# DocOnce Description

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**Warning.**

Some parts of this manual may be outdated. Please create an issue at https://github.com/hplgit/doconce to report errors.

## 1 What Is DocOnce?

DocOnce is a very simple and minimally tagged markup language that looks like ordinary ASCII text, much like what you would use in an email, but the text can be transformed to numerous other formats, including HTML, Sphinx, LaTeX, PDF, reStructuredText (reST), Markdown, MediaWiki, Creole wiki, blogger.com, wordpress.com, Epytext, and also plain (untagged) text for email. From reST or Markdown you can go to XML, OpenOffice, MS Word, HTML, LaTeX, PDF, DocBook, GNU Texinfo, and more.

DocOnce supports a working strategy of never duplicating information. Text is written in a single place and then transformed to a number of different destinations of diverse type: scientific reports, software manuals, books, thesis, software source code, wikis, blog posts, emails, etc. The slogan is: "Document once, include anywhere".

Here are some DocOnce features:

- DocOnce addresses small and large documents containing *text with much computer source code and LaTeX mathematics*, where the output is desired in different formats such as LaTeX, PDFLaTeX, Sphinx, HTML, MediaWiki, blogger.com, and wordpress.com. A piece of DocOnce text can enter (e.g.) a classical science book, an ebook, a web document, and a blog post.

- DocOnce offers a range of HTML designs, including many Bootstrap and Sphinx styles and solarized color schemes. A special feature is the many styles for admonitions (boxes for warning, notice, question, etc.) in HTML and LaTeX.
- DocOnce targets in particular large book projects where many different pieces of text and software can be assembled in different ways and published in different formats for different devices (see example).
- DocOnce enables authors who write for many types of media (blog posts, wikis, LaTeX manuscripts, Sphinx, HTML) to use a common source language such that lots of different pieces can easily be brought together later to form a coherent (big) document.
- DocOnce has good support for copying computer code directly from the source code files via regular expressions for the start and end lines.
- DocOnce first runs two preprocessors (Preprocess and Mako), which allow programming constructs (includes, if-tests, function calls, variables) as part of the text. This feature makes it easy to write *one text* with different flavors: long vs short text, Python vs Matlab code examples, experimental vs mature content.
- DocOnce can be converted to plain *untagged* text, often desirable for email and computer code documentation.
- DocOnce markup does include tags, so the format is more tagged than Markdown, but less than reST, and very much less than LaTeX and HTML.
- Compared to the related tools Sphinx and Markdown, DocOnce allows more types of equations (especially systems of equations with references), has more flexible inclusion of source code, integrates preprocessors, has special support for exercises, and produces cleaner LaTeX and HTML output.

**History.** The DocOnce development started in 2006 at a time when most popular markup languages used quite some tagging (LaTeX, reStructuredText, HTML). Later, almost untagged markup languages became popular, especially Markdown and its sisters MultiMarkdown, Pandoc-extended Markdown, and Markua. DocOnce looks much like Markdown and is in particular close to the functionality and nature of MultiMarkdown. The advantage of DocOnce, however, is a series of features for supporting both small and large documents (books in particular) with much mathematics and computer code. While Markdown tools are heavily geared toward HTML, DocOnce has strong support for LaTeX since this is the dominating format for books and articles on mathematical subjects. DocOnce can also output Sphinx (not supported by Pandoc or MultiMarkdown), a format that is very attractive for presenting scientific material and

software documentation on the web. (DocOnce allows basic Markdown syntax as input, extended with DocOnce syntax as you like.)

**Disclaimer.** DocOnce applies *text transformations*, mostly via regular expressions. This is not a fool-proof method of translation compared to real parsing. Moreover, the possibility for tweaking the layout in the DocOnce document is obviously limited (at least compared to LaTeX and HTML) since the text can go to all sorts of markup languages. This disadvantage can be quite easily compensated, however, by clever use of the programmable Mako preprocessor used by DocOnce and by automatic editing of the generated output (e.g., via regular expressions).

