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Climate Program Opening Workshop
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Lecture: ***Deep Learning for Extreme Weather Detection***

Speaker: Prabhat

Abstract:

Extreme weather events pose great potential risk on ecosystem, infrastructure and human health. Analyzing extreme weather in the observed record (satellite, reanalysis products) and characterizing changes in extremes in simulations of future climate regimes is an important task. Thus far, extreme weather events have been typically specified by the community through hand-coded, multi-variate threshold conditions. Such criteria are usually subjective, and often there is little agreement in the community on the specific algorithm that should be used. We propose the use of a different approach: machine learning (and in particular deep learning) for solving this important problem. If human experts can provide spatio-temporal patches of a climate dataset, and associated labels, we can turn to a machine learning system to learn the underlying feature representation. The trained Machine Learning (ML) system can then be applied to novel datasets, thereby automating the pattern detection step. Summary statistics, such as location, intensity and frequency of such events can be easily computed as a post-process.

We will report compelling results from our investigations of Deep Learning for the tasks of classifying tropical cyclones, atmospheric rivers and weather front events. For all of these events, we observe 90-99% classification accuracy. We will also report on progress in localizing such events: namely drawing a bounding box (of the correct size and scale) around the weather pattern of interest. Both tasks currently utilize multi-layer convolutional networks in conjunction with hyper-parameter optimization. We utilize HPC systems at NERSC to perform the optimization across multiple nodes, and utilize highly-tuned libraries to utilize multiple cores on a single node. We will conclude with thoughts on the frontier of Deep Learning and the role of humans (vis-a-vis AI) in the scientific discovery process.