Formal Verification of Chemical Reaction Networks using Bayesian Inference*

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Abstract. We present a data-driven verification approach that determines whether or not the underlying biological system satisfies a given property, expressed as a formula in a probabilistic temporal logic. Our approach consists of three phases, integrating formal verification over models with learning from data. Firstly, we consider a set of possible models, and classify them against the property of interest. Secondly, we utilise Bayesian inference techniques to obtain a probability distribution over the model class from system data. In the third and final step, we combine the results of both steps to compute the probability that the underlying system satisfies the property. We apply our approach on a given case study and compare to standard statistical model checking. Depending on the value of this probability, this influences a decision on whether to collect more data or to refine the model in order to describe the underlying system with the highest degree of accuracy.

Keywords: CRN · Formal Verification · Bayesian Inference · data driven modelling · Systems Biology · Synthetic Biology

* Supported by University of Oxford, EPSRC and BBSRC for Synthetic Biology..