A Gaussian Mixture Model Approach for Open Cluster Membership with Gaia DR3

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Open Clusters are often regarded as a laboratory for stellar evolution; stars in these clusters have similar ages and metallicities, like their age and metallicities. The simplest way to find an Open Cluster is by looking for star overdensities in the night sky, supplemented with a color-magnitude diagram. This study aims to determine accurate membership probabilities, analyze proper motions, and constrain the cluster's age and its metallicity. We used photometric data from Gaia DR3 to determine the membership of Open Clusters. A variety of machine learning models can be used; we applied the Gaussian Mixture Model (GMM). We have applied this model to 8 Open Clusters (OCs), with varying ages (log age 7.555 to 8.91) and distances (275.5 parsec to 7004 parsec), and compared our results for these clusters for different methods, and investigated the efficiency of this model for identifying the member stars in the cluster. The refined parameters will aid in understanding the early dynamical evolution of nearby clusters and calibrating stellar models. These results contribute to broader efforts in mapping the local Galactic environment and can be extended to other young clusters.