# Contents

## 1.1 Demos and Documentation

**This guide is for the experienced DocOnce writer!**

Do not read the detailed descriptions of DocOnce syntax that follows (this is a manual!) before you have read the tutorial and played a little around with a simple document.

The primary demo for what can be achieved as output from DocOnce documents regards a little scientific report that is compiled to a range of various output documents. A version of that web page contains the specific compilation commands to create each of the output demonstrations.

There is also a demo on the many different ways one can create slides.

**Write DocOnce documents in a text editor with monospace font!**

Some DocOnce constructions are sensitive to whitespace (indentation in lists is a primary example), so you *must* use a text editor with monospace font (also known as verbatim text). Never use fonts like Arial or Helvetica. (Other popular markup languages such as Sphinx and Markdown are also sensitive to whitespace and require a monospace font in the text editor.)

**Tip: Read the FAQ!**

A lot of tips and problems have over the years been collected in the Troubleshooting and FAQ document, available in Sphinx, HTML, and PDF. The FAQ and this manual are the two key references for how to make use of DocOnce.

The DocOnce tutorial (available in Sphinx, HTML, and PDF formats) has its source code in the GitHub repository for DocOnce, more precisely in the file

`doc/src/tutorial/tutorial.do.txt`

One can compare this source with the output in HTML, Sphinx, and PDF. The `make.sh` script in the same directory tells in detail how the various versions were compiled.

The DocOnce source of the current manual is also found at the GitHub repository for DocOnce, in the file

`doc/src/manual/manual.do.txt`

You can compare this source with the available output in HTML, Sphinx, and PDF.

# 2 Markup Based on Special Lines

The DocOnce markup language has a concept called *special lines*. Such lines starts with a markup at the very beginning of the line and are used to mark document title, authors, date, sections, subsections, paragraphs, figures, movies, lists, etc.

## 2.1 Heading with title and author(s)

Lines starting with `TITLE:`, `AUTHOR:`, and `DATE:` are optional and used to identify a title of the document, the authors, and the date. The title is treated as the rest of the line, so is the date, but the author text consists of the name and associated institution(s) with the syntax

```
AUTHOR: name at institution1 & institution2 & institution3
```

The `at` with surrounding spaces is essential for adding information about institution(s) to the author name, and the `and` with surrounding spaces is essential as delimiter between different institutions. An email address can optionally be included, using the syntax

```
AUTHOR: name Email: somename@site.net at institution1 & institution2
```

Multiple authors require multiple `AUTHOR:` lines. All information associated with `TITLE:` and `AUTHOR:` keywords must appear on a single line. Here is an example:

```
TITLE: On an Ultimate Markup Language
AUTHOR: H. P. Langtangen at Center for Biomedical Computing, Simula Research Laboratory & Dept. of In
AUTHOR: Kaare Dump Email: dump@cyb.space.com at Segfault, Cyberspace Inc.
AUTHOR: A. Dummy Author
DATE: November 9, 2016
```

Note how one can specify a single institution, multiple institutions (with `&` as separator between institutions), and no institution. In some formats (including `rst` and `sphinx`) only the author names appear. Some formats have "intelligence" in listing authors and institutions, e.g., the plain text format:

```
Hans Petter Langtangen [1, 2]
Kaare Dump  (dump@cyb.space.com) [3]
A. Dummy Author

[1] Center for Biomedical Computing, Simula Research Laboratory
[2] Department of Informatics, University of Oslo
[3] Segfault, Cyberspace Inc.
```

Similar typesetting is done for LaTeX and HTML formats.

The current date can be specified as `today`.

## 2.2 Copyright

A copyright notice can be given as part of the `AUTHOR:` command. The syntax is

```
{copyright,year1-year2|license}
```

where `year1-year2` represents the year(s) and `license` represents the type of license (e.g., Creative Commons license) if that apply. The year and license parts can be left out. In that case, the current year is used, and no license appears. Note that *the year and the license must be identical in all copyright specifications* for all authors who claim copyright! (Otherwise, an error message is issued.) The `{copyright...}` specification can appear after the author's name (and email address) and/or after an organization's name (see examples below).

