Density-Based Clustering

Density-Based Clustering

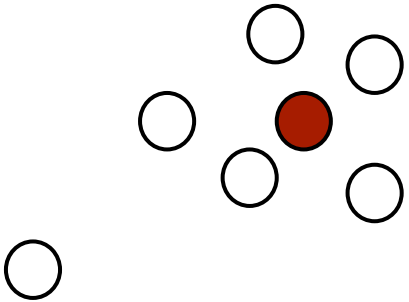
Goal: cluster together points that are densely packed together.

How should we define density?

Given a fixed radius **ε** around a point, if there are at least **min_pts** number of points in that area, then this section is dense.

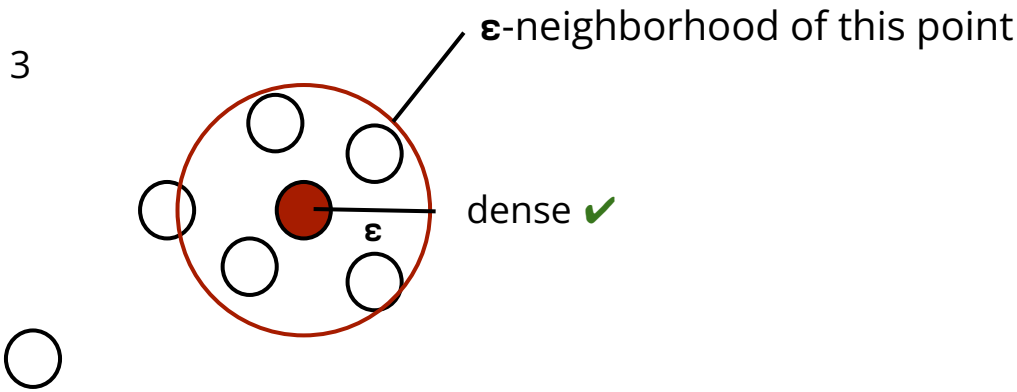
Example

Min_pts = 3



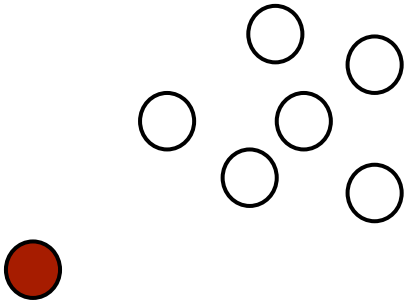
Example

Min_pts = 3



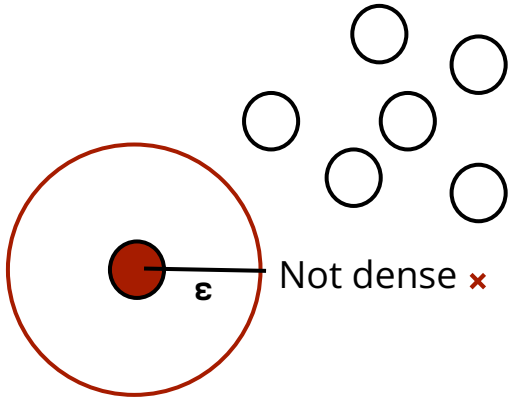
Example

Min_pts = 3



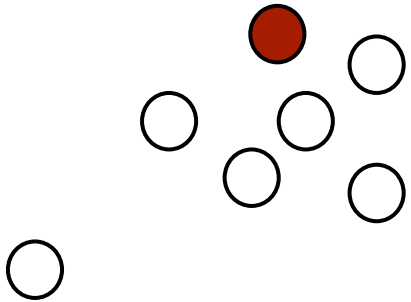
Example

Min_pts = 3



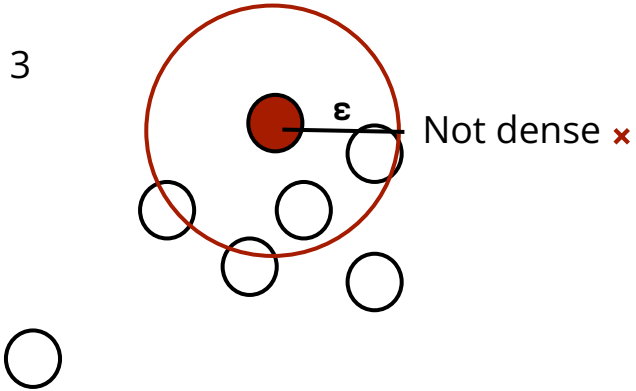
Example

Min_pts = 3



Example

Min_pts = 3



But... That point was part of a dense section earlier...

