.113393 4.178516 4.102438 3.806573 3.811824 4.006245 4.06245 4.628175 3.738984 3.764306 3.952215 3.896152 4.032369 4.110961 4.036087 1.284523 6.458258 2.424871 0.538516 1.086278 1.593738 0.469042 0.282843 0.793725 1.489966
	6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 120 121 122 123 124 125 126 127 128 129 129 129 129 129 129 129 129 129 129	5.397222 5.200961 5.523586 5.274467 5.097058 5.190376 5.397222 5.245511 5.304715 5.061620 5.217279 5.158488 4.904080 5.109795 5.781003 4.876474 4.944694 5.116640 5.125897 5.140039 5.221111 5.225897 0.223607 1.640122 1.303840 1.322876 0.316228 0.648074 1.407125 1.334166 0.670820 0.836660 0.848528	5.267827 5.082322 5.406478 5.165269 4.977951 5.071489 5.286776 5.724509 5.180734 4.925444 5.081338 4.925444 5.082916 4.794789 4.976947 4.832184 5.0646238 4.749737 4.832184 5.007994 4.911212 5.102940 5.109795 5.102940 5.109795 5.102940 5.109795 5.102940 6.300000 1.532971 1.581139 1.284523 1.284523 1.284523 1.284523 1.797933 1.122497	4.796874 4.598913 4.914265 4.666905 4.503332 4.597826 4.7484349 4.501111 4.617359 4.609772 4.229657 4.570558 4.302325 4.511097 5.178803 4.259108 4.366921 4.501111 4.429447 4.538722 4.610857 4.627094 0.574456 1.195826 1.838478 0.768115 0.616441 1.086278 0.836660 0.836660 0.836660 0.836660 0.836660 0.836660	4.384062 4.200000 4.429447 4.220190 4.170132 4.184495 4.324350 4.764452 4.453089 4.297674 4.325506 4.237924 3.937004 4.235564 3.937004 4.235564 3.937004 4.235564 3.944617 4.048456 4.048456 4.165333 4.227292 4.183300 1.224745 0.774597 2.224860 0.244949 1.153256 0.387298 0.556776 0.707107 1.337909 1.584298	4.593474 4.397727 4.701064 4.457578 4.316248 4.387482 4.576024 5.025933 4.420407 4.052160 4.379498 4.106093 4.324350 4.984977 4.068169 4.144876 4.295346 4.295346 6.24500 6.734847 0.969536 1.931321 0.509902 0.624500 0.574456 0.469042 1.00000 0.574456 0.469042 1.004988 1.292285	4.749737 4.589118 4.888763 4.672259 4.511097 4.561798 4.7791659 4.479955 4.616276 4.606517 4.254409 4.536518 4.328972 4.485532 4.315090 4.522168 4.414748 4.542026 4.627094 4.597826 0.787401 1.029563 2.095233 1.000000 1.284523 0.984886 0.624500 1.284523 0.984886 0.818535 0.692820 1.345362 1.565248	4.217819 4.060788 4.302325 4.106093 4.032369 4.022437 4.217819 4.631414 4.333590 4.113393 4.178516 4.102438 3.806573 4.060788 3.811824 4.006245 4.006245 4.032369 4.110961 4.036087 1.284523 0.458258 2.424871 0.538516 1.086278 1.593738 0.469042 0.282843 0.793725 1.489966 1.816590
	6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 120 121 122 122 123 124 125 126 127 128 129 129 129 129 129 129 129 129 129 129	5.397222 5.200961 5.523586 5.274467 5.097058 5.190376 5.397222 5.845511 5.061620 5.217279 5.218237 4.817676 5.158488 4.904080 5.109795 5.781003 4.876474 4.944694 5.116640 5.037857 5.140039 5.221111 5.225897 6.223607 1.640122 1.303840 1.322876 0.316228 0.648074 1.407125 1.334166 0.670820 0.836660	5.267827 5.082322 5.406478 5.165269 4.977951 5.071489 5.286776 5.724509 5.081338 5.092151 4.700000 4.794789 4.976947 5.646238 4.749737 4.832184 5.007994 4.911212 5.021952 5.102940 5.109795 0.300000 1.532971 1.581139 1.284523 0.400000 0.916515 1.341641 1.256981 0.714143 1.077033	4.796874 4.598913 4.914265 4.666905 4.503332 4.597826 4.784349 5.235456 4.73809 4.501111 4.617359 4.609772 4.229657 4.570558 4.302325 4.511097 5.178803 4.259108 4.366921 4.501111 4.429447 4.538722 4.610857 4.627094 0.574456 1.195826 1.838478 0.616441 1.086278 0.836660 0.574456 1.048809	4.384062 4.200000 4.429447 4.220190 4.170132 4.184495 4.324350 4.764452 4.453089 4.297674 4.325506 4.237924 3.937004 4.235564 3.924283 4.168933 4.794789 3.863936 4.048456 4.038564 4.165333 4.227292 4.183300 5.1.224745 6.7774597 2.224860 6.244949 1.153256 1.519868 6.387298 6.7077107 1.337909	4.593474 4.397727 4.701064 4.457578 4.316248 4.387482 4.576024 5.025933 4.553021 4.341659 4.448595 4.420407 4.052160 4.379498 4.106093 4.324350 4.984977 4.068169 4.144876 4.295346 4.234383 4.343961 4.419276 4.413615 0.734847 0.969536 1.931321 0.509902 0.624500 1.100000 0.574456 0.538516 0.469042 1.004988	4.749737 4.589118 4.888763 4.672259 4.511097 4.561798 4.791659 5.205766 4.750789 4.479955 4.616276 4.606517 4.254409 4.536518 4.328972 4.485532 5.135173 4.260282 4.315090 4.522168 4.414748 4.542026 4.627094 4.597826 4.627094 4.597826 6.787401 1.029563 2.095233 1.000000 0.624500 1.284523 0.984886 0.692820 1.345362	4.217819 4.060788 4.302325 4.106093 4.022437 4.217819 4.631414 4.333590 4.113393 4.178516 4.102438 3.806573 3.811824 4.006245 4.06245 4.628175 3.738984 3.764306 3.952215 3.896152 4.032369 4.110961 4.036087 1.284523 6.458258 2.424871 0.538516 1.086278 1.593738 0.469042 0.282843 0.793725 1.489966

