Boston University CS 506 - Lance Galletti

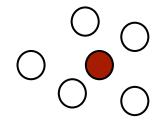
Goal: cluster together points that are densely packed together.

How should we define density?

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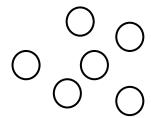
Given a fixed radius ε around a point, if there are at least **min_pts** number of points in that area, then this **area** is dense.

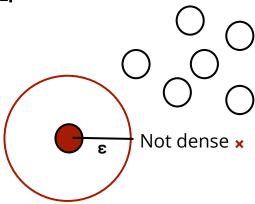


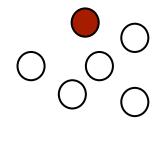
Min_pts = 3

E-neighborhood of this point

dense ✓







Min_pts = 3

Not dense ×

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

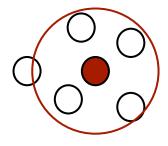
We need to distinguish between points at the core of a dense region and points at the border of a dense region.

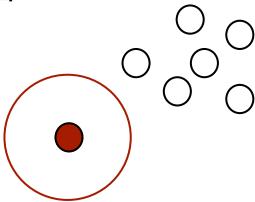
Let's define:

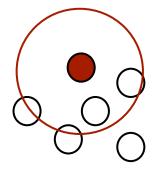
Core point: if its ε-neighborhood contains at least min_pts

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

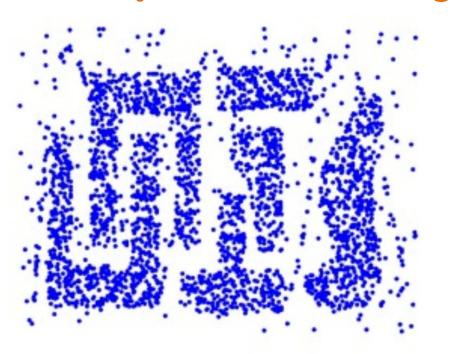
Noise point: if it is neither a core nor border point

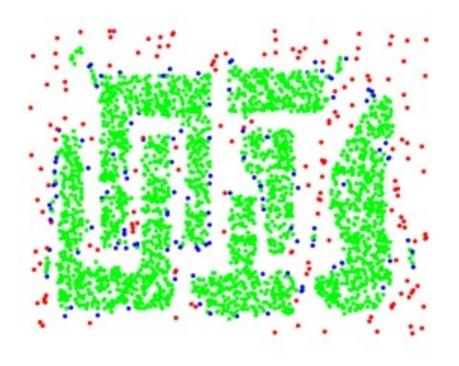




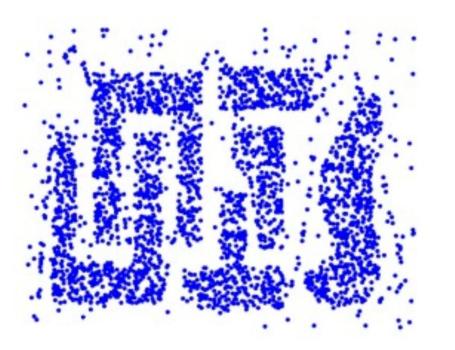


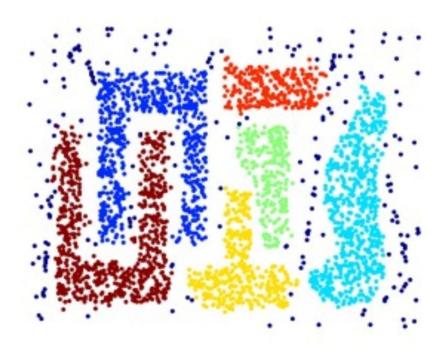






Core | Border | Noise



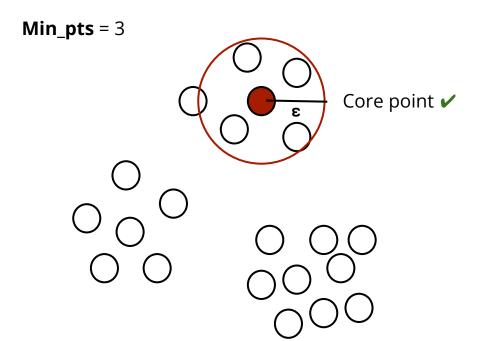


Create clusters by connecting core points

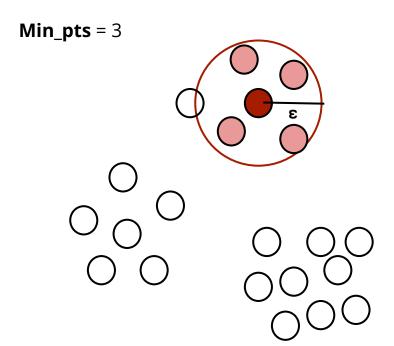
DBScan Algorithm

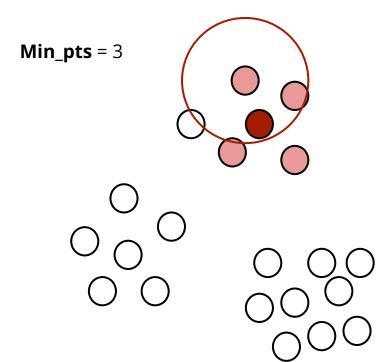
ε and min_pts given:

