Probabilistic hierarchical Model

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Things we will go through

Presentation Overview

Probabilistic Hierarchical Model: The ultimate combination of two of the most popular classification techniques in ML but first the basics.

Hierarchical Classifiers

Flexibility of the Agglomerative and divisive hierarchical classifiers

Probabilistic Classifiers

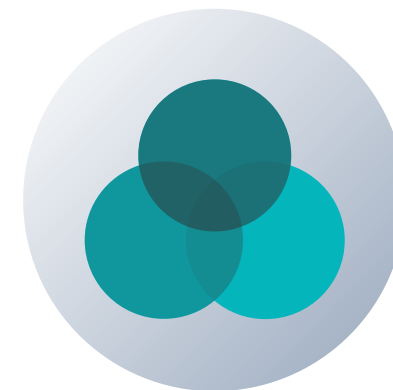Data distribution understanding of the probabilistic GMM classifiers.

Hierarchical Models

It is a powerful unsupervised machine learning algorithm used to group data points into a hierarchy of clusters.
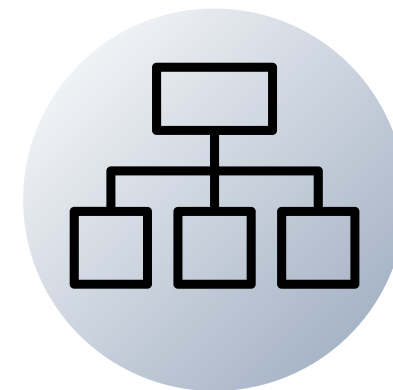
No predefined Clusters

Don't know how many clusters you need? we got that covered

Dendogram diagrams

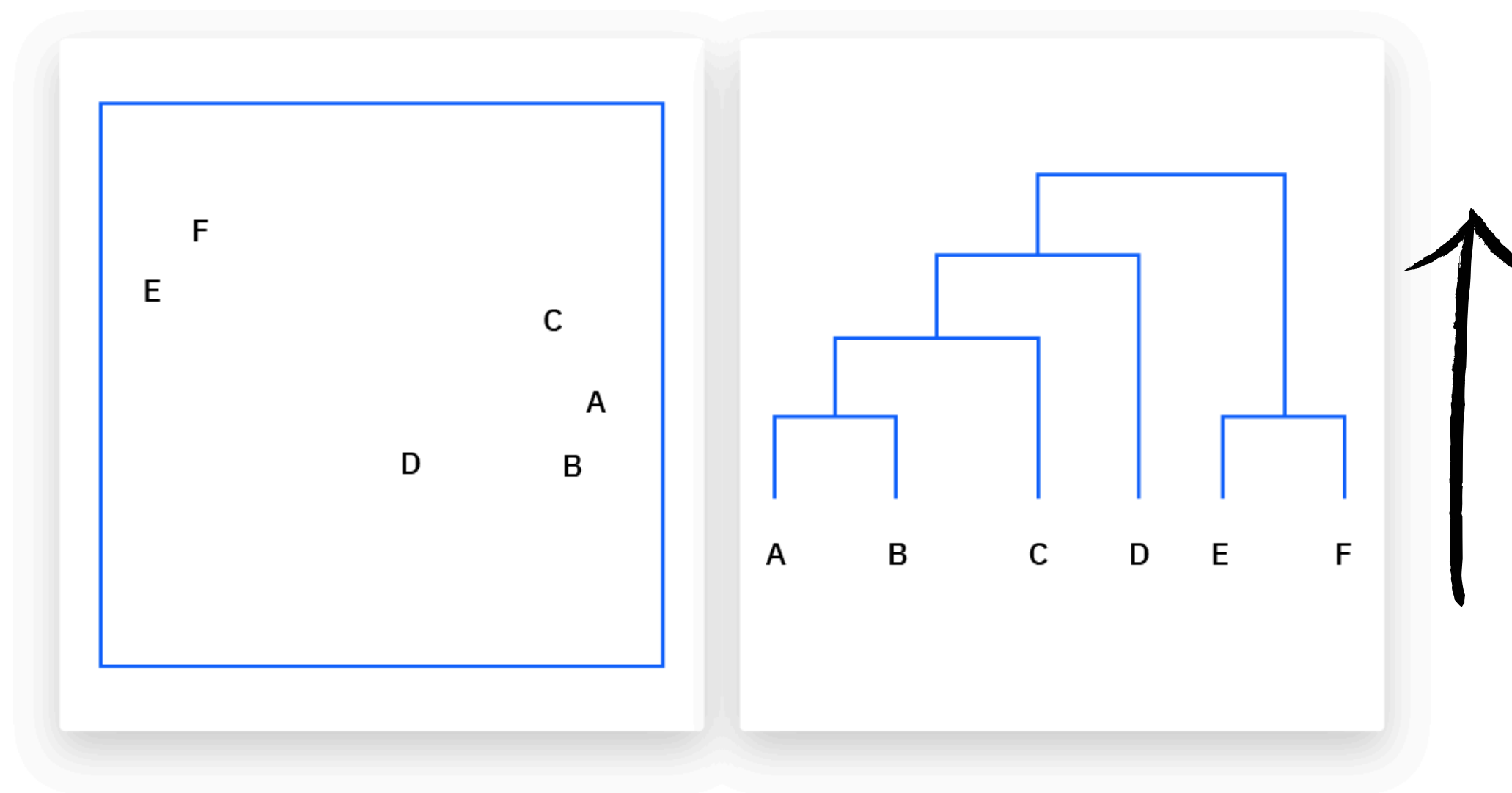Want quick visualization of the cluster distribution? we can do that too

