

# On the Technicalities of Scientific Writing Anno 2012: The Doconce Way

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## 1 Scope

- *scientific writing* = lecture notes, slides, reports, thesis, books, ...
- (Journal papers typeset by journals are out of scope)
- Scope: documents with much *math* and *computer code*
- Key question: What tools should I use for writing?
- Default answer: L<sup>A</sup>T<sub>E</sub>X
- Alternative: MS Word w/math
- Recent popular alternative tools: Sphinx, Markdown, IPython notebook

## 2 Scientific writing needs to address many new media

- Old days (1985-2005): mostly black-and-white documents aimed at printing
- Now:
  1. Black-and-white books
  2. Colorful books and PDFs
  3. PDFs with hyperlinks
  4. HTML web pages (plain or fancy design)
  5. Wikis
  6. epub
- L<sup>A</sup>T<sub>E</sub>X does not support all of this
- We need to write for multiple formats!

### 3 Popular tools anno 2012

- **LaTeX**: de facto standard in math-intensive sciences
- **pdfLaTeX**: takes over (figures in png, pdf)
- **Word**: popular, but limited math support and not so good-looking math fonts
- **HTML with MathJax**: "full"  $\text{\LaTeX}$  math in HTML
- **Sphinx**, based on reStructuredText (HTML,  $\text{\LaTeX}$ ): limited  $\text{\LaTeX}$  math support, great support for web design
- **reStructuredText**: no math support, transforms to lots of formats ( $\text{\LaTeX}$ , HTML, XML, Word, OpenOffice, ...)
- **Markdown**: email-style untagged formatting, limited  $\text{\LaTeX}$  math support, transforms to lots of formats ( $\text{\LaTeX}$ , HTML, XML, Word, OpenOffice, ...)
- **MediaWiki**: "full"  $\text{\LaTeX}$  math support (Wikipedia)
- Other **wiki** formats: no math support, great for collaborative editing
- **Epydoc**: for Python code documentation
- **IPython notebooks**: combines Python code, interactivity and Markdown writing
- **Plain text for email** (no tagging)

### 4 $\text{\LaTeX}$ is very rich; other tools support only some elements

- $\text{\LaTeX}$  inline math:  $\text{\LaTeX}$ , MathJax, Sphinx, Markdown, MediaWiki
- $\text{\LaTeX}$  equation math:
  - $\text{\LaTeX}$ : `equation*`, `equation`, `align*`, `align` + `eqnarray`, `split`, `alignat`, ...
  - MathJax: `equation*`, `equation`, `align*`, `align`
  - MediaWiki: `equation*`, `equation`, `align*`, `align`
  - Sphinx: `equation*`, `equation`, `align*`
  - Markdown: `equation*`, `equation`

## 5 $\text{\LaTeX}$ is very rich; other tools support only some elements

- Figures: all
- Subfigures:  $\text{\LaTeX}$  (`subfigure`)
- Movies:  $\text{\LaTeX}$  (can run separately), just raw embedded HTML in others
- Floating computer code:  $\text{\LaTeX}$
- Fixed computer code: all
- Floating tables:  $\text{\LaTeX}$
- Fixed tables: all
- Algorithms:  $\text{\LaTeX}$
- Margin notes:  $\text{\LaTeX}$
- Footnotes:  $\text{\LaTeX}$ , Sphinx, reStructuredText, MediaWiki
- Bibliography:  $\text{\LaTeX}$ , Sphinx, reStructuredText, MediaWiki
- Hyperlinks: all (but does not work on paper!)

Conclusion: Highly non-trivial to translate a  $\text{\LaTeX}$  document into something based on HTML and vice versa.

## 6 Concerns I

- Sphinx refers to figures by the caption (has to be short!) and strips away any math notation (avoid that!).
- Sphinx refers to sections by the title, but removes math in the reference, so avoid math in headlines.
- Algorithms must be written up using basic elements like lists or paragraphs with headings.
- Tables cannot be referred to by numbers and have to appear at a fixed position in the text.
- Computer code has to appear at fixed positions in the text.

