

Improving mathematical knowledge items by acting on issue-based community feedback

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Resource

Edit

Discussion

History

Issue Alice 2008-05-30 [Idea][Argument][Agree][Disagree][Decision]

It's hard to find out how to improve content (= resources) in [semantic wikis](#) ☹

Agree Bob 2008-05-31

Indeed, besides automated approaches it's hard to get focused feedback from users.

Idea Claire 2008-06-01 [Argument][Agree][Disagree][Decision]

So let's make wiki discussions semantic!

Argument Dave 2008-06-02 [Agree][Disagree]

We could take types from the [DILIGENT argumentation ontology](#) for the posts.

Argument Eric 2008-06-03 [Agree][Disagree]

And every discourse should be connected to resources corresponding to the wiki page, and there should be domain-specific *Idea* and *Issue* subclasses.

Agree Anonymous 2008-06-04

That's great, then the wiki could assist with the realisation of an approved idea.

Decision Christoph 2008-06-05

So let's do it! (Available in the latest [IkeWiki](#), domain-specific extension for mathematics in [SWiM](#), IkeWiki's math edition, is work in progress)

Outline

- Issues with knowledge items: generally and in mathematics
- Issues and discussions in Wikipedia
- Foundations: semantic wikis, argumentation ontologies
- Domain-specific ontology and assistance
- Implementation, Demo
- Communities of Practice
- Outlook

Issues with Knowledge Items

Terminology:

- “Issue” = “Problem” = “Bug” (cf. issue tracking systems)
- “Knowledge Item” = a distinctive subject of interest

Typical issues with knowledge items:

- hard to understand
- wrong
- redundant
- too many independent subparts

Setting: community-driven knowledge management

- community members discuss knowledge items, issues, and solutions
- other users want to retrace modelling decisions (collective experience of the community)

Issue Management in Wikipedia

- no well-defined workflow, no structure for discussions
- community agrees on best practices, makes them official policies for the community, issue management done manually
- example: neutrality of an article debated
 - ① some author inserts warning message (template) into article
 - ② gives justification in a new section on the discussion page (manual editing conventions)
 - ③ issue and proposed solutions in natural language
 - ④ possible solution: represent the “other” view better
 - ⑤ ad hoc voting, e. g. “yes” and “no” list items
 - ⑥ trusted author judges, counts votes, puts solution into practice
 - ⑦ documentation: editing comment, possibly referring to discussion page
- works sufficiently in Wikipedia (large community)

Semantic Wikis

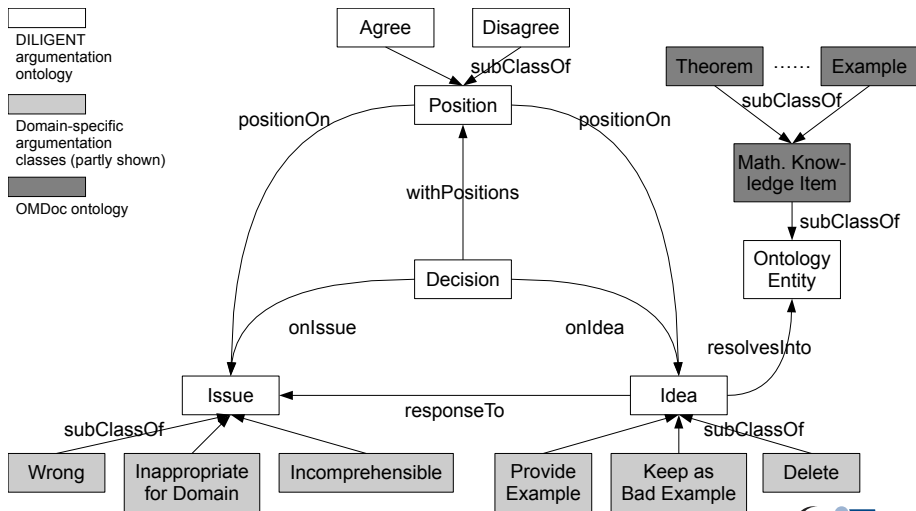
Semantic wiki = wiki with *semantic web* technologies

