

Automated Workflows for Mathematical Equation Processing and Rendering

**EDUPUB 2013
October 29, 2013**

Sanders Kleinfeld
O'Reilly Media, Inc.

Or:

$$-b \pm \frac{\sqrt{b^2 - 4ac}}{2a} \neq \text{☹}$$

**How should I
produce books with
complex
mathematical
content?**

**Publishers often
go one of two
routes for source
files...**

Typeset with L^AT_EX!

```
\section{Bayes's Theorem}
```

At this point we have everything we need to derive Bayes's Theorem.

We'll start with the observation that conjunction is commutative; that is

```
%
```

```
\[ \p{A \AND B} = \p{B \AND A} \]
```

```
%
```

for any events A and B .

```
\index{Bayes's Theorem derivation}
```

```
\index{conjunction}
```

Next, we write the probability of a conjunction:

```
%
```

```
\[ \p{A \AND B} = \p{A}~\p{B|A} \]
```

```
%
```

(Source From *Think Bayes* [O'Reilly Media]:

<http://code.google.com/p/thinkstats/source/browse/trunk/thinkbayes/book.tex#634>)

OR...

Just Embed Images!

rules for numeric operations



Math Magnets

Time for a little extra judging. Below are several problems that are partially worked out. Your job is to figure out what the next thing to do in the problem is. Use the order of operations, and place the correct magnet for the operation you'd do next.

For this one, what is the first thing you do inside the parentheses?

$$\frac{(6 - 3 \cdot 2 + 4^2)}{2}$$

.....
What goes next?

$$\frac{8}{12} - 1 - \frac{1}{3} - \left(\frac{2}{3}\right)$$

.....
What goes next?

Remember, a root is just an exponent

$$2 \cdot (-1) + \sqrt{4} - 3$$

$$-1\left(\frac{5+3}{12}\right) - \frac{1}{3} - 2^3$$

$$-1\left(\frac{8}{12}\right) - \frac{1}{3} - 2^3$$

$$-1\left(\frac{8}{12}\right) - \frac{1}{3} - 8$$

$$-0.4 + 0.1(6 + \sqrt{9})^3$$

inside

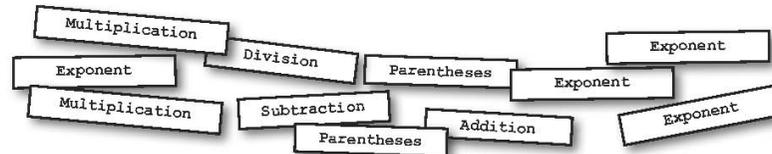
$$\frac{(12 + 13)^{1/2} + 7}{6}$$

This one is tricky - take your time, and you'll figure it out

$$\frac{(25)^{1/2} + 7}{6}$$

$$\frac{5 + 7}{6}$$

..... then



Downsides of L^AT_EX approach:

- **What if you don't want to build a T_EX toolchain?**
- **L^AT_EX is great for PDF export, but what about output to EPUB/Mobi?**

Downsides of image approach:

- **Maintenance is a pain!**
- **How to scale/optimize for different output formats?**

O'Reilly's Solution: Embed L^AT_EX in Standard ASC or DB Source

Instead, we start with a small congestion window and double it for every roundtrip--i.e., exponential growth. As a result, the time required to reach a specific throughput target is a function (`<<SS_TIME>>`) of both the roundtrip time between the client and server and the initial congestion window size.

```
[[SS_TIME]]  
[latexmath]  
.Time to reach the cwnd size of size N  
++++  
\begin{aligned}  
\mathrm{Time} = \mathrm{RTT} \times \left\lceil \log_2 \left( \frac{\mathrm{N}}{\mathrm{initial\ cwnd}} \right) \right\rceil  
\end{aligned}  
++++
```

(From *High Performance Browser Networking* [O'Reilly Media])

BUT...

**How do I render
embedded L^AT_EX for
all my different
(e)book outputs?**

What about MathML?

