

CLUSTERING

CLUSTERING



What is clustering?



Benefit of clustering



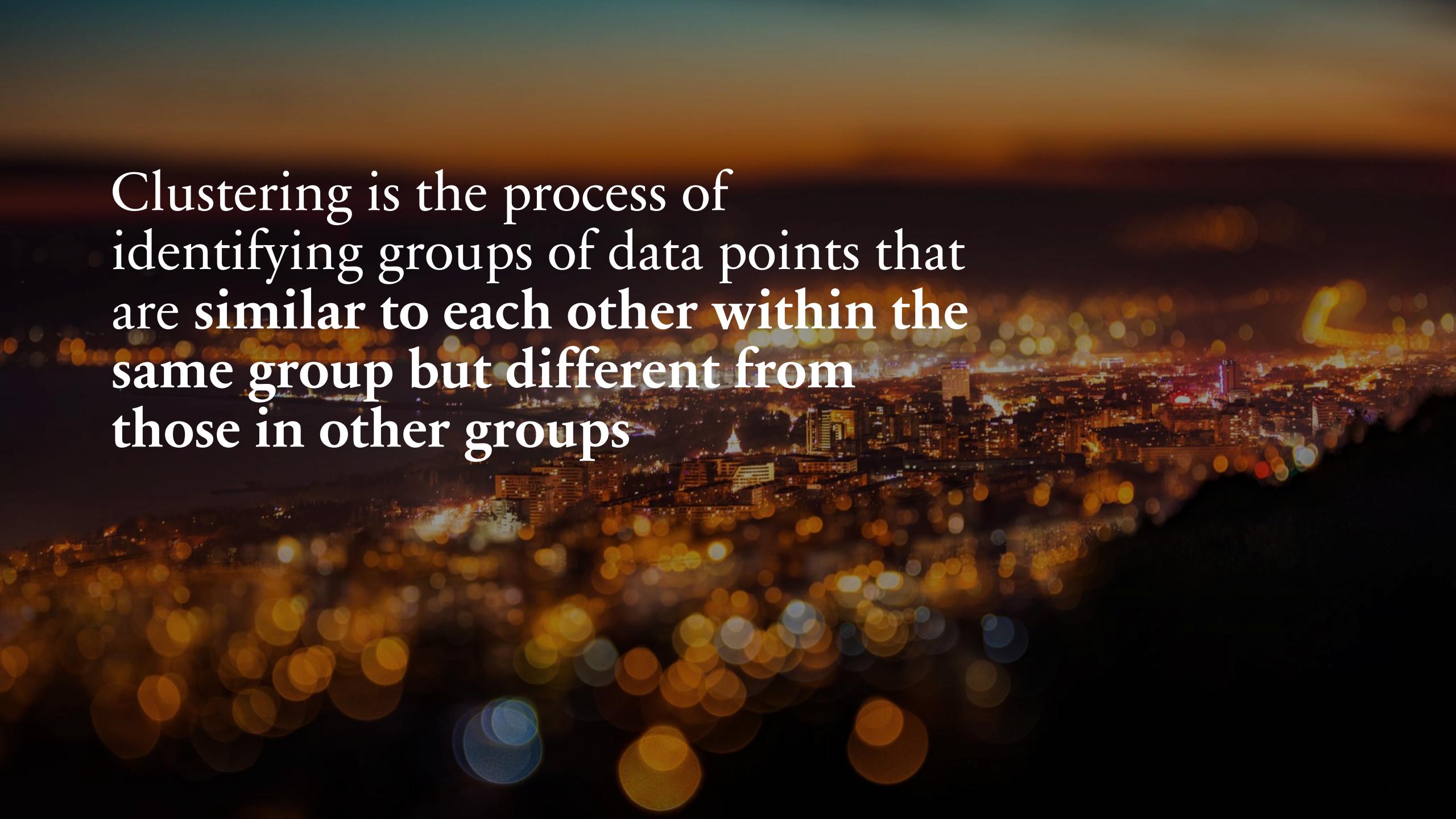
Types of clustering



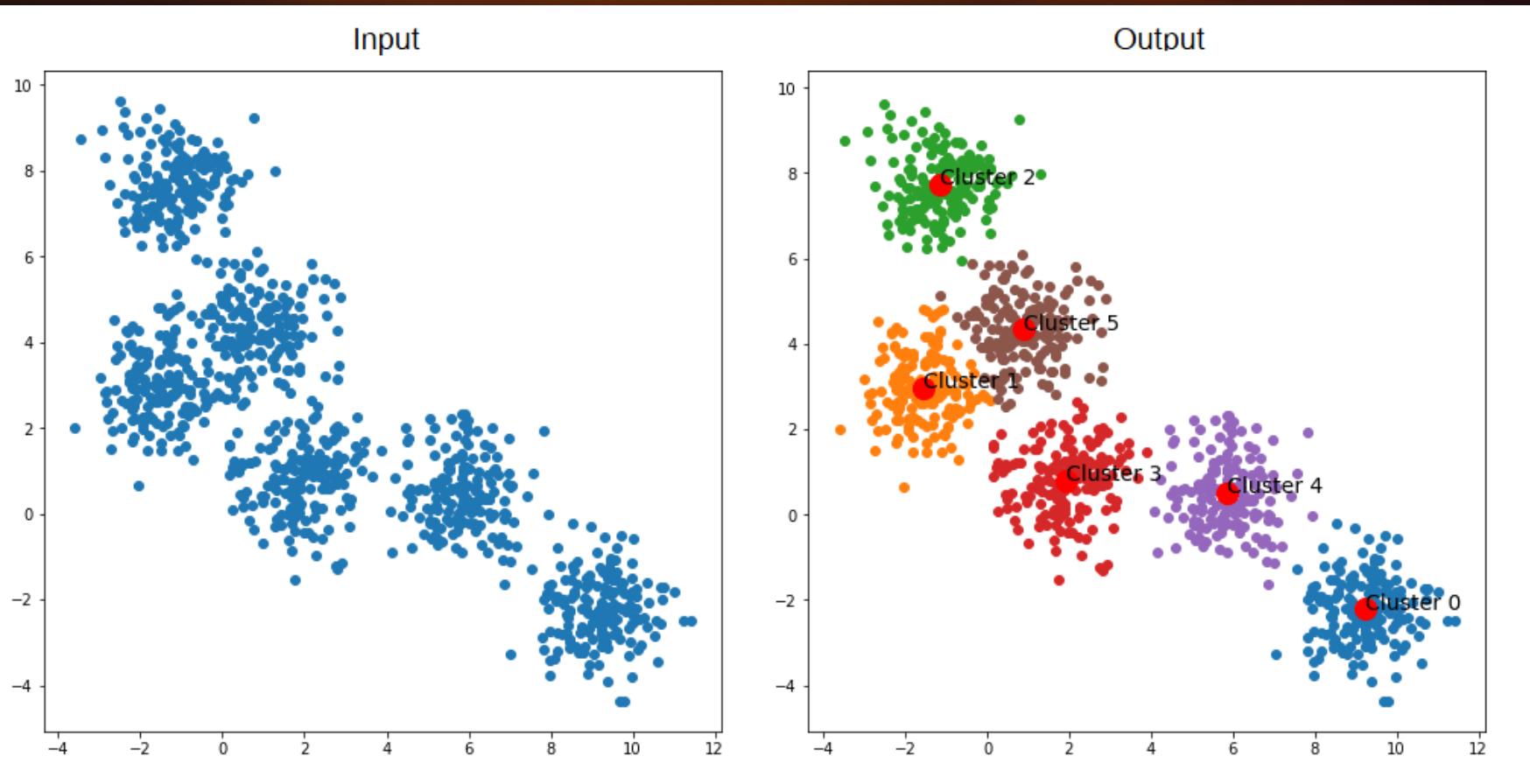
Further reading

The background of the image is a blurred night cityscape, likely a coastal city, with numerous warm-toned lights from buildings and street lamps creating a bokeh effect. The colors range from deep blues and purples in the upper sky to bright yellows and oranges near the horizon. The city lights reflect off what appears to be a body of water in the foreground.

WHAT IS CLUSTERING?



Clustering is the process of identifying groups of data points that are **similar to each other within the same group** but different from those in other groups



BENEFIT OF CLUSTERING



Understand hidden
patterns and structures

Understand hidden patterns and structures

- Feature engineering
- Improve performance
- Prevent overfitting

FOR MORE EXPLAIN

TYPE OF CLUSTERING



CENTROID-BASED
CLUSTERING



DENSITY-BASED
CLUSTERING



DISTRIBUTION-
BASED CLUSTERING



HIERARCHICAL
CLUSTERING

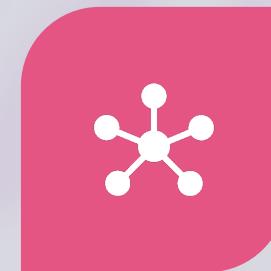
CLUSTERING ALGORITHMS



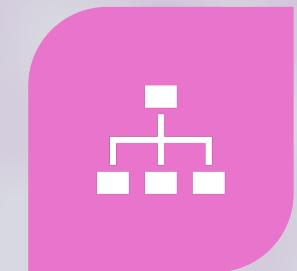
K-MEANS CLUSTERING



DBSCAN



GAUSSIAN MIXTURE
MODEL



AGGLOMERATIVE
HIERARCHY
CLUSTERING

K-MEANS CLUSTERING

A photograph of a large group of skydivers in mid-air, forming a circular pattern. The skydivers are wearing various colored jumpsuits (black, white, red, blue, yellow, green) and are arranged in concentric circles, resembling a flower or a target. The background is a clear blue sky.

K-MEANS CLUSTERING

What is K-mean clustering?



Calculation step



Calculation example



Code



What is K-mean clustering?

K-mean clustering is centroid-based clustering method that aims to partition n observations into K clusters in which each observation belongs to the cluster with the nearest mean (cluster centers or cluster centroid)

