Some New Developments in kP-Lingua (Extended Abstract)

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Abstract. In this short note we discuss a first step in extending kP-Lingua, the domain specific language allowing to define kernel P system, simulate them and verify their correctness through specific model checkers available in the software tool kPWorkbench. We focus here on defining indexed entities, such as rules, objects and compartments, as well as constant values.

Keywords: Membrane Systems · Kernel P Systems · Model Checking

Membrane computing is a bio-inspired computing paradigm introduced by Gh. Păun [5]. It uses models called *membrane systems* or *P systems*, which are inspired by the structure and functionality of the living cell. Membrane computing research has evolved very rapidly, consistently and covering both theoretical aspects and a significant number of applications, with numerous variants of membrane systems being proposed and investigated. A first research monograph was published two years after the field emerged [6] and then a comprehensive handbook [7] and a survey paper [8] appeared. Applications in systems and synthetic biology and real-life complex problems have also been investigated with this computing paradigm. [2, 9].

Amongst various types of membrane systems studied for different purposes, a new variant of membrane system, called *kernel P system* (*kP system*, for short) model has been introduced with the aim of providing a coherent computational framework where several features available in various membrane system variants can work together in a consistent and efficient manner [3]. These kP systems are specified in a domain specific language, called *kP-Lingua*, allowing models to be simulated with a software tool, called kPWorkbench [1]. The capabilities of the tool are presented in [4].

We investigate the possibility of extending the current kP-Lingua specification language. In the first instance, we consider a set of new features that provide additional flexibility, modularisation and reusability. Later on, the aim is to con-

nect kP-Lingua with other P systems, especially those P systems benefiting from software support tools, at least for simulation.

In this stage of developing kP-Ligua further with new additional features, the aim is to provide facilities for indexing different components of the language such as rules, objects, compartments and execution strategies. We also aim to allow the definition of constants and to insert (part of) existing models into newly build ones.

We illustrate below the use of indexed rules and constant values in a kP-Lingua fragment.

```
#define n = 3, m = 9

type In {
  max {
    a{i,d} -> a{i-1,d} . : 0 < i ≤ n, 0 ≤ d ≤ m
    a{0,d} -> a{d} (P) . : 0 ≤ d ≤ m
  }
}
type P {
}
```

The indexation of objects and components as well as some case studies will be further discussed. Also, suggestions on using indexation in execution strategy definition will be made.

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