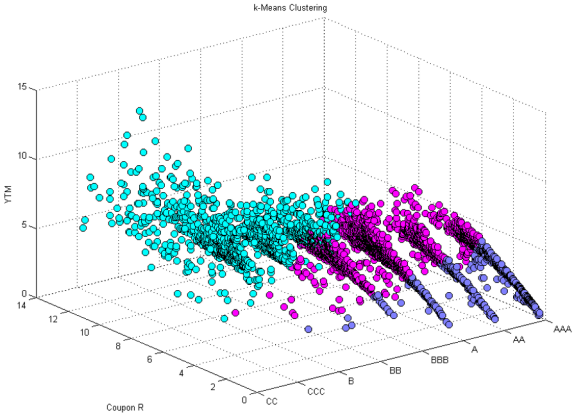
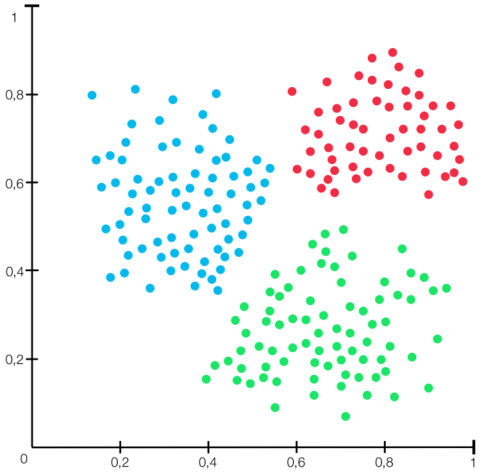
Clustering with K-Means & DBSCAN





Egehan Eralp

What is Clustering?

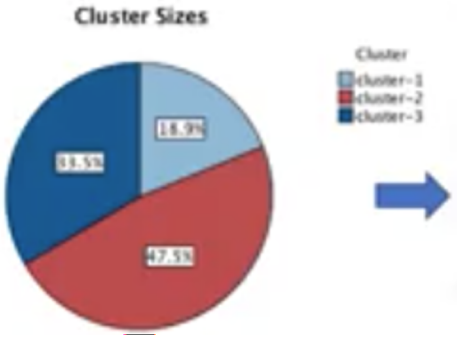
Grouping **unlabeled examples** is called **clustering**.

Why do we need Clustering?

- Segmentation
- Outlier Detection
- Fraud Detection
- Computer Vision
- Pre-processing step

Clustering for segmentation

Customer Id	Age	Edu	Years Employed	Income	Card Debt	Other Debt	Address	DebtIncomeRatio	Defaulted
1	41	2	6	19	0.124	1.073	NBA001	6.3	0
2	47	1	26	100	4.582	8.218	NBA021	12.8	0
3	33	2	10	57	6.111	5.802	NBA013	20.9	1
4	29	2	4	19	0.681	0.516	NBA009	6.3	0
5	47	1	31	253	9.308	8.908	NBA008	7.2	0
6	40	1	23	81	0.998	7.831	NBA016	10.9	1
7	38	2	4	56	0.442	0.454	NBA013	1.6	0
8	42	3	0	64	0.279	3.945	NBA009	6.6	0
9	26	1	5	18	0.575	2.215	NBA006	15.5	1

