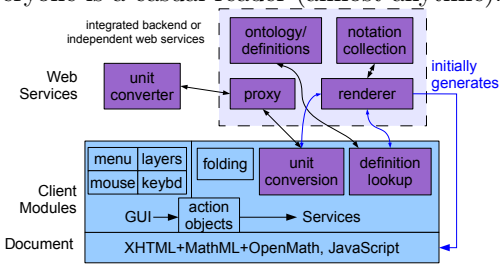
JOBAD – Interactive Mathematical Documents

Michael Kohlhase, Jana Giceva, Christoph Lange, Vyacheslav Zholudev

Computer Science, Jacobs University, Bremen, Germany
{j.giceva,m.kohlhase,ch.lange,v.zholudev}@jacobs-university.de

That "*Mathematics is hard*" is so well-accepted that no one will object – except mathematicians and mathematical practitioners. Indeed, mathematical documents are very concise and minimalistic. They talk about objects that are so abstract that we have difficulties remembering their construction and predicting their properties. Finally, mathematical documents pile layers and layers of definitions and proved assertions. As a consequence, a document will usually depend on others, which in turn depend on further documents. In a nutshell, mathematics is hard because it is embodied in documents that are optimized for the initiated (mathematical practitioners of the respective areas) at the cost of being virtually unintelligible to the casual reader. Unfortunately, with 120,000 articles being published in mathematical journals annually, everyone is a casual reader (almost anytime).



In this situation, the aim of the JOBAD system is to provide mashup services[1] in mathematical documents that alleviate some of the comprehension barriers by providing the necessary information *in time* and *in place*. JOBAD is a JavaScript library that makes specially prepared documents in XHTML+MathML format interactive and connects it to mathematical web services. Current services comprise subterm folding, definition lookup, and units conversion. Subterm folding works on the client side, provided that the functional structure of terms and subterms is sufficiently annotated. This is the case, if the document has been generated from a semantic representation in the OMDoc format, using our own rendering service. Definition lookup works by connecting to a server-side database, passing the URI of the symbol to be looked up. In our XHTML+MathML documents, we annotate every rendered symbol (e. g. +) with the URI of the underlying formal concept (here: `http://www.openmath.org/cd/arith1#plus`), which is defined in a mathematical ontology stored on the server. Currently, our lookup service returns the definition of a symbol, as retrieved from that ontology, rendered as XHTML+MathML; it will be displayed in a pop-up window. The unit conversion service passes a complete subterm (concretely: a number multiplied with a unit, e. g. 3.5 km) in OpenMath semantic markup to a remote web service — via a proxy, due to security restrictions, retrieves the result (here: 2.175 miles) as semantic markup, has it rendered, and displays it in the document, undoably replacing the original value.

JOBAD[2] consists of an extensible, modular library of JavaScript utility functions, GUI elements, in-document services, and web service clients. We specified a RESTful communication protocol for communicating with web services. We have implemented web services for definition lookup and rendering within our own server back ends; the unit conversion case demonstrates how to connect to an external web service.

The online demo features definition lookup on a corpus of more than 1,000 OMDoc documents hosted in a TNTBase repository[3], mainly comprising modules of computer science lecture notes in semantic markup, as well as unit conversion on a smaller test document. From this semester on, our students will interact with the lecture notes and thus contribute to the evaluation of JOBAD. Future services that we are planning include interactive notation adaptation, graphing, formula search, theorem proving, and saving and sharing of interactively adapted documents.

[1] Demo URL: `http://jomdoc.omdoc.org/wiki/AI-Mashup`

[2] Jana Giceva, Christoph Lange, and Florian Rabe. Integrating web services into active mathematical documents. In Jacques Carette, Lucas Dixon, Claudio Sacerdoti Coen, and Stephen M. Watt, editors, *MKM/Calculemus 2009 Proceedings*, number 5625 in LNAI, pages 279–293. Springer Verlag, 2009.

[3] TNTBase is our versioned XML database; see `http://trac.mathweb.org/tntbase/`