- more structured knowledge representation
- here: one article = one knowledge item
 - most common model, but different from e. g. knowledge wikis
- articles and links *typed* with terms from *ontologies*
 - (ontology = “shared formalisation of a conceptualisation of a domain”)
- semantic/structured discussions are rare
 - so far only known from IkeWiki
 - using SIOC ontology (semantically interlinked online communities)

Argumentation Ontologies

- rationale: discuss/argue about “wicked problems”, focus towards solution
- solutions are “not true–or–false but good–or–bad”
- DILIGENT argumentation ontology: from ontology engineering
 - *Issues*: conceptualise something from the domain
 - reaction: agreement/disagreement
 - or *Idea*: how to formalise it
 - agreement/disagreement with idea, or detailed argumentation (challenges vs. justification)
 - final *Decision*: implement an idea for an issue, “resolves into” a knowledge item
- Note: our issues are issues *with* knowledge items! (Rest is the same)

Math-Specific Argumentation Ontology



Survey among Domain Experts

Asked 44 people experienced with mathematical knowledge management (22 answered all questions):

- Previous experience: mostly software libraries (e. g. of proof assistants), but also wiki-like knowledge collections
- Common granularities of knowledge: course unit, mathematical theory, mathematical statement (e. g. definition, theorem, proof)
- Software support for issue tracking and solving? Hardly.
- Knowledge items affected by issues: definitions, axioms, theorems, proofs, examples, notation definitions, theories
- Common issues: wrong, incomprehensible, uncommon style, underspecified, redundant, truth uncertain
- Common solutions: directly improve affected knowledge item, split it
- Unresolved issues? Yes, frequent – mostly due to insufficient restructuring support

Survey still running: <http://tinyurl.com/5qdetd>

Assist with the Best Solution

What is a legitimate issue?

- no decision taken yet
- no disagreement with issue, or more agreement

What solution wins?

- at least one agreement
- highest agreement/disagreement ratio
- no detailed argumentation (challenges/justifications) so far

Assist with implementation

- system knows most common idea and issue types (survey results)
- hard-coded assistance for common solutions to be implemented

Implementation in SWiM

- SWiM: Semantic Wiki for Mathematical Knowledge Management
- IkeWiki + OMDoc + ontology for mathematical knowledge items
- DILIGENT argumentation ontology, math-specific issues and ideas

The screenshot displays the SWiM interface for the article 'arith1'. The page is structured with a top navigation bar (Article, Discuss, Metadata, Context, Edit, Annotate, History), a left sidebar with user and navigation options, and a right sidebar with references and social media links.

Article: arith1
 Identifier: `cd:arith1`
 Types: `rdfs:Resource` - `omo:ContentDictionary` - `omo:OpenMathConcept` - `rdfs:Resource`

This CD defines symbols for common arithmetic functions. The symbol to represent the n-ary function to return the least common multiple of its arguments.

Symbol Definition (plus)
 COMMENTED PROPERTY: for all $a, b \mid a + b = b + a$
 FORMAL PROPERTY: $\forall a, b. (a + b) = (b + a)$

This symbol denotes unary minus, i.e. the additive inverse.
Symbol Definition (unary_minus)
 COMMENTED PROPERTY: for all $a \mid a + (-a) = 0$
 FORMAL PROPERTY: $\forall a. (a + (-a)) = 0$

The symbol representing a binary minus function. This is equivalent to adding the additive inverse.
Symbol Definition (minus)
 COMMENTED PROPERTY: for all $a, b \mid a - b = a + (-b)$
 FORMAL PROPERTY: $\forall a, b. (a - b) = (a + (-b))$

The symbol representing an n-ary multiplication function.
Symbol Definition (times)
 EXAMPLE: $\begin{pmatrix} 12 & 56 \\ 34 & 78 \end{pmatrix} = \begin{pmatrix} 1922 \\ 4350 \end{pmatrix}$
 COMMENTED PROPERTY: for all $a, b \mid a * 0 = 0$ and $a * b = a * (b - 1) + a$

