Bayesian Parameter Inference of Markov Population Model.

Master Thesis

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Contents

Abstract

Chapter 1

Introduction

- Brief introduction to Markov Chain
- Brief introduction to parameterization or Markov Chains
- Applications of parameter synthesis problem.
- Description of thesis structure.

We study the parameter synthesis problem of parametric Discrete-Time Markov Chain. Markov Chain is a probabilistic model to formalize stochastic processes.

Parameter synthesis is a relatively new research area [**katoen2016probabilistic**]
This thesis is structured as follow.

- **Chapter 1** states the parameter synthesis problem and its applications.
- **Chapter 2** describes the most important definitions and theoretical background. In this chapter, we defines Discrete-Time Markov Chain formally. A brief introduction to Bayesian Inference is also included.
- **Chapter 3** reviews the state-of-the-art works of other researchers on the problem of parameter synthesis.
- **Chapter 4** describes the method.
- **Chapter 5** describes the benchmark.
- **Chapter 6** conclusion and future work.

Chapter 2

Preliminaries

- transition system
- markov property
- discrete-time markov chain and parametric dtmc
- continuous-time markov chain
- bayesian inference
- metropolis-hastings algorithm

2.1 Discrete-Time Markov Chain

2.2 Probabilistic Model Checking

2.3 Bayesian Inference

2.3.1 Bayesian formula

2.3.2 Posterior conjugation

2.4 Metropolis-Hastings algorithm

2.5 Selection of prior distribution

The selection of prior distribution has strong effect on the result [what result specifically?] of a Bayesian inference [Citation needed].

Chapter 3

Literature review

- Probabilistic model checking: basic building blocks from Katoen and his fellas.
- Parameter synthesis: important papers and concepts
- Bayesian parameter synthesis: Polgreen paper
- Bayesian property checking: Jha paper
- Tools: mention PRISM and STORM

3.1 Probabilistic model checking

3.2 Parameter synthesis

3.3 Bayesian model checking

In the paper (Polgreen), the authors proposed an algorithm to decompose

In the paper (Jha) [], the authors proposed an algorithm to statistically check for (PB)LTL properties. The advantage of the algorithm is that The disadvantage of the algorithm is that it does

3.4 Tool