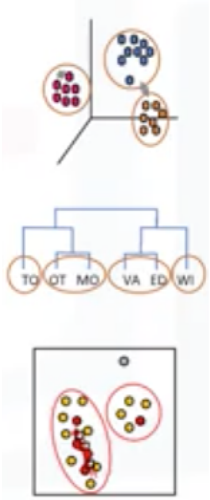


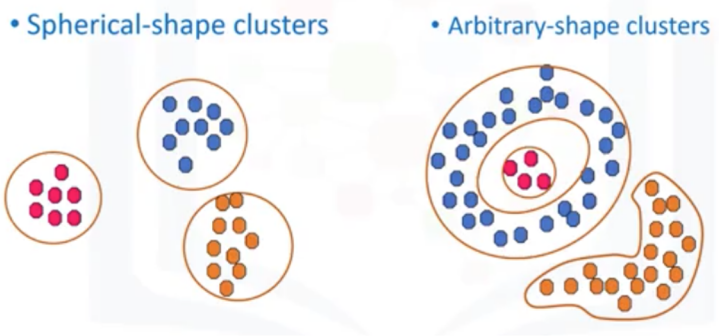
Customer ID	Segment
1	YOUNG AND LOW INCOME
2	AFFULUENT AND MIDDLE AGED
3	AFFULUENT AND MIDDLE AGED
4	YOUNG AND LOW INCOME
5	AFFULUENT AND MIDDLE AGED
6	AFFULUENT AND MIDDLE AGED
7	YOUNG AND LOW INCOME
8	YOUNG AND LOW INCOME
9	AFFULUENT AND MIDDLE AGED

Cluster	Segment Name
cluster-1	AFFULUENT AND MIDDLE AGED
cluster-2	YOUNG EDUCATED AND MIDDLE INCOME
cluster-3	YOUNG AND LOW INCOME

Clustering Algorithms

1. **Partition-based Clustering** (k-Means, Fuzzy c-Means,etc.)
   - Efficient when used for Medium or Large sized datasets
2. **Hierarchical Clustering** (Agglomerative, Divisive)
   - Produces Trees of Clusters
   - Small sized datasets
3. **Density-based Clustering** (DBSCAN)
   - Produces **Arbitrary shaped** clusters
   - Efficient when there is **Noise** in dataset

