Density-Based Clustering

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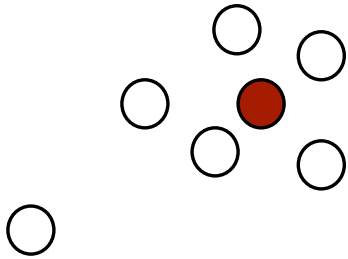
Goal: cluster together points that are densely packed together.

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.
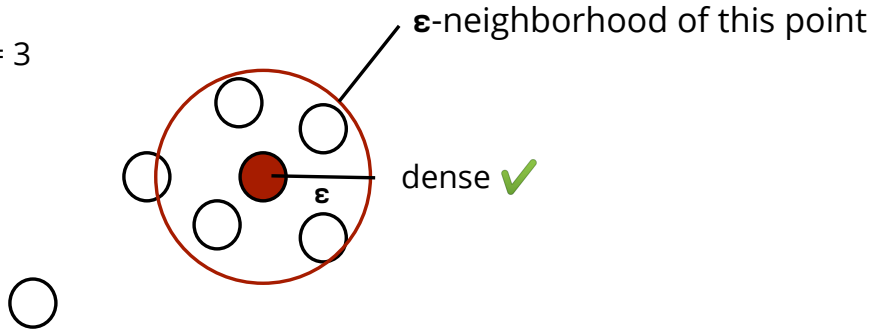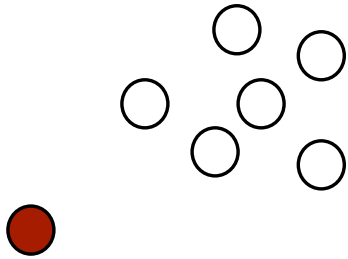
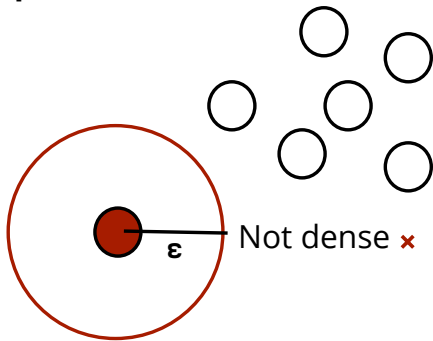# Example

Min_pts = 3

Example

Min_pts = 3

ε-neighborhood of this point

dense ✔

ε

Example

Min_pts = 3

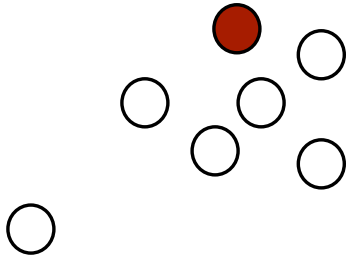# Example

Min_pts = 3
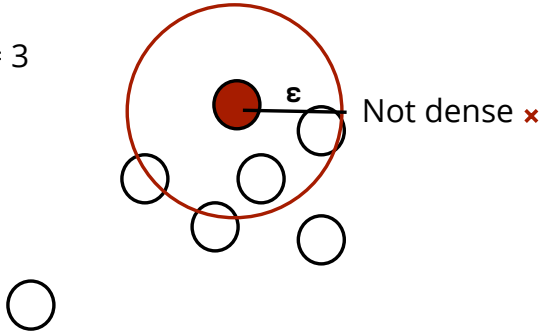
ε

Not dense ✗

Example

Min_pts = 3

Example

Min_pts = 3

ε

Not dense ✗

In this case
we don't count the center point.

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

Density-Based Clustering

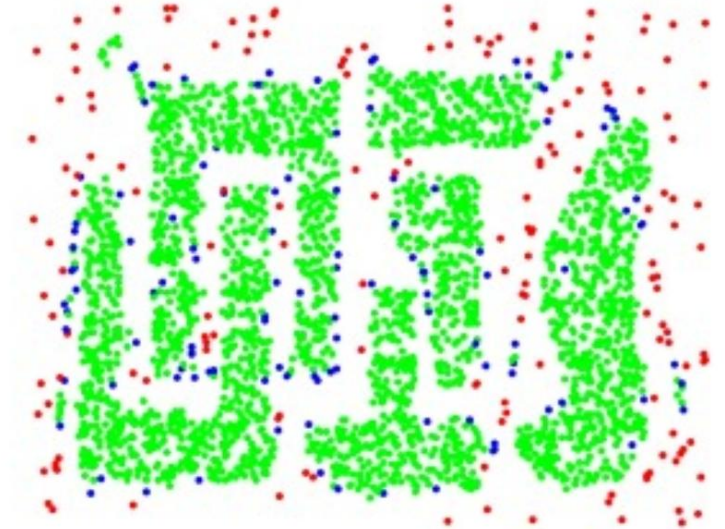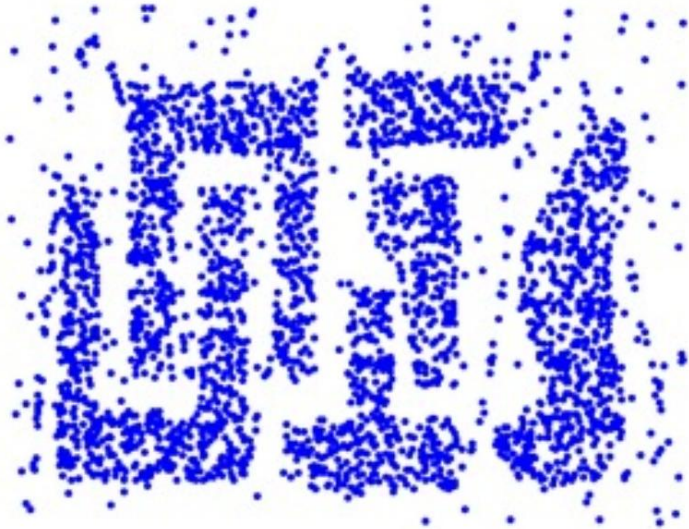We need to distinguish between points at the core of a dense region and points at the border of a dense region.