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

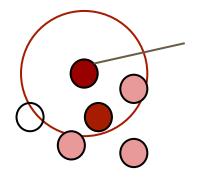


Iterate through the dataset

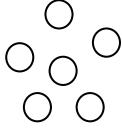


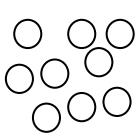


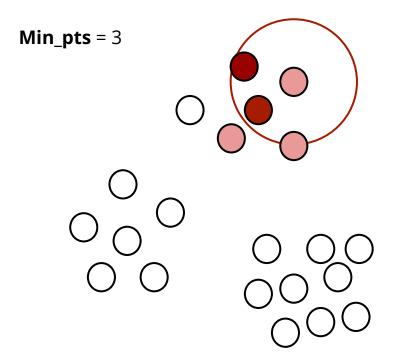


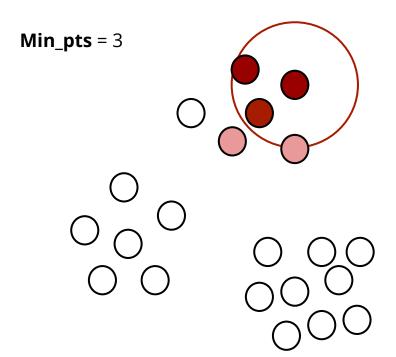


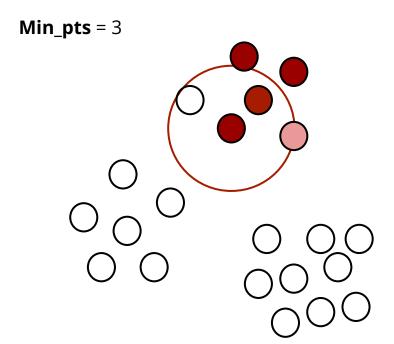
Border point but let's just assign it to this cluster

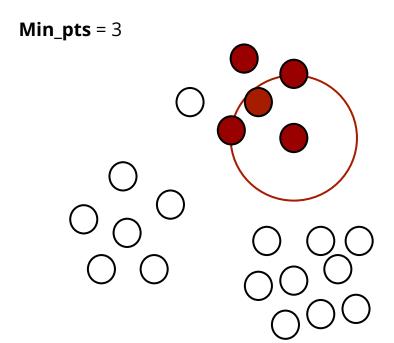










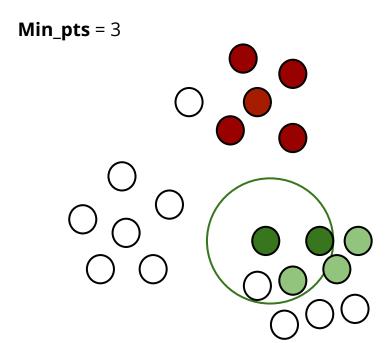


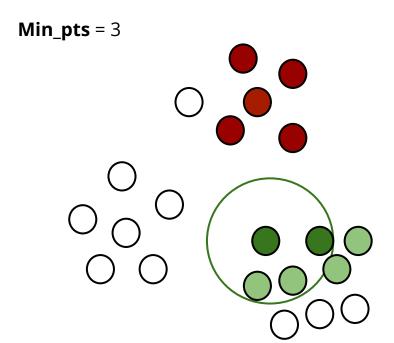
Min_pts = 3

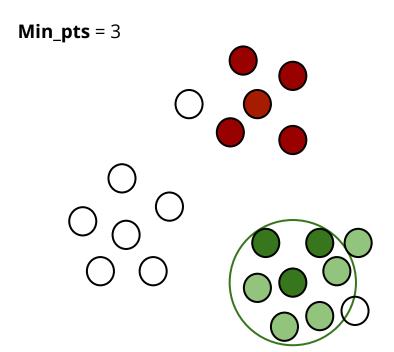
Go to next data point in the dataset

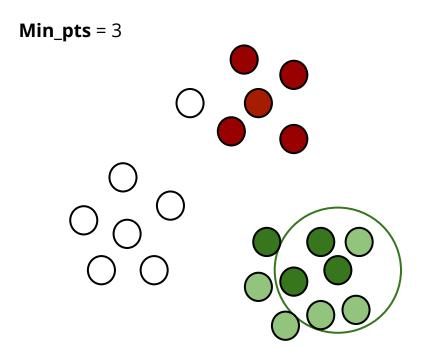
Min_pts = 3

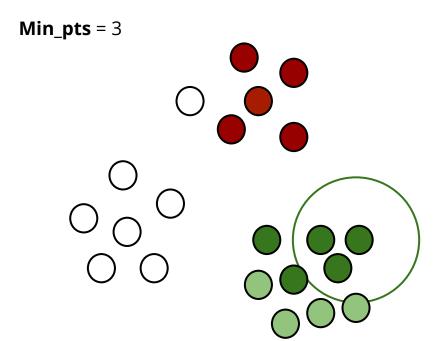
Iterate over its neighborhood since it's a core point