Calculation step

1

Choose the number of clusters K

2

Select K random datapoints from the data as centroids

3

Assign all the datapoints to the closest cluster centroid

4

Recompute the centroids of newly formed clusters

5

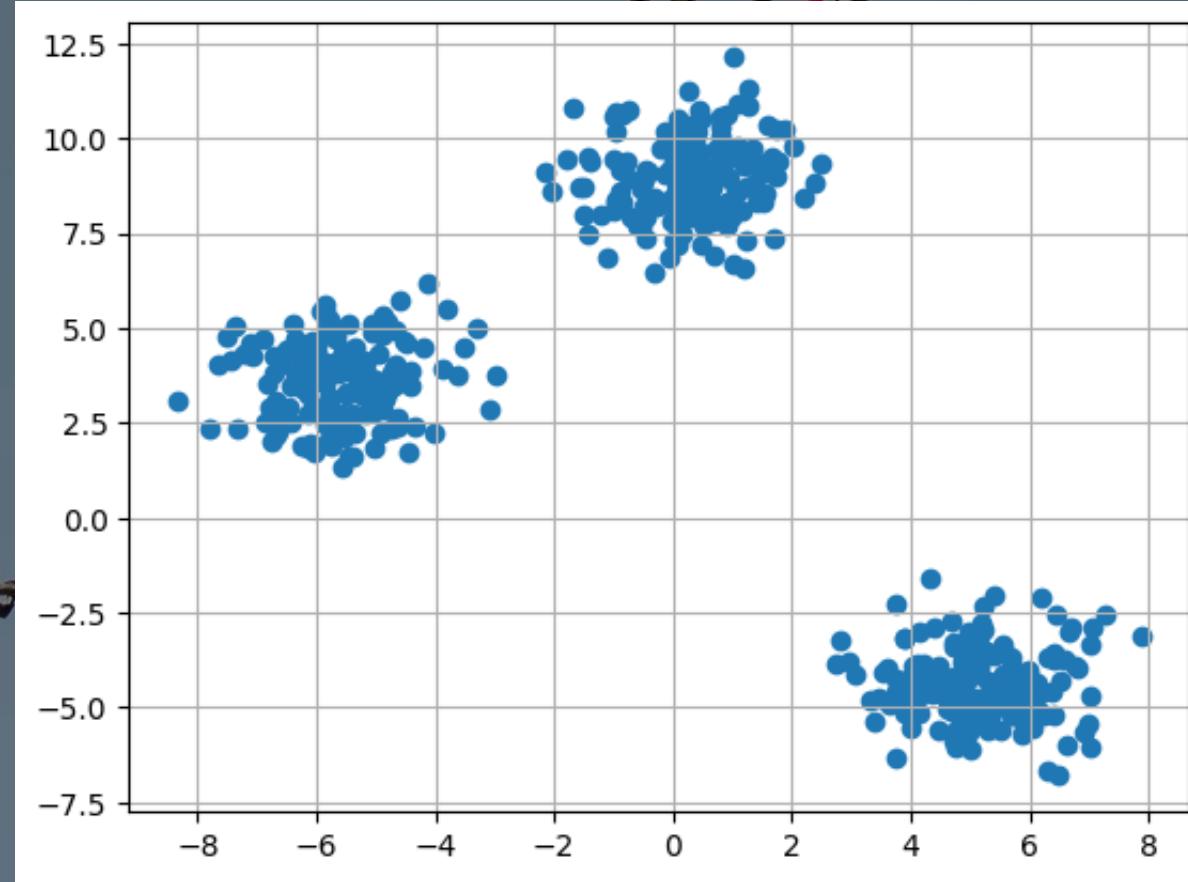
Repeat steps 3 and 4 until meet stopping criteria

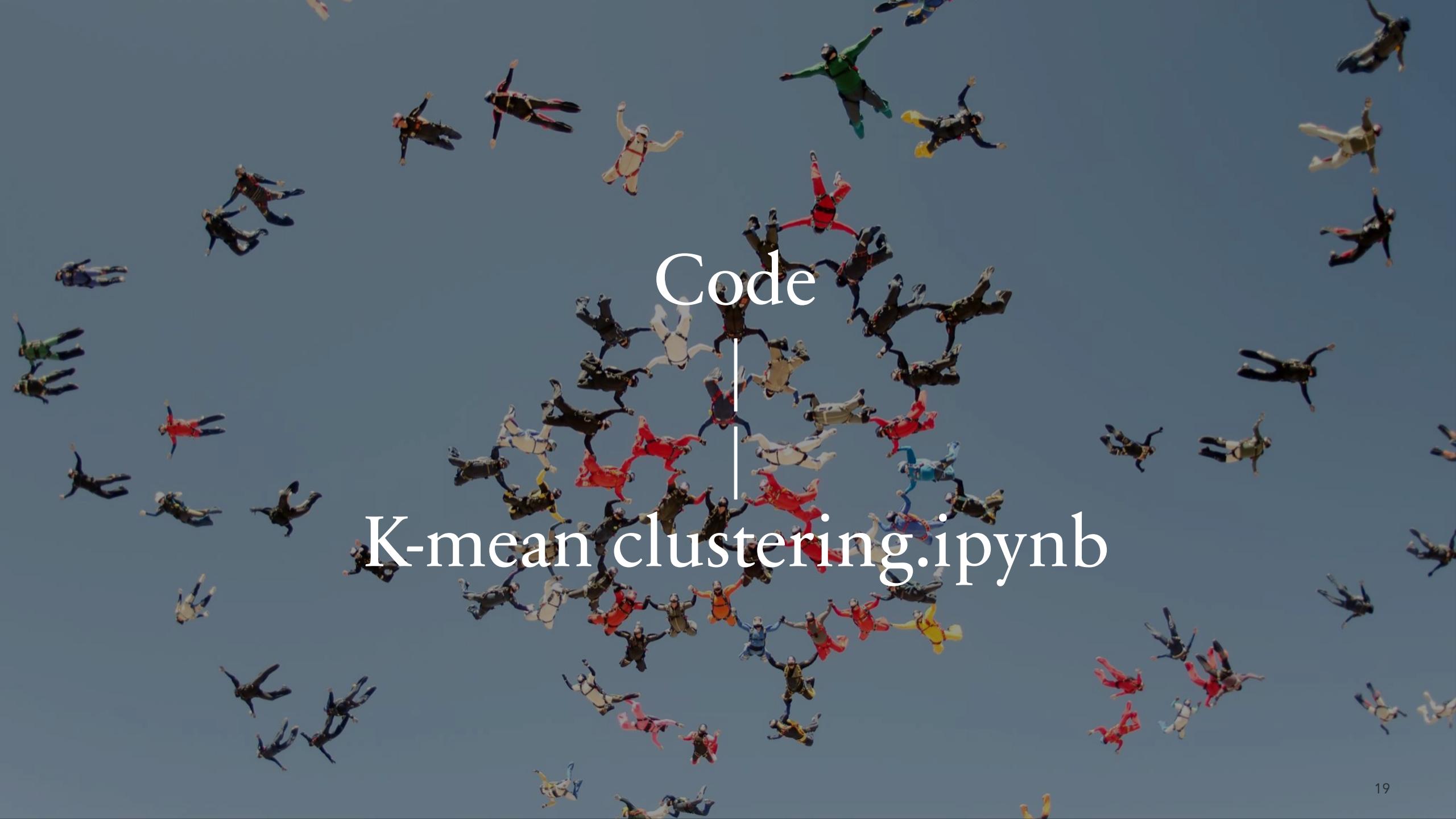
Stopping criteria

1. Centroids do not change
2. All datapoints remain in the same cluster
3. Maximum number of iterations is reached

Calculation example

Calculation concept





Code
K-mean clustering.ipynb

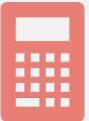
DBSCAN



DBSCAN



What is DBSCAN?