(<http://www.w3.org/Math/>)

MathML Rendered to PDF*

Equation 1-6.

$$a_0 + \frac{1}{a_1 + \frac{1}{a_2 + \frac{1}{a_3 + \frac{1}{a_4}}}}$$

Equation 1-7.

$$a_0 + \frac{1}{a_1 + \frac{1}{a_2 + \frac{1}{a_3 + \frac{1}{a_4}}}}$$

Equation 1-8.

$$\binom{n}{k/2}$$

MathML in EPUB (iBooks)

Equation 1-6.

$$a_0 + \frac{1}{a_1 + \frac{1}{a_2 + \frac{1}{a_3 + \frac{1}{a_4}}}}$$

Equation 1-7.

$$a_0 + \frac{1}{a_1 + \frac{1}{a_2 + \frac{1}{a_3 + \frac{1}{a_4}}}}$$

Equation 1-8.

$$\binom{n}{k/2}$$

Equation 1-9.

$$\binom{p}{2} x^2 y^{p-2} - \frac{1}{1-x} \frac{1}{1-x^2}$$

Equation 1-10.

$$\sum_{\substack{0 \leq i \leq m \\ 0 < j < n}} P(i, j)$$

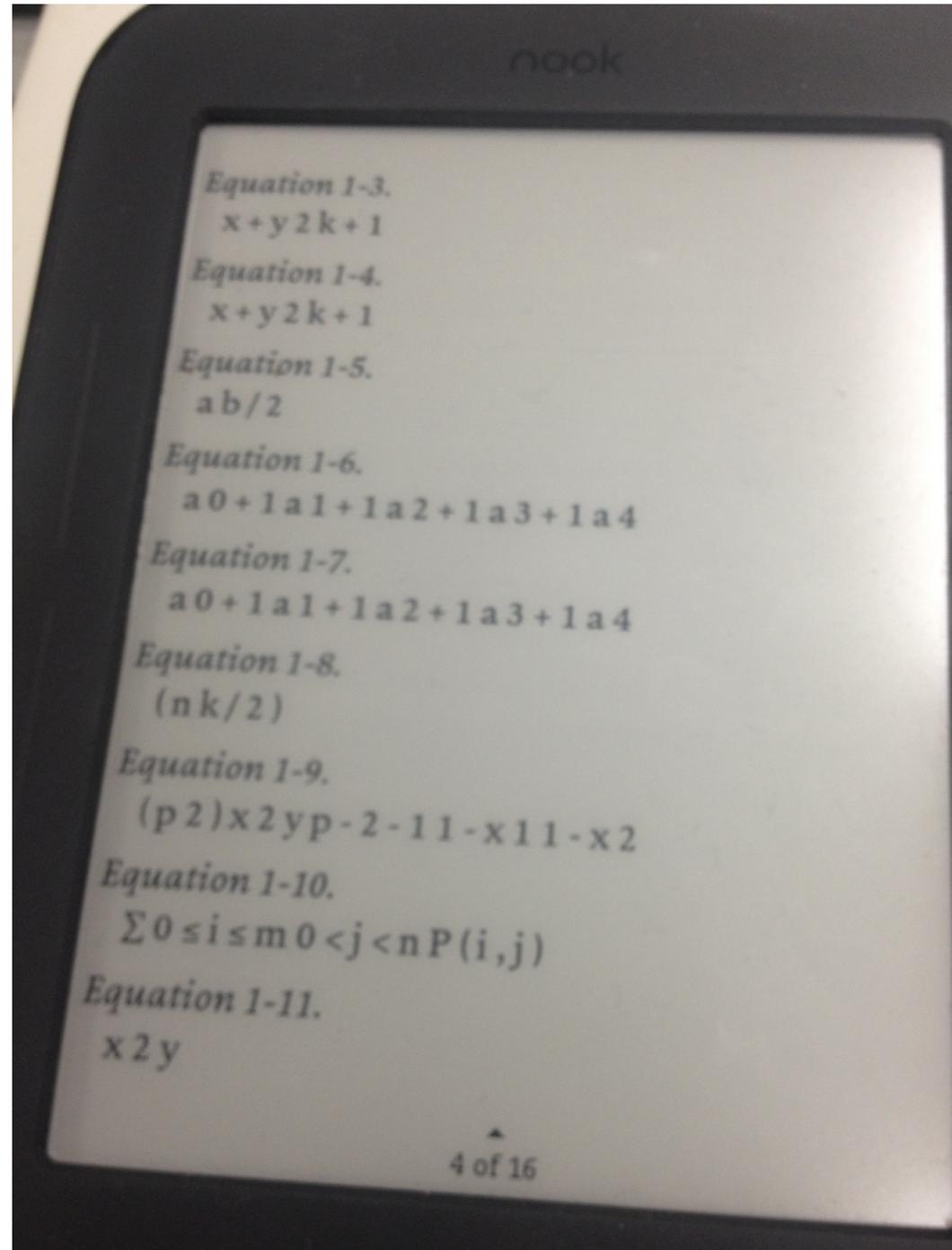
Equation 1-11.