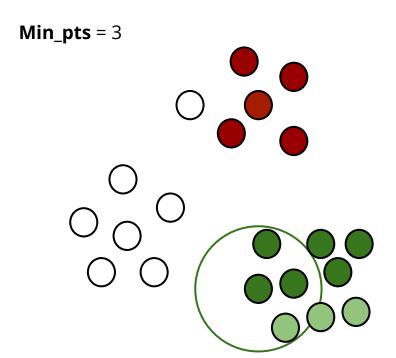




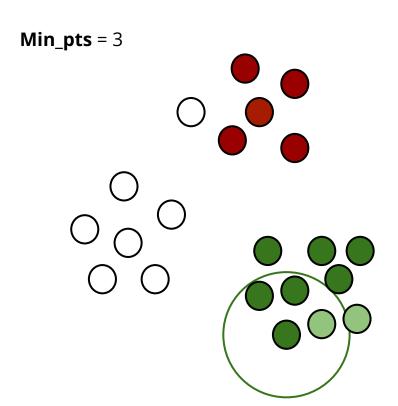




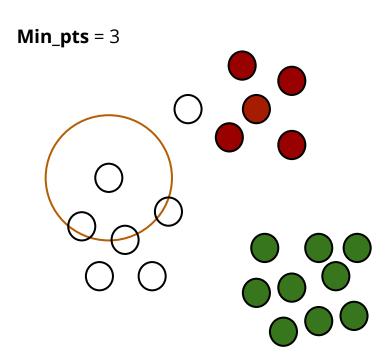
Border point but let's assign it to the cluster now

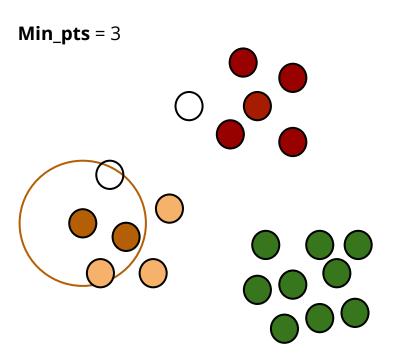


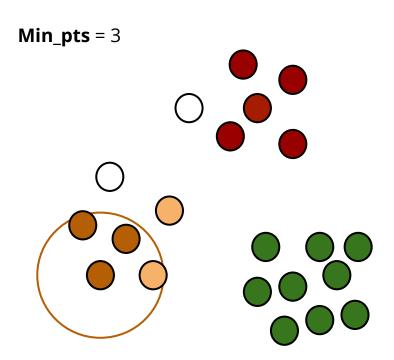
Core point but all its neighborhood is already tracked

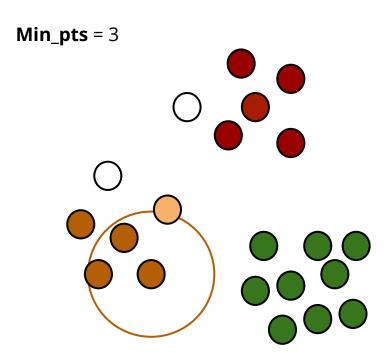


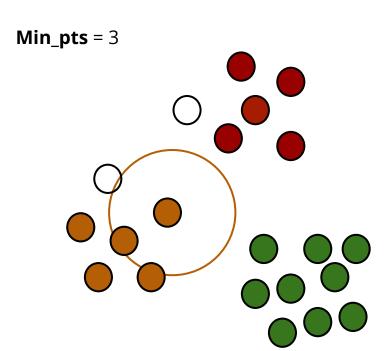
Core point but all its neighborhood is already tracked

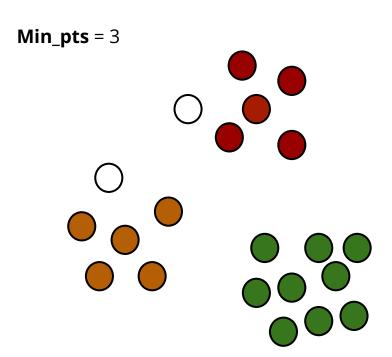








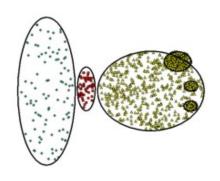




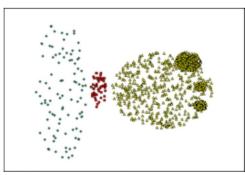
DBScan - Benefits

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

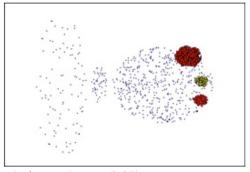
DBScan - Limitations



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



(MinPts=4, Eps=9.75).



(MinPts=4, Eps=9.92)

Demo

Attribute A	Attribute B	Attribute C	Attribute D
Yes	Single	125k	No
No	Married	100k	No
No	Single	70k	No
Yes	Married	120k	No
No	Divorced	90k	Yes
No	Married	60k	No
Yes	Divorced	220k	No
No	Single	85k	Yes
No	Married	75k	No
No	Single	90k	Yes