ETH
Eidgenössische Technische Hochschule Zürich
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Distributed Computing

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Differentiable Logic Gate Networks with Classic Computer Vision Encoding

Machine learning models are often huge, which causes them to have high latency, low throughput, and high energy usage. In response to this, methods such as DiffLogic [1, 2, 3, 4], a logic-gate-based neural network architecture designed for FPGA acceleration (see in Figure 1), offer an efficient computational alternative.

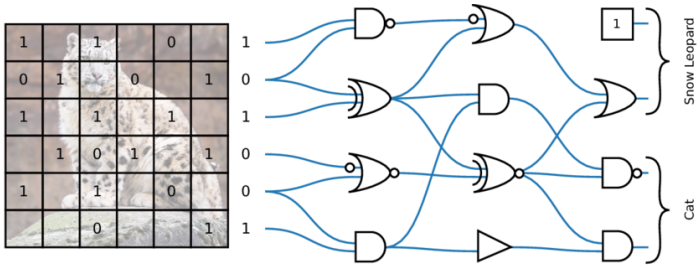

Figure 1: Overview of DiffLogic for image classification.

Existing work in the area of differentiable logic gate networks encodes the RGB pixels using a thermometer encoding (see [3] for details). This project seeks to explore whether the models would benefit from other encodings that maintain the benefits of the original models, namely, having low latency and high throughput.

The project will be done fully remote. We would have weekly meetings on Zoom to go over results, discuss open questions, and resolve any potential problems. You will have a lot of possibilities to shape the project in the directions you find the most interesting.

Requirements

Solid programming skills in Python and knowledge of machine learning evaluation are required.

Contact

In a few short sentences, please describe your interest in this project and any relevant coding experience or background (e.g., projects or coursework).

- Andreas Plesner: aplesner@ethz.ch, ETZ G95
- Till Aczel: taczel@ethz.ch, ETZ G60.1

References

[1] Simon Bührer et al. *Recurrent Deep Differentiable Logic Gate Networks*. Aug. 2025. DOI: 10.48550/arXiv.2508.06097. arXiv: 2508.06097.

[2] Felix Petersen et al. "Convolutional differentiable logic gate networks". In: *Advances in Neural Information Processing Systems* 37 (2024), pp. 121185–121203.

[3] Felix Petersen et al. "Deep differentiable logic gate networks". In: *Advances in Neural Information Processing Systems* 35 (2022), pp. 2006–2018.

[4] Lukas Rüttgers et al. *Light Differentiable Logic Gate Networks*. Sept. 2025. DOI: 10.48550/arXiv.2510.03250. arXiv: 2510.03250.