Project Description

LATIN: Logic Atlas and Integrator

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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.
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.
  andI : 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
  - $\lambda$-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

All implementations are

- semantics-aware
- foundation-independent
- ongoing work

http://cds.OMDoc.org:8181/