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FOSSACS invited lecture

Marcelo Fiore in his invited talk proposed a new mathematical approach for modeling computational structures that emphasizes a combinatorial perspective. Using sophisticated categorical techniques he develops a combinatorial formalism and then shows that three diverse mathematical structures that represent important computational structures all arise in the same manner using this approach. We will be catching up with Marcelo later in the week to ask him what this leads to in terms of programming language design and program verification.

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Interview with Marcelo Fiore

Daily ETAPS spoke with keynote speaker Marcelo Fiore about his recent talk.

[Daily ETAPS] Can you give us a little history leading to the topic of your talk?

[Marcelo Fiore] I started working in domain theory, with my thesis *Axiomatic Domain Theory in Categories of Partial Maps*. There are many different categories of domains in which the same results hold —importantly adequacy theorems— and I wanted to show that these followed from general abstract principles. Thus, it was natural to axiomatize and investigate domain-theoretic models in this light. Along the way, and in enjoyable collaboration with various colleagues, I applied the axiomatic approach in different computational scenarios. In particular, with Eugenio Moggi and Davide Sangiorgi we constructed a *denotational model of the π-calculus* for which we established full abstraction axiomatically. Not much later, it was pointed out to me (at a PSSL meeting, if I remember correctly) that the constructor that we use for modeling bound output had been considered by André Joyal in the different setting of *combinatorial species of structures* as a differentiation operator. Ever since I've been interested in understanding and deepening the connection. Yet another piece was added to the puzzle by my work with Gordon Plotkin and Daniele Turi on *algebraic theories with variable-binding operators*. There an operator of context extension (again similar to that of differentiation) serves for modeling variable-binding. The first part of my contribution to the FOSSACS conference proceedings gives an outline of the unifying technical themes underlying these developments.

[DE] What do you see the role of mathematical models (axiomatic, operational, denotational) is in general, and in particular in the context of the work you presented on generalized combinatorial species of structures?

[MF] My rough general view is that in studying and investigating computation structures we should have as many models (of the various sorts you mention) related in the strongest possible cohesive way. In fact, achieving such situations is a recurrent theme in my research. Of course this is generally hard, but of great value I believe. For instance, operational semantics is very good at quickly adapting to various computational scenarios but less so than denotational semantics at helping to identify mathematical structure, and vice versa. The work on generalized species has its intellectual roots in the idea of viewing combinatorial structure (as it appears in mathematics) from the perspective of programming-language theory, with the aim of leading to language design (under the guidance of the mathematical model) and with the further hope of being able to incorporate algorithmic studies (as e.g. in the work of Flajolet et al.).