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Benchmark of Generative Adversarial Networks for Fast HEP Calorimeter Simulations

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Accurate simulations of elementary particles in High Energy Physics (HEP) detectors are fundamental to accurately reproduce and interpret the experimental results and to correctly reconstruct particle flows. Today, detector simulations typically rely on Monte Carlo-based methods which are extremely demanding in terms of computing resources. The need for simulated data at future experiments - like the ones that will run at the High Luminosity LHC (HL-LHC) - are expected to increase by orders of magnitude. This expectation motivates the research for alternative deep learning based simulation strategies.
In this research we speed up HEP detector simulations for the specific case of calorimeters using Generative Adversarial Networks with a huge factor of over 100 000x compared to the standard Monte Carlo simulations. This could only be achieved by designing smart convolutional 2D network architectures for generating 3D images representing the detector volume. Detailed physics evaluation shows an accuracy similar to the Monte Carlo simulation.
Furthermore, we quantized the data format for the neural network architecture (usually INT32) with the novel Intel Low Precision Optimization tool (LPOT) to a reduced precision (INT8) data format. This resulted in an additional 1.8x speed up on modern Intel hardware while maintaining the physics accuracy. These excellent results consolidate the beneficial use of GANs for future fast detector simulations.

Summary

I think the abstract fits best to 9. Big data Analytics and Machine learning

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