Cluster Hierarchy

Want to know the hierarchical structure? don't worry about it

Agglomerative approach

Bottom up approach with each data point a indiv. cluster

what is it?

ITS A BOTTOM-UP APPROACH FOR DEALING WITH CLASSIFICATION PROBLEMS USING HIERARCHICAL STRUCTURE
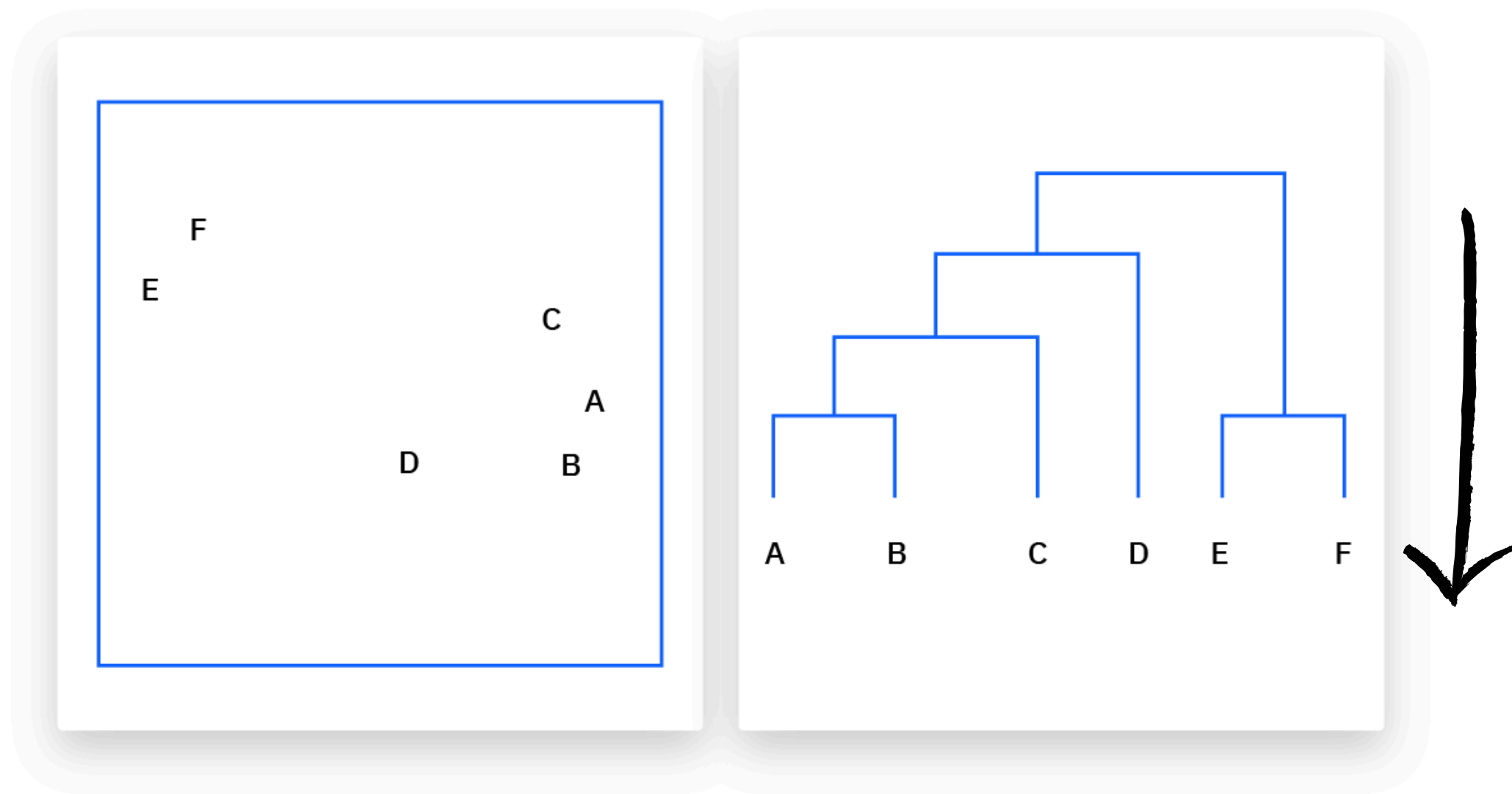
methodology

