MINING THE SDSS ARCHIVE. I. PHOTOMETRIC REDSHIFTS IN THE NEARBY UNIVERSE

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ABSTRACT

We present a supervised neural network approach to the determination of photometric redshifts. The method was fine-tuned to match the characteristics of the Sloan Digital Sky Survey, and as case of ''a priori'' knowledge, it exploits the rich wealth of spectroscopic redshifts provided by this survey. In order to train, validate, and test the networks, we used two galaxy samples drawn from the SDSS spectroscopic data set, namely, the general galaxy sample (GG) and the luminous red galaxy subsample (LRG). The method consists of a two-step approach. In the first step, objects are classified as nearby ($z < 0:25$) and distant ($0:25 < z < 0:50$), with an accuracy estimated as 97.52%. In the second step, two different networks are separately trained on objects belonging to the two redshift ranges. Using a standard multilayer perceptron operated in a Bayesian framework, the optimal architectures were found to require one hidden layer of 24 (24) and 24 (25) neurons for the GG (LRG) sample. The final results on the GG data set give a robust $\Delta\sigma$ ca0.0208 over the redshift range $z[0:01; 0:48]$ and $\Delta\sigma$ ca $0:0197$ and 0.0238 for the nearby and distant samples, respectively. For the LRG subsample we find instead a robust $\Delta\sigma$ $0:0164$ over the whole range, and $\Delta\sigma\,\chi\alpha$ $0:0160$ and $\Delta\sigma$ 0.0183 for the nearby and distant samples, respectively. After training, the networks have been applied to all objects in the SDSS table GALAXY matching the same selection criteria adopted to build the base of knowledge, and photometric redshifts for circa 30 million galaxies having $z < 0:5$ were derived. A catalog containing redshifts for the LRG subsample was also produced.