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Lightweight Jet Identification and Reconstruction as an Object Detection Task

In this contribution, we apply deep learning object detection techniques based on convolutional blocks to jet identification and reconstruction problem encountered at the CERN Large Hadron Collider. Particles reconstructed through the Particle Flow algorithm can be represented as an image composed of calorimeter and tracker cells as an input to a Single Shot Detection network. The algorithm, called PFJet-SSD is able to perform localization, classification and additional regression tasks to measure jet features in a single feed-forward pass. Besides this parallelization, we gain additional acceleration from network slimming, homogeneous quantization and optimized runtime for meeting memory and latency constraints. We compare the Ternary Weight Network (TWN) with weights constrained to $\{-1, 0, 1\}$ with per layer- and channel-dependent scaling factors to networks running with an 8-bit fixed point and a 32-bit floating-point precision. We show that the Ternary Weight Network closely matches the performance of its full-precision equivalent while all the variants of PFJet-SSD outperform the physics baseline. Finally, we report the inference latency on different hardware platforms and discuss future applications.

Significance

The proposed PFJet-SSD solution builds on the previously proposed Jet-SSD algorithm (in Reference). Besides multiple architectural changes (e.g. grouped convolutions, attention modules), PFJet-SSD tackles a more challenging dataset (with added pile-up). We introduce a physics baseline and present accuracy for multiple quantization setups. We compare inference latency estimates for multiple hardware platforms/runtimes. With these results, we are able to discuss the feasibility of the deployment of PFJet-SSD in the production system.

References

https://arxiv.org/abs/2105.05785

Speaker time zone

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