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# Foreword in honor of Glynn Winskel

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ABSTRACT

A foreword to the contributed papers on *Branching cells for asymmetric event structures* and *Application of branching cells to QoS aware service orchestrations*.



Nearly four decades later, the theory of concurrency originally proposed by Glynn Winskel under the model of Event Structures still has a strong impact. Event Structures capture concurrency and choice with a minimal apparatus. Event Structures gave birth to a school of researchers—several of them are contributing to this special issue—who analyzed the different variants of concurrency in depth. Relations with the theory of domains on the fundamental side, and with the widely used models of nets on the more concrete side, were extensively developed.

A central difficulty in concurrency theories is the notion of *conflict*, which serves to decide whether or not events can coexist in the same execution. Conflict can be symmetric and asymmetric, binary or not. There are many possible variants of conflict. All of this was extensively studied since the 90s. When Samy Abbes started working on equipping Event Structures with probabilities, it came as a surprise to us that, even though conflict was deeply understood, the notion of *choice* was not. More precisely, it was not clear *when* choices could be performed between different futures of an execution. Probability theory with its stochastic processes had provided the right answer to this issue since Doob in the 60s, with the concept of *stopping time*. To our surprise, stopping times were not obvious to carry over to Event Structures and Samy Abbes devoted an important part of his thesis in identifying the notion of *stopping prefix*, a subclass of prefixes from which futures could be properly drawn. *Branching Cells* were then proposed by Samy Abbes to localize choice in Prime Event Structure—Branching Cells can be seen as a dynamic refinement of the older concept of *cluster* in 1-safe nets.

Having a proper notion of choice through the notion of Branching Cell, equipping Event Structures with probabilities became feasible and resulted in the elegant constructions of Probabilistic Event Structures and Markov nets, exhibiting Markov properties in both time and space (taking advantage of concurrency). So far probabilistic models of concurrency remained the only application of Branching Cells, which came as sort of frustration. Clearly, the triple (causality, concurrency, choice) should be of wider use. The world of services with its prevailing dynamic binding turns out to be another relevant target. Late service binding is an online choice, for which Branching Cells should be useful if Event Structure frameworks are used to formalize it. Service management is therefore a very practical target of these theories and paper [2] develops a proposal for it. Since most service orchestration languages allow for the use of contexts in guarding service calls, we had to abandon prime Event Structures for Asymmetric Event Structures. Extending Branching Cells to Asymmetric Event Structures was definitely non-trivial; it is the subject of paper [1].

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Our opinion is that the extreme concision and elegance of the concepts introduced by Glynn Winskel made it much easier to lift the concepts of causality, concurrency, conflict, and choice, to richer frameworks than just sets of events.

## References

[1] S. Abbes, Branching cells for asymmetric event structures, Theor. Comput. Sci. 546 (2014) 32–51.
[2] A. Benveniste, C. Jard, S. Abbes, Application of branching cells to QoS aware service orchestrations, Theor. Comput. Sci. 546 (2014) 52–62.