

# Verification of Binarized Neural Networks using alpha-beta-CROWN and Marabou

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# Overview

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# Introduction

- ▶ Motivation
  - ▶ Improving verification rates of benchmark
- ▶ Problem specification
  - ▶ Self-driving
  - ▶ Neural networks tool verifiers versus real life testing

## Dataset description



Figure: Some images used in the German Traffic Signs Recognition Benchmark

## Dataset description

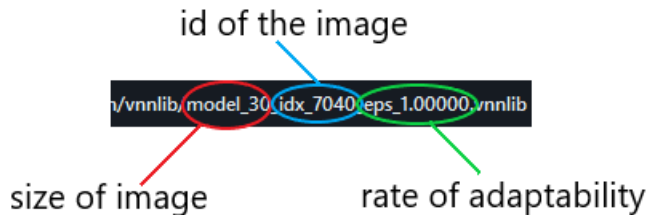


Figure: Properties file used for verification

## ► alpha-beta-CROWN

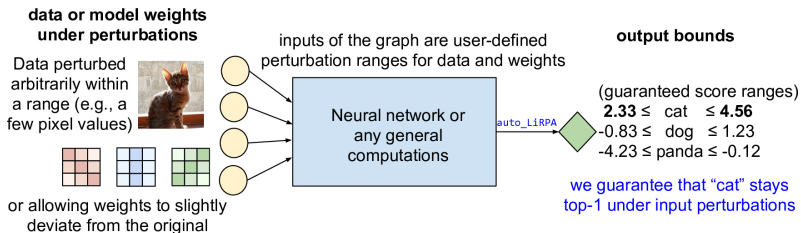


Figure: Rough explanation of efficient linear bound propagation

# Tools

► Marabou

## Experimental Results

#	Tool	Verified	Falsified	Penalty
1	alpha-beta-CROWN	0	39	3
2	Marabou	-	-	-
3	Nnenum	0	0	46



# Conclusion

- ▶ Possibility of verification improvement exists.
- ▶ Image verification is hard!

- ▶ alpha-beta-CROWN

<https://www.youtube.com/watch?v=cXHRKEpAh78>

- ▶ Marabou & Nnenum

<https://www.youtube.com/watch?v=YZIZdvPJcC8>