ETH
Eidgenössische Technische Hochschule Zürich
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Distributed Computing

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Solving Minesweeper with Differentiable Logic Gate Networks

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, 3, 4, 5], a logic-gate-based neural network architecture designed for FPGA acceleration (see in Figure 2), offer an efficient computational alternative.

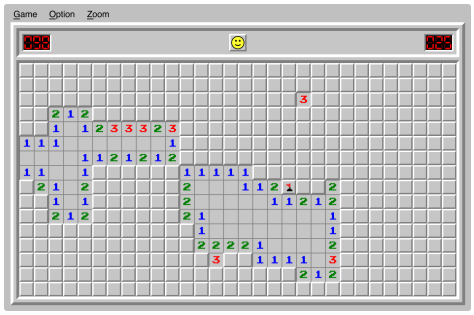

Figure 1: The classic Minesweeper logic game

Difflogic creates networks of Boolean logic functions, making them very computationally efficient for tasks such as image classification and language processing.

However, a natural and unexplored application of Difflogic is to domains that directly work with logic-based rules, such as logic puzzles.

The goal of this project is to apply Difflogic models to puzzle games, starting with Minesweeper, but then working towards solving as many puzzles as possible [2].

We will have weekly meetings on Zoom or in person 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. An interest in logic puzzles is beneficial.

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
- David Jenny: davjenny@ethz.ch, ETZ G95

References

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

[2] Benjamin Estermann et al. *PUZZLES: A Benchmark for Neural Algorithmic Reasoning*. 2024. arXiv: 2407.00401 [cs.LG]. URL: https://arxiv.org/abs/2407.00401.

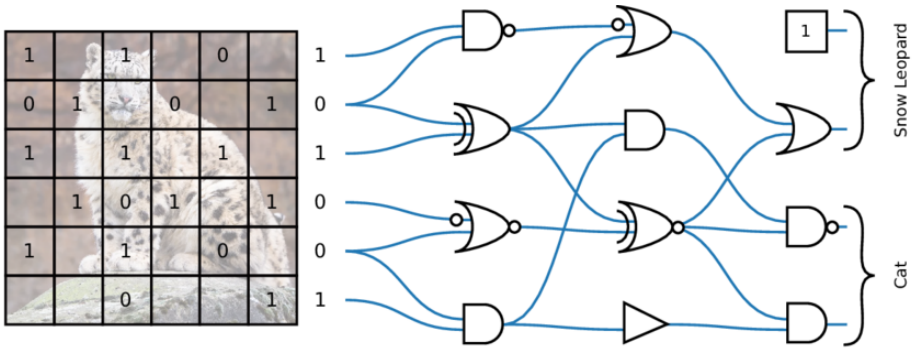

Figure 2: Overview of DiffLogic for image classification.

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

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

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