Synthesis Benchmarks for Matrix Multiplication

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Abstract—We present benchmarks for matrix multiplication. We let the environment provide matrices and expect the controller to correctly perform multiplication on them.

I. Introduction

The original AIGER format [1] is a safety property specification used for model checking. Its extended version was introduced in 2014 by Jacobs [2] to represent safety objectives for controller synthesis. It was first used in the Synthesis Competition 2014, a satellite event of the 26th International Conference on Computer Aided Verification 2014.

The AIGER files describe synchronous circuit, with inputs that are partitionned between the controllable and uncontrollable ones, and one output that signal an error. The goal of synthesis is to control the controllable inputs, so that the error output is never set to true.

Matrix multiplication is a basic operation which has many applications in mathematics, physics, and engineering. Implementing this operation with a logical circuit of small size is important to produce hardware at small cost.

II. Static multiplication

In the first set of benchmarks, the goal is to obtain a circuit that provides a correct implementation of Boolean matrix multiplication. We consider the set of Booleans $\mathbb{B} = \{0, 1\}$ and multiplication of matrices in the Boolean ring $\langle \mathbb{B}, \vee, \wedge, 0, 1 \rangle$. Formally, inputs provide matrices $A \in \mathbb{B}^{m \times n}$, $B \in \mathbb{B}^{n \times o}$, and $C \in \mathbb{B}^{m \times o}$, with the inputs for C being controllable. The controllers has to perform a correct multiplication, that is at each step the circuits checks that $A \cdot B = C$. The error output is set to true if $A \cdot B \neq C$.

In the benchmark package, the AIGER file `mult_bool_matrix_m_n_o.aag` encodes the mutiplication of a matrice A of dimension $m \times n$ and a matrice B of dimension $n \times o$.

The AIGER files for these benchmarks have been generated from an OCaml program that can be downloaded from the following address: https://github.com/romainbrenguier/Speculoos.

References

[1] A. Biere. Aiger format and toolbox. [Online]. Available: http://fmv.jku.at/aiger/

[2] S. Jacobs. (2014, February) Extended aiger format for synthesis (v0.1). [Online]. Available: http://www.syntcomp.org/wp-content/uploads/2014/02/Format.pdf