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## Rapid ML inference in HEP using logic gate neural nets

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Fast machine learning (ML) inference is of great interest in the HEP community, especially in low-latency environments like triggering. Faster inference often unlocks the use of more complex ML models that improve physics performance, while also enhancing productivity and sustainability. Logic gate networks (LGNs) currently achieve some of the fastest inference times for standard image classification tasks. In contrast to traditional neural networks, each node consists of a learnable logic gate. While this is generally slow when training, inference allows for a network that is implicitly pruned and discretized. LGNs are excellent candidates for FPGA implementations as they consist of logic gates, but they are also suitable for GPUs. In this work, we present our implementation of logic gate convolutional neural nets. We apply them to open data for anomaly detection, similar to that used at the CMS Level-1 Trigger by the CICADA collaboration. We demonstrate that LGNs offer comparable physics performance to existing methods while promising a much faster inference speed. This opens the door to broader applications of LGNs in fast ML workflows across HEP.

### Significance

Logic gate neural nets have to our knowledge never been used in HEP, yet promises very fast inference

### References

This builds on work done by an external non-HEP group presented in <https://arxiv.org/pdf/2210.08277> and <https://arxiv.org/abs/2411.04732>

### Experiment context, if any

The talk will include CMS CICADA open data that they are aware we are using

**Author:** VAGE, Liv Helen (Princeton University (US))

**Co-authors:** KAUFFMAN, Elliott (Princeton University (US)); GERLACH, Lino Oscar (Princeton University (US))

**Presenter:** VAGE, Liv Helen (Princeton University (US))

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