Calculation Step



Calculation Example



Code

What is DBSCAN?

DBSCAN is a density-based clustering method: given a set of points in some space, it groups together points that are closely packed together (points with many nearby neighbors), marking as outliers points that lie alone in low-density regions (whose nearest neighbors are too far away)

Calculation step

1

Choose a value
for eps and MinPts

2

For a particular datapoint
(x) calculate its distance
from every other
datapoints.

3

Find all the
neighbourhood points
of x which fall inside the
circle of radius (eps)

4

If the number of
neighborhood points
around x are greater or
equal to MinPts then
treat x as a core point (if
it is not assigned to any
cluster.)

Calculation step

5

If the number of neighborhood points around x are less than MinPts and it has a core point in its neighborhood, treat it as a border point.

6

If no neighborhood points around x , treat it as a outlier.

7

Include all the density connected points as a single cluster.

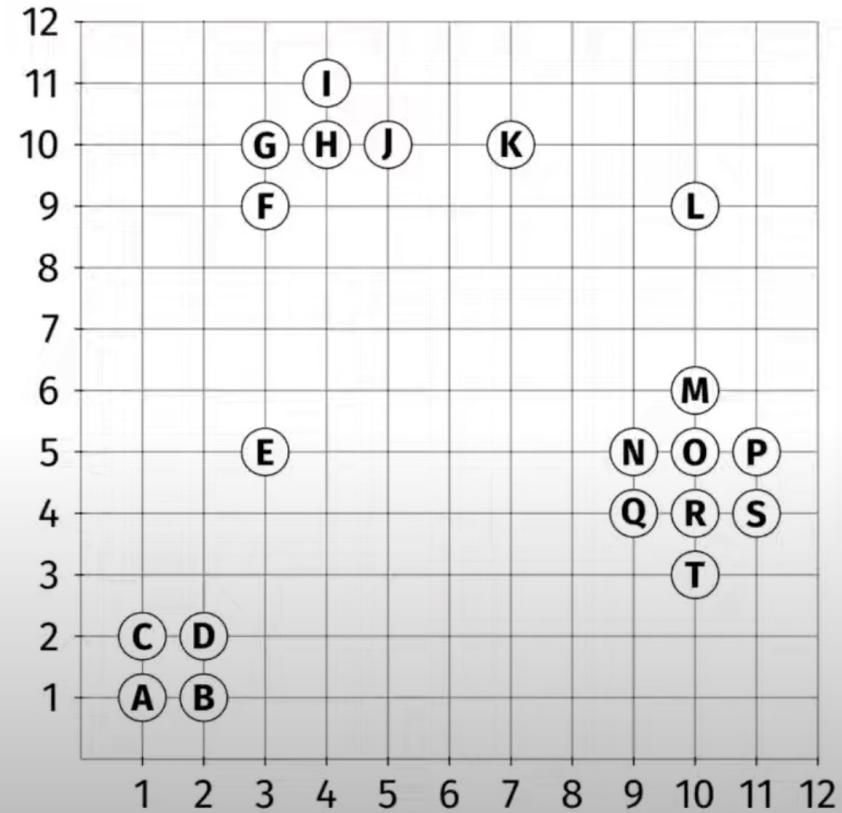
8

Repeat the above steps for every unvisited point in the data set and find out all core, border and outlier points.

