Behavioural distances: a logical approach

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Abstract

In the analysis of systems that exhibit probabilistic behaviour, traditional notions of behavioural equivalence, such as probabilistic bisimilarity, often prove too rigid for practical purposes. This has led to the development of behavioural distances, which provide a quantitative measure of how similar two system behaviours are, rather than requiring them to be exactly the same. These distances extend the idea of equivalence by assigning a value, often in the unit interval $[0, 1]$, that reflects the difference in observable behaviour. They have emerged as a powerful tool for reasoning about probabilistic systems, allowing for a more nuanced comparison of systems that are "close" but not identical —a crucial feature for verification, approximation, and synthesis of these systems.

Although these distances are often defined as the least fixed point of a functional on the complete lattice of distance functions, they can usually also be characterized in terms of a logic. These logics have a real-value interpretation, that is, the interpretation of a formula of the logic in a state of the system is a nonnegative real number. In this talk, I will provide an overview of some of such logics.

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