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GPU Implementation of Bayesian Neural Networks in SUSY Studies

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The search for new physics has typically been guided by theoretical models with relatively few parameters. However, recently, more general models, such as the 19-parameter phenomenological minimal supersymmetric standard model (pMSSM), have been used to interpret data at the Large Hadron Collider. Unfortunately, due to the complexity of the calculations, the predictions of these models are available at a discrete set of parameter points, which makes the use of analysis techniques that require smooth maps between the parameters and a given prediction problematic. It would be useful, therefore, to have a computationally routine way to construct such mappings. We propose to construct the mappings using Bayesian neural networks (BNN). Bayesian neural networks have been used in a few high-profile analyses in high energy physics for both classification and functional approximation. The main limitation to their widespread use is the time required to construct these functions. In this talk, we describe an efficient Graphical Processing Unit (GPU) implementation of the construction of BNNs using the Hybrid Markov-Chain Monte Carlo (MCMC) method. We describe our implementation of the MCMC algorithm on the GPU, including the speedups we have achieved so far and illustrate the effectiveness of our implementation by mapping the pMSSM parameter space to some of its key predictions.

Summary

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