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Assignment 1

Shashwat Shah

60004220126

TYBtech Comp B

1 No, k means and gaussian mixture models (GMM) will generally not produce same cluster centers (means) for a given dataset.

Reasoning →

- k-means: This is a centroid-based clustering algorithm. It works by initially placing a fixed no. of centroids at random locations. Then it iteratively assigns each data point to the closest centroid and recomputes the centroid locations as the means of the point assigned to it.

Gaussian Mixture Model - This is a probabilistic clustering method that assumes the data is generated by a mixture of gaussian distributions. It uses expectation maximization (EM) algorithm to find the optimal parameters for the model, including the means and variances of the gaussian distributed that best fit the data.

Due to the fundamental differences, k-means and GMM will often produce different clustering results even with the same no. of clusters specified.

In conclusion, while both k-means and GMM are clustering algorithms, they make different assumptions about the data and produce different cluster representations. The choice of algorithm depends on the characteristics of your data and the desired outcome of your clustering tasks.

Hidden Markov model are versatile tool with numerous real-time applications due to their ability to model sequential data with hidden states.

Speech recognition - They can model the statistical properties of phonemes, words or sentences, allowing them to recognise spoken language patterns in real time.

Gesture recognition - In add applications where gestures are used as input (eg. Sign language, interpretation, human computer interaction), HMMs can be used to model and recognise different gestures based on observed movements.

Bioinformatics: HMMs are used for tasks such as gene prediction protein structure prediction and sequence alignment they can model biological sequence and their hidden structures, aiding in the understanding of genetic information.

Financial time series Analysis - They can be used to model and predict trends in financial data such as stock prices or market indices by capturing hidden states that represent market conditions or investor behavior.

Robotics and autonomous systems: They are used in robotics for localization and mapping tasks. They can model the robot's environment and its movements allowing for real-time navigation and path planning.

Independent component analysis is a method used to separate mixed signals into their original independent components. It assumes that the observed data is combined of these independent sources each with its own unique distribution. By finding their linear transformation that maximizes the statistical independence of the components, ICA can effectively extract useful information from complex data.

The fast ICA algorithm is commonly in various fields including image and signal processing, where the ability to isolate individual sources from mixed signals is crucial.

Deep neural networks are a class of ANN that are composed of multiple layers of nodes which attempt to model high level abstraction in data.

In the context of unsupervised learning, DNN are used to learn the underlying structure of the input data without explicit supervision.

DNN consist of an input layer, multiple hidden layer and an output layer.

Each layer contains a set of nodes that perform computations on input data.

Application

- Image Recognition
- Speech Recognition
- Natural Language Processing
- Anomaly Detection.