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A Comparison of Machine Learning Techniques for Multi Variate Unfolding

The hadron-in-jet observable has been proposed as a useful tool to study a number of physics quantities such as fragmentation functions and quark transversity. In particular, in high energy proton-proton collisions, hadrons-in-jets may provide improved constraints on gluon fragmentation functions, since a gluon is often one of the hard scattered partons in these interactions.

STAR (The Solenoidal Tracker at RHIC) is well equipped to carry out these measurements. STAR reconstructs full jets using energy deposits from the electromagnetic calorimeters, and charged particle tracks from the time projection chamber (TPC). Subsequently, STAR can identify these particles within jets with the TPC and time-of-flight detector.

Challenges to the measurement include correcting the kinematics for the effects of momentum resolution and tracking efficiency, where data become skewed due to the imperfect nature of the detectors. For observables like hadrons in jets, it is necessary to apply such corrections for multiple kinematic quantities, for example, jet momentum and pion momentum. However, traditional unfolding tools are difficult to use for this purpose. This poster investigates modern machine learning methods for correcting multiple kinematic quantities, simultaneously, event-by-event. We use Monte Carlo simulations to train several machine learning packages, such as TMVA in Root, and Keras and XGBoost in Python, and discuss their various advantages and disadvantages.