USES DATA POINT LINKAGE TO DEFINE RELATIONS AND MERGE

benefits

EASY TO IMPLEMENT AND COMPREHEND

Divisive approach

Top-down approach with all the data points represented as a single cluster

what is it?

TOP-DOWN APPROACH WITH ALL THE DATA POINTS IN A SINGLE CLUSTER ITERATIVELY SEPARATED

methodology

USES CUT COST AND INTRA COST TO JUSTIFY SPLIT.

benefits

BENEFICIAL WHEN EACH ITERATION IS TO BE CHECKED FOR PATH

Why Bother about Hierarchical Models?

what advantages does this guy offer?

FLEXIBILITY   No need to specify number of clusters

INTUITIVE AND EASY TO GET   Dendrograms provide easy visualization

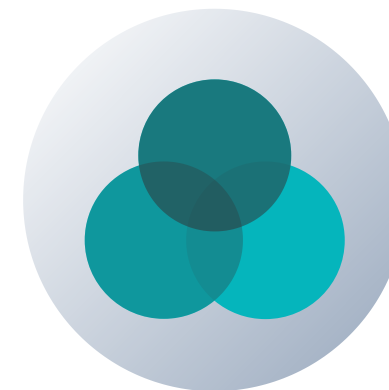**DETERMINISTIC**   Same clusters every time any time

Probabilistic Models

Models that incorporate the concepts of probability to define and handle uncertainty in the data and make predictions
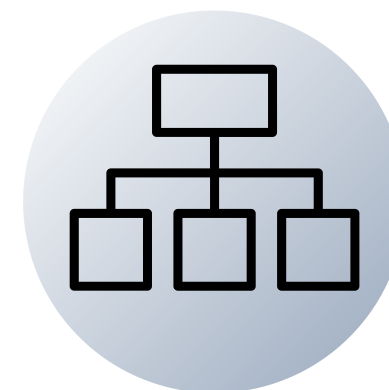
Uncertainty Quantification

Can provide a measure of uncertainty for those risking problems.