$$x^{2y}$$

Equation 1-12.

$$\sum_{i=1}^p \sum_{j=1}^q \sum_{k=1}^r a_{ij} b_{jk} c_{ki}$$

MathML in EPUB (NOOK)



MathML in Mobi (Kindle Fire)

Equation 1-6.

$$a_0 + 1a_1 + 1a_2 + 1a_3 + 1a_4$$

Equation 1-7.

$$a_0 + 1a_1 + 1a_2 + 1a_3 + 1a_4$$

Equation 1-8.

$$\binom{n}{k} / 2$$

Equation 1-9.

$$(p^2)x^2y^{p-2} - 11 - x^{11} - x^2$$

Equation 1-10.

$$\sum_{0 \leq i \leq m} \sum_{0 < j < n} P(i, j)$$

Equation 1-11.

$$x^2y$$

Equation 1-12.

$$\sum_{i=1}^p \sum_{j=1}^q \sum_{k=1}^r a_{ij} b_{jk} c_{ki}$$

Equation 1-13.

$$1 + 1 + 1 + 1 + 1 + 1 + 1 + x$$

OK, what about SVG?

(<http://www.w3.org/Graphics/SVG/>)

SVG Rendered to PDF*

Equation 1-6.

$$a_0 + \frac{1}{a_1 + \frac{1}{a_2 + \frac{1}{a_3 + \frac{1}{a_4}}}}$$

Equation 1-7.

$$a_0 + \frac{1}{a_1 + \frac{1}{a_2 + \frac{1}{a_3 + \frac{1}{a_4}}}}$$

Equation 1-8.

$$\binom{n}{k/2}$$

SVG in EPUB (iBooks)

Equation 1-4.

$$x + y^{\frac{2}{k+1}}$$

Equation 1-5.

$$\frac{a}{b/2}$$

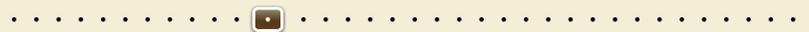
Equation 1-6.

$$a_0 + \frac{1}{a_1 + \frac{1}{a_2 + \frac{1}{a_3 + \frac{1}{a_4}}}}$$

Equation 1-7.

$$a_0 + \frac{1}{a_1 + \frac{1}{a_2 + \frac{1}{a_3 + \frac{1}{a_4}}}}$$

Equation 1-8.



SVG in Mobi (Kindle Paperwhite)

$$x + y^{\frac{2}{k+1}}$$

Equation 1-5.

$$\frac{a}{b/2}$$

Equation 1-6.

$$a_0 + \frac{1}{a_1 + \frac{1}{a_2 + \frac{1}{a_3 + \frac{1}{a_4}}}}$$

SVG in Mobi (Kindle “classic”)

Equation 1-5.

Equation 1-6.

Equation 1-7.

Equation 1-8.

Equation 1-9.

Equation 1-10.

Equation 1-11.

Equation 1-12.

Equation 1-13.

Equation 1-14.

Equation 1-15.

Equation 1-16.

Equation 1-17.

Equation 1-18.

Equation 1-19.

Equation 1-20.

Equation 1-21.

Equation 1-22.

Equation 1-23.

Equation 1-24.

Equation 1-25.

Equation 1-26.

Gah, what's left?
JPEG or PNG?

**Well, yes.
Only standard
bitmap image
formats work
reliably
everywhere**

BUT...

