Automatic signal-background decomposition of multidimensional data

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Thanks to the commodification of techniques like automatic differentiation [1] and probabilistic programming [2], data scientists are successfully fitting increasingly complex models to very large datasets. These same tools can be leveraged for the analysis of physics experiments. In this talk I will demonstrate the use of a generic, nonparametric background model in the form of a Markov Random Field with applications for denoising, probabilistic interpolation of gaps in data coverage, and fitting of a signal model directly to a high-dimensional dataset without making cuts or projections, including in the presence of spurions and other background features. The focus is on practical methods that can be immediately employed by non-expert users for rapid analysis of their experiments. I will show applications to time-of-flight neutron spectroscopy but the technique is general and can be adapted to other data-intensive experimental techniques including light scattering and electron spectroscopy.

[1] Baydin et al. Automatic differentiation in machine learning: a survey. The Journal of Machine Learning Research. 18(153): 1-43, 2018.

[2] Gordon et al. Probabilistic programming. In Future of Software Engineering, FOSE 2014, 167-181. ACM, 2014.