The syntax of the `year1-year` part goes as follows:

- A single year: `2012`.
- A range: `2006-2010`. Up to the current year is specified by `2005-present`. Any attempt to use an upper limit into the future will be replaced by `present`, e.g., `2001-2100` becomes `2001-present`.
- A single year: `date`, which fetches the year from the `DATE:` field in the DocOnce document.

The syntax of the `license` part is flexible:

- Any formulation can be given. For example, `{copyright|This work is released under an MIT license}`.
- Standardized short forms for Creative Commons (CC) licenses are available. For example, `CC BY`, which means a CC Attribution license. `BY` can be replaced by `BY-NC` (Attribution-NonCommercial) and other abbreviations from https://creativecommons.org/licenses/. The command-line option `--CC_license=` is used to provide a template for embedding the spelled out name of the abbreviated CC license. By default this template reads `Released under a CC %s 4.0 license`, where `%s` is to be replaced by the license name. A common value is `--CC_license="This work is released under the Creative Commons %s 4.0 license"`.

How the copyright is typeset depends on the format:

- LaTeX: The copyright appears as a footer on all pages (typeset with the `\fancyfoot[C]` command from the `fancyhdr` package). The command-line option `--latex_copyright=titlepages` leads to a copyright statement in the footer of the titlepage and (for books) the first page of each chapter.
- Sphinx: The copyright is provided as the `copyright` variable in `conf.py` and appears in the footer according to the chosen theme.
- HTML: The copyright appears at the bottom of all pages (right before the `</body> tag`).
- Other formats: A copyright line is inserted after the date.

Here are some examples on specifying copyright.

```
AUTHOR: Joe Doe Email:joe.doe@somemail.com {copyright}
AUTHOR: Jane Doe {copyright}
```

Output becomes “Copyright 2015, Joe Doe, Jane Doe” (if the present year is 2015).

```
AUTHOR: Joe Doe {copyright,2001-present}
```

Output becomes “Copyright 2001-2015, Joe Doe” (if the present year is 2015).

```
AUTHOR: Joe Doe {copyright,2001-2010|CC BY}
AUTHOR: Jane Doe Email:jd@kk.org {copyright,2001-2010|CC BY}
```

Output becomes “Copyright 2001-2010, Joe Doe, Jane Doe. Released under CC Attribution 4.0 license”. One can provide the option `\\ --CC_license="This work is released under t` and the output becomes “Copyright 2001-2010, Joe Doe, Jane Doe. This work is released under the Creative Commons Attribution 4.0 license.”

```
AUTHOR: Joe Doe {copyright} at Digital Company {copyright}
AUTHOR: Jane Doe
```

In this case, an author and an institution (but not the second author) hold the copyright. The output is typically “Copyright 2015, Joe Doe, Digital Company”. Below, two institutions but no authors hold the copyright:

```
AUTHOR: Joe Doe at Digital Company {copyright,2015|CC BY}
AUTHOR: Jane Doe at Analog Company {copyright,2015|CC BY}
```

The output becomes “Copyright 2015, Digital Company, Analog Company. Released under CC Attribution 4.0 license”.

## 2.3 Table of contents

A table of contents can be generated by the line

```
TOC: on
```

This line is usually placed after the `DATE:` line. The value `off` turns off the table of contents.

The depth of the table of contents is dictated by the command-line option `--toc_depth=`, which is 2 by default, meaning that sections and subsections are included, but not subsubsections. When making Sphinx documents, `toc_depth=` is a command-line option for for the `doconce sphinx_dir` command (and not `doconce format`).

