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EXPAND Mentor

Hls4ml Machine Learning on FPGAs Webcam Demo

Javier Duarte/Duarte Lab (06/2022)

What you will do

The project encompasses the classification of *Pókemon* cards using neural networks running on Field Programmable Gate Arrays (FPGAs) with the aid of the *hls4ml* tool. FPGAs are hardware allowing the acquisition of data at ultra-low latencies. At the Large Hadron Collider (LHC), proton-proton collisions occur at a rate of 40 million per second, corresponding to millions of gigabytes of data. These large volumes of data cannot simply be stored, so detectors like the Compact Muon Solenoid (CMS) rely on FPGA-based trigger algorithms to select and save data from proton-proton collision events for further analysis. Through these analyses, the High Energy Physics (HEP) community studies and discovers new particles, like the Higgs boson discovery in 2012. However, discovery may be limited because the earliest stages of the triggers are only designed to save data corresponding to particles with a set of specific features, potentially ruling out the detection of undiscovered particles predicted by many theories. Given recent advances in deploying efficient machine learning algorithms on hardware, we have the opportunity to design, implement, and deploy these algorithms on the FPGA-based trigger systems. This will result in the implementation of more intelligent triggers for particle detection, which will offer a window for the discovery of new particles. **Thus, by working on this project, you will have the opportunity to deploy your own machine learning model on FPGAs.** This is exactly similar to my work with the FPGA-based triggers, with the exception that your model will be developed based on data sets consisting of *Pókemon* images.

Skills you will acquire

- *Python* coding skills
- Familiarity with machine learning concepts and applications
- Science communication
- Professional development and networking