Mixed Inductive-Coinductive Reasoning

Types, Programs and Logic

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PhD Defence
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Motivation

Well-behaved Programs and Proof Methods

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Crashed Control System

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Well-behaved Programs and Proof Methods

Crashed Control System

Non-responsive Control System

What are Induction and Coinduction?

Coinduction: Observable systems

Alive control systems

Induction: Terminating computations

Internal computations finish

Induction-Coinduction: Interleaved control and computations

Alive and responsive control systems

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Induction-Coinduction: Interleaved control and computations

Alive and responsive control systems

Aims of the Thesis

Develop **formal languages** for inductive-coinductive programming and reasoning . . .

that enable **automatic verification** of proofs, . . .

have **formal semantics**, and . . .

are easy to understand **for humans**.

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Approach in the Thesis

Category Theory
Abstraction of Mathematical Theories

Type Theory
Typed Computations and Constructive Logic

Coalgebraic Methods
Theory of Systems

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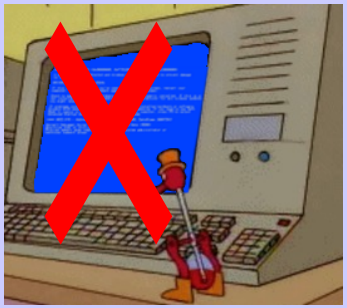
Results of the Thesis

Well-behaved inductive-coinductive programs




Equivalence of inductive-coinductive programs

- Coalgebraic description of the equivalence
- Coalgebraic up-to techniques to simplify proofs
- Recursive logic to enable computer-verifiable proofs

Constructive logic based on induction and coinduction

- Inspired by category theoretical principles
- Justified computationally as type theory

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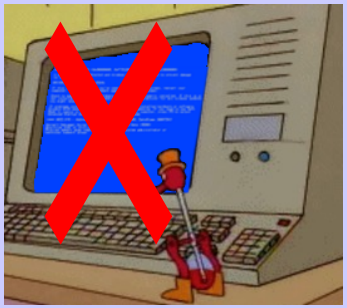


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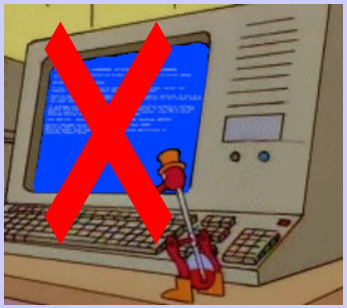


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Thank you and back to the commitee.