T08b Galaxy Group Finding via Unsupervised Clustering

Hai-Xia MA (1), Tsutomu T. TAKEUCHI (1, 2), Suchetha COORAY (1)
(1) Nagoya University; (2) Institute for Statistical Mathematics

Galaxy groups are collections of galaxies comprising about a few to a hundred gravitationally bounded members. Galaxy groups tend to have chaotic structures. This makes it difficult to determine if galaxies in their region of the sky are gravitationally connected to the group. Cross-sectional studies have suggested an association between unsupervised machine learning, especially clustering algorithm, and identifying galaxy groups. In this work, we made use of six clustering algorithms to test their performance on finding galaxy groups from the galaxy catalogs (De Lucia & Blaizot 2007) built from the Millennium Simulation (Springel et al. 2005). We defined purity and completeness to optimize the values of hyperparameters of each algorithm, and evaluate how close they have predicted for the group members comparing to the real halo members. Of these six algorithms, the well-known hierarchical clustering algorithm, Ordering Points to Identify the Clustering Structure (OPTICS), most consistently balances purity rate completeness, even with a high fraction of identified groups which are exactly the same as given in simulated catalog. We conclude that OPTICS is a robust group finder that is effective at determining a wide range of group shapes and sizes with minimal contamination. We anticipate conducting OPTICS on observed galaxy catalogs to construct galaxy groups that may be more reliable than we could get from traditional methods such as Friends-of-friends.