

Hidden Markov Chains and their languages and logics

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Background

- Markov Processes are perhaps the most widely used class of stochastic models for the quantitative analysis of IT Systems.
- They come in many forms; examples include DTMCs and CTMCs which admit no nondeterminism, and MDPs and CTMDPs which do admit nondeterminism.
- Logics derived from Computation Tree Logic has proved useful as "query languages" for such models; examples include the logics PCTL and CSL as well as their extensions.
- A number of state-of-the-art stochastic model checkers are able to check whether a logical formula holds on a given model.

Hidden Markov Models

- A Hidden Markov Model is a stochastic model in which observations depend on a Markov Process that cannot be observed.
- They have many uses in applied statistics, speech recognition, bioinformatics, environmental processes, econometrics, image processing and computer vision, wind power forecasting, and has also been used in security.
- There has been much less focus on logics for Hidden Markov Models and indeed a study of the extent to which logics provide the appropriate “query language” for Hidden Markov Models.
- Hardly any “model checkers” for Hidden Markov Models exist.

Reading Material

- A text books on Hidden Markov Models: Zucchini, W. and I. MacDonald. 2009. Hidden Markov Models for Time Series. Chapman & Hall/CRC, London.
- A tutorial paper on Hidden Markov Models: Lawrence R. Rabiner: A tutorial on Hidden Markov Models and selected applications in Speech Recognition. Proceedings of the IEEE, 1989, pages 257-286.
- A paper on a logic for Hidden Markov Models: Lijun Zhang, Holger Hermanns, David N. Jansen: Logic and Model Checking for Hidden Markov Models. FORTE 2005: 98-112

The Purpose

- A main aim of this working group is to identify a small consortium that would be interested in developing logics, "query languages", and model checkers that would be able to deal with some of the applications of Hidden Markov Models.
- Hopefully this would lead to useful tools in much the same way that existing stochastic model checkers make the analysis of Markov Processes available to a wider audience than applied statisticians.
- What is your vision?
- How to proceed?