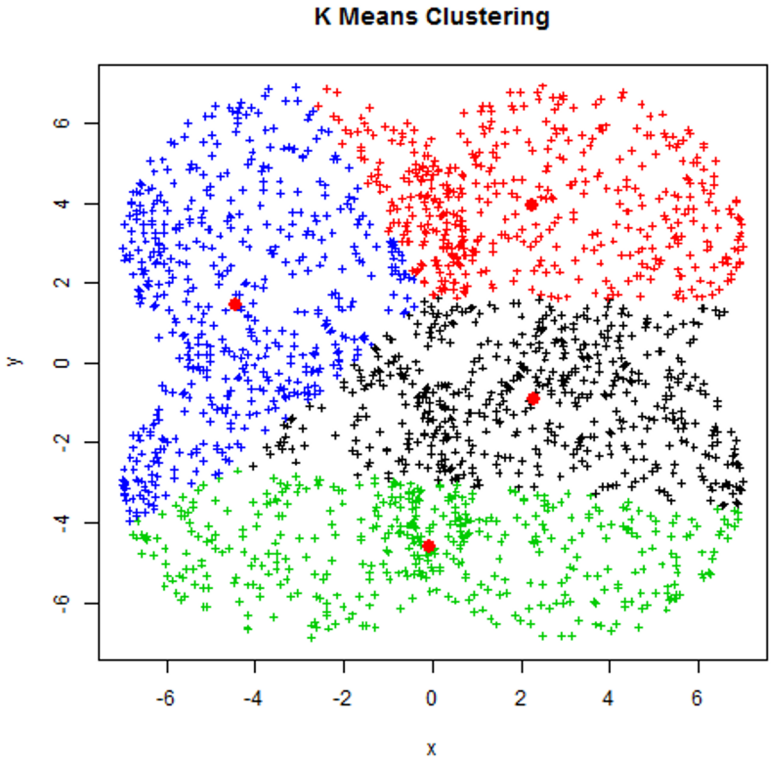




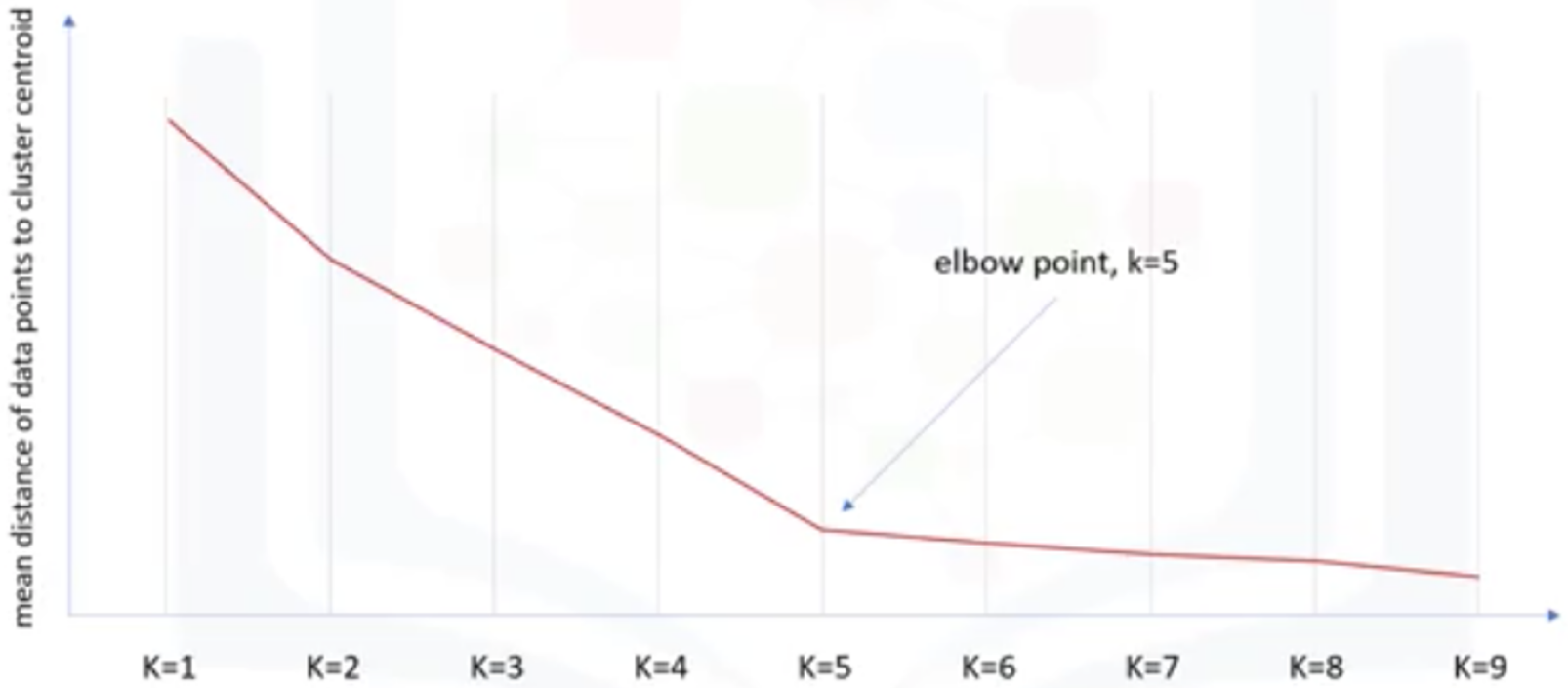
k-Means

k-Means algorithm steps

1. Define num of clusters
   a. Initialize k value
2. Calculate distance of each data point from the centroids
3. Assign each point to closest centroid
   b. Clusters produced
4. Move the existing centroids to its clusters's data points means.
5. Repeat steps 2-3-4 until no centroids will move


