

## **Automated machine learning for neural network verification** König, H.M.T.

## Citation

König, H. M. T. (2025, October 9). *Automated machine learning for neural network verification*. Retrieved from https://hdl.handle.net/1887/4266921

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## **Propositions**

accompanying the dissertation

## Automated Machine Learning for Neural Network Verification

- 1. The state of the art in neural network verification is not defined by a single algorithm but by several algorithms with their own strengths and weaknesses. (Chapter 3)
- 2. Formal verification algorithms relying on mixed integer programming solvers are sensitive to the setting of their hyper-parameters and their performance can be greatly improved by leveraging automated configuration and portfolio construction techniques. (Chapter 4)
- 3. Verification problem instances cannot always be solved within a reasonable time budget but it is possible to reliably detect these cases early in the verification procedure. (Chapter 5)
- 4. During robust model selection, the likelihood of a given instance to be robust or non-robust can be estimated to guide the search towards neural network models that are most likely to show the highest adversarial robustness. (Chapter 6)
- 5. In theory, formal verification can provide rigorous safety guarantees for neural network models that go well beyond empirical evaluation.
- 6. Formal verification still remains computationally challenging and, therefore, difficult to scale to larger models or data sets.
- 7. Most research considers robustness properties that do not capture realistic perturbations, which might be hard to encode.
- 8. The most scalable verification algorithms rely on an approximation, which typically has a negative impact on precision.
- 9. Neural networks are powerful, but brittle learners.
- 10. The capabilities of AI systems are often overstated, which offers a great risk to the reputation of the field.

H.M.T. König Leiden, 9<sup>th</sup> of October, 2025