Mathematical Semantics of Computer Systems

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Course website: Home -> TEACHING

General

- Monday 10.30h-12.00h
- Room 102, School of Science Bldg. No. 7
- For Graduate Students. Code: 4810-1168
- Lectures are in English

Course Objective

Correctness of computer systems and programs is a pressing issue in the modern world. Their verification—providing mathematical proofs for their correctness—calls for the mathematical modeling of systems or programs. This is what the field *semantics* is all about. And in the modern approaches to program/system semantics, *category theory* is an indispensable language.
Category theory is used in many different applications; and its use in each application comes with a greatly different flavor. The course exhibits two eminent uses of category theory—concurrency and functional programming—and shows two different "faces" of category theory. These different faces are unified in the latter half of the course, where the lectures are led by categorical concepts rather than applications.
Keywords: category theory, algebra, coalgebra, type theory, semantics, reactive system, automaton, functional programming

Course Structure

1. Categorical Algebra and Coalgebra
    - Introduction to category theory I: the category of sets and functions
    - System as coalgebra
    - Syntax as an algebraic signature
2. Categories and Type Theory
    - Introduction to category theory II: cartesian closed categories and more
    - The category of types
    - Functorial semantics
3. Monad
    - For branching in coalgebra
    - For effect in functional programming
4. Presheaf Category
    - Further on category theory: the Yoneda lemma
    - Binding signature, categorically

2012年9月28日
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Evaluation

Based on four reports (one after each of the four parts)