WEST UNIVERSITY OF TIMIŞOARA
FACULTY OF MATHEMATICS AND COMPUTER SCIENCE
MASTER STUDY PROGRAM: SOFTWARE ENGINEERING

Verification of Neural Networks

Supervisor:
Mădălina Erașcu

Students:
Amalia Duma Diana
Răzvan Maciovan Alexandru
Luca Mitroi
Vlad Petcu
Vlad Țîrcomnicu

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Chapter 1

Introduction

The assignments for this project, required the usage of one benchmark and two tools for which to analyze upon. For the purpose of our project, we have decided to utilize the ACASXU benchmark[1], along with the tools Alpha Beta Crown[2] and Marabou [3]

1.1 Acasxu

Acas stands for Airborne Collision Avoidance System. There are multiple types of Acas benchmarks, but the one this paper is based on is Xu, which is optimized for unmanned aircraft systems (UAS), issuing turn rate advisories to remote pilots[Katz et al., 2017]. The installation process for the benchmark was easy, only needing to download it from GitHub[1]. The files are divided into 3 components as followed:

Onnx

These files contain the neural network models encoded in the Open Neural Network Exchange (ONNX) format[ONNX Contributors, 2023]. They collectively are the core architecture for the "brain" of the benchmark, which dictates the verification and evaluation steps.

Vnnlib

These files contain specifications and properties that need to be verified or analyzed for the neural network models (ONNX). They contain a similar syntax to that of z3 smt-solvers.

[1] https://github.com/ChristopherBrix/vnncomp2023_benchmarks/tree/main/benchmarks/acasxu

[2] https://github.com/Verified-Intelligence/alpha-beta-CROWN

[3] https://github.com/NeuralNetworkVerification/Marabou

Instances.csv

This CSV file bundles the onnx and vnnlib files into groups, where vnnlib files are associated with onnx ones. There are 10 vnnlib files and 45 onnx files, and they are combined to form a total of 186 combinations. Each combination also has metadata containing how long can the selected tool run one specific combination.

Bibliography

[Katz et al., 2017] Katz, G., Barrett, C., Dill, D. L., Julian, K., and Kochenderfer, M. J. (2017). Reluplex: An efficient smt solver for verifying deep neural networks. In *Computer Aided Verification: 29th International Conference, CAV 2017, Heidelberg, Germany, July 24-28, 2017, Proceedings, Part I 30*, pages 97–117. Springer.

[ONNX Contributors, 2023] ONNX Contributors (Accessed: 2023). Open Neural Network Exchange (ONNX). `https://onnx.ai/`.