Classifying Charged Current Neutrino Events using Machine Learning in the MINERvA Experiment

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Neutrinos are by far the second most abundant particles in the universe. About 100 trillion neutrinos pass through our body every second and we don't even realize it. The reason behind this ghostly presence is that they are chargeless and their mass is negligible. These unique features enable them to play an important role in the universe. Physicists believe that studying neutrinos may give us a better insight to still unanswered questions like the matter-anitimatter imbalance. But before answering such questions and understanding the role of neutrinos in the universe, we need to understand how they interact with matters; and MINERvA is one such attempt. It's an experiment in Fermilab which is being conducted to precisely characterize different types of neutrino interactions, and to study the physical processes that govern these interactions. Studying those interaction directly is not possible and hence we study the final state particles produced after such interaction instead, and try to understand the interactions from the information inferred from the particles. The experimental observations only give us information about the energy deposited by the particles while they travel through the detectors, but we need to know the type of particles in order to understand the interaction. In our approach, the gap between the two is bridged using Machine Learning (ML). We try some state of the art ML algorithms which have been proven to perform well in similar problems from other fields, and see how they perform in the problem at hand.