## 2.4 Section headings

Section headings are recognized by being surrounded by equal signs (=) or underscores before and after the text of the headline. Different section levels are recognized by the associated number of underscores or equal signs (=):

- 9 = characters for chapters
- 7 for sections
- 5 for subsections
- 3 for subsubsections
- 2 *underscores* (only! - it looks best) for paragraphs (paragraph heading will be inlined)

Headings can be surrounded by as many blanks as desired, but the first = must start in column 1 and there must one blank on each side of the heading, between the heading and the = signs. Here are examples on headings:

```
======= Example on a Section Heading =======

The running text goes here.


===== Example on a Subsection Heading =====

The running text goes here.

=== Example on a Subsubsection Heading ===

The running text goes here.

__A Paragraph.__ The running text goes here.
```

## 2.5 Abstract

DocOnce also supports abstracts. The syntax is like an ordinary paragraph with heading *Abstract*, *Summary*, or *Preface*, but the text *must* be followed by a

- section or paragraph heading
- table of contents (`TOC:`)
- date (`DATE:`)

Everything up to the first heading, table of contents, or date is taken as the abstract. For articles, the abstract is placed after the date, but before the table of contents or the first ordinary heading. For books one may insert the abstract before the date to make appear on the first page.

Here are examples on an abstract and some type of ending text (section headings, table of contents, or date).

```
__Abstract.__ This abstract
lasts up to the section heading.

======= Here Is the First Section Heading =======

# or

__Summary.__
This is
a summary.

Even with two paragraphs. It lasts
until the table of contents.

TOC: on

# In books we may place the summary before DATE

TITLE: Some Title
AUTHOR: Some Author

__Summary.__ Here is the backmatter
promotion text for this book, appearing
on the front page...

DATE: today
```

## 2.6 Appendix

Appendix is supported too: just let the heading start with “Appendix: ” This affects only `latex` output, where the appendix formatting is used - all other formats just leave the heading as it is written.

## 2.7 Figures

**Basic syntax.** Figures are recognized by the special line syntax

```
FIGURE:[filename, width=600 frac=0.8] caption
```

The filename can be without extension, and DocOnce will search for an appropriate file with the right extension. If the extension is wrong, say `.pdf` when requesting an HTML format, DocOnce tries to find another file, and if not, the given file is converted to a proper format (using ImageMagick's `convert` utility).

**Warning.**

Note the comma between the filename and the figure size specifications and that there should be no space around the = sign. This syntax must be strictly followed.

Note also that, like for `TITLE:` and `AUTHOR:` lines, all information related to a figure line *must be written on the same line*. Introducing newlines in a long caption will destroy the formatting (only the part of the caption appearing on the same line as `FIGURE:` will be included in the formatted caption).

The `height`, `width`, and `frac` keywords can be included if desired and may have effect for some formats: the height and width are used for output in the formats `html`, `rst`, `sphinx`, while the frac specification is used for `latex` and `pdflatex` to specify the width of the image as a fraction of the text width.

**Figure Placement.** In web formats (`html`, `sphinx`, `ipynb`, `matlabnb`, wikis), the `FIGURE:` command is replaced by an `img` tag exactly where the `FIGURE:` appears in the document. LaTeX, however, will normally place the figure at a different location. The generated LaTeX code applies

```
\begin{figure}[!ht] % my:fig
```

i.e., we use the "here" option `[!ht]` to recommend a placement as near the `FIGURE:` command as possible. One can autoedit the `.tex` file and modify the `figure` environment options, e.g.,

```
Terminal> doconce replace '{figure}[!ht]' '{figure}[t]' mydoc.tex
```

The above command will change all `[!ht]` options to `[t]` (top). A specific figure can also be edited, using the fact that the label is printed at the same line as `\begin{figure}`:

```
Terminal> doconce subst '{figure}[!ht] .+my:fig' \
          '{figure}[!h] % my:fig' mydoc.tex
```

Of greater influence than options like `[ht]`, `[h]`, etc., is the LaTeX code found in the preamble:

```
\setcounter{topnumber}{2}
\setcounter{bottomnumber}{2}
\setcounter{totalnumber}{4}
\renewcommand{\topfraction}{0.95}
\renewcommand{\bottomfraction}{0.95}
\renewcommand{\textfraction}{0}
\renewcommand{\floatpagefraction}{0.75}
% floatpagefraction must always be less than topfraction!
\usepackage[section]{placeins}  % flush all figs before next
    section
```

These values can be manipulated to fine-tune how LaTeX places figures.

