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Neutrino Event Classification with Deep Learning in NOvA

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Deep learning has aided the NOvA experiment in selection of NuMI beam neutrino events. Low statistics makes enhancements in signal efficiency especially critical to the success of the NOvA analysis. Use of convolutional neural networks (CNNs) for event and particle identification has led to significant gains in signal efficiency for neutrino event selection while also reducing the complexity of the reconstruction chain. Convolutional Visual Network (CVN) was introduced in 2016 as the class of methods and CNN architectures used for solving image recognition tasks in NOvA. Initial adoption of CNNs increased effective exposure by 30%, while optimizing training sample composition led to a 14% improvement in efficiency. Despite these advances, numerous avenues remain that show potential to increase signal efficiency. Recent efforts to improve the performance of CVN are summarized in this talk. Among these efforts, residual learning has shown the most promise for enhancing the purity and efficiency of neutrino event selection in the NOvA far detector. Large-scale hyperparameter optimization of existing CVN models is another tool for improving classifier performance despite presenting new computational challenges. Models are trained and evaluated using Monte Carlo samples of the NOvA Far Detector and results and insight from experiments with residual learning and hyperparameter optimization are shown.

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