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Comparison algorithms with optimization for clustering multi-criteria

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Abstract

In higher education, forecasting student graduation is crucial for early intervention development, policy formulation, and class planning. This categorizes the factors that affect student graduation according to both academic and non-academic traits. To compare various clustering techniques, such as K-means, fuzzy C-means (FCM), K-medoids, density-based spatial clustering of applications with noise (DBSCAN), spectral clustering, Gaussian mixture model (GMM), and deep learning (DL), as well as particle swarm optimization (PSO) and genetic algorithm (GA) optimization for K-means and FCM, this article applies the hybrid elbow + silhouette optimization prior to the clustering process. Two clusters were found in the pre-cluster optimization research results. K-means, FCM, GMM, and DL clustering all demonstrated more distinct centroid separation; K-means and GMM were the most visually stable and comprehensible. Inter-cluster separation is the main goal of post-cluster optimization, and the K-means + PSO method is the best option. The cross-dataset validation findings indicate that the clustering model exhibits moderate consistency on the new dataset, with an adjusted Rand index (ARI) of 0.478 and a normalized mutual information (NMI) of 0.433.