**Figure References.** Suppose we have the DocOnce code

```
The results are presented in Figure ref{myfig}.

FIGURE:[myfigfile, width=400 frac=0.8] Results for $a=2$. label{myfig}
```

Different formats will display the figure reference differently. In LaTeX, DocOnce generates the code `... in Figure~\ref{myfig}`, which reads "... in Figure 5" (article) or "... in Figure 5.2" (book). Requesting the `varioref` package (with `--latex_packages=varioref`) makes DocOnce emit `\vref` references and then the above reference becomes `in Figure~\ref{myfig}`, which reads "... in Figure 5 on page 67". However, if Figure 5 appears on the present page where the reference is done, the page reference is left out, and one can read just "in Figure 5".

Sphinx applies the caption as name of the figure, so the reference reads "... in Figure Results for .", and the caption/name is a link to the figure. Note that Sphinx strips off the mathematics from the caption. In HTML, figures are given numbers, so the reference reads "... in Figure 3", with the figure number as a link to the place in the document where the `FIGURE:` command was located. The IPython notebook format makes a Markdown link: `... in [Figure](#myfig)`, where `myfig` is an anchor such one can click on `Figure`. The plain text format displays the reference as "... in Figure **??**.". Wiki formats show "... in Figure myfig.". So to summarize, figure references work best in LaTeX, HTML, and Sphinx. Other formats should avoid figure references with labels.

**Inline Figures.** The figure caption is optional. If omitted, the figure appears "inline" in the text without any figure environment in LaTeX formats or HTML. An inline figure is handy in LaTeX since it appears exactly where the `FIGURE:` command appears (figures with captions are encapsulated in the LaTeX `figure` environment and become floating objects whose placement is up to LaTeX do decide).

**Tip: use linebreak to insert space around inline figures.**

Sometimes inline figures (`FIGURE` line without caption) get squeezed into the text. You can add vertical space in LaTeX and HTML by inserting several lines with `<linebreak>`.

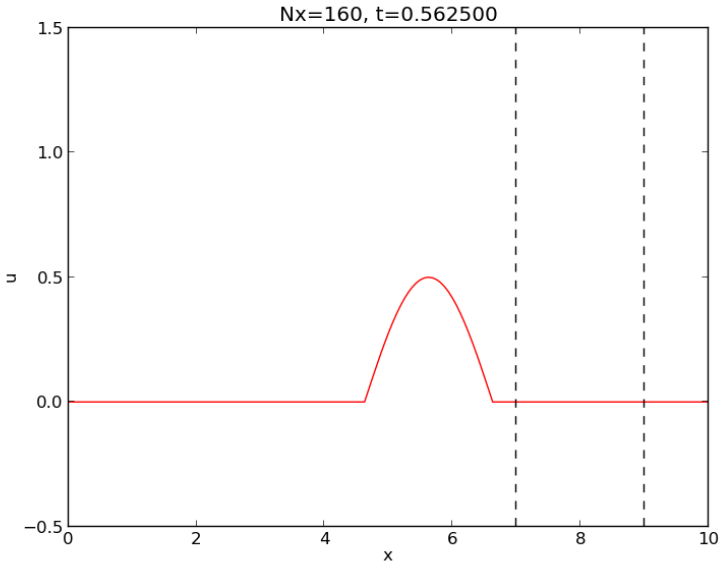



Figure 1: A wave.