## 7 Concerns II

- Footnotes must appear as part of the running text (e.g., sentences surrounded by parenthesis), since only a few formats support footnotes.
- Sphinx does not handle code blocks where the first line is indented.
- Multiple plots in the same figure: mount the plots to one image file and include this (`montage` for png, gif, jpeg; `pdftk`, `pdfnup`, and `pdfcrop` for PDF).
- Keys for items in the bibliography are made visible by Sphinx so "bib-items" a la BibTeX must look sensible and consistent.
- If you need several equations numbered in an `align` environment, recall that Sphinx and Markdown cannot handle this.

## 8 Concerns III

- Index words can appear anywhere in  $\text{\LaTeX}$ , but should be outside paragraphs in other tools.
- References to tables, program code and algorithms can only be made in  $\text{\LaTeX}$ .
- Figures are floating in  $\text{\LaTeX}$ , but fixed in other tools, so place figures exactly where they are needed the first time.
- Curve plots with color lines do not work well in black-and-white printing. Make sure plots makes sense in color and BW (e.g., by using colors and markers).

## 9 Solution I: Use a format that translates to many

- Sphinx can do nice HTML,  $\text{\LaTeX}$ , epub, (almost) plain text, man pages, Gnome devhelp files, Qt help files, texinfo, JSON
- Markdown can do  $\text{\LaTeX}$ , HTML, MS Word, OpenOffice, XML, reStructuredText, epub, DocBook, ... but not Sphinx
- IPython notebook: can convert to  $\text{\LaTeX}$ , reStructuredText, HTML, PDF, Python script
- Sphinx and Markdown has some limited math support :-)

## 10 Solution II: Use Doconce

Doconce offers minimalistic typing, great flexibility wrt format, especially for scientific writing.

- Can generate  $\text{\LaTeX}$ , HTML, Sphinx, Markdown, MediaWiki and other wiki formats
- Good support for math and code
- Great flexibility for typesetting code
- Made for science books *and* smaller teaching modules
- Support for code snippets from files, embedded movies, warnings/hint/info, generalized links
- Support for HTML5 slides - short way from prose to slides
- Integrates with preprocessors: preprocess and mako
- Handles multiple formats for figures
- Between Markdown and Sphinx wrt tagging (and richness)

## 11 Doconce demo

[http://hplgit.github.com/teamods/writing\\_reports/](http://hplgit.github.com/teamods/writing_reports/)

- HTML with MathJax
- PDF from LaTeX
- Sphinx (agni theme)
- Sphinx (pyramid theme)
- Sphinx (classy theme)
- Sphinx (fenics theme)
- Sphinx (redcloud theme)
- Doconce source
- Doconce tutorial

## 12 A tour of Doconce

## 13 Doconce: title, authors, date, toc

```
TITLE: Some Title
AUTHOR: name1 at institution1, with more info, and institution2
AUTHOR: name2 email:name2@web.com at institution
DATE: today
```

```
# A table of contents is optional:
TOC: on
```

Note: title and authors must have everything on a single line!

## 14 Doconce: abstract

```
__Abstract.__
Here goes the abstract...
```

Or:

```
__Summary.__
Here goes the summary...
```

## 15 Doconce: section headings

Headings are marked with ==:

```
===== This is an H2/section heading =====
===== This is an H3/subsection heading =====
=== This is an H4/paragraph heading ===
__This is a paragraph heading.__
```

## 16 Doconce: markup and lists

```
* Bullet lists start with '*'
  and may span several lines
* *Emphasized words* are possible
* _Boldface words_ are also possible
* 'inline verbatim code' is featured
```

This gets rendered as

- Bullet lists start with `*` and may span several lines
- *Emphasized words* are possible
- **Boldface words** are also possible
- inline verbatim code is featured

## 17 Doconce: labels, references, index items

```
# Insert index items in the source
idx{key word1} idx{key word2}

# Label
===== Some section =====
label{this:section}

# Make reference
As we saw in Section ref{this:section}, references, index
items and labels follow a syntax similar to LaTeX
but without backslashes.

# Make reference to equations
See (ref{eq1})-(ref{myeq}).
```

## 18 Doconce: figures and movies

Figure with HTML and L<sup>A</sup>T<sub>E</sub>X info, and caption, all on one line:

```
FIGURE: [figdir/myfig, width=300 frac=1.2] My caption. label{fig1}
```

(Will be 300 pixels wide in HTML and span 1.2 times the linewidth in L<sup>A</sup>T<sub>E</sub>X.)