K Means Clustering
y
x
6
4
2
0
-2
-4
-6
-6
-4
-2
0
2
4
6

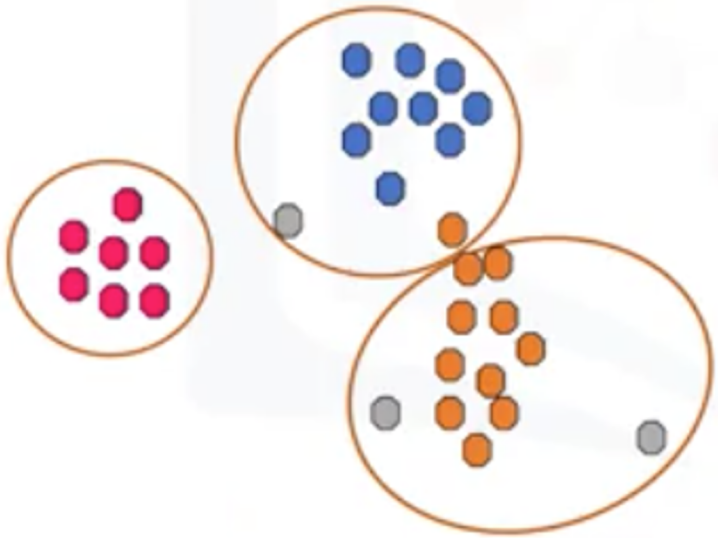
Choosing k


mean distance of data points to cluster centroid
elbow point, k=5
K=1
K=2
K=3
K=4
K=5
K=6
K=7
K=8
K=9

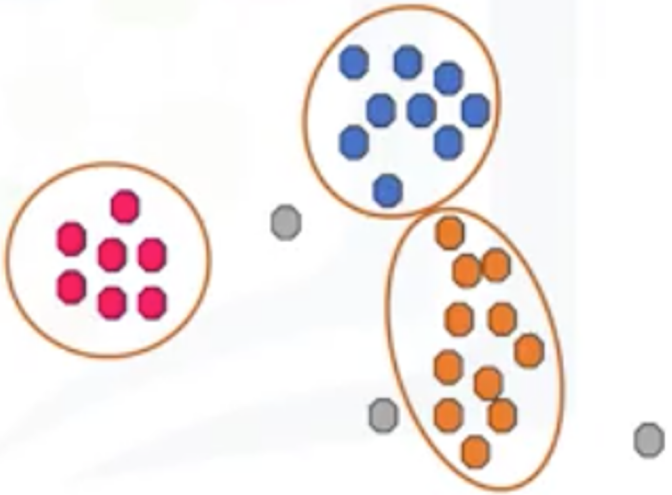
DBSCAN

k-Means Vs. density-based clustering

- k-Means assigns all points to a cluster even if they do not belong in any



- Density-based Clustering locates regions of high density, and separates outliers

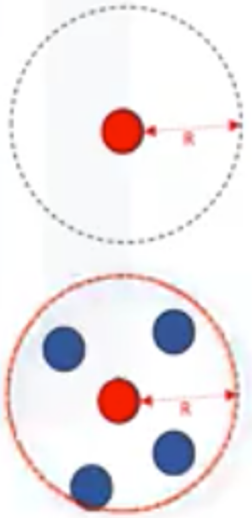


What is DBSCAN?

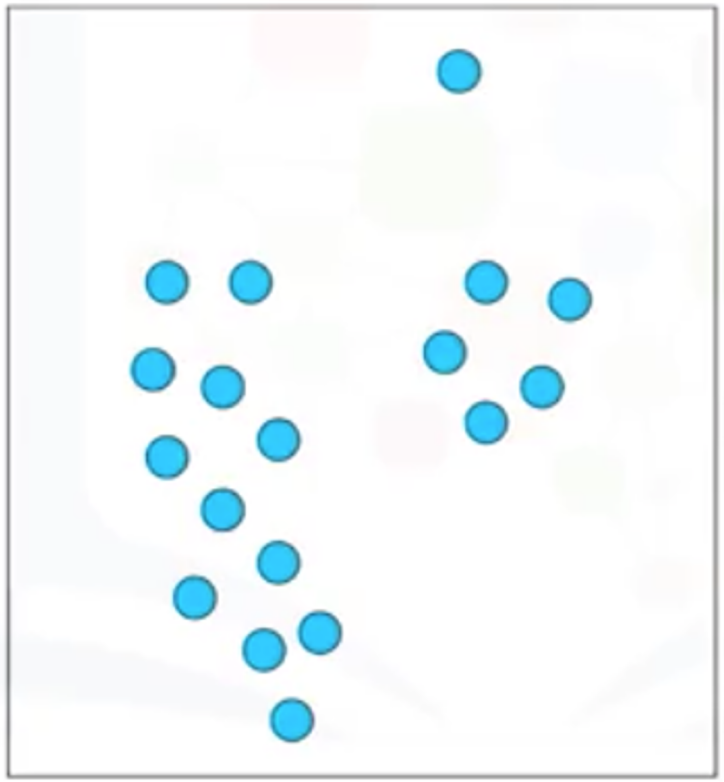
- DBSCAN (**D**ensity-**B**ased **S**patial **C**lustering of **A**pplications with **N**oise)
  - Is one of the most common clustering algorithms
  - Works based on density of objects