**Choosing the Figure Format.** For each output format, there is a preference for the type of graphics file to use. That is, for HTML, for instance, we can accept many types of graphics formats. If we specify the extension as part of the filename, DocOnce will try to find that specific format. If not found, it will convert whatever can be used to some format suitable for HTML. It is highly recommended to prepare figures in different formats manually and not rely on automatic conversion by DocOnce – that gives the best quality. For example, plots should always be prepared in both PDF and PNG formats.

If we just specify the filestem of the figure file, DocOonce will pick the most appropriate version of the file for given output format. For HTML there is a preference for `.svg`, thereafter comes `.html` (typically Bokeh plots), then `.png`, then `gif`, then `.jpg`. Here is the preference list for the various formats:

- `latex`: `.eps`, `.ps`

- pdflatex: .pgf, .tikz, .pdf, .png, .jpg, .jpeg
- html: .svg, .html, .png, .gif, .jpg, .jpeg
- sphinx: .png, .gif, .jpg, .jpeg
- pandoc: .png, .gif, .jpg, .jpeg, .tif, .tiff, .pdf

Other formats, which can display graphics, will prefer .png files.

**Handling Variable Figure Paths.** Figure files are usually located in some directory. Sometimes one needs to compile the DocOnce source file(s) from different directories, and then the path to figure files changes. For example, think of a master DocOnce file that includes different sections whose DocOnce source files are located in different directories. If you want to compile a section as stand-alone document, you have to do that from the subdirectory for that section. The path to a common directory for figures may then be like ../fig/myfig.png, while for the master document in the parent directory, the corresponding path is fig/myfig.png.

The simplest way out of this problem is to use the --fig_prefix= command-line option to set a path prefix for the figure filename. When compiling a section in a subdirectory one sets --fig_prefix=../fig while in the parent directory one needs --fig_prefix=fig to compile the master document. In the DocOnce source file one has FIGURE: [myfig, width=...].

A more manual method is to introduce a Mako variable FIGPREFIX that is set on the command line as part of the doconce format command. The FIGPREFIX variable holds a prefix for the path to the figure. In our example one writes

```
FIGURE: [${FIGPREFIX}/myfig, width=500 frac=0.8] caption label{my:fig}
```

and set FIGPREFIX=../fig after the doconce format ... command if one compiles a section, while FIGPREFIX=fig is the appropriate value of the path when compiling the master document.

**Figures with Subfigures.** Combining several image files into one, in a table fashion, can be done by the montage program from the ImageMagick suite:

```
montage -background white -geometry 100% -tile 2x \
        file1.png file2.png ... file4.png result.png
```

The option -tile XxY gives X figures in the horizontal direction and Y in the vertical direction (tile 2x means two figures per row and -tile x2 means two rows).

The montage program is only appropriate for bitmap images (PNG, JPEG, GIF, TIFF). Images in the PDF format should be mounted together using pdftk (to combine images to one file), pdfnup (to align them in tabular format), and pdfcrop (to remove surrounding whitespace):

```
Terminal> pdftk file1.pdf file2.pdf ... file4.pdf output tmp.pdf
Terminal> pdfnup --nup 2x2 tmp.pdf        # output in tmp-nup.pdf
Terminal> pdfcrop tmp-nup.pdf result.png  # output in FE1.png
```

Instead of using `montage`, `pdftk`, etc., one can rely on the convenient command `doconce combine_images`:

```
Terminal> doconce combine_images pdf -2 fig1 fig2 fig3 fig4 fig
```

This command will combine `fig1.pdf`, `fig2.pdf`, `fig3.pdf`, and `fig4.pdf` with two images per row (`-2` option) and place the result in `fig.pdf`. By just changing the `pdf` option to `png`, the same will happen with `fig1.png`, `fig2.png`, `fig3.png`, and `fig4.png`, resulting in `fig.png`. The tool employs the technique above for PNG and PDF files to produce ultimate quality of the combined image.

One can also run `doconce combine_images` with filenames with extension, e.g.,

```
Terminal> doconce combine_images myfig1.png myfig2.png fig2.png
```

Here, `myfig1,png` and `myfig2.png` are placed next to each other in a new figure file `fig2.png`.

