

Open Source: Abstract Algebra, Sage and PreTeXt

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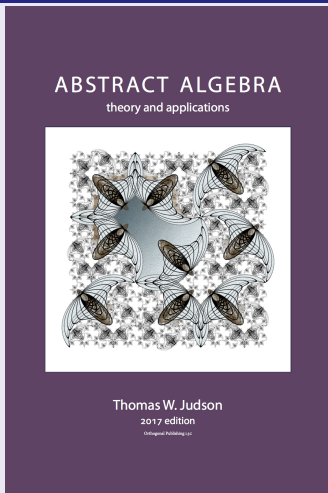
September 28, 2017

Some Background

- *Abstract Algebra: Theory and Applications (AATA)* was first published by PWS in 1994.
- There was a second printing but no second edition.
- After PWS merged with Brooks/Cole, *AATA* went out of print.
- I assumed ownership of the copyright in 1997.
- *AATA* sat idle until 2008.

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An Open Source Linear Algebra Textbook

- Rob Beezer (University of Puget Sound) began *A First Course in Linear Algebra (FCLA)* began as an experiment over 10 years ago.
- *FCLA* was open source from Day 1.
- Version 1.0 was released Summer 2004.
- An online version was released Summer 2008.
- At Rob Beezer's urging, *AATA* became open source in 2008 with a full text version released in early 2009.

What Is An Open Textbook?

- Definition: A textbook is open if the copyright holder explicitly allows unlimited copying, and the distribution of modified versions.
- AATA is licensed under *Gnu Free Document License (GFDL)*.
- Another possible way to go is the *Creative Commons License*.
- You have a copyright in everything you create, *automatically*.
- A lifetime monopoly, plus seventy years.
- As copyright holder, you control copies of your work.
- An open license grants additional rights.

Open Licenses

- Unlimited copying, forever.
- Possibly distribute modified versions.
- Possibly require attribution in modified versions.
- Possibly require modified versions to have same license.
- Example: Creative Commons (various options)
- Example: GNU Free Documentation License
- An open license is different than “free to download.”

Why Open Source?

- Authors are freed from market forces.
- Open source materials have zero or low cost.
- Open source materials are widely available.
- Open source materials can support interactive versions.
- Open source invites wide participation.
- Open source materials are easy to maintain.

Open textbooks allow a return to a free exchange of ideas.

- The best book for the course that you are teaching is the one that you wrote.
- Others may find your book useful.
- *AATA* is currently on the first page of a Google “abstract algebra” search and “abstract algebra textbook.”
- *AATA* has 50+ adoptions—I stopped counting in 2014.

Zero Or Low Cost

- Commercially published textbooks are expensive.
 - J. Gallian. Contemporary Abstract Algebra, 9th Edition. \$199.95
 - T. Hungerford. Abstract Algebra: An Introduction, 3rd Edition. \$195.95
 - The 2017 edition of *AATA* (through Orthogonal Publishing) is available for \$25.99.
- The Internet makes physical manufacturing a non-issue.
- The Internet makes distribution almost a non-issue.
- Open licenses make digital rights restrictions unnecessary.
- Print-on-demand makes physical copies possible at a reasonable price.

- Open source can be universally available via the Internet.
- Open source textbooks can be made available in a variety of formats.
 - Print, PDF, HTML, EPUB, Sage and Jupyter Notebooks
 - Paper, Desktop, Laptop, Smartphone, Tablet, Kindle
- Commercial publishers have difficulty duplicating the access that open source textbooks can provide.

Weekly AATA Stats Report: September 18–24, 2017

Weekly Stats Report: 18 Sep - 24 Sep 2017

Project: AATA-Sections

URL: <http://abstract.pugetsound.edu/aata/>

Summary

	Mon	Tues	Wed	Thur	Fri	Sat	Sun	Total	Avg
Pageloads	505	904	622	442	336	239	516	3,564	509
Unique Visits	230	317	284	210	169	79	206	1,495	214
First Time Visits	134	196	199	137	110	40	120	936	134
Returning Visits	96	121	85	73	59	39	86	559	80

HTML enriched with Javascript widgets/applets/tools.

- GeoGebra (geometry demonstrations)
- JSXGraph (interactive graphs)
- WeBWorK (homework system)
- Skulpt (in-browser Python)
- Sage Cells (live Sage and R commands)
- Audio and Video players
- MathJax (typesetting math)

Open Source Textbooks Can Be Collaborative

We can borrow ideas from open source software development.

- Version control: Git, Mercurial.
- Modular design: topics, applications, exercises.
- We can release early and often.
- Open source does not go out of print.
- Continuous improvement.

Quality Can Be Better And Maintenance Is Easier

Open textbooks have the potential to be better than commercially published textbooks.

- Every reader is a copy-editor.
- Students may be the best copy-editors.
- Typos and errors can be fixed easily and quickly.

