

SWiM – A Semantic Wiki for Mathematical Knowledge Management

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KWARC – Knowledge Adaptation and Reasoning for Content

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Mathematical Knowledge Management

- Goal: support collaborative authoring of documents usable for knowledge management
- semantic markup common for documents in mathematics: MathML, OpenMath, OMDoc
- layers of knowledge: symbols, statements, theories, documents
- has many applications, but how to acquire the knowledge?
- \Rightarrow services to support the authoring workflow

Example (a simple formula?)

```
<apply>  
  <csymbol definitionURL="http://openmath.org/cd/arith1#plus"/>  
  <cn type="integer">1</cn>  
  <ci>n</ci>  
</apply>
```

Semantic Wiki and Ontologies

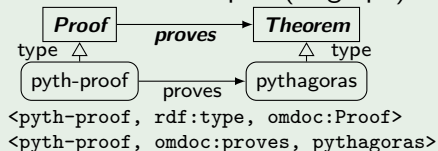
- Semantic wikis found usable to support collaborative formalisation
- Difference here is: deeply nested markup, lots of cross-references
- Right granularity of pages: one page = one theory, one statement, one formula?
- \Rightarrow extract knowledge relevant for search and navigation, build most services on top of that
- RDF graph in terms of an ontology that models the semantics of the markup; direct and inferred relationships: dependency, containment

Example

A wiki page:

```
<omdoc>
  <proof id="pyth-proof"
    for="pythagoras">
    ...</proof>
</omdoc>
```

Extracted RDF triples ($\hat{=}$ graph):



SWiM: IkeWiki + Mathematical Markup

- editing, presentation, navigation, discourse, semantic services
- See <http://swim.kwarc.info>



User

- [Login](#)
- [Create Account](#)
- Theme: [tundra] [soria]

Navigation

- [IkeWiki Help](#)
- [Recent Changes](#)

Edit

- [Create Resource](#)
- [Create Class](#)
- [Create Property](#)
- [Create Multimedia](#)
- [Create Template](#)
- [Delete Resource](#)
- [Add Relation](#)
- [Remove Relation](#)

Search

Article [Discuss](#) [Metadata](#) [Context](#) [Edit](#) [Annotate](#) [History](#)

Languages: [en]

MathematicalDocument

Identifier: MathematicalDocument

Types: odo:Theory - odo:OMDocConcept - rdfs:Resource

This document represents a mathematical theory with some OpenMath formulae. OpenMath standard symbols and custom symbols are used.

Actually, there's not yet much of a theory structure, except for one symbol and two imports of dummy theories. A real theory would introduce and define several related symbols and axioms about their properties. Theorems, proofs and examples are also possible.

This is a formula with one custom symbol:

$\mu y.p(2y)$

Its source is an ASCII notation of OpenMath and looks as follows:

```
B(MathematicalDocument/mylambda, [ _y ], @(p, @(arith1/times, 2, _y)))
```

This is a formula using several standard symbols:

$$\sum_{x=1}^n x^2$$

Some import declarations follow. They are not yet rendered properly:

CONCEPT: mylambda

This theory introduces a custom binder named "mylambda".

NOTATION DEFINITION: for symbol mylambda@MathematicalDocument

Prototype	Rendering
<code><om:OMS cd="MathematicalDocument" name="mylambda"/></code>	μ

References



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Proof Formalisation and Dictionaries of Symbols

Flyspeck: Formalising a **P**roof of the **K**epler conjecture:
hundreds of proof sketches, collaboratively transform them
into something machine-verifiable
formalising, annotating, discussing, project management

OpenMath 3: revision of the content dictionaries (collections of symbol
definitions)
user interface: editing formulae, metadata, symbol notations
“Let’s write multiplication as $a \times b$ instead of $a \cdot b$!”

The SWiM Approach: Good for Math and other Domains

- SWiM makes mathematical documents editable collaboratively and facilitates common workflows by exploiting the knowledge they contain.
- Domain-specific semantic markup and ontology allows for advantages over generic semantic wikis, and over non-semantic mathematical wikis (more and easier knowledge management)
- Approach considered transferable to other domains (e. g. chemistry): decide on page granularity, capture semantics in ontology, extract RDF, integrate suitable editors

Come and see the demo tonight!