

Exercises Sheet #5

Exercise 1. K-means clustering

Use the k-means algorithm and Euclidean distance to cluster the following 8 examples into 3 clusters:

$A1=(2,10)$, $A2=(2,5)$, $A3=(8,4)$, $A4=(5,8)$, $A5=(7,5)$, $A6=(6,4)$, $A7=(1,2)$, $A8=(4,9)$.

The distance matrix based on the Euclidean distance is given below:

	A1	A2	A3	A4	A5	A6	A7	A8
A1	0	$\sqrt{25}$	$\sqrt{36}$	$\sqrt{13}$	$\sqrt{50}$	$\sqrt{52}$	$\sqrt{65}$	$\sqrt{5}$
A2		0	$\sqrt{37}$	$\sqrt{18}$	$\sqrt{25}$	$\sqrt{17}$	$\sqrt{10}$	$\sqrt{20}$
A3			0	$\sqrt{25}$	$\sqrt{2}$	$\sqrt{2}$	$\sqrt{53}$	$\sqrt{41}$
A4				0	$\sqrt{13}$	$\sqrt{17}$	$\sqrt{52}$	$\sqrt{2}$
A5					0	$\sqrt{2}$	$\sqrt{45}$	$\sqrt{25}$
A6						0	$\sqrt{29}$	$\sqrt{29}$
A7							0	$\sqrt{58}$
A8								0

Suppose that the initial seeds (centers of each cluster) are A1, A4 and A7. Run the k-means algorithm for 1 epoch only. At the end of this epoch show:

- The new clusters (i.e. the examples belonging to each cluster)
- The centers of the new clusters
- Draw a 10 by 10 space with all the 8 points and show the clusters after the first epoch and the new centroids.
- How many more iterations are needed to converge? Draw the result for each epoch.

Exercise 2. Hierarchical clustering

Use agglomerative hierarchical clustering to group the data described by the following distance matrix. Show the dendrograms. The distance between two clusters is the shortest distance between a pair of elements from the two clusters

	A	B	C	D
A	0	1	4	5
B		0	2	6
C			0	3
D				0

Exercise 3. DBScan

If Epsilon (Eps) is 2 and minpoint (MinPts) is 2, what are the clusters that DBScan would discover with the following 8 examples: $A1=(2,10)$, $A2=(2,5)$, $A3=(8,4)$, $A4=(5,8)$, $A5=(7,5)$, $A6=(6,4)$, $A7=(1,2)$, $A8=(4,9)$.

The distance matrix is the same as the one in Exercise 1. Draw the 10 by 10 space and illustrate the discovered clusters. What if Epsilon is increased to $\sqrt{10}$