Poster | Edit | Discussion | History

SWiM – A Semantic Wiki for Mathematical Knowledge Management

SWiM is a semantic wiki for collaboratively building, editing, browsing, and discussing collections of mathematical knowledge represented in structural semantic markup. It motivates users to contribute by instantly sharing the benefits of knowledge-powered services with them.

User

Christoph Lange
<ch.lange@jacobs-university.de>

School of Engineering and Science
Jacobs University Bremen, Germany

JACOBS UNIVERSITY

Digital Enterprise Research Institute
NUI Galway, Ireland

Search

$\int_?^? s^2(t)dt$

Go!

Import

- OpenMath CD
- OMDoc
- Ontology
- LaTeX

Export

- OpenMath CD
- OMDoc
- XHTML+MathML
- RDF
- PDF

Mathematical Knowledge Management

Goal: web collaboration on structured mathematical knowledge

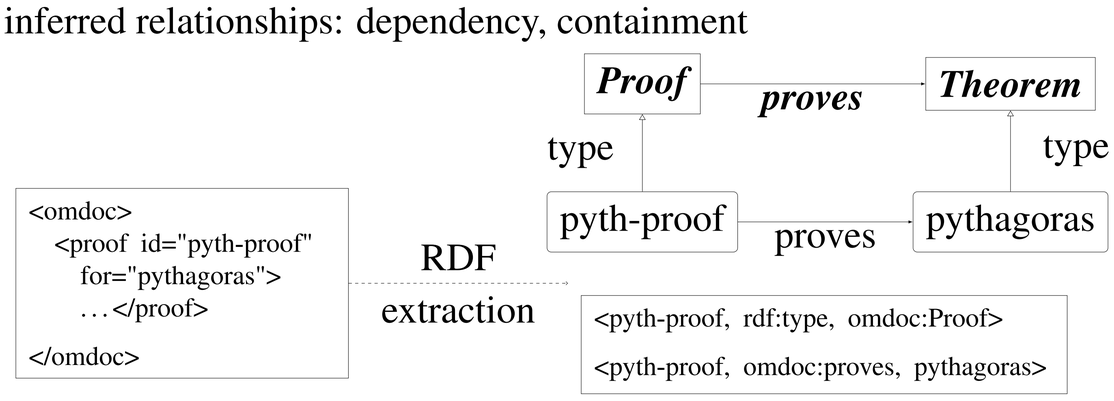
- semantic markup common for documents in mathematics: MathML, OpenMath, OMDoc, sTeX
- layers of knowledge: symbols, statements, theories, documents
- applications: e-learning, publishing, proof verification
- but how to acquire the knowledge?
- ⇒ services to motivate the user and support the authoring workflow

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

A “simple” semantic formula

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?
- ⇒ 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



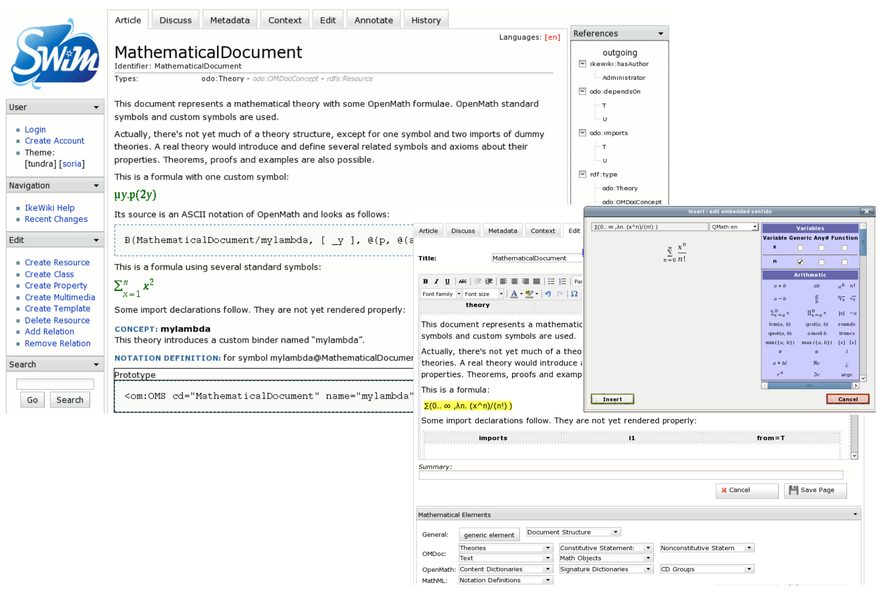
SWiM = IkeWiki + OMDoc + $\Sigma_{i=1}^{\infty}\sigma_i, \sigma_i \in$ service

Technical foundations:

- IkeWiki [Schaffert]
- OMDoc [Kohlhase]

Features:

- editing
- presentation
- navigation
- discourse
- import/export
- refactoring
- semantic services



OpenMath 3 Case Study

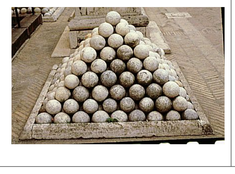
- revision of the content dictionaries (collections of symbol definitions)
- user interface: editing formulae, metadata, symbol notations

Examples for notational preferences:

- language: $\binom{n}{k}$, $\mathcal{C}_n^k$, $\mathcal{C}_k^n$
- domain: $\sqrt{-1} = i$, $\sqrt{-1} = j$
- taste: $f''(x)$, $f^{(2)}(x)$, $\frac{d^2y}{dx^2}$, $\frac{d^2}{dx^2}f(x)$
- exactness: $f \in \mathcal{O}(n)$, $f = \mathcal{O}(n)$

Flyspeck Case Study

- **F**ormalising a **P**roof of the **K**epler conjecture [Hales 1998]
- hundreds of proof sketches (400 pages LaTeX), collaboratively transform them into something machine-verifiable
- formalising, annotating, discussing, project management



References

- hasDemo
  http://swim.kwarc.info
- homepageURL
  http://kwarc.info/projects/swim/
- presentedAt
  Semantic Wiki Workshop
  JEM Workshop (Joining Educational Mathematics)
  MathUI Workshop
- rdfs:seeAlso
  PlanetMath
  Semantic MediaWiki
  Connexions
  ActiveMath
- rdf:type
  Semantic Wiki
  Mathematical Editor
  Collaboration Tool
  Browser

Conclusion

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

Roadmap

- ontology for narrative structures
- formalisation workflow
- dependency graph navigation
- refactoring support
- adaptive presentation

Acknowledgments

science foundation ireland
fondúireacht eolaíochta éireann

kwarc

Studienstiftung des deutschen Volkes