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Advancing the CMS Level-1 Trigger: Jet Tagging with DeepSets at the HL-LHC

At the Phase-2 Upgrade of the CMS Level-1 Trigger (L1T), particles will be reconstructed by linking charged particle tracks with clusters in the calorimeters and muon tracks from the muon station. The 200 pileup interactions will be mitigated using primary vertex reconstruction for charged particles and a weighting for neutral particles based on the distribution of energy in a small area. Jets will be reconstructed from these pileup-subtracted particles using a fast cone algorithm. For the first time at the CMS L1T, the particle constituents of jets will be available for jet tagging. In this work we present a new multi-class jet tagging neural network (NN). Targeting the L1T, the NN is a small DeepSets architecture, and trained with Quantization Aware Training. The model predicts the classes: light jet (uds), gluon, b, c, tau_h+, tau_h-, electron, muon. The model additionally predicts the pT of the object. The new model enhances the selection power of the L1T for important processes for CMS at the High Luminosity LHC such as di-Higgs and Higgs production via Vector Boson Fusion. We present the model including its performance at object tagging and deployment into the L1T FPGA processors, and showcase the improved trigger capabilities enabled by the new tagger.

AI keywords

multi-class jet tagging neural network; Quantization Aware Training; DeepSets architecture

Primary author: SPEAKER, CMS

Presenter: SPEAKER, CMS

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