Calculation example

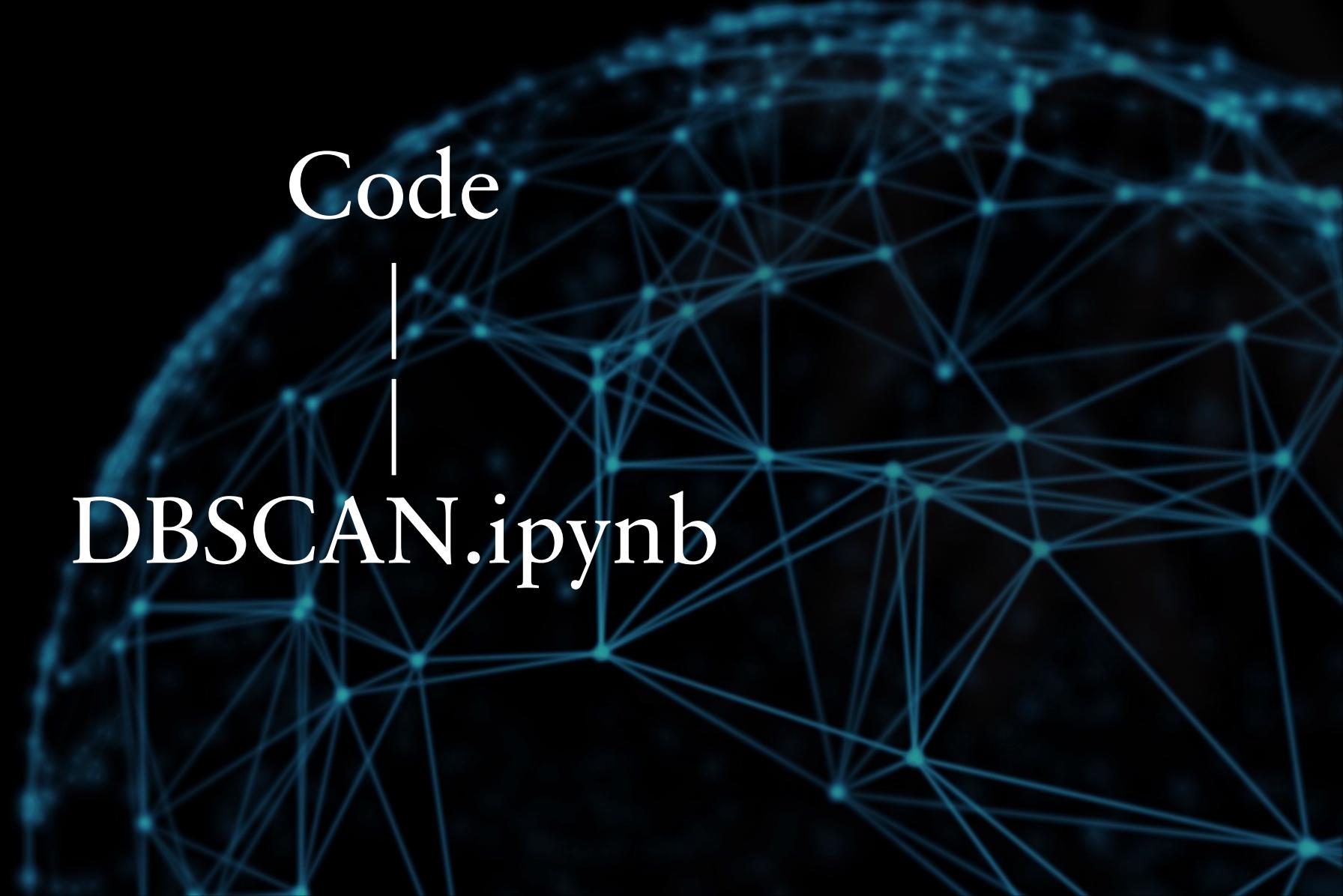


Calculation concept



$\varepsilon = 1.75$
minPts = 4





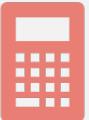
Code
|
DBSCAN.ipynb

GAUSSIAN MIXTURE MODEL

GAUSSIAN MIXTURE MODEL



What is Gaussian mixture model?



Calculation Step



Calculation Concept



Code

What is Gaussian mixture model?

A Gaussian Mixture Model is a probabilistic model used for clustering and density estimation. It assumes that the data points are generated from a mixture of several Gaussian distributions. Each component in the mixture represents a cluster in the data, and each Gaussian distribution represents the probability distribution of data points belonging to that cluster.