References


- outgoing
 - ikewiki:hasAuthor
 - omo:contains
 - omo:containsSymbol
 - arith1=abs
 - arith1=divide
 - arith1=dot
 - arith1=krn
 - arith1=minus
 - arith1=plus
 - arith1=power
 - arith1=product
 - arith1=root
 - arith1=sin
 - arith1=times
 - arith1:unary_minus
 - rdf:type
 - omo:ContentDictio
 - omo:openmathcon
 - rdfs:Resource
- incoming
 - untyped

Socialise

- Digg this
- Post to del.icio.us
- Post to Fun
- Post to Magnolia
- Post to Yahoo
- Permalink


User Interface (1)

Article Discuss Metadata Context Edit Annotate History

 **Issue/Incomprehensible** **Alice**
Wed, 14 May 2008 18:00:24 +0100


I don't understand anything. How can this be applied?

Idea Decision


 **Idea/ProvideExample** **Bob**
Wed, 14 May 2008 18:00:42 +0100

I'd suggest to provide an example that applies this theorem in a concrete domain.

Agree Disagree Decision

 **We don't need this.** **Cecil**
Wed, 14 May 2008 19:02:18 +0100

Reply

 **Great idea! Let's do that.** **Dan**
Wed, 14 May 2008 19:01:52 +0100

Reply

New Issue New Comment



User Interface (2)

Article Discuss Metadata Context Edit Annotate History

SampleTheorem

Identifier: SampleTheorem

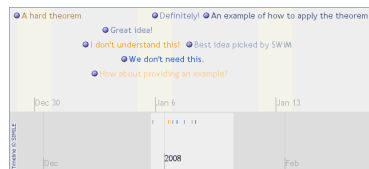
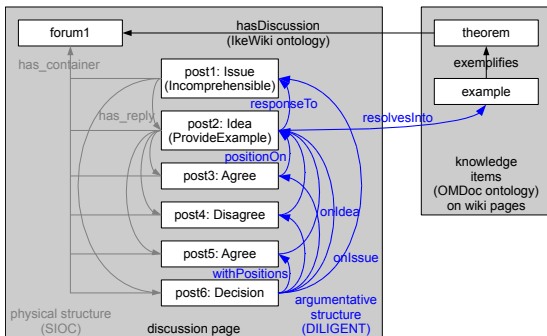
Types: [odo:Theorem](#) - [odo:Assertion](#) - [odo:NonconstitutiveStatement](#) - [odo:OMDocConcept](#) - [odo:Statement](#) - [rdfs:Resource](#)

Languages: [en]  

There is the following issue with this knowledge item: It was found to be incomprehensible.
Suggested action: [Create an example for it.](#)

THEOREM:
For every sound and complete calculus, there is ...

Under the Hood: RDF Graph



■ Agree
 ■ Decision
 ■ Disagree
 ■ Example
■ Incomprehensible
 ■ ProvideExample
 ■ Theorem

How does it Support Communities of Practice?

- SWiM assumes its user base to be one community of practice
- Wenger “practice as learning”
- (new) community members learn about established practices
 - old discourses about the knowledge engineering decisions are recorded in a structured way
- community in whole learns
 - new issue or idea types? Administrators can adapt the argumentation ontology directly in SWiM!

Outlook

- Make it more flexible: issues not only tied to knowledge items, but issues of general concern (“conceptualise this”, “formalise this”)
- Scale it to the web: SIOC allows for interlinking online communities; where else did the same users participate in discussions? (working on proper argumentation module for SIOC)
- Test cases for SWiM:
 - **Flyspeck** large-scale proof formalisation (partly from informal \LaTeX)
 - **OpenMath** formalisation of mathematical symbols and notations in “content dictionaries”
- Will the 80/20 rule hold? Does the system offer helpful support in common situations? How does it cope with wicked problems?