

Probabilistic Session Types

Recent developments

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In general, an important feature of a probabilistic model is that it distinguishes between nondeterministic and probabilistic choices. The nondeterministic choices refer to the choices made by an external process, while probabilistic choices are choices made internally by the process, not under control of an external process. When modelling the probabilistic behaviour of a concurrent system we need to be able to model the fact that either the system or the environment chooses between several alternative behaviours. Probabilistic extensions of various process calculi have been considered in the literature. The basic idea of probabilistic process calculi is to incorporate a probabilistic choice operator.

There are two possibilities for extending a model using probabilities: either to replace nondeterministic choices by probabilistic choices, or to allow both probabilistic choices and nondeterministic choices. In [2] we considered the second approach because the concept of nondeterminism in process calculi is necessary to describe the interleaving of concurrent processes. There are some interesting issues that arise from communication and branching, because for any given concurrent system, there can be a number of processes competing with each other to control the execution of the next step. The most natural way to define such an extension consists of adding probabilistic information to some of the actions, and adopting a mixture of the classical generative and reactive models. Sending a value and selecting a label is generative, while receiving a value and branching a process using a selected label is reactive. For the reactive actions no probability is attached, while the generative actions are given probabilities.

We have presented some motivations for introducing probabilities in multiparty session types in a previous IC1201 meeting [1]. Then we define a calculus in [2] that joins together probabilistic internal choices (sending a value and selecting a label) with nondeterministic external choices (receiving a value and branching a process by using a selected value) to employ a generative-reactive like synchronization. In this setting the nondeterministic actions of a process use information (values and labels) provided only by the probability actions. For this calculus we define and study a typing system that extends the multiparty session types to deal also with probabilistic behaviours. The new calculus and its typing system are motivated and illustrated by a running example.

References

1. B. Aman, G. Ciobanu. Probabilistic Multiparty Session Types. Presented at the IC1201 BETTY Meeting in Malta (2016).
2. B. Aman, G. Ciobanu. Probabilistic Multiparty Session Types, submitted to a journal (2016)