Density-Based Clustering

We need to distinguish between points at the core of a dense region and points at the border of a dense region.

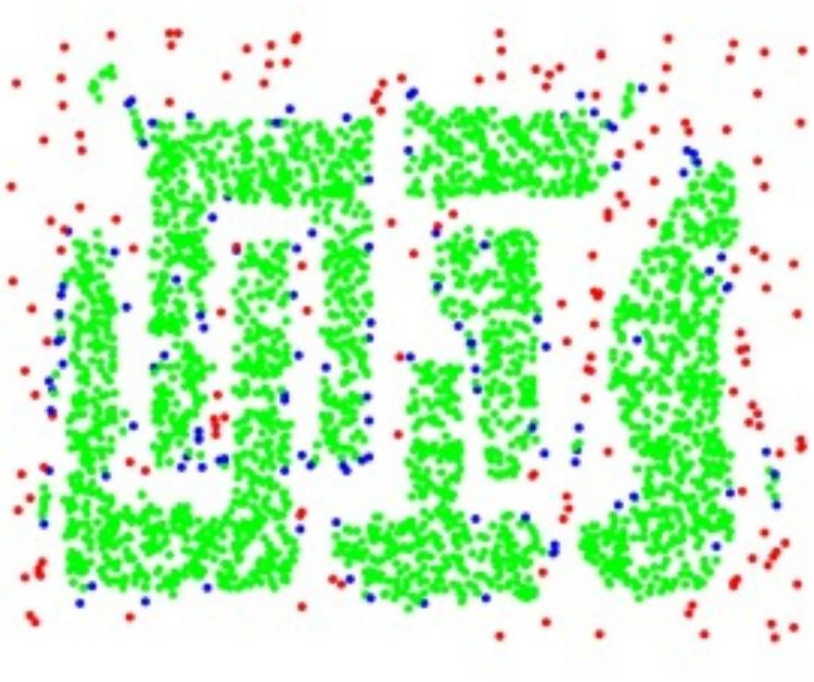
Let's define:

Core point: if its **ε**-neighborhood contains at least **min_pts**

Border point: if it is in the **ε**-neighborhood of a core point

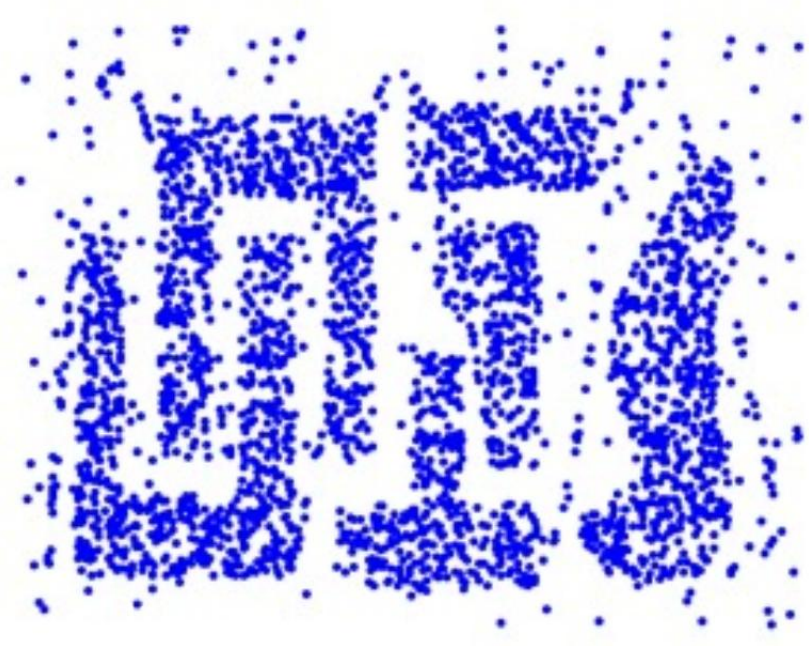
Noise point: if it is neither a core nor border point

