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Enhancement of Density-Based Spatial Clustering Algorithm with Noise for Fire Risk Assessment and Warning in Metro Manila

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Abstract : This study focuses on applying an enhanced density-based spatial clustering algorithm with noise for fire risk assessments and warnings in Metro Manila. Unlike other clustering algorithms, DBSCAN is known for its ability to identify arbitrary-shaped clusters and its resistance to noise. However, its performance diminishes when handling high dimensional data, wherein it can read the noise points as relevant data points. Also, the algorithm is dependent on the parameters (eps & minPts) set by the user; choosing the wrong parameters can greatly affect its clustering result. To overcome these challenges, the study proposes three key enhancements: first is to utilize multiple MinHash and locality-sensitive hashing to decrease the dimensionality of the data set, second is to implement Jaccard Similarity before applying the parameter Epsilon to ensure that only similar data points are considered neighbors, and third is to use the concept of Jaccard Neighborhood along with the parameter MinPts to improve in classifying core points and identifying noise in the data set. The results show that the modified DBSCAN algorithm outperformed three other clustering methods, achieving fewer outliers, which facilitated a clearer identification of fire-prone areas, high Silhouette score, indicating well-separated clusters that distinctly identify areas with potential fire hazards and exceptionally achieved a low Davies-Bouldin Index and a high Calinski-Harabasz score, highlighting its ability to form compact and well-defined clusters, making it an effective tool for assessing fire hazard zones. This study is intended for assessing areas in Metro Manila that are most prone to fire risk.

Keywords : DBSCAN, clustering, Jaccard similarity, MinHash LSH, fires
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