Reaction systems and approximation spaces

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Abstract

The computational model of reaction systems was originally proposed in 2007 by Ehrenfeucht and Rozenberg [4] as a formal framework for modeling biochemical processes occurring in living cells. Since then, reaction systems have attracted considerable attention and have proven to be a convenient and expressive modeling paradigm in various areas of applied mathematics, including process algebras [2], Boolean networks [1], and chemical reaction systems [3].

Rough set theory was introduced by Pawlak [6] as a mathematical tool for handling different aspects of imprecise and uncertain information. An approach based on approximation spaces was later developed by Mihálydeák and Csajbók [5]. In this talk, we provide an overview of reaction systems and of the computational methodology based on approximation spaces. We further explore some elementary observations on the behavior of reaction systems in the presence of uncertainty, arising from the introduction of rough data and approximate computational procedures. In particular, given a finite set S and a similarity relation R on S, we can define an approximation space induced by R. Intuitively, the relation R captures the fact that certain symbols may appear indistinguishable to an external observer and can therefore be confused during the evaluation of a computation. We show that such vagueness may have serious consequences: for any reaction system, it is possible to define an approximation space such that the function computed by the induced rough reaction system—namely, the function perceived by the observer—differs significantly from the function actually computed by the original reaction system. Next, we generalize the notion of computation by reaction systems induced by approximation spaces and introduce the corresponding definitions.

References

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