

MathBook XML  
T<sub>E</sub>X User's Group 2014  
Portland, Oregon, USA

Robert Beezer

July 28, 2014

## 1 About Me

- First BASIC program, 1969
- PhD in Mathematics, Univ. of Illinois, 1984
- T<sub>E</sub>X/L<sup>A</sup>T<sub>E</sub>X user since mid-1980's
- Roughly 15 research articles, 80's and 90's
- Gopher site, approx. 1992
- Open source linear algebra textbook, initiated 2004
- Sage software developer, 2008–present
- 36 years teaching mathematics, strictly undergraduates
- Know a little about each of many things

## 2 Introduction

Problem: Make a good-looking mathematics book (or paper) in an electronic format

Problem: Make it easy to navigate the rich structure of a mathematics book

Problem: Convert one source to multiple output formats

Opportunity: There are great interactive widgets you can put on a web page

Solution: very structured source, easily translated to a variety of outputs —  
traditional, new and unimagined

Joint Work: David Farmer, Steve Blood, Michael DuBois

Support: UTMOST (NSF Education Grant), Shuttleworth Flash Grant

## 3 Philosophy

- Structure of a text = hierarchical tree (chapter/section/subsection)
- Markup to *clearly* reflect structure, *no* presentation allowed
- Powerful and flexible processing tools, designed for the job

Conclusion:

- XML (eXtensible Markup Language) – simple syntax
- XSL (eXtensible Stylesheet Language) – declarative, complex and powerful
- An “XML application” – design of the elements (“tags”)

## 4 Goals

- Simple markup: sensible names and abbreviations, few attributes
- No more complicated than  $\text{\LaTeX}$
- Excellent support for *authors*
- Knowledge embedded in system (such as MathJax configuration)
- Flexibility through processing switches (e.g. numbering depth)
- Industrial-strength converters to popular formats (reference design)

All of this is possible with very few compromises

## 5 MathBook XML

The principal (only?) “product” of this project.

- An “XML application”, a set of elements, attributes and their relationships
- Easy for an *author* to comprehend
- Very few attributes, none obtuse
- No presentation. Really
- Easy cross-references: `xml:id="a-label"` and `<xref ref="a-label">`
- $\text{\LaTeX}$  syntax for mathematics (no attempt to be semantic here)
- Define  $\text{\LaTeX}$  convenience macros once (e.g. for notation)
- Minimal escaped characters: `&` generally, `\lt`, `\gt`, `&amp;` in math
- Designed for authors, not archivists. Practical

## 6 Conversion to $\text{\LaTeX}$

- What you would expect...
- Human-readable  $\text{\LaTeX}$
- Money-back guarantee for the cautious
- All customizations in the preamble, only as required
- Selective about packages: “standard” and well-supported
- A body you could easily style differently
- `pdflatex` or `xelatex` compatible
- Processing switches: `fontsize`, `page geometry`, `numbering depth`, ...
- Language-independent: e.g. “Chapter”, “Theorem”,
- Unicode-aware

## 7 Conversion to HTML

- Writing HTML with clear separation from presentation (CSS)
- Mathematics rendering from MathJax library
- Fonts, Code Prettifier from Google
- Interactive elements (now): Video, Sage Cell, GeoGebra, Program Listings
- Interactive elements (possible): Audio, Skulpt, WebRTC, WeBWorK,
- SVG graphics from TikZ, Asymptote, Sage sources
- Numbering, cross-referencing matches L<sup>A</sup>T<sub>E</sub>X version (equations, too)
- Extensive code-sharing with L<sup>A</sup>T<sub>E</sub>X conversion

## 8 Conversion to Sage Worksheets

- “Sage Notebook” is web interface for Sage worksheets (c. 2006-2008)
- Worksheet: HTML plus some non-standard markup, graphics files, in tar archive
- My original itch: L<sup>A</sup>T<sub>E</sub>X to XHTML (tex4ht) to worksheet(s), (c. 2010)
- Now: about 200 lines of additional XSLT, 200 lines of Python

## 9 Demonstrations

Tom Judson’s *Abstract Algebra: Theory and Applications*

Chapter 5, Permutation Groups

Open Source’d in early 2009: <http://abstract.ups.edu>

- PDF/Print
- HTML/Webpages
- Sage Worksheets in Sage Notebook
- Sage DocTests (another itch)

*Explorations in Algebraic Graph Theory*, with Chris Godsil

## 10 Existing Projects

- RAB: This presentation
- RAB: traditional printed monograph on Combinatorial Designs (CUP)
- RAB: A Second Course on Linear Algebra (open-source now)
- Judson: Abstract Algebra: Theory and Applications (beta: AY 2014-15)
- Judson, Hitchman: Ordinary Differential Equations Textbook (in-progress)
- RAB, Godsil: Explorations in Algebraic Graph Theory with Sage
- Others at initial stages

## 11 To Do

Development priority: user requests

First things first.

- Knowlification for HTML, selectable with processing switches
- Finish Document Type Definition (DTD)
- Convert FCLA's one-off XML to MBX
- Tables and lists need work
- Generate back matter automatically: index, notation list, list of ...
- New converters: Sage Math Cloud, iPython Notebooks
- New converters: EPUB 3 EDUPUB Specification, DocBook, Word XML (?)
- Suggestions welcome!

## 12 Conclusion

- MathBook XML is fairly stable now
- Ready for authoring, if ... you are prepared for *a few* changes
- Converters are firming up, and provide modular base for other formats
- Main site: <http://mathbook.pugetsound.edu>
- Announcements and discussion at the [mathbook-xml-support](#) Google Group