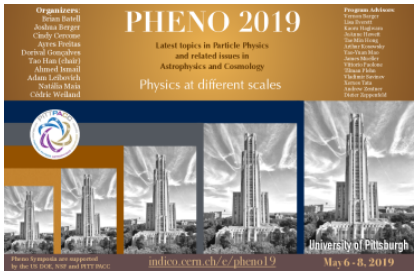

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Machine learning in event selection: Improving the supervisory signal and output usage

Tuesday 7 May 2019 14:15 (15 minutes)

Recently machine learning methods like artificial neural networks and boosted decision trees are being used with great success in the task of event selection in collider physics data analysis, in order to improve the significance of a potential excess or the precision of a parameter measurement. But traditional classification cost functions used for training these ANNs aren't geared directly towards optimizing the quality of the analysis, and only indirectly attack the problem via the heuristic "signal is better than background". This disconnect between traditional classification goal and the goals of HEP event selection is mitigated somewhat by heuristics like choosing appropriate "working points".

In this work, we demonstrate how the output of neural networks, taken as a proxy for likelihood that an event is from the signal distribution, can be used to construct "optimal" event selectors and categorizers to maximize the expected significance of an excess. We also demonstrate the shortcomings of the "signal is better than background" heuristic (0/1 supervisory signal) for the purpose of parameter measurement, and introduce a new supervisory signal for training ANNs based on event reweighting techniques. The output from networks trained this way can again be used to construct optimal event selectors and categorizers to minimize the expected measurement uncertainty.

Summary

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