**Why do we need a
one-size-fits-all
solution?**

**Can't we optimize
equation output
separately for
each format?**

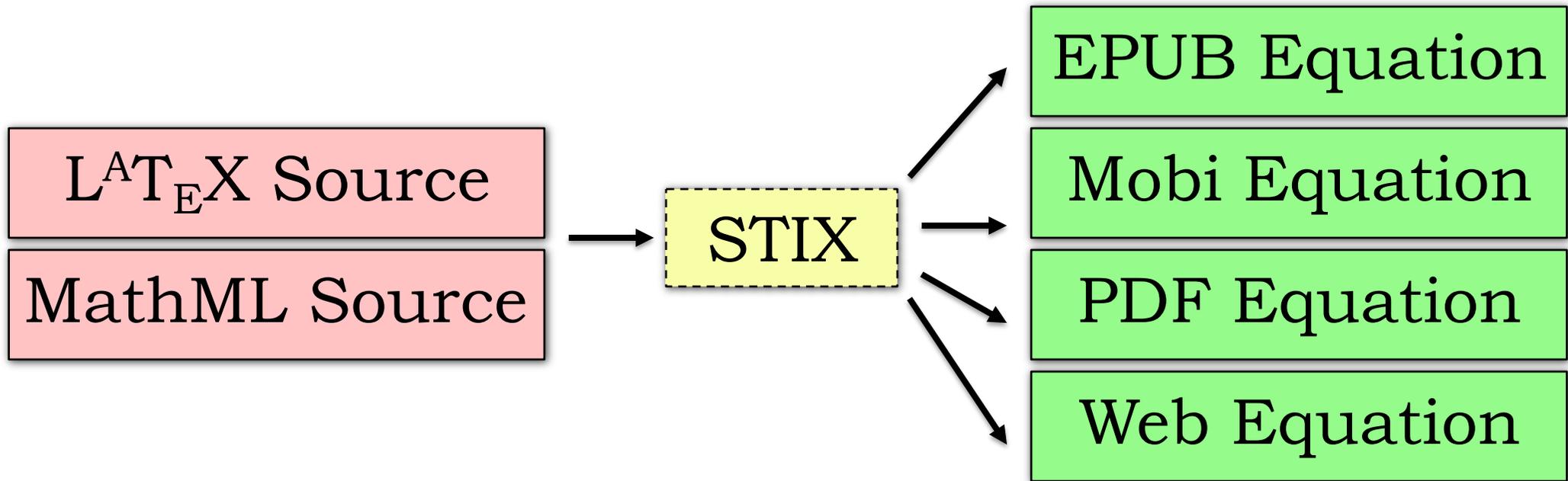


“Frustrated man at a desk” (by LaurMG; [http://commons.wikimedia.org/wiki/File:Frustrated_man_at_a_desk_\(cropped\).jpg](http://commons.wikimedia.org/wiki/File:Frustrated_man_at_a_desk_(cropped).jpg))

Don't Worry!

Make an API!

O'Reilly Media's Math Conversion API (*a.k.a. STIX*)



STIX: Under the Hood

L^AT_EX



tralics

(<http://www-sop.inria.fr/marelle/tralics/>)



MathML

MathML



SVGMath

(<http://sourceforge.net/projects/svgmath/>)



SVG



rsvg

(<https://developer.gnome.org/rsvg/stable/>)



PNG

Source Format

Conversion Tool

Intermediate Format

Output Format

Equation Output Formats Per Ebook Format

EBOOK Format	Equation Output Format
EPUB	PNG
Mobi	PNG
PDF	MathML (rendered by AntennaHouse Formatter*)
HTML (for Web)	$\text{L}^{\text{A}}\text{T}_{\text{E}}\text{X}$ or MathML (with MathJax** for rendering)

* <http://www.antennahouse.com/>

** <http://www.mathjax.org/>

Future Improvements

- **MathJax-based engine for STIX
(à la `svgtex`)**

 <https://github.com/agrbin/svgtex>

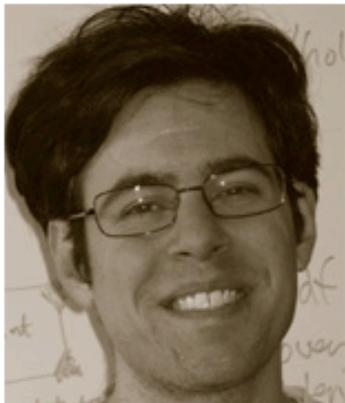
- **Improved Accessibility!
(alt text for PNG via ChromeVox)**

 <http://kefletcher.blogspot.com/2013/07/next-steps-from-accessibility-sprint.html>

Contact Me!

Email: sanders@oreilly.com

Twitter: [@sandersk](https://twitter.com/sandersk)



Sanders Kleinfeld

sanders@oreilly.com

<http://twitter.com/sandersk>

Cambridge, Massachusetts

Ebook Alchemist

Areas of Expertise:

- DocBook XML
- XSLT
- XPath
- XQuery
- RDF
- SPARQL
- EPUB
- Mobi
- HTML5
- speaking
- writing

Biography

Books

Blog

Multimedia

Sanders Kleinfeld has been employed at O'Reilly Media since 2004 and has held a variety of positions, including roles on O'Reilly's Production, Editorial, and Tools teams. Currently, he works as a Publishing Technologies Specialist, maintaining O'Reilly's XML-based toolchain for generating EPUB and Mobi formats of both frontlist and backlist titles. He also helps coordinate O'Reilly's digital distribution efforts to electronic sales channels, and is currently assisting in R&D efforts surrounding HTML5

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Author Events

Webcast: HTML5 for Publishers