Movies are also supported:

```
MOVIE: [http://www.youtube.com/embed/P8VcZzgdfSc, width=420 height=315]
```

and rendered as

```
: http://www.youtube.com/watch?v=P8VcZzgdfSc
```

## 19 Doconce: math

Inline math as in L<sup>A</sup>T<sub>E</sub>X:

```
...where $a=\int_{\Omega} f dx$.
```

gets rendered as ...where  $a = \int_{\Omega} f dx$ .

An equation environment is surrounded by `bt!` and `et!` tags (see the source of this document), the rest is plain L<sup>A</sup>T<sub>E</sub>X:

$$\frac{\partial u}{\partial t} = \nabla^2 u, \tag{1}$$

$$\nabla \cdot \boldsymbol{v} = 0 \tag{2}$$

Limit environments to

```
\[ ... \]

\begin{equation*}
\end{equation*}

\begin{equation}
\end{equation}

\begin{align*}
\end{align*}

\begin{align}
\end{align}
```

## 20 Doconce: writing code

Code is enclosed in `bc!` and `ec!` tags (see the source for this page).

```
def solver(I, a, T, dt, theta):
    """Solve u'=-a*u, u(0)=I, for t in (0,T] with steps of dt."""
    dt = float(dt)          # avoid integer division
    N = int(round(T/dt))      # no of time intervals
    T = N*dt                 # adjust T to fit time step dt
    u = zeros(N+1)           # array of u[n] values
    t = linspace(0, T, N+1)  # time mesh

    u[0] = I                 # assign initial condition
    for n in range(0, N):    # n=0,1,...,N-1
        u[n+1] = (1 - (1-theta)*a*dt)/(1 + theta*dt*a)*u[n]
    return u, t
```

## 21 Doconce: copying code from source files

We recommend to copy as much code as possible directly from the source files:

```
@@@CODE file fromto: start-regex@end-regex
```



ex:

```
@@@CODE src/dc_mod.py  fromto: def solver@def verify_three
```

- Computer language can be specified:
  - bc pycod! for Python snippet,
  - bc pypro! for complete Python program
- Similar for C (c), C++ (cpp), Fortran (f), Matlab (m): bc mpro!
- From files: .py gives bc pycod!, .f gives bc fcod!, etc.
- ptex2tex can be used to choose between 40+ typesettings of computer code in L<sup>A</sup>T<sub>E</sub>X
- pygments is used for code typesetting in HTML

## 22 Doconce: tables

```
|-----|
|time   | velocity | acceleration |
|---r---r-----r---|
| 0.0   | 1.4186   | -5.01        |
| 2.0   | 1.376512 | 11.919       |
| 4.0   | 1.1E+1   | 14.717624    |
|-----|
```

Gets rendered as

time	velocity	acceleration
0.0	1.4186	-5.01
2.0	1.376512	11.919
4.0	1.1E+1	14.717624

## 23 Doconce: newcommands for math

- newcommands\*.tex files contain newcommands
- Used directly in L<sup>A</sup>T<sub>E</sub>X
- Substitution made for many other formats

## 24 Doconce: exercises

Doconce offers a special format for *exercises*, *problems* and *projects*:

```
===== Problem: Flip a Coin =====
label{demo:ex:1}
files = flip_coin.py, flip_coin.pdf
solutions = mysol.txt, mysol_flip_coin.py

!bsubex
Make a program that simulates flipping a coin $N$ times.

!bhint
Use 'r = random.random()' and define head as 'r <= 0.5'.
!ehint
!esubex

!bsubex
Compute the probability of getting heads.

!bans
A short answer: 0.5.
!eans

!bsol
A full solution to this subexercise can go here.
!esol
!esubex

!bsubex
Make another program that computes the probability
of getting at least three heads out of 5 throws.
!esubex
```

## 25 Doconce: exercises

Last page gets rendered as follows:

### Problem 1: Flip a Coin

- a) Make a program that simulates flipping a coin  $N$  times.

