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Artificial neural network classification of the Fermi-LAT catalog blazars of unknown type and unidentified sources

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The *Fermi*-LAT detected more than 7000 γ-ray sources in 14 years of operation which are collected in 4FGL-DR4 catalog. About a third of these sources are still unassociated with counterparts in other wavelengths and approximately one-fifth are associated with blazar of unknown type, but their classification as either BL Lac type blazars (BLL) or Flat Spectrum Radio Quasars (FSRQ) is still unclear. Among the sources in 4FGL-DR4 catalog, most have incomplete spectra. For the classification of the 4FGL-DR4 catalog unidentified sources (UID) and blazars of unknown type (BCU) we developed a machine learning method that uses an artificial neural network (ANN) trained with multi-wavelength data. To mitigate the issue of the incomplete spectra, which reduce the ANN's classification power, we developed a method to fit the spectra of the sources and use the reconstructed spectra in the ANN. We used this method to classify BCUs as BLL or FSRQ. Then we implemented another ANN to find a possible multi-wavelength counterpart for every *Fermi*-LAT unidentified γ-ray sources and to classify them as possible Blazar or Not-Blazar sources.

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