Machine Learning for DUNE Supernova Trigger
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Introduction & DUNE Background

• DUNE will consist of the world’s most intense neutrino beam, which will be located at Fermilab, as well as two detectors: a near detector (at Fermilab) and a far detector (at SURF, South Dakota)
• DUNE will use Liquid Argon Time Projection Chambers (LArTPCs) to detect neutrino interactions
• In LArTPCs, particle interactions ionize the LAr medium. An electric field is applied between the plates such that the ionization electrons drift towards the collection plane
• One of the major scientific goals of DUNE is to detect and measure the neutrino flux from galactic core-collapse supernovae

Detected Supernova Neutrinos

• 99% of the gravitational binding energy of core-collapse supernovae is carried away by neutrinos
• Galactic supernovae are expected to occur once every few decades. Neutrinos from a core-collapse supernova have been observed once before, with SN 1987a
• DUNE detectors require a trigger to signal when supernova neutrino events occur
• Goal of this work is to build the machine learning pipeline that will train the trigger algorithm

Ingredients for Machine Learning

• Neutrino interactions in LArTPC detectors can be characterized as “shower-like” or “track-like,” depending on the flavor of neutrino that caused the interaction
• This project aims to generate images of supernova neutrino interactions simulated by the Model of Argon Reaction Low Energy Yields (MARLEY) event generator for use in machine learning
• Ground truth images are generated by cropping by a certain window size around pixel with the highest ADC count

Putting It All Together: Pipeline

1. Simulate neutrino interactions
2. Convert events to images, and generate ground truth images
3. Sparse convolutional neural network classifies image pixels
4. Observe performance of sparse CNN

Conclusion & Future Work

• Generating ground truth images is a step towards establishing the machine learning pipeline
• Future work will continue towards the goal of building a supernova neutrino trigger for DUNE using machine learning

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