Calculation step

1

Choose the number of clusters K

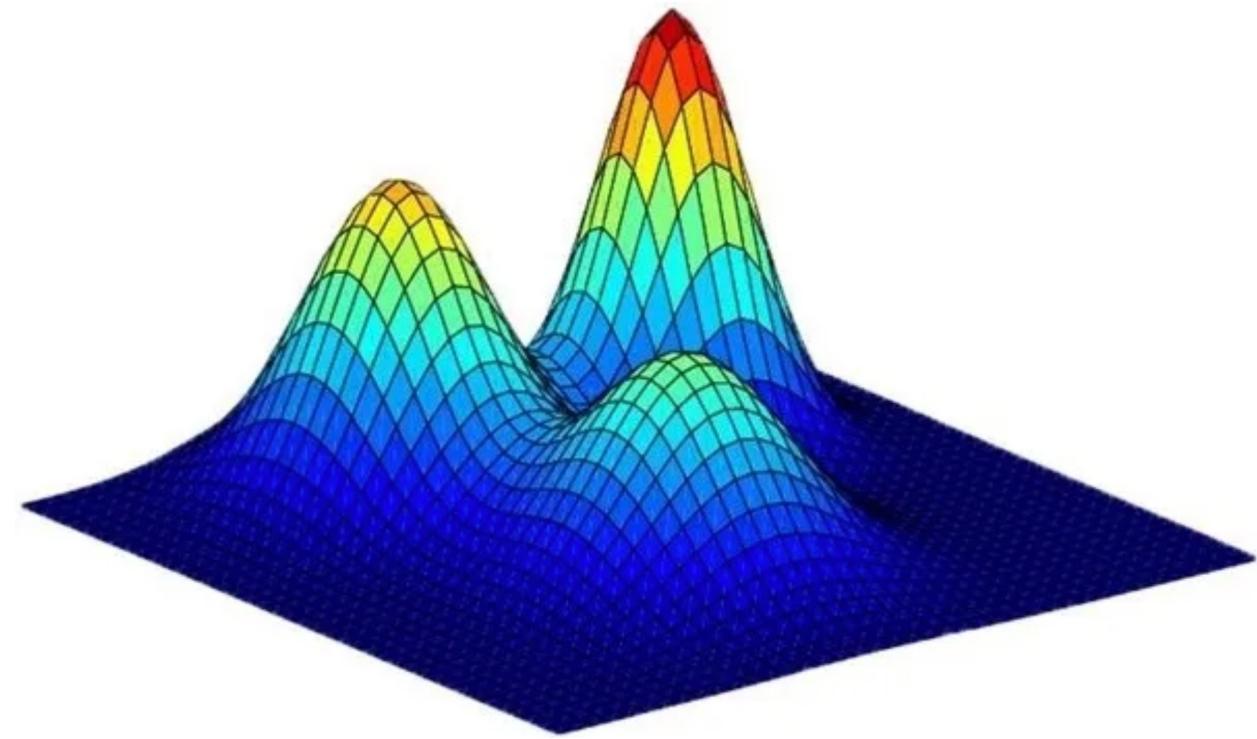
2

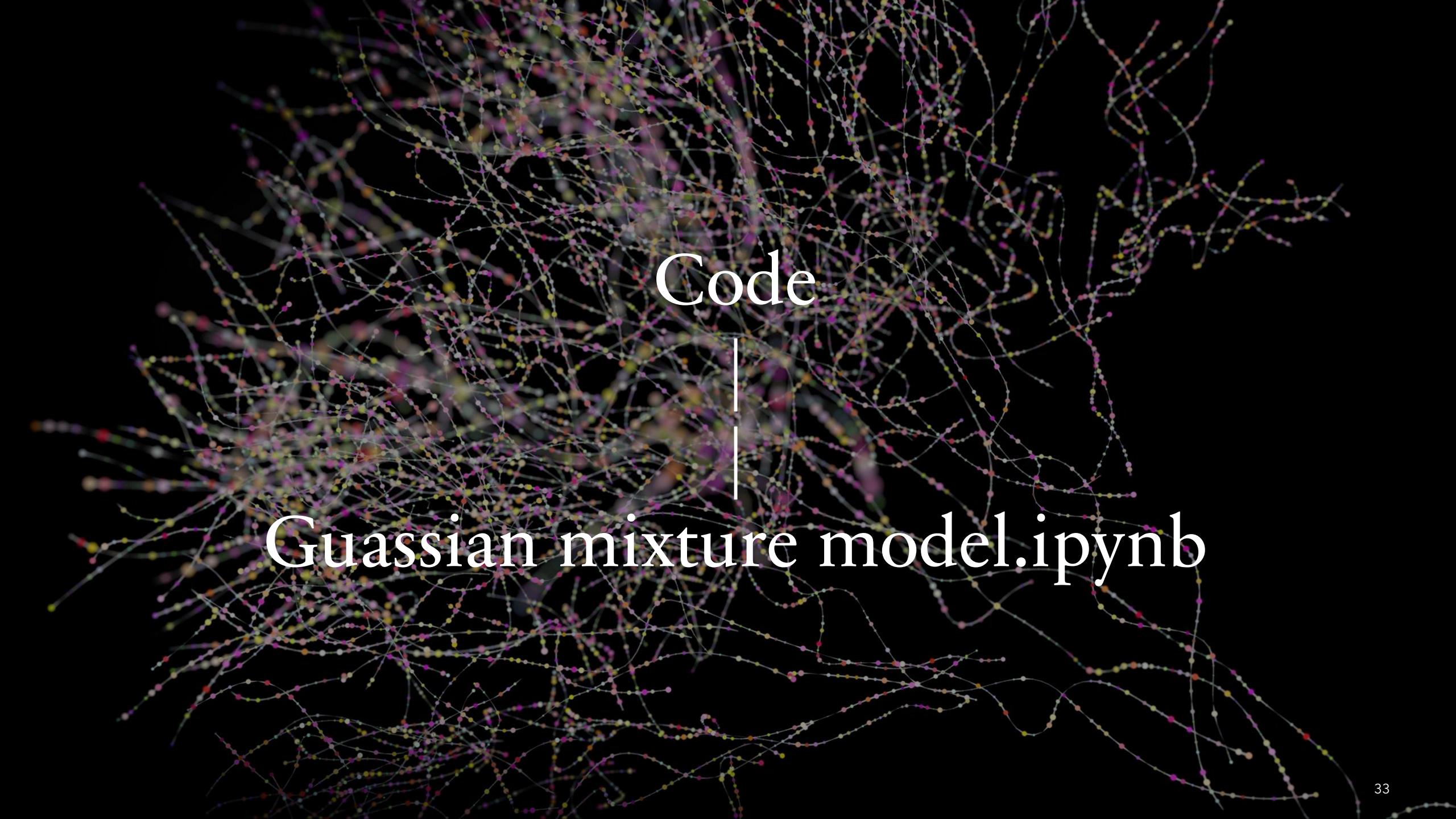
Initialize parameters
