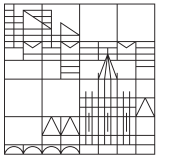
Universität Konstanz



# Minimization of Weighted Automata

**Fabian Klopfer**

Modelling of Complex Self-Organizing Systems Group, 12.06.2020

# Introduction

In the last presentation . . .

- two models for stochastic dynamical systems were considered:
  Weighted Automata (WA) and Differential Equations (DE)

- an example for modelling a CRN's dynamics in both models was given:
  DE Solving Chemical Master Equation
  WA Monte Carlo CTMC

# Goals specified

1. Implement minimization algorithm for weighted automata [1]. ✓
2. Implement model reduction algorithm for ODEs [2].
3. Develop reproducible benchmarks
4. Write report including

# What has been done so far

- Software Requirement Specification & Software Design Document
- Random Basis Minimal WA Construction Algorithm by Kiefer/Schützenberger [1]
- Execution of example by Matlab script and hand
- Implementation of minimization & equivalence algorithm, interfaces, TUI, CLI, tests

# The Weighted Automaton Minimization Algorithm

Weighted Automaton $A = (n, \Sigma, \alpha, \mu, \eta)$, where

- $n$ the number of states
- $\Sigma$ the input alphabet
- $\alpha$ the initial vector with a non-zero value for all starting states
- $\mu$ the set of transition matrices, one per input character

Intuition:

1. Generate |states| many random matrices $r_i$ with $|\Sigma|$ rows and |states| columns with values between 1 and , $r$

# The Weighted Automaton Minimization Algorithm: Pseudo Code

b

# The Weighted Automaton Minimization Algorithm: Example

c

# Implementation Details

d

# Up Next

e

# Bibliography


- S. Kiefer, A. S. Murawski, J. Ouaknine, B. Wachter, and J. Worrell, "On the complexity of equivalence and minimisation for q-weighted automata", *Logical Methods in Computer Science*, vol. 9, 2013.
- L. Cardelli, M. Tribastone, M. Tschaikowski, and A. Vandin, "Maximal aggregation of polynomial dynamical systems", *Proceedings of the National Academy of Sciences of the United States of America*, vol. 114 38, pp. 10 029–10 034, 2017.