**Hint.** Use `r = random.random()` and define head as `r <= 0.5`.

- b) Compute the probability of getting heads.

**Answer.** A short answer: 0.5.

**Solution.** A full solution to this subexercise can go [here](#).

c) Make another program that computes the probability of getting at least three heads out of 5 throws.

Filenames: `flip_coin.py`, `flip_coin.pdf`.

## 26 Doconce: use of preprocessors

- Simple if-else tests a la C preprocessor
- `FORMAT` variable can be used to test on format
  - if latex/pdflatex do one sort of code (raw `LATEX`?)
  - if html, do another type of code, etc.
- Easy to comment out large portions of text
- Easy to make different versions of the document
- The mako preprocessor is really powerful - gives a complete programming language inside the document (!)

## 27 Doconce: slides

Very effective way to generate slides from running text:

- Take a copy of your Doconce prose
- Strip off as much text as possible
- Emphasize key points in bullet items
- Focus on figures and movies
- Focus on key equations
- Focus on key code snippets
- Insert `split!` wherever you want a new slide to begin
- Use `7 =` or `5 =` in headings (H2 or H3)
- Slides are made with HTML5 tools such as `reveal.js`, `deck.js`, `csss`, or `dzs-lides`

## 28 Doconce: example on slide code

```
!split
===== Headline =====

* Key point 1
* Key point 2

FIGURE: [figs/myfig, width=800]

MOVIE: [http://www.youtube.com/embed/P8VcZzgdfSc, width=420 height=315]

Key equation:

\[ -\nabla^2 u = f \quad \hbox{in } \Omega \]

And maybe a final comment?

!split
===== Next slide... =====
```

## 29 Doconce: output in HTML

```
doconce format html doconcefile

# Solarized HTML style
doconce format html doconcefile --html-solarized

# Control pygments typesetting of code
doconce format html doconcefile --pygments-html-style=native

# Or use plain <pre> tag
doconce format html doconcefile --no-pygments-html

# Further making of slides
doconce slides_html doconcefile reveal --html-slide-theme=darkgray
```

## 30 Doconce: output in pdf $\text{\LaTeX}$

```
doconce format pdflatex doconcefile

# Result: doconcefile.p.tex (ptex2tex file)
# Run either
ptex2tex doconcefile
# or
```

```
doconce ptex2tex doconcefile -DHELVETICA envir=minted

pdflatex doconcefile
bibtex doconcefile
pdflatex doconcefile

# More control of how code is typeset
doconce format pdflatex doconcefile --minted-latex-style=trac
doconce ptex2tex doconcefile envir=minted

doconce format pdflatex doconcefile
doconce ptex2tex doconcefile envir=ans:nt
```

## 31 Doconce: output in Sphinx

```
doconce format sphinx doconcefile

# Autocreate sphinx directory
doconce sphinx_dir theme=pyramid doconcefile
# Copy files and build HTML document
python automake-sphinx.py

google-chrome sphinx-rootdir/_build/html/index.html
```

Much easier than running the Sphinx tools manually...

## 32 Doconce: output in other formats

```
doconce format pandoc doconcefile # Markdown (pandoc extended)
doconce format mwiki doconcefile # MediaWiki
doconce format gwiki doconcefile # Googlecode wiki
doconce format cwiki doconcefile # Creole wiki (Bitbucket)
doconce format rst doconcefile # reStructuredText
doconce format plain doconcefile # plain, untagged text for email
```