i) means
ii) covariances
iii) weights

3

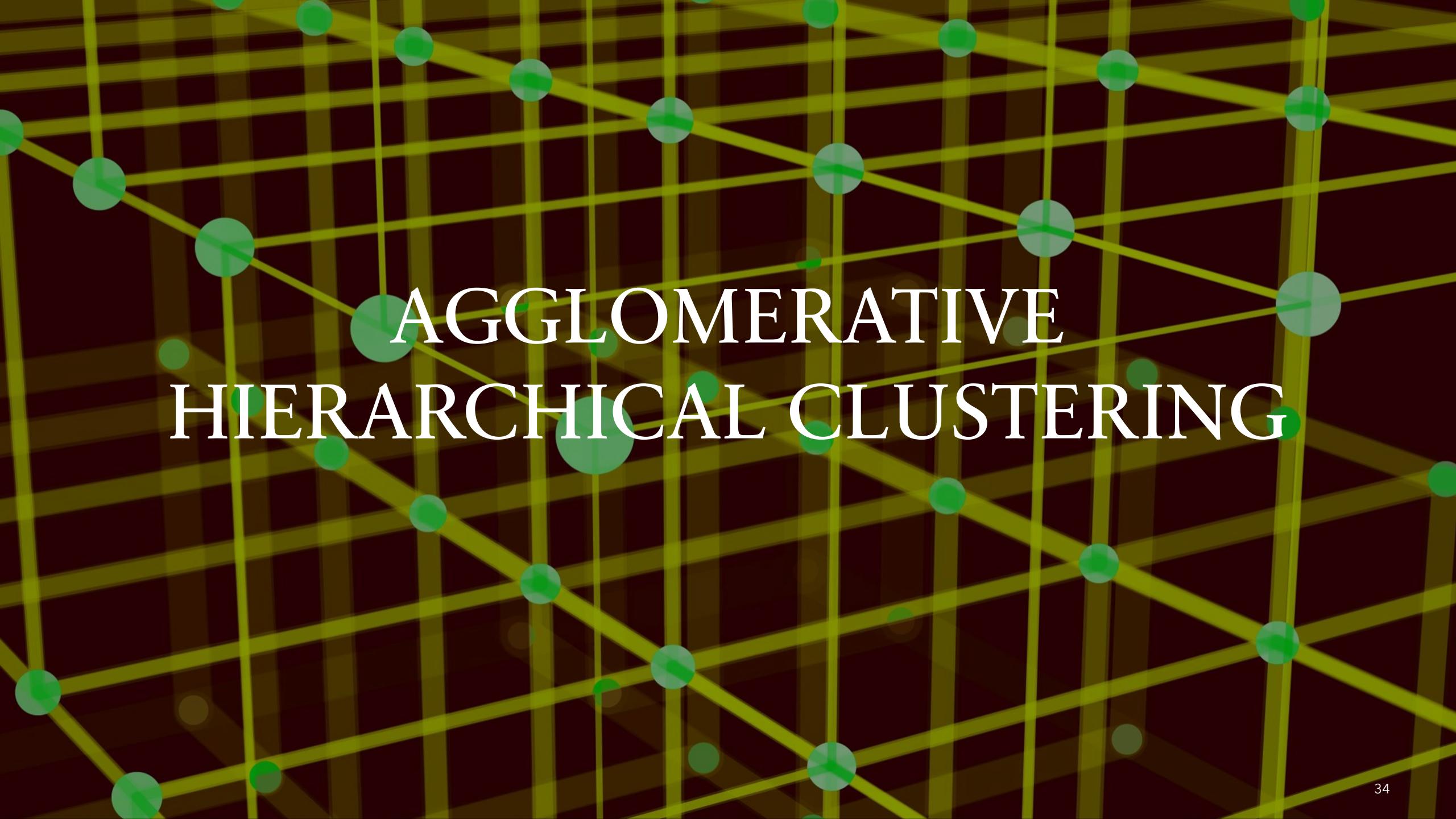
Apply EM algorithm for finding the converged parameters