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[150 rows x 150 columns]
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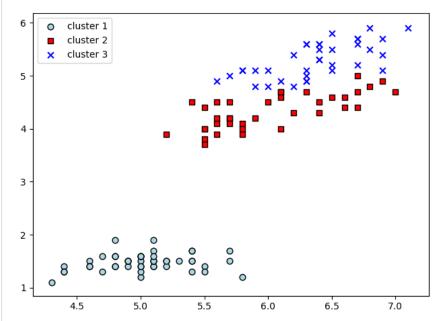
Code:

```
import numpy as np
import matplotlib.pyplot as plt
from sklearn import datasets
import pandas as pd
np.random.seed(5)
iris = datasets.load_iris()
X = iris.data
v = iris.target
print(len(X))
variables = ['W','X', 'Y', 'Z']
df = pd.DataFrame(X, columns=variables)
print(df)
from scipy.spatial.distance import pdist, squareform
row_dist = pd.DataFrame(squareform(pdist(df, metric='euclidean')), )
print(row_dist)
from scipy.cluster.hierarchy import linkage
row_clusters = linkage(row_dist, method='complete', metric='euclidean')
pd.DataFrame(row_clusters,
             columns=['row label 1', 'row label 2',
             'distance', 'no. of items in clust.'], index=['cluster %d' % (i + 1)
                    for i in range(row clusters.shape[0])])
print(row clusters)
row_clusters = linkage(pdist(df, metric='euclidean'), method='complete')
pd.DataFrame(row clusters.
             columns=['row label 1', 'row label 2',
             'distance', 'no. of items in clust.'], index=['cluster %d' % (i + 1)
                    for i in range(row_clusters.shape[0])])
print(row_clusters)
from scipy.cluster.hierarchy import dendrogram
row_dendr = dendrogram(row_clusters, )
plt.tight_layout()
plt.ylabel('Euclidean distance')
plt.show()
# plot row dendroaram
fig = plt.figure(figsize=(8, 8), facecolor='white')
axd = fig.add_axes([0.09, 0.1, 0.2, 0.6])
row_dendr = dendrogram(row_clusters, orientation='left')
# reorder data with respect to clustering
df_rowclust = df.iloc[row_dendr['leaves'][::-1]]
axd.set_xticks([])
axd.set_yticks([])
# remove axes spines from dendrogram
for i in axd.spines.values():
   i.set_visible(False)
# plot heatmap
axm = fig.add_axes([0.23, 0.1, 0.6, 0.6]) # x-pos, y-pos, width, height
cax = axm.matshow(df_rowclust, interpolation='nearest', cmap='hot_r')
fig.colorbar(cax)
axm.set_xticklabels([''] + list(df_rowclust.columns))
axm.set_yticklabels([''] + list(df_rowclust.index))
axm.set_aspect('auto')
plt.show()
```

