

Variable Importance Ranking in the CMS Search for pp to $t\bar{t}t$ in the Single Lepton Final State at a Center-of-Mass Energy of 13 TeV

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Variable Importance is a variable ranking framework that uses machine learning methods, such as neural networks, to construct a quantitative metric for characterizing a variable's discriminatory power in binary classification problems. The Variable Importance framework is presented in the context of the CMS search for the rare Standard Model process of three top quark production to the single lepton final state. The importance metrics for a set of 76 multivariate variables describing a 13 TeV proton-proton collision are determined, and a neural network discriminator is trained for a subset of the ranked variables which will be used in a likelihood analysis. The Variable Importance framework includes hyper parameter optimization and k-fold cross validation training when constructing the final discriminator. Preliminary results for the expected three top signal and cross section using 101 fb^{-1} of simulated Monte Carlo samples using the Run 2 CMS detector is shown. Additionally, a study on Variable Importance's predictive power of the expected significance using a cumulative importance metric is shown to further validate the accuracy of Variable Importance's quantitative ranking.

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