Calculation concept





Code
|
Guassian mixture model.ipynb



AGGLOMERATIVE HIERARCHICAL CLUSTERING

AGGLOMERATIVE HIERARCHICAL CLUSTERING



What is Agglomerative hierarchical clustering?



Calculation Step



Calculation Example



Code

What is AHC?

Agglomerative hierarchical clustering (AHC) is hierarchical clustering method that seeks to build a hierarchy of clusters.

Calculation step

1

Create each datapoint as a single cluster.

2

Take two closest datapoints or clusters and merge them to form one cluster.

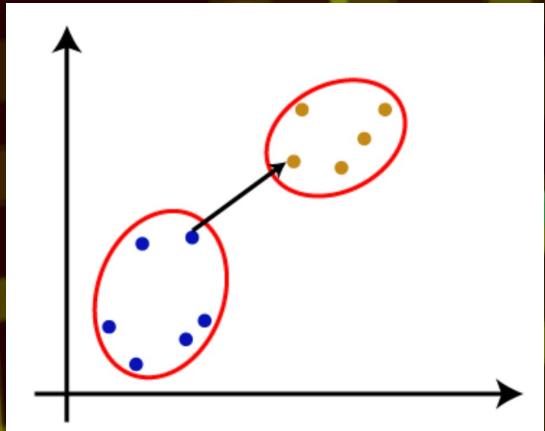
3

Repeat Step 2 until only one cluster left.

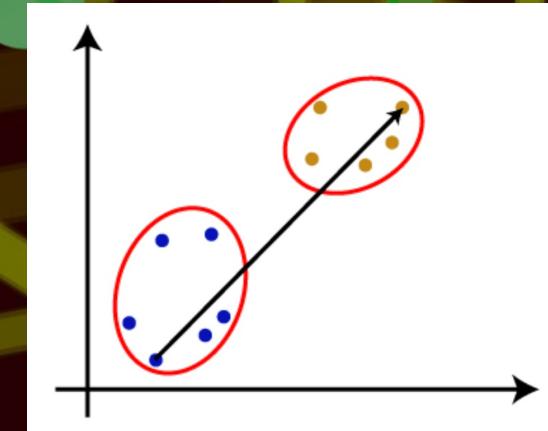
4

Once all the clusters are combined into one big cluster, develop the dendrogram to divide the clusters