- R (**R**adius of neighborhood)
  - Radius (R) that if includes enough number of points within, we call it a dense area

- M (**M**in number of neighbors)
  - The minimum number of data points we want in a neighborhood to define a cluster



How DBSCAN works

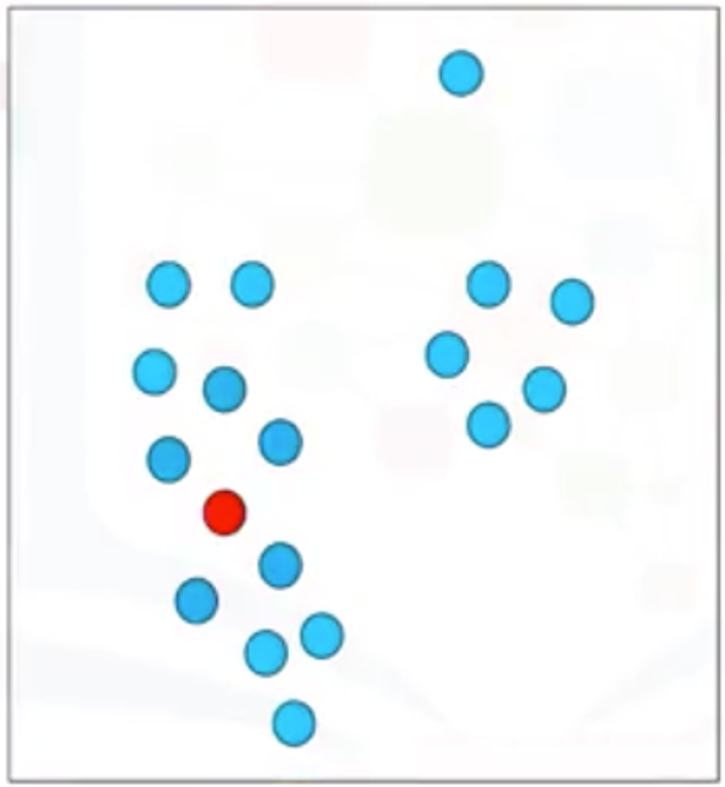


Each point is either:

- *core point*
- *border point*
- *outlier point*

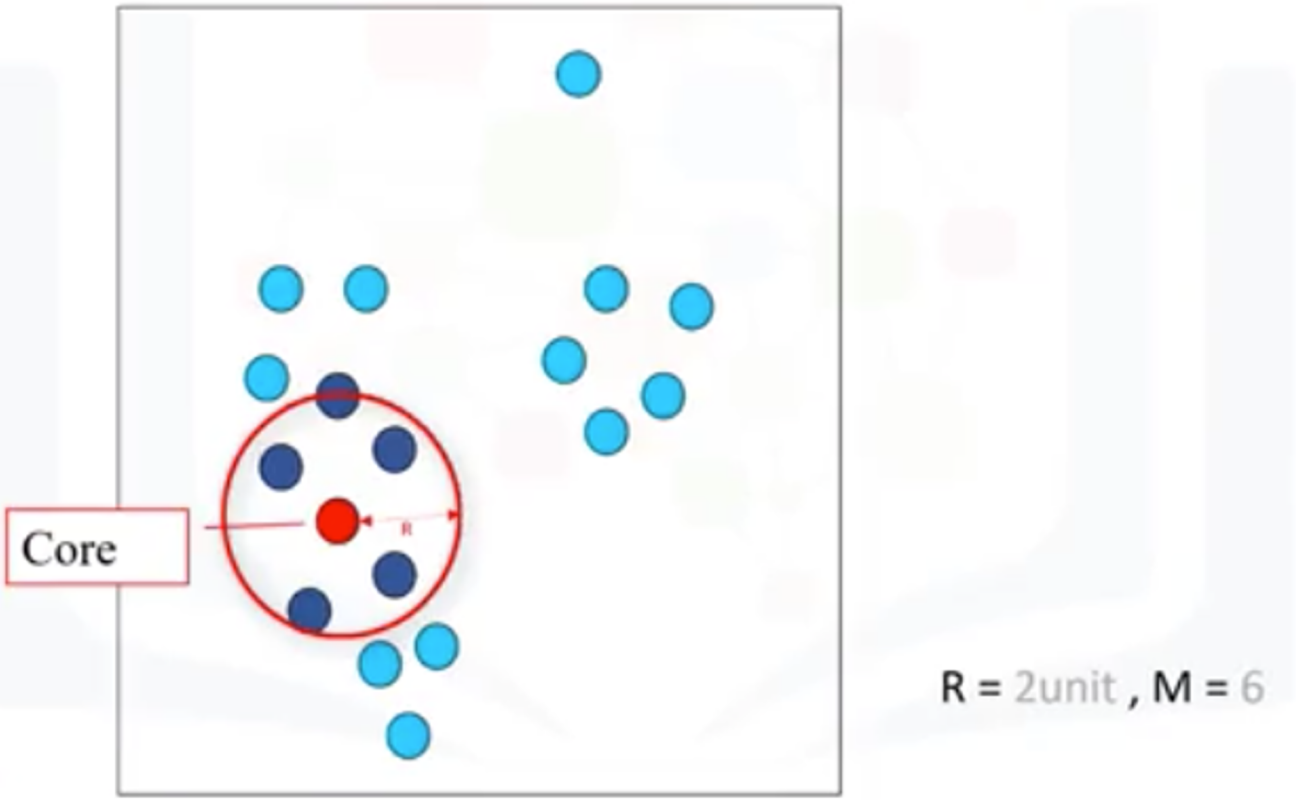
R = 2unit , M = 6

DBSCAN algorithm – core point?



