

Pathway Logic: Executable Models of Cellular Processes

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Abstract. Pathway Logic (PL) is a framework based on rewriting logic for developing and analysing executable models of cellular processes. The long term objective is better understanding of how cells work. Progress towards this goal involves curation of experimental knowledge, assembly of models to study a question of interest, visualisation, and analysis.

In this tutorial we will focus on signal transduction: how cells sense their external and internal environment and make decisions. We will begin with some background and describe the informal models and reasoning often used by biologists.

We will describe the PL representation of cellular signalling systems as Maude modules, and explain how knowledge is curated, including steps toward partial automation.

We will then introduce the Pathway Logic Assistant (PLA) a tool for interacting with PL knowledge bases. Using PLA one can search a knowledge base or assemble and visualise a model. Once a model is assembled one can explore its structure or ask questions such as ‘how can a given state be reached?’ (the answer is an execution pathway) or ‘what if I remove this or add that?’.

We will look under the hood of PLA to see how reflection is used to enable Maude to be part of an interactive system. Reflection is also used to manage multiple representations of the knowledge base and derived models for export/import to integrate with other tools and knowledge bases, for example graph drawing tools or special purpose model checkers.