ML Assignment 1

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Read 8/10/24 A

(1) No, K-Means & Gaussian Mixture Model (GMM) will generally not produce same cluster for a given dataset/ data.

K-Means

K-Means is a centroid based clustering algorithm
It works by initially placing a fixed no. of centroids at random locations.
Then, it iteratively arranges the data point to the clustered centroid

Gaussian Mixture Model

GMM is a probabilistic clustering model that assumes the data is generated by a massive gaussian distribution
It uses expectation maximization.

Hence, K-Means & GMM make different assumptions & hence produce different cluster appropriations.
The choice of algorithm depends on the characteristics of the data

(2) Hidden Markov Model is a statistical model that is used to describe the probabilistic relationship between a sequence of observations & a sequence of hidden states

Applications :

(1) Speech Recognition
Can model statistical properties of words or sentences to recognise patterns

(2) Gesture Recognition
Used to model different gestures based on observed movements

(3) Bioinformatics
Protein structure prediction, sequence alignment & model various biological sequences.

(4) Robotics & Autonomous Systems
Localisation & mapping tasks

(3) Independent Component Analysis
It is used to separate mixed signals into their original independent components
It assumes that input is a combination of sources
By finding the linear transformations that maximizes the statistical independence of the components
ICA can be used to extract patterns.
The fast ICA algorithm is used by leveraging a non gaussian nature of natural signals

DATE:

(4) Deep Neural Networks (DNN) are neutral networks that are composed of multiple layers of nodes which attemp to model high level abstraction in data.
It consist of input layer, multiple hidden layer & an output layer.
Each layer contains a set of nodes that performs computations on data
They are capable of automatically learning features that can be used for various tasks. such as classification as, clustering or dimensionality reduction.

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ML Assignment 2

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(1) Explain how machine learning can be used for the following applications.
Also, describe which ML technique is most suitable for designing it.

(a) Video Surveillance

Application

Machine learning can be used in video surveillance for various tasks such as object detection, activity recognition, & anomaly detection
It can help in automatically detecting & tracking objects of interest, identifying suspicious behaviours & alerting security personnel in real time

Suitable ML techniques

Convolutional Neural Networks (CNNs) are commonly used for such tasks due to their ability to effectively analyze spatial features in images or frames of videos

(b) Sentiment Analysis

Application

Sentiment Analysis involves determining the sentiment or

opinion expressed in text
It could be
- social media posts
- product reviews
- customer feedback
It can be used by businesses to understand customer opinions or analyze user feedback for product improvement

Suitable ML Techniques
- NLP
- RNN
- Transformer models (BERT)

(c) Image Recognition

Application
Image Recognition involves identifying & classifying objects or patterns with images.
It is used in various applications :
- medical diagnosis
- autonomous vehicles
- facial recognition systems

Suitable ML technique
Convolutional Neural Networks (CNNs) are the most suitable technique for image recognition tasks. CNNs are specifically designed to extract spatial hierarchies of feature

from images, making them highly effective

(d) Recommender Systems :

Application

Recommender systems are used to predict & suggest items or content that users might be interested in based on their past behaviour, preferences, or similar user behaviour