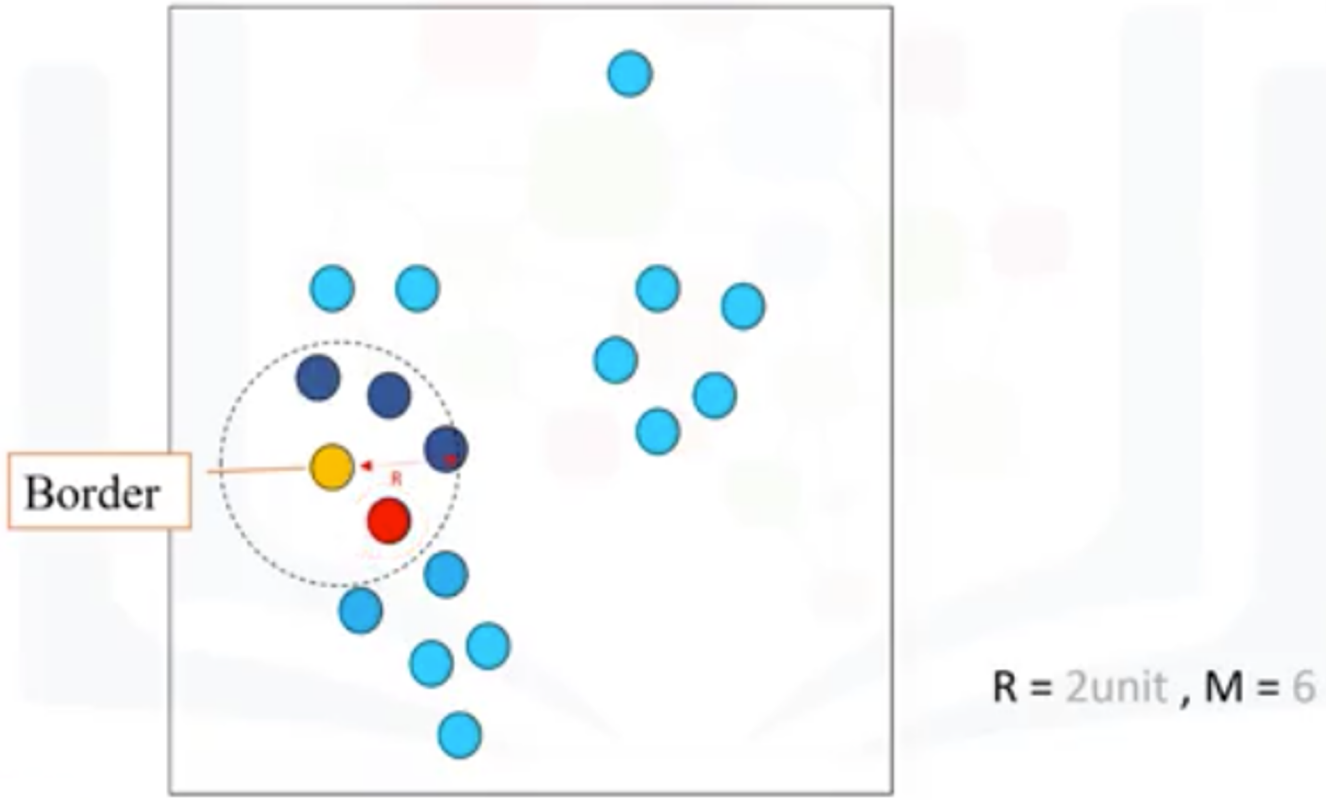
R = 2unit , M = 6

DBSCAN algorithm – core point



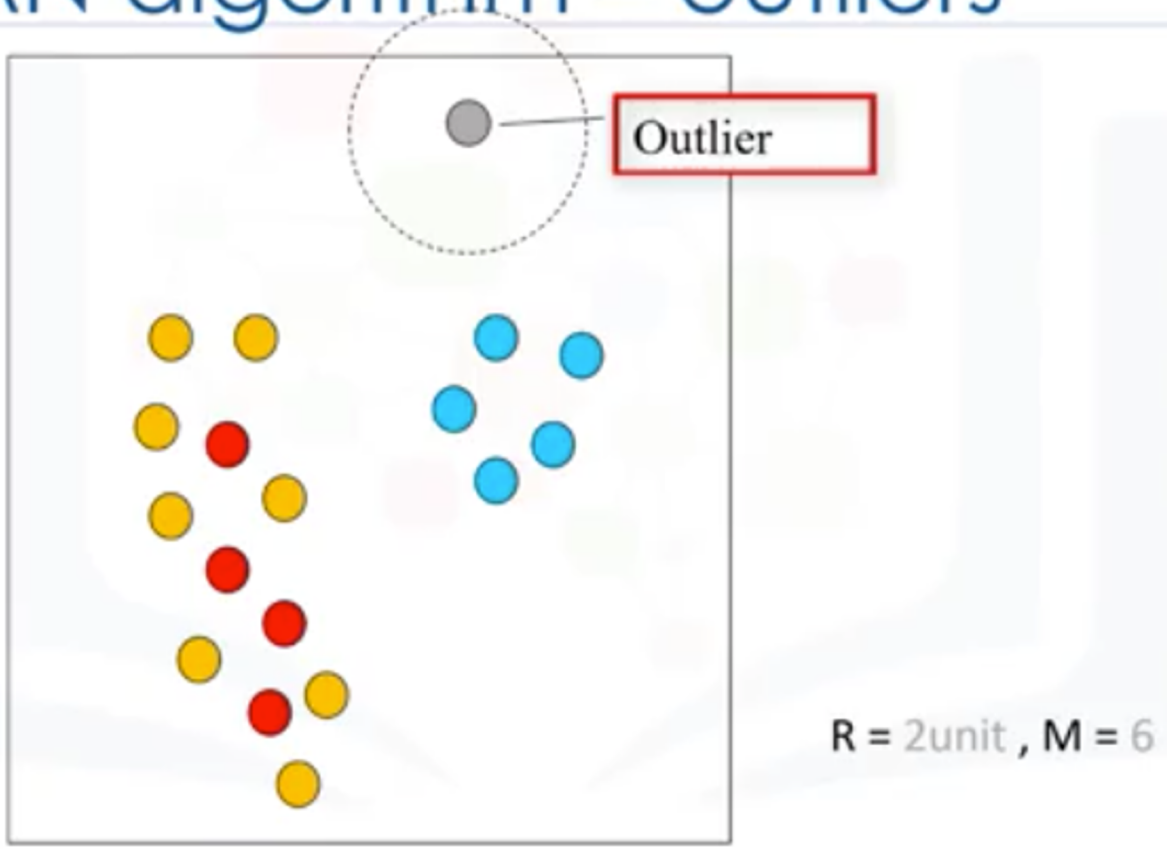
R = 2unit , M = 6

DBSCAN algorithm – border points?