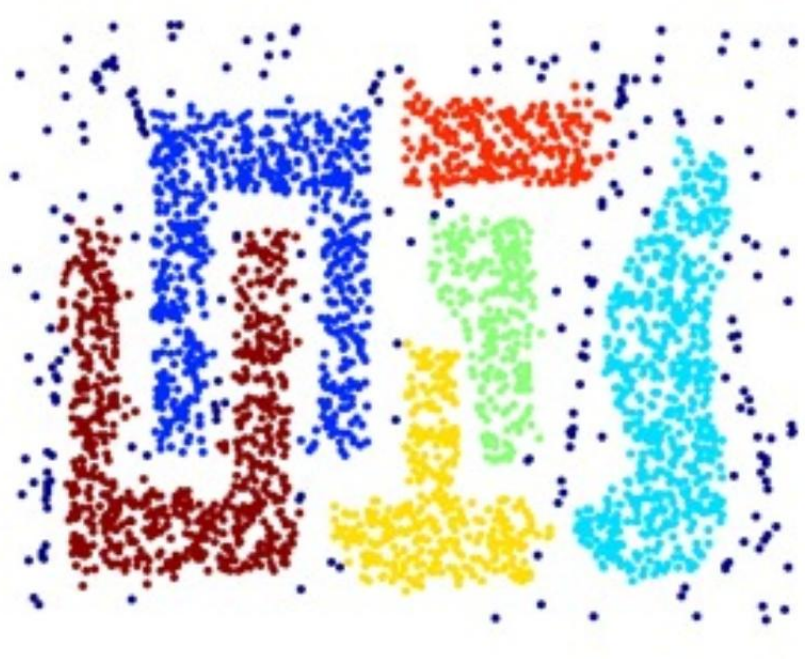
Density-Based Clustering



Core | Border | Noise

Density-Based Clustering





Create clusters by connecting core points

DBScan Algorithm

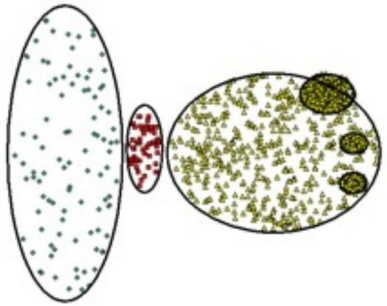
ε and **min_pts** given:

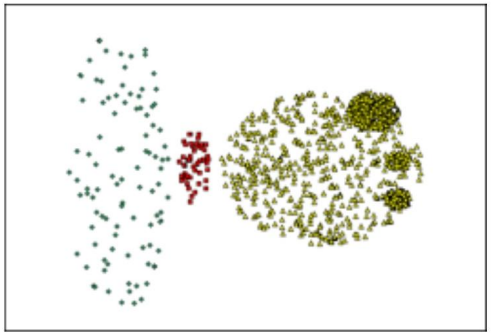
1. Find the **ε**-neighborhood of each point
2. Label the point as **core** if it contains at least **min_pts**
3. Label points in its neighborhood that are not **core** as **border**
4. Label points as **noise** if they are neither **core** nor **border**
5. For each **core** point, assign to the same cluster all **core** points in its neighborhood
6. Assign border points to nearby clusters

DBScan - Benefits

1. Can identify clusters of different shapes and sizes
2. Resistant to noise

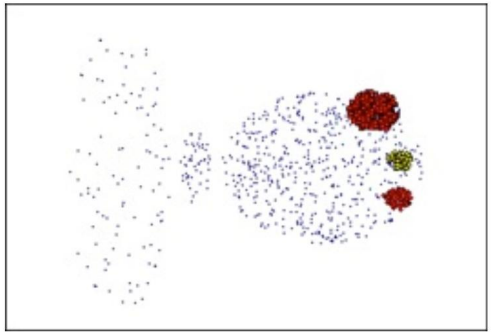
DBScan - Limitations





(MinPts=4, Eps=9.75).

1. Can fail to identify clusters of varying densities.
2. Tends to create clusters of the same density.
3. Notion of density is problematic in high-dimensional spaces



(MinPts=4, Eps=9.92)

Demo