

Research on fuzzy clustering algorithms and applications

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Abstract: This thesis investigates fuzzy clustering algorithms and their practical applications, focusing on enhancing clustering performance in the presence of overlapping and ambiguous data. Traditional hard clustering methods assign each data point to a single cluster, which proves inadequate for real-world datasets where boundaries between groups are indistinct. Fuzzy clustering, particularly the Fuzzy C-Means (FCM) algorithm, addresses this limitation by allowing data points to belong to multiple clusters with varying degrees of membership. This research first provides a comprehensive analysis of the theoretical foundations of fuzzy clustering, including the mathematical formulation of the objective function and the iterative optimization process. Subsequently, the study proposes modifications to the standard FCM algorithm to improve convergence speed and robustness to noise. The effectiveness of the proposed algorithm is validated through extensive experiments on benchmark datasets. Finally, the thesis demonstrates a concrete application of the enhanced fuzzy clustering technique in a specific domain, such as image segmentation or pattern recognition, highlighting its superior ability to capture complex data structures and deliver more accurate and interpretable results compared to conventional methods.

Keywords: fuzzy clustering, data mining, fuzzy C-means, application