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 *. it is not a core point.*
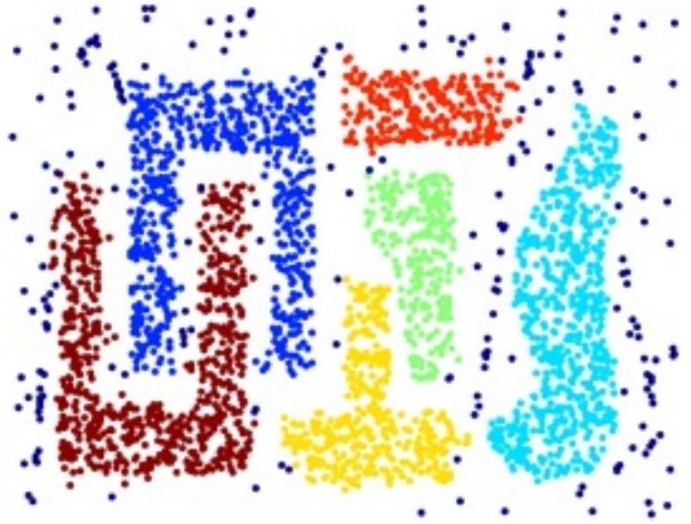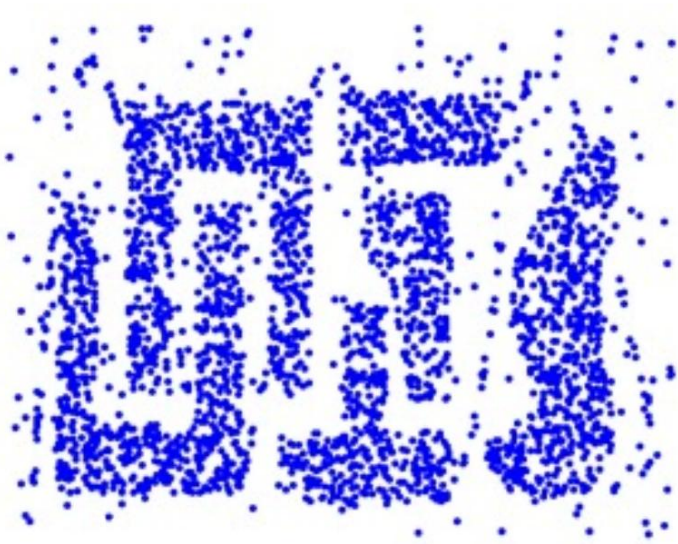
Noise point: if it is neither a core nor border point

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
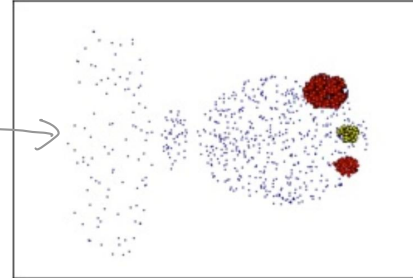6. Assign border points to nearby clusters

DBScan - Benefits

Similar to Width First Search.

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

DBScan - Limitations

ideal clustering
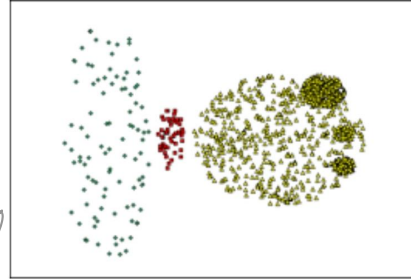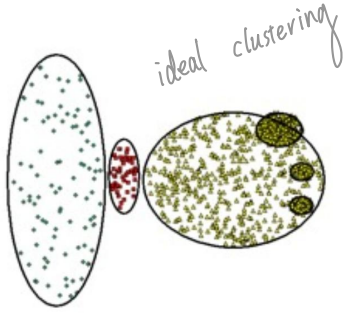
(MinPts=4, Eps=9.75).

(MinPts=4, Eps=9.92)

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

Demo