Flexibility in Complexity

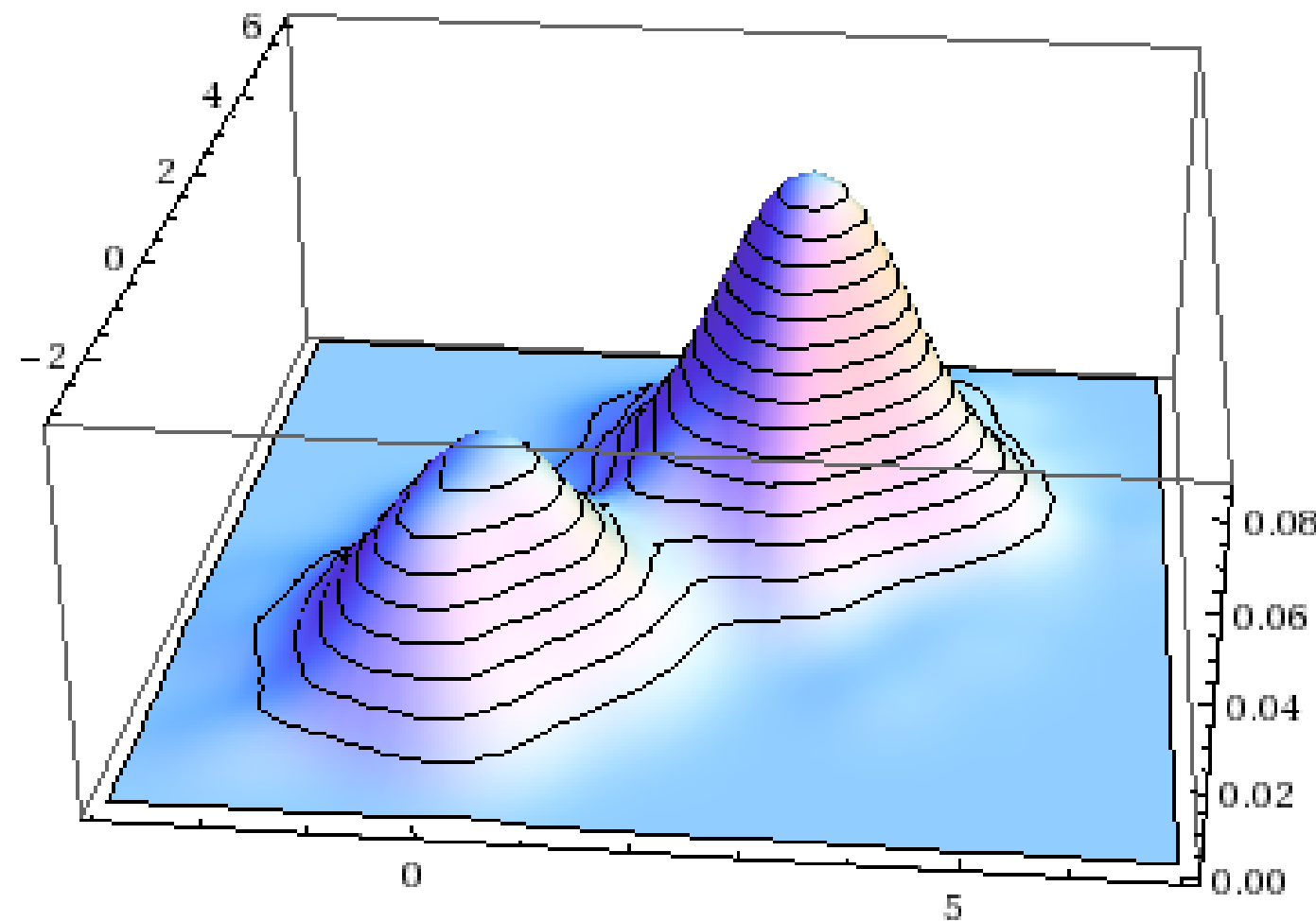Can handle complex and high-dimensional data like a breeze.

Probabilistic inference

Dynamic hypothesis updates to make predictions easy and life of ML engineers livable.

Gaussian Mixture Model (GMM)

Top of the line probabilistic model for classification and clustering

Mixture of Gaussian's

A MODEL FORMED BY COMBINING THE GAUSSIAN CLASSIFICATION OF VARIOUS CLUSTERS TOGETHER

Soft Clustering

PROVIDES PROBABILITY OF A DATA POINT EXISTING IN MULTIPLE CLUSTERS ALLOWING FLEXIBILITY

Robustness to outliers

PROBABILITIES REDUCE THE RISK ASSOCIATED WITH HARD LABEL CLASSIFIERS

What Lacked?

Until now we have been repeating that these models are the best in their class but where are they lacking?

limit 1

limit 2

limit 3

high complexity when dealing with large datasets

limited flexibility in complex datasets

limited update potential and can suffer from bias caused by linkage

Probabilistic Hierarchical Models

builds on top of the Hierarchical model with a little squeeze of probabilistic freshness

likelihood based classification

no more distance based uncertainty linkage

complex data? no problem

Using the internal probabilistic likelihood can better understand complex data nature

uncertainty causing issues?

outliers dont have much effect now thanks to probabilistic nature

built in Flexibility

can handle more complex distributions and true to the data