MMT Tutorial, Part 1: Designing Languages in MMT

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Bringing your notebook is recommended but not required.

Overview

1. Brief introduction to MMT
2. Download, install MMT and MMT IDE
3. Design languages in MMT
   - 3.1 LF as an example of a logical framework LF
   - 3.2 FOL as an example of a formal language
   - 3.3 algebraic theories as examples of domain knowledge
   - 3.4 module system for algebra
   - 3.5 design logics modularly
   - 3.6 implement logical frameworks modularly

Further Resources

- MMT homepage: `http://uniformal.github.io/`
- Introductory articles: `http://uniformal.github.io/doc/philosophy/intros.html`
- Publications: `http://uniformal.github.io/doc/philosophy/papers.html`
- Sources: `http://uniformal.github.io/MMT`
- API documentation: `http://uniformal.github.io/apidoc`

Language-Independence

MMT = meta-meta-theory/tool

a universal framework for the
formal representation of all knowledge and its semantics
in math, logic, and computer science

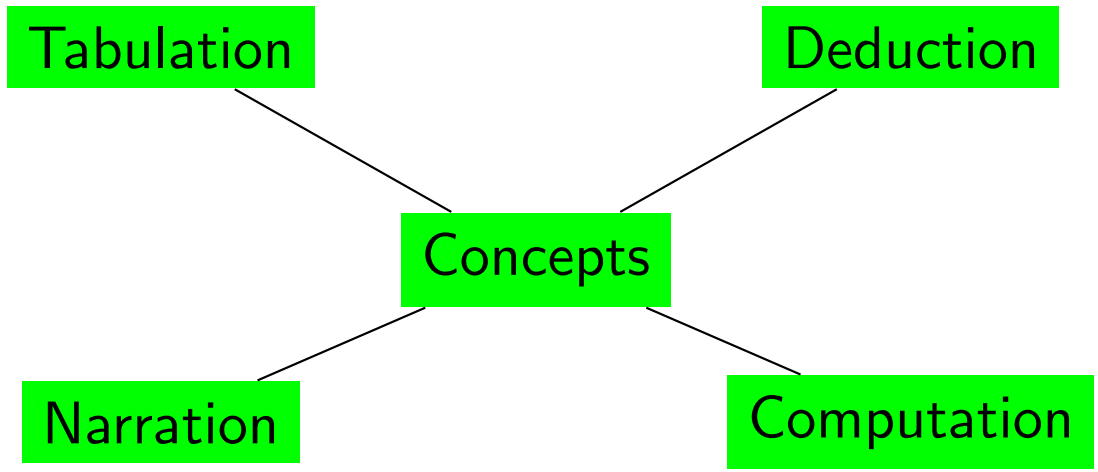
- Avoid fixing languages wherever possible
- Use formal meta-languages for defining languages . . .
- . . . and avoid fixing even the meta-languages.

Obtain (meta-)language-independent results

Mathematics	Formalization	Logical Framework	Language-Independence
			meta-meta-framework
		meta-language	
	language (logics, DSLs, etc.)		
domain knowledge			

Subsume All Paradigms of Knowledge Representation

- Conceptualization: identifiers and their properties
- Narration: human-oriented, informal-but-rigorous
- Deduction: machine-verificable, formal
- Computation: executable, algorithmic
- Tabulation: databases, queryable



Design Principles

Separation of concerns between

- language development — logical primitives, rules
- knowledge management — e.g., search, change management
- verification — e.g., type checking, theorem prover
- application development — e.g., IDE, proof assistant

