

Hi Team,

Please go through this document on DBSCAN. As you read, take a moment to think through the concepts and check if they make sense to you. If anything feels unclear, we can discuss it together. The content is divided into three parts — A, B, and C. Try to ensure you understand each of them.

## A.

### What DBSCAN Does

Instead of guessing how many groups there are, DBSCAN says:

“I will walk around, and if I see enough dots near me, I’ll start a group right here!”

**eps ( $\epsilon$ ):** Maximum distance between two points to be considered as neighbors.

**min\_samples/min\_points:** Minimum number of points required to form a dense region (i.e., a core point).

**Core Point:** A point with at least `min_samples` within distance `eps`.

**Border Point:** Has fewer than `min_samples` within `eps`, but is in the neighborhood of a core point.

**Noise Point (Outlier):** Neither a core point nor a border point.

## B.

For each point, count how many points are within distance `eps`.

If this count  $\geq \text{min\_samples}$ , it's a **core point**.

Core points form the **center of a cluster**. Expand the cluster by including all directly density-reachable points.

**Border points** are included in a cluster but don't expand it.

Points not reachable from any core point are marked as **noise**.

## C.

### Core Points as Cluster Centers

In DBSCAN:

- A **core point** is a point that has **at least `min_samples` neighbors** (including itself) **within a distance `eps`**.
  - These core points are considered the "**heart**" or **center** of a potential cluster.
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### Cluster Expansion: Directly Density-Reachable

Now, what does "*expand the cluster by including all directly density-reachable points*" mean?

- ♦ "Directly density-reachable" = **close & dense**
  - A point **A** is directly density-reachable from point **B** if:
    - **B is a core point**, and
    - **A is within `eps` distance from B**.

So, from a core point, DBSCAN **looks around in its `eps` neighborhood** and pulls all nearby points into the same cluster — whether they are:

- other **core points** (which in turn expand the cluster even further), or
  - **border points** (which do not expand the cluster themselves but are included).
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### Think of it like this:

1. Imagine placing a **circle of radius `eps`** around a point.
2. If that circle contains enough other points ( $\geq \text{min\_samples}$ ), it's a **core point**.
3. Then DBSCAN **grows** a cluster from this point by:
  - Adding all other **points within this circle**.
  - If those new points are also **core points**, it repeats the process from them.
4. It **keeps expanding** until no new points are reachable.