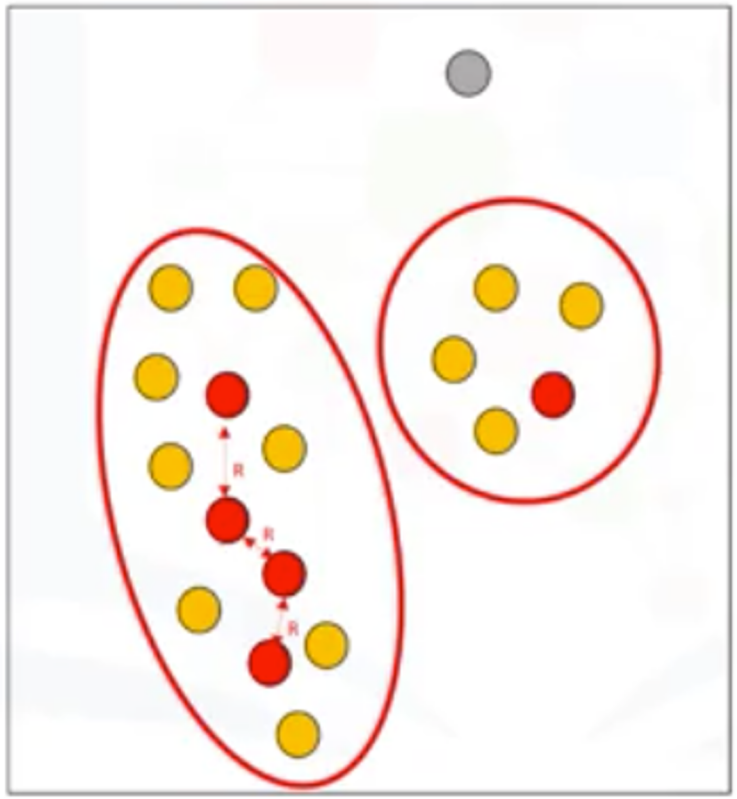
R = 2unit , M = 6

DBSCAN algorithm – outliers



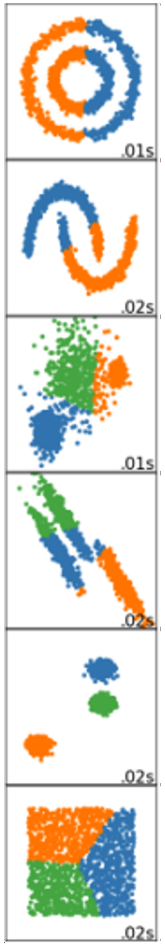
R = 2unit , M = 6

DBSCAN algorithm – clusters?



R = 2unit , M = 6

k-Means



DBSCAN