Universal language

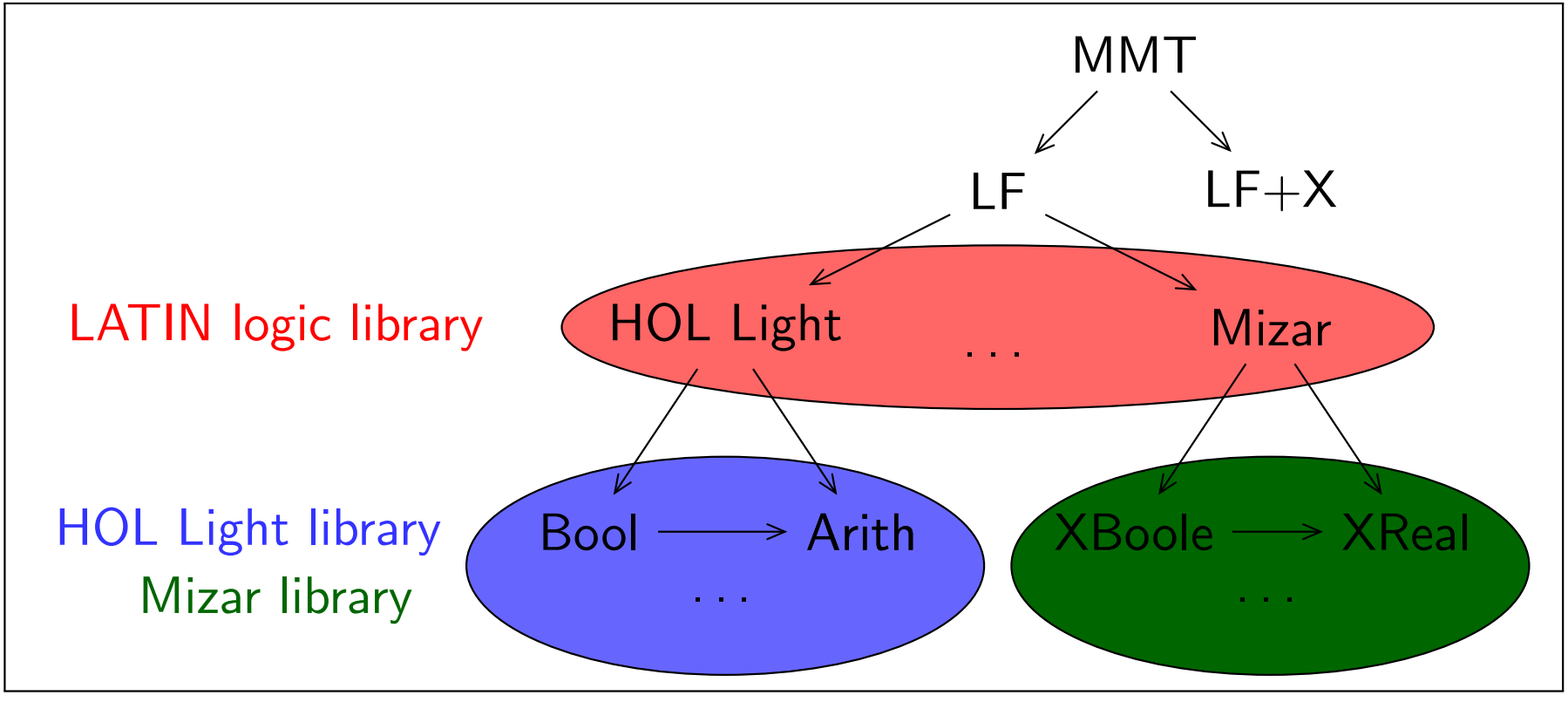
- few primitives ...
- that unify different domain concepts

Language-Independent Implementations

- possible for surprisingly many results
- yields rapid prototyping for logic systems

The Meta-Hierarchy of Languages

- Languages at all meta-level uniformly represented as MMT theories
- Same module system at all levels



Language-Independent Results So Far

Knowledge Management

- Change management — recheck only if affected
- Project management — indexing, hosting
- Extensible build system — presentation, import/export, ...
- Search, querying — substitution-tree and relational index
- Browser — interactive web browser
- Editing — IDE-like graphical interface

Logical Results

- Module system — modularity transparent to foundation developer
- Concrete/abstract syntax — notation-based parsing/presentation
- Type reconstruction — foundation plugin supplies only core rules
- Simplification — rule-based, integrated with type reconstruction
- Anticipated: Theorem proving, code generation, stateful computation

MMT is Not a Stand-alone System

- MMT and all the above results implemented as a Scala library
  mmt.jar
- Execution of raw MMT possible as
  - an interactive shell
  - an script interpreter
  - an HTTP server
- But main use as component in other applications
  See Part 2 of the tutorial
- One particular application: MMT IDE based on jEdit
  We'll use that one in Part 1

Let's Start

- I will work through the tutorial on the screen
- You should follow on your computers
- Main link: `http://uniformal.github.io/doc/tutorials/prototyping/`

no need to type this —
these slides are linked from the CICM program