MPhil in Advanced Computer Science
Advanced Category Theory in Computer Science

Leader: Marcelo Fiore (course lecturer)
Timing: Lent
Prerequisites: Category Theory in Computer Science
Structure: 8 Lectures

AIMS
This module aims to train students at the forefront of research in the application of category theory to computer science.

SYLLABUS
A range of topics for the course follows.

1. Algebraic theories: universal algebra; equational logic; soundness and completeness; theory translations and constructions.
2. Algebras: initial algebras; induction principle; recursive domain equations; free algebras.
3. Presheaves: cartesian closure; essential geometric morphisms; free cocompletions; Kan extensions; coends.
4. Simply typed lambda calculus: $\lambda$-definability; Kripke logical relations; glueing; normalisation by evaluation; conservative extensions.
5. Monoidal categories: Day’s convolution tensor product; substitution tensor products; operads.
6. Second-order algebraic theories: variable binding and $\alpha$-equivalence; capture-avoiding substitution; metavariables; meta-substitution.
7. Joyal’s species of structures: calculus of combinatorial constructions; analytic functors; the Schanuel topos.

OBJECTIVES
On completion of this module students should:

- be able to start research in theoretical computer science involving category theory.

COURSEWORK
N/A
PRACTICAL WORK
N/A

ASSESSMENT
The course will be assessed by means of an essay on one or more research papers related to the syllabus. Papers will be chosen by students on their own or from a given list of papers in accordance with the lecturer.

The essays will be marked by the lecturer and returned to the students. Subsequently, a technical discussion with each student on the material of their essay will take place. The mark for the course will be that of the essay, with an upgrade for those students that give evidence of mastering the subject during the discussion.

RECOMMENDED READING


Last updated: July 2010