Algebraic and Coalgebraic Methods in the Semantics of Programming Languages

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Abstract

8 Lectures

The aim of this course is to give a gentle introduction to the mathematical theory of structural operational semantics of [TP97] and to the algebraic treatment of syntax with variable binding of [FPT99].

The course is structured in three parts:

- In the first part we shall review initial algebra semantics [GTW78], structural operational semantics [Plo81], and final coalgebra semantics [Acz88, Tur96] of (first-order) programming languages.

- In the second part we shall bring these three semantics together using the category theory notion of distributive laws [TP97].

- In the last part we shall move on to higher-order languages, focussing on the initial algebra semantics of languages with variable binding [FPT99].

Prerequisites. Familiarity with the basic notions of category theory is required.

References

[Acz88] P. Aczel. *Non-well-founded sets*. Number 14 in Lecture Notes. CSLI, 1988.

[FPT99] Marcelo Fiore, Gordon Plotkin, and Daniele Turi. Abstract syntax and variable binding (extended abstract). In *Proc. 14$^{\text{th}}$ LICS Conf.*, pages 193–202. IEEE, Computer Society Press, 1999. Accessible from my web page.

[GTW78] J.A. Goguen, J.W. Thatcher, and E.G. Wagner. An initial algebra approach to the specification, correctness and implementation of abstract data types. In R.T. Yeh, editor, *Current Trends in Programming Methodology*, volume IV, pages 80–149, 1978.

[Plo81] G.D. Plotkin. A structural approach to operational semantics. Technical Report DAIMI FN-19, Computer Science Department, Aarhus University, 1981.

[TP97] D. Turi and G.D. Plotkin. Towards a mathematical operational semantics. In *Proc. 12$^{\text{th}}$ LICS Conf.* IEEE, Computer Society Press, 1997. Accessible from my web page.

[Tur96] D. Turi. *Functorial Operational Semantics and its Denotational Dual*. PhD thesis, Free University, Amsterdam, June 1996. Accessible from my web page.