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Interpretable ML for CLAS12 data analysis: adaptation of Generalized Additive Models

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The Generalized Parton Distributions (GPDs) describe the correlations between the transverse position and the longitudinal momentum of the partons (i.e. quarks and gluons) inside the nucleon. They can be extracted from exclusive inelastic processes, i.e. processes with a fully characterized final state. In the Hall B of the Jefferson Laboratory, the CLAS12 collaboration probes the inner structure of the proton by colliding 11 GeV electrons into a fixed proton target. Among the exclusive inelastic processes that are produced, we focus on the Deeply Virtual Compton Scattering (DVCS) in which the collided proton emits a high-energy photon. The objective is to be able to isolate these events in CLAS12 data, and notably separate the DVCS from mimicking exclusive Pi0 production events since Pi0 decays instantly into two photons.

We propose to use interpretable machine learning algorithms to perform event classification in CLAS12 data. Interpretable or transparent algorithms are preferred for the sake of trust or for further understanding the patterns in the data. Currently, Generalized Additive (Squared) Models (GAM and GA2M) are gaining interest in other application domains because of their ability to fit the data well while at the same being intelligible.

In this talk, we propose to introduce the GAM/GA2M and our improved versions better suited to our particular event classification task. We focus in particular on how to incorporate prior physics knowledge by building high-level variables that are the most relevant to the task and using assumptions on their distributions.

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