

Project Description

LATIN: Logic Atlas and Integrator

Mihai Codescu, Fulya Horozal, Michael Kohlhase, Till
Mossakowski, Florian Rabe

DFKI Bremen, Jacobs University Bremen

Goals

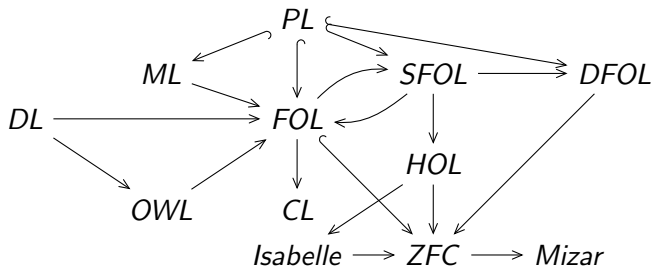
- ▶ Formalize and interrelate all foundational languages of mathematics, logics, and computer science uniformly in a simple framework
 - ▶ logics, type theories, set theories, category theory, etc.
 - ▶ syntax, proof theory, model theory
- ▶ Little Foundations: systematic reuse of theorems across logics and semantic domains
 - ▶ building logics out of little components
 - ▶ representation theorems to connect different domains

Methods

- ▶ Proof theoretical logical frameworks
 - ▶ based on type theory
 - ▶ specifically LF/Twelf
- ▶ Model theoretical logical frameworks
 - ▶ based on set/category theory
 - ▶ specifically institutions
- ▶ MKM-oriented representation languages
 - ▶ based on XML, URIs
 - ▶ specifically OMDoc, MMT

Continuous feedback loop between LATIN as an application and the employed technologies.

Global View



Logics-as-Theories, Relations-as-Theory-Morphisms

Uniform representation of foundations, domains, logics as nodes in a graph of modular theories.

Local View

```
%sig Logic = {  
  form : type.  
  proof: form → type.  
}
```

```
%sig Conjunction = {  
  %include Logic.  
  and : form → form → form.  
  andl : proof A → proof B → proof (A and B).  
}
```

Proofs-as-Terms and Judgments-as-Types

Uniform representation of constants, functions, predicates, sorts, binders, axioms, theorems, inference rules, tactics as typed/defined constants.

Current State

- ▶ 700 little theories including
 - ▶ propositional, (unsorted, sorted, dependently-sorted) first-order, higher-order, common, modal, description, linear logic
 - ▶ λ -cube, Curry and Church-style type theories
 - ▶ ZFC set theory, Mizar's set theory, Isabelle/HOL
 - ▶ category theory
- ▶ 500 little morphisms including
 - ▶ relativization of quantifiers from sorted first-order, modal, and description logics to unsorted first-order logic
 - ▶ negative translation from classical to intuitionistic logic
 - ▶ translation from type theory to set theory
 - ▶ translations between ZFC, Mizar, Isabelle/HOL
 - ▶ Curry-Howard correspondence between logic, type theory, and category theory

Implementations

- ▶ Input: IDEs based on Eclipse, jEdit, web browser (Planetary)
- ▶ Compilation: LF+Twelf extended with MMT module system, compiled to OMDoc/MMT
- ▶ Manipulation: MMT API — analyzing, querying, presenting, refactoring, change management
- ▶ Storage: TNTBase (= SVN + XML database)
- ▶ Output: interactive XHTML+MathML

<http://cds.omdoc.org:8181/>

All implementations are

- ▶ semantics-aware
- ▶ foundation-independent
- ▶ ongoing work