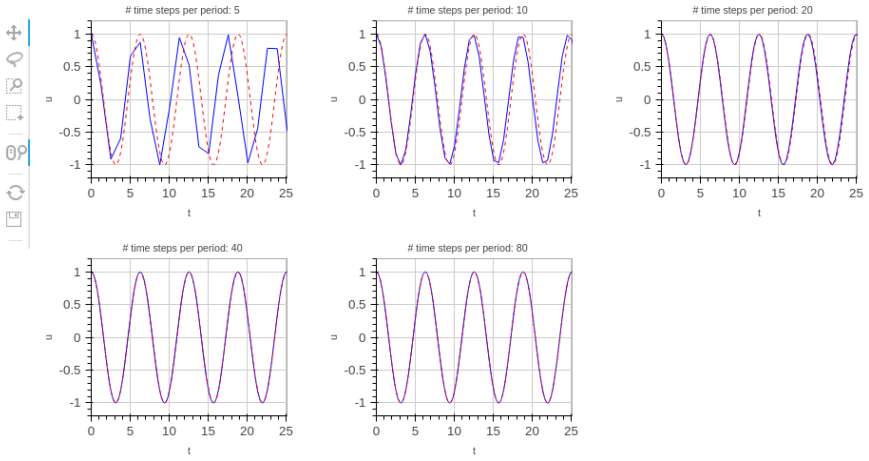
**Sidecaption in LaTeX and HTML.** The figure caption can be placed on the (right) side of figures by using the `sidecap` feature as figure option, e.g., `FIGURE: [myfig, width=500 frac=0.5 sidecap=True]`. The generated `latex` and `pdflatex` output then uses the `sidecap` package and the `SCfigure` environment to typeset the figure. Remember to use a quite low `frac` value for figures with sidecaption (0.5 for instance). A table is used for typesetting a figure with sidecaption in HTML, and a low `width` value is recommended. The `sidecap=True` figure option has no impact on other formats.

**TikZ Figures.** Many LaTeX writers are dependent upon TikZ figures, and these can be used in DocOnce documents, see the demo document.

**Plot Files in LaTeX.** Users who applies Matplotlib to make figures get plots with fonts that differ from the rest of a LaTeX document. A blog post describes techniques for overcoming this problem. The plotfile is then a `.pgf` file and one must use the `pgf` LaTeX package. DocOnce supports `.pgf` plot files for the `pdflatex` output format and will make use of such files if they exist. These are included by a simple `\input{file.pgf}`. If no `.pgf` file is found, the `pdflatex` output format will apply `.pdf`, `.png`, or `.jpg` file, in that order of preference.

**Interactive Bokeh Plots for HTML.** Fancy interactive plots for data exploration can be made with the Bokeh library. Such plots reside in an HTML file. DocOnce will for the HTML output format detect files of this type and use the HTML code in the file to embed the plot(s) in the generated output document.

Below is a complete example on creating a grid of interactive plots where the horizontal axes are coupled to each other. Panning the graph in one plot automatically moves all the other graphs. In this way, one can scroll through a long time series simultaneously for many plots. Our demo looks as follows in a browser:




Such a figure is specified the normal way: if the HTML code for the figure is in `myfig.html`, write

```
FIGURE: [myfig] caption
```

Options like `width` are ignored for Bokeh plots, unless you have other versions of the figure (`myfig.png`, for instance, see the box below) where such options may be useful for some formats.

**Make alternatives to Bokeh plots.**

Note that Bokeh plots have only meaning when DocOnce translates the document to HTML. For other formats, one needs to supply figure files that those formats can accept (PNG, PDF, etc.).

Suppose you have made a Bokeh plot in `myfig.html`. Either you have to embed the `FIGURE` command inside a preprocessor test that the `FORMAT == 'html'` or you must provide alternatives like `myfig.png`. A Bokeh plot will often have a save button that can be used to save the plot to PNG

format. This can be used for Sphinx, wikis, and PDFLaTeX (although the latter would appreciate real vector graphics in a PDF plot).

