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A sample Algorithm Processing Unit implementation with the deployment of the deep neural network model for the Global Event Processor trigger subsystem for HL_LHC Upgrade at ATLAS

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During the next update of the High-Luminosity Large Hadron Collider (HL-LHC) of ATLAS, a new global trigger subsystem will be installed into the L0 Trigger. New and improved hardware and algorithms will be deployed during the upgrade to increase the performance of the trigger system. The global trigger subsystem consists of various components, including the FPGA-based Global Event Processor (GEP), which processes the data through the trigger algorithm. Within the GEP, data will be pipelining through different Algorithm Processing Units (APU), which handle individual subtasks of the overall trigger. We present our work in creating an APU specification and sample APU as a guide to future APU developers. We also present a redesign of the APU interface to follow the AXI-stream protocol, which allows streaming computations that overlap operations at multiple pipeline levels, potentially improving overall throughput. Finally, we present our work deploying HLS4ML (high-level synthesis for machine learning) into the APU development. HLS4ML is a design tool for generating a deep neural network (DNN) algorithm model with ultra-low delays, and has been developed specifically to support the needs of high-energy physics experiments. Our goal is to demonstrate that the application of HLS4ML to APU development is practical, and we have already implemented a convolution neural network (CNN) model for the APU. The performance of the CNN APU is tested using a test vehicle and a sandbox provided by the ATLAS developers. The next step is developing another new algorithm using a deep neural network.

In-person or Virtual?

In-person

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