Digital Textbooks

- Some digital textbooks are simply PDF files. Maybe the PDF will include hyperlinks (<http://abstract.ups.edu/download/aata-20170805.pdf>)
- Many publishers now offer their text in a digital format in addition to the hardbound version.
- Since publishers must protect their product, commercially published digital textbooks often require special apps, can be slow to load, and must be password protected.
- Compare this to the online version *AATA* (<http://abstract.ups.edu/aata/>)

UTMOST: Undergraduate Teaching of Mathematics with Open Software and Textbooks (2010–2014) NSF Undergraduate Education Grant (DUE-1022574).

- Rob Beezer (University of Puget Sound): Converted FCLA to Sage Notebooks via tex4ht, MathBook XML
- Jason Grout + Students (Drake University): Sage Cell
- Kiran Kedlaya (UC-San Diego)
- Susan Lynds (University of Colorado Boulder): Evaluation
- William Stein (University of Washington): Sage, SageMathCloud
- Tom Judson (Stephen F. Austin University): Abstract Algebra textbook converted to MathBook XML
- Everyone at the American Institute of Mathematics (AIM)

UTMOST: Undergraduate Teaching of Mathematics with Open Software and Textbooks (2016–2018) NSF Undergraduate Education Grant (DUE-1626455).

- Rob Beezer (University of Puget Sound): PreTeXt (formerly MathBook XML)
- David Farmer (American Institute of Mathematics): PreTeXt
- Susan Lynds (University of Colorado Boulder): Evaluation
- Vilma Mesa (University of Michigan): Investigating how students and faculty use textbooks
- Kent Morrison (American Institute of Mathematics): The AIM Open Textbook Initiative
- Tom Judson (Stephen F. Austin University): Abstract Algebra textbook converted to MathBook XML

- Extensible Markup Language (XML) is a markup language that defines a set of rules for encoding documents in a format which is both human-readable and machine-readable.
- PreTeXt (formerly MathBook XML) is a set of XML tags and is structured in a manner very similar to \LaTeX .
- PreTeXt is processed by XSLT (Extensible Stylesheet Language Transformations) into the target format.
- *AATA* was the first book to be written in PreTeXt.

Multiple Formats From A Single Source

PreTeXt is the brainchild of Rob Beezer, who received a Shuttleworth Foundation Flash Grant in May 2013.

- Frees an author from presentation and technical details
- Write once, read anywhere
- Multiple output formats from one source
- Designed to be easy for authors
- \LaTeX syntax for math (and math only)

A Simple PreTeXt Example

```
<book>
  <title>My Great Novel</title>
  <chapter>
    <title>The White Whale</title>

    <p>Call me Ishmael ...</p>
  </chapter>
</book>
```

What About The Math?

```
proposition xml:id="proposition-roots-permute">
  <statement>
    <p>Let  $E$  be a field extension of  $F$ 
    and  $f(x)$  be a polynomial in  $F[x]$ .
    Then any automorphism in  $G(E/F)$ 
    defines a permutation of the roots of  $f(x)$ 
    that lie in  $E$ .</p>
  </statement>
  <proof>
    <p>Let
      
$$f(x) = a_0 + a_1 x + a_2 x^2 + \dots + a_n x^n \dots$$

    </p>
  </proof>
</proposition>
```

Adding A Live Sage Cell Is Easy

```
<sage>  
  <input>integral(x*sin(x^2), x)</input>  
</sage>
```

This will return a live Sage cell that will integrate

$$\int x \sin^2 x \, dx$$

when executed

(<http://sage-cell-repository.wikidot.com/sage:indefinite-integrals>).

What About Existing \LaTeX Documents?

- David Farmer has written a conversion program: SL2X: Structured \LaTeX to XML
- <http://sl2x.aimath.org/development/collectedworks/htmlpaper/1002.1616>

The Current State Of Affairs For AATA

- Print, hardcover, about \$25 for AATA Lon Mitchell of Orthogonal Publishing.
- Available as a Sage worksheet on SageMathCloud, online, PDF. It is also possible to create ePub, iBook, Sage Notebook, and Jupyter versions (experimental).
- The updated instructors solution manual is a work in progress.

What We Are Doing Now

- Continued development PreTeXt tools to be able quickly publish in different formats.
- Rob Beezer and Alex Jordan are integrating WeBWork into PreTeXt: <http://spot.pcc.edu/~ajordan/ww-mbx/html/>
- AIM's Open Textbook Initiative. Stop by the AIM booth at JMM in San Diego.
- Integration with Sage and CoCalc. Stop by the Sage booth at JMM in San Diego.
- Investigating how students actually use their books.

- The PreTeXt website: <http://mathbook.pugetsound.edu>
- Discussion: Google Groups
- CoCalc <https://cocalc.com/>
- My website: <http://faculty.sfasu.edu/judsontw/>

Thanks For Listening

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One last cool example.

<http://mathbook.pugetsound.edu/examples/humanities/html/hia.html>