# Classifying Blazar Candidates of Uncertain type in the fourth Fermi-LAT catalog by machine learning techinques

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In the Fermi-LAT Fourth Source Catalogue (3FGL) about 50% of the sources have no clear association with a likely -ray emitter. We use machine learning techinque aimed at distinguishing BL Lacs from FSRQs to investigate the source subclass of uncertain (BCU) or unassociated ( UCS) sources characterised by -ray properties very similar to those of Active Galactic Nuclei.

This work is a follow up of previous papers : https://arxiv.org/abs/1607.07822 , https://arxiv.org/abs/1705.09832, https://arxiv.org/abs/1808.05881, https://arxiv.org/abs/1602.00385  and will use the 2019 optimization of the original algorithm as described in : Optimizing neural network techniques in classifyingFermi-LAT-ray sources.

The result of this study will suggest a new zoo for 4FGL -ray objects, opening up new considerations on the population of the -ray sky, and it will facilitating the planning of significant samples for rigorous analyses and multiwavelength observational campaigns.

## 4FGL BCUs Classification

| Class | 1FGL | 2FGL | 3FGL | 4FGL |
|---|---|---|---|---|
| BL Lac | 295 (44%) | 436 (41%) | 660 (38%) | 1116 (36%) |
| FSRQ | 278 (42%) | 370 (35%) | 484 (28%) | 686(22%) |
| BCU | 92 (14%) | 257 (24%) | 573 (34%) | 1329(42%) |
| Total | 665 | 1063 | 1717 | 3131 |

Table 1. Blazar class distribution in Fermi-LAT catalogs.

Classifying  BCUs, using a supervised machine learning method based on an artificial neural  network, **probabilities for each  of 1329 uncertain blazars to be a BL Lac or FSRQ are obtained**.

Using 90% precision metric, **801 can be classified as BL Lacs and 406 as FSRQs while 122 still remain unclassified.**

Here the full list  4FGL BCUs_ANN_table.txt

A spectrometric optical observation campaign will be organized to confirm the data resulting from the neural algorithm.