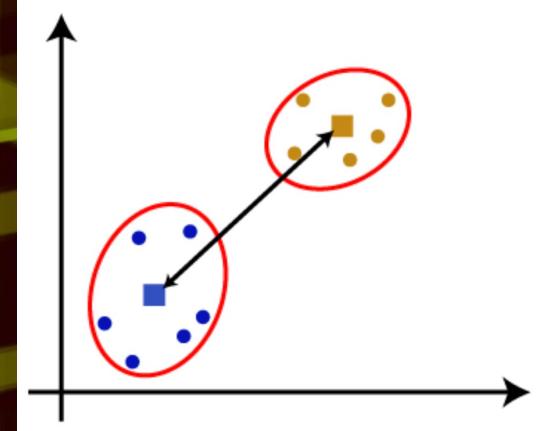
Linkage methods



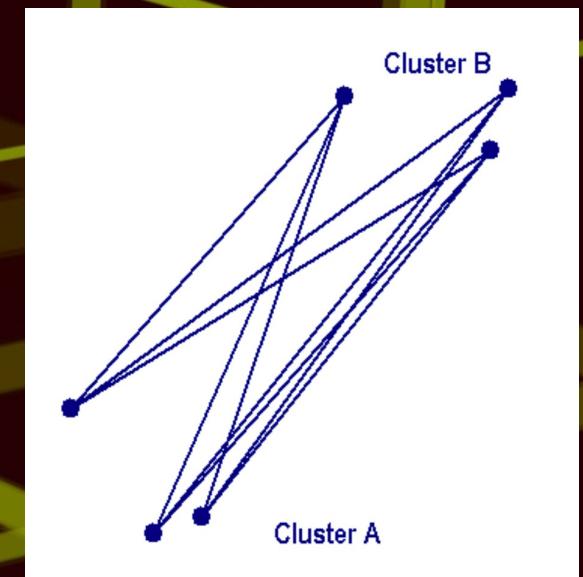
Single linkage



Complete linkage



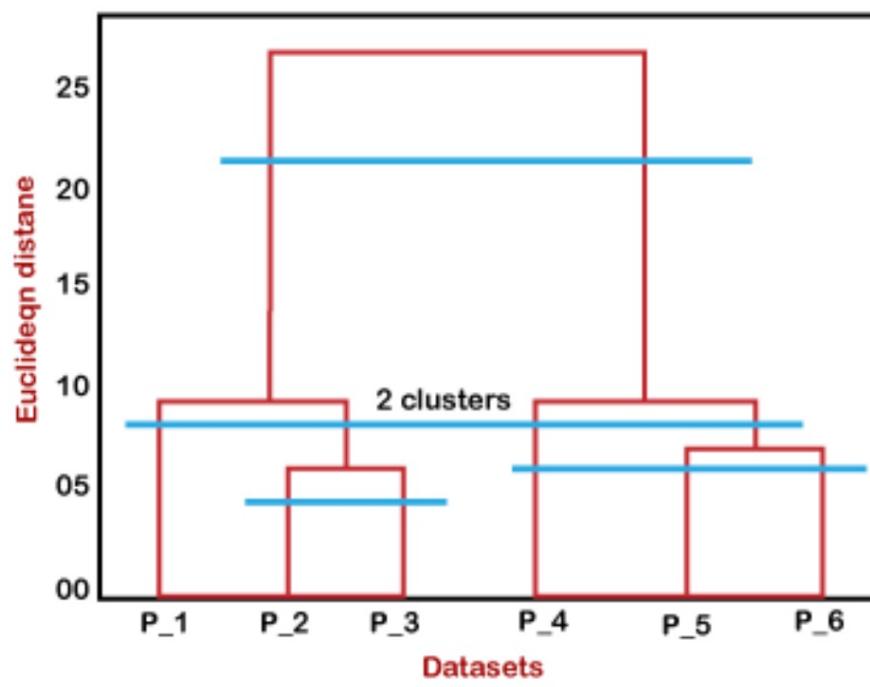
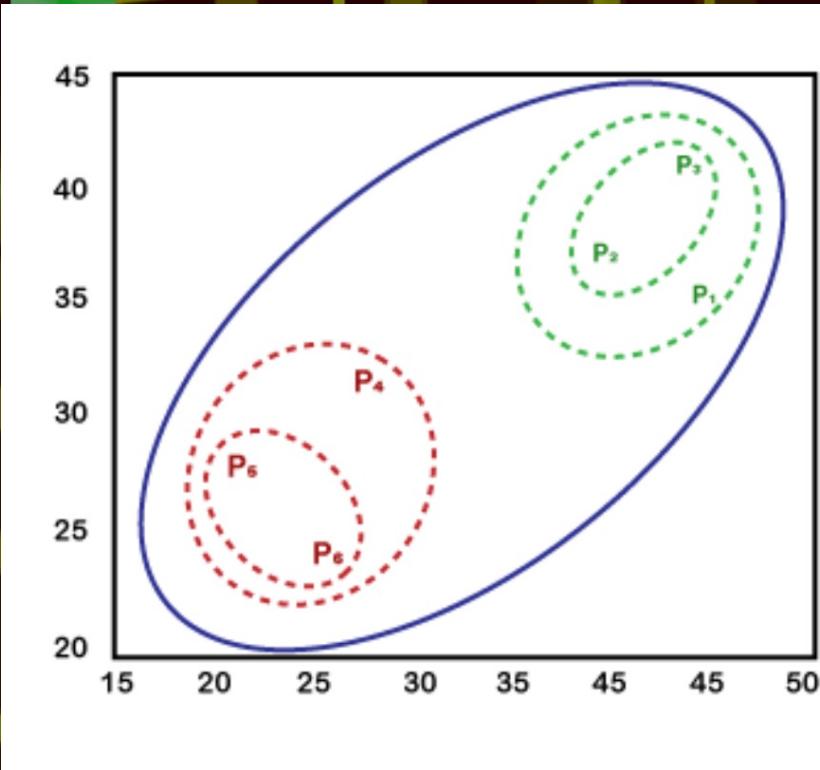
Centroid linkage



Average linkage

Calculation example

Calculation concept



Agglomerative hierarchical clustering.ipynb

Code

Comparison



	K-mean clustering	DBSCAN	Gaussian Mixture Model	Agglomerative hierarchical clustering
Clustering type	Centroid-based	Density-based	Distribution-based	Hierarchical
What users define	<ul style="list-style-type: none"> - Number of clusters - Initial cluster centroid (optional) 	<ul style="list-style-type: none"> - Epsilon - MinPts 	<ul style="list-style-type: none"> - Number of clusters - Initial parameters (optinoal) 	<ul style="list-style-type: none"> - Distance threshold or number of clusters - Linkage method
Ability to handle outliers	Sensitive to outliers	Robust to outliers	Assign low probability to outliers	Incorporate outliers into singleton clusters or ignore them
Soft clustering?	No	No	Yes	No
Suitable data shape	Sphere (convex)	Arbitary shapes (convex & non convex)	Arbitary shapes (convex & non convex) *** not that good	Arbitary shapes (convex & non convex)
Local minima?	Yes	No	Yes	No

FURTHER READING

- Ensemble clustering
- Adaptive clustering
- Dynamic time wraping
- Spectral clustering
- BIRCH
- Affinity propagation clustering
- Mean-Shift clustering
- OPTICS
- Evaluation metric for clustering

QUESTION & ANSWER



Reference (1)

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THANK YOU