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Using a Neural Network to Approximate the Negative Log Likelihood Function

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An increasingly frequent challenge faced in HEP data analysis is to characterize the agreement between a prediction that depends on a dozen or more model parameters-such as predictions coming from an effective field theory (EFT) framework-and the observed data. Traditionally, such characterizations take the form of a negative log likelihood (NLL) distribution, which can only be evaluated numerically. The lack of a closed-form description of the NLL function makes it difficult to convey results of the statistical analysis. Typical results are limited to extracting "best fit" values of the model parameters and 1-D intervals or 2-D contours extracted from scanning the higher dimensional parameter space. It is desirable to explore these high-dimensional model parameter spaces in more sophisticated ways. One option for overcoming this challenge is to use a neural network to approximate the NLL function. This approach has the advantage of being continuous and differentiable by construction, which are essential properties for an NLL function and may also provide useful handles in exploring the NLL as a function of the model parameters. In this talk, we demonstrate the application of this technique to an analysis involving a search for new physics in the top quark sector within the framework of effective field theory. We also touch on options for distributing this likelihood function in a portable fashion.

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