Publishing Mathematics with XML

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Truths

• Much information/knowledge is discovered/learned from screens
• The Internet is a *publishing* platform
• MathJax makes math look good in a browser
• The Sage Cell and Sage Cloud are important developments
• Doctesting Sage examples is *critical*
• Browsers: yes! E-Books: not quite there yet.
The Problem with LaTeX

• It does not really separate content and presentation
• It is really, really hard to parse and convert
• It does not capture the structure of a document
XML - eXtensible Markup Language

- Hierarchical tree-like structure imposed on text
- Powerful tools to edit, validate, parse, convert
- Minimal reserved characters (primarily <, &)
- HTML (XHTML) is an example
- “XML Application” - tags and converters
- Downside: verbose (harder to read than \LaTeX?)
My Experiments

- FCLA converted Summer 2012
- Chris Godsil’s “Explorations in Algebraic Graph Theory with Sage”
- Tom Judson’s AATA Instructor Manual
- Exams, letters
- Classroom Note to submit to the Monthly
A Language for Mathematics

Properties:

- Structure of academic works (articles, books, chapters, sections)
- Support for mathematics (e.g. displayed mathematics)
- Sage code (static or dynamic)
- Usual: citations, cross-references, ToC, numbered equations
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Outputs:

- Web pages (MathJax, Sage Cell)
- Latex → PDF
- Worksheets, Notebooks (sagenb, Salvus/Cloud)
- Doctest file
- In-browser preview (CSS or XSLT stylesheet)
- E-Books
Current Thinking

- **Structure**: book, article, chapter, section, subsection
- **Math**: inline, displayed, aligned (with, without numbering)
- **Sage**: sage, input, output (random, not tested, etc)
- **Recycle usual HTML**: p, ol, li, em, q, etc.
- **Borrow from DocBook**: Figures, tables
- **Borrow from DocBook**: metadata, bibliography
- **Keep It Super Simple, but grow ”organically”**
It is well known that if $A$ is a nonsingular matrix of size $n \times n$, we can augment with the identity matrix of the same size, bring the matrix to reduced row-echelon form, and then the final $n \times n$ columns will contain the inverse of $A$.

Given a matrix $A$, four associated subspaces are of special interest: the column space $\col{A}$, the (right) null space $\nullspace{A} = \nullspace{\transpose{A}}$, the row space $\row{A}$ and the left nullspace $\leftnullspace{A}$. Strang has dubbed these "The Four Fundamental Subspaces" (XX: citation) and their properties and relationships are indeed fundamental, as well as being varied and interesting. Bases for all four of these subspaces can be obtained easily from $A$ and $A^\top$. By-products are a canonical description of the row operations which bring a matrix to reduced row-echelon form, and the fact that row rank and column rank are equal. We only know of one other textbook, besides our own, which describes this procedure (XX: citation, Beezer, Stuart Find). So the purpose of this note is to make this approach better known.
Demonstrations