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CONVOLUTION NEURAL NETWORK TO CHARACTERIZE THE VOIGT PROFILE OF THE LYMAN-ALPHA FOREST ABSORBERS

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Numerous cosmological studies including the equation of state of the Intergalactic medium (IGM) can be well studied using the Lyman-alpha (Lyα) forest. This work aims to develop a machine learning (ML) algorithm to analyze the absorption lines in the Lyα forest. This involves a two-part process: (i) a classification algorithm based on a Deep Neural Network to predict the number of Voigt profiles in a given section of the Lyα forest, and (ii) an ML algorithm based on a Convolutional Neural Network to predict the physical parameters of the Lyα absorption systems, such as Doppler width (b), H I column density (NH I), and absorption redshift. To achieve this, we have simulated the Voigt profiles and forward-modelled them to have similar properties to the real data such as adding realistic noise and convolving with the line spread functions of the Hubble space telescope (HST) spectrograph. This allows us to test the performance of our ML algorithms on real data. The technique recovers excellent estimates of NH I and b when tested on a held-back validation set. We tested the algorithms on the low-redshift quasar data observed from HST and compared the predicted values with values estimated using semi-automated codes and manual fitting. Our results demonstrate that ML can significantly increase the efficiency of analyzing the Lyα spectra and therefore improve the studies of the IGM.