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Machine learning-based photometric classification of galaxies, quasars and stars

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The vastness of astronomical datasets and the intricate nature of celestial objects create a pressing demand for robust classification techniques. Machine learning emerges as a powerful solution in this context, capable of discerning complex patterns and classifications. The work we will present delves into the application of machine learning techniques for classifying astronomical sources based on photometric data, including normal and emission line galaxies, quasars, and stars. Our analysis is grounded in datasets from the Sloan Digital Sky Survey (SDSS) Data Release 18 (DR18), encompassing approximately 100.000 patterns. We will present a comprehensive investigation, evaluating various classification models such as Random Forest (RF), XGBoost (XGB), Support Vector Machine (SVM), and k-Nearest Neighbors (KNN).
Our approach involves an in-depth analysis of the metrics used and a meticulous feature selection process aimed at optimizing figures of merit, particularly mean class accuracy. We explore different classification strategies such as one-vs-one and one-vs-all. Furthermore, to reduce the risk of overfitting or under-utilization of data, k-fold cross-validation is performed. The various configurations explored yield promising results.

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