III) Performing the DBSCAN and compare it to K-means and agglomerative clustering, similar to inputs [24] to [25] of this notebook.



DBSCAN:



```
from sklearn.cluster import AgglomerativeClustering
f, (ax1, ax2) = plt.subplots(1, 2, figsize=(8, 3))
km = KMeans(n_clusters=3, random_state=0)
y_km = km.fit_predict(X)
ax1.scatter(X[y_km == 0, 0], X[y_km == 0, 2],
             edgecolor='black',
c='lightblue', marker='o', s=40, label='cluster 1')
ax1.scatter(X[y_km == 1, 0], X[y_km == 1, 2],
             edgecolor='black'
             c='red', marker='s', s=40, label='cluster 2')
ax1.scatter(X[y_km == 2, 0], X[y_km == 2, 2],
             edgecolor='black',
             c='blue', marker='x', s=40, label='cluster 3')
ax1.scatter(km.cluster_centers_[:, 0],
             km.cluster_centers_[:, 2],
             s=250, marker='*'
             c='red', edgecolor='black',
label='centroids')
ax1.set_title('K-means clustering')
ac = AgglomerativeClustering(n_clusters=3,
```

```
affinity='euclidean',
                                 linkage='complete')
y_ac = ac.fit_predict(X)
ax2.scatter(X[y_ac == 0, 0], X[y_ac == 0, 2], c='lightblue',
edgecolor='black',
marker='o', s=40, label='cluster 1')
ax2.scatter(X[y_ac == 1, 0], X[y_ac == 1, 2], c='red',
              edgecolor='black',
marker='s', s=40, label='cluster 2')
ax2.scatter(X[y_ac == 2, 0], X[y_ac == 2, 2], c='blue',
             edgecolor='black',
marker='x', s=40, label='cluster 3')
# ax2.scatter(km.cluster_centers_[:, 0],
# km.cluster_centers_[:, 2],
# s=250, marker='*',
               c='red', edgecolor='black',
label='centroids')
#
ax2.set_title('Agglomerative clustering')
plt.legend()
plt.tight_layout()
plt.show()
from sklearn.cluster import DBSCAN
db = DBSCAN(eps=0.8, min_samples=10, metric='euclidean')
y_db = db.fit_predict(X)
edgecolor='black',
             label='cluster 1')
label='cluster 2')
plt.scatter(X[y_db == 2, 0], X[y_db == 2, 2],
              c='blue', marker='x', s=40, edgecolor='black',
             label='cluster 3')
plt.legend()
plt.tight_layout()
plt.show()
```

hw5

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Updated 2 years ago by MD SHIRAJUM MUNIR

followup discussions for lingering questions and comments