HAMLET
How to Apply Machine Learning to Experimental & Theoretical PHYSICS
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Keynote - Thea Aarrestad (ETH Zurich): AI at the Extreme Edge: Nanosecond inference for New Physics Discovery at the Large Hadron Collider

Tuesday 20 August 2024 09:10 (55 minutes)

At the CERN Large Hadron Collider (LHC), real-time event filtering systems must process millions of proton-proton collisions every second on field programmable gate arrays (FPGAs) and perform efficient reconstruction and decision making. Within a few microseconds, over 98% of the collision data must be discarded fast and accurately. As the LHC is upgraded to its high luminosity phase, HL-LHC, these systems must deal with an overwhelming data rate corresponding to 5% of the total internet traffic and will face unprecedented data complexity. In order to ensure data quality is maintained such that meaningful physics analyses can be performed, highly efficient ML algorithms are being utilised for data processing. This has necessitated the development of novel methods and tools for extremely high throughput, ultra low latency inference on specialised hardware.

In this talk, we will discuss how real-time ML is used to process and filter enormous amounts of data in order to improve physics acceptance. We will discuss state-of-the-art techniques for designing and deploying ultrafast ML algorithms on FPGA and ASIC hardware. Finally, we will explore applications of real-time inference in particle physics experiments and discuss how anomaly detection can be used to discover New Physics.

Session Classification: Plenaries & Keynotes