The plot example above is so advanced that there is no natural counterpart in a static PNG or PDF plot.

**Tip: reduce the size of Bokeh HTML files.**

When making Bokeh plots in Python programs, we recommend to use the `mode='cdn'` option in the call `output_file`. This argument leads to links to Bokeh tools in the resulting HTML file. Without the argument, Bokeh embeds long HTML code for its tools into the file. DocOnce issues a warning in this case and recommends the `mode` argument.

Note that with `mode='cdn'` the HTML code for the plot requires Internet access.

An interactive plot like the one shown above, stored in a file `tmp.html`, can be made by the code below (download file):

```
from __future__ import division
from builtins import range
from past.utils import old_div

def bokeh_plot(u, t, legends, u_e, t_e, I, w, t_range, filename):
    """
    Make plots for u vs t using the Bokeh library.
    u and t are lists (several experiments can be compared).
    legends contain legend strings for the various u,t pairs.
    Each plot has u vs t and the exact solution u_e vs t_e.
    """
    import numpy as np
    import bokeh.plotting as plt
    plt.output_file(filename, mode='cdn', title='Comparison')
    # Assume that all t arrays have the same range
    t_fine = np.linspace(0, t[0][-1], 1001)  # fine mesh for u_e
    tools = 'pan,wheel_zoom,box_zoom,reset,'\
            'save,box_select,lasso_select'
    u_range = [-1.2*I, 1.2*I]
    font_size = '8pt'
    p = []  # list of all individual plots
    p_ = plt.figure(
        width=300, plot_height=250, title=legends[0],
        x_axis_label='t', y_axis_label='u',
        x_range=t_range, y_range=u_range, tools=tools,
        title_text_font_size=font_size)
    p_.xaxis.axis_label_text_font_size=font_size
    p_.yaxis.axis_label_text_font_size=font_size
    p_.line(t[0], u[0], line_color='blue')
    p_.line(t_e, u_e, line_color='red', line_dash='4 4')
    p.append(p_)
    for i in range(1, len(t)):
        p_ = plt.figure(
```

```
            width=300, plot_height=250, title=legends[i],
            x_axis_label='t', y_axis_label='u',
            x_range=p[0].x_range, y_range=p[0].y_range,
                tools=tools,
            title_text_font_size=font_size)
        p_.xaxis.axis_label_text_font_size=font_size
        p_.yaxis.axis_label_text_font_size=font_size
        p_.line(t[i], u[i], line_color='blue')
        p_.line(t_e, u_e, line_color='red', line_dash='4 4')
        p.append(p_)

    # Arrange in grid with 3 plots per row
    grid = [[]]
    for i, p_ in enumerate(p):
        grid[-1].append(p_)
        if (i+1) % 3 == 0:
            # New row
            grid.append([])
    plot = plt.gridplot(grid, toolbar_location='left')
    plt.save(plot)
    plt.show(plot)

def demo_bokeh():
    """Plot numerical and exact solution of sinousoidal shape."""
    import numpy as np

    def u_exact(t):
        return I*np.cos(w*t)

    def u_numerical(t):
        w_tilde = (old_div(2.,dt))*np.arcsin(w*dt/2.)
        return I*np.cos(w_tilde*t)

    I = 1                # Amplitude
    w = 1.0              # Angular frequency
    P = 2*np.pi/w        # Period of signal
    num_steps_per_period = [5, 10, 20, 40, 80]
    num_periods = 40
    T = num_periods*P    # End time of signal

    t_e = np.linspace(0, T, 1001)  # Fine mesh for u_exact
    u_e = u_exact(t_e)
    u = []
    t = []
    legends = []

    # Make a series of numerical solutions with different time
        steps
    for n in num_steps_per_period:
        dt = old_div(P,n)  # Time step length
        t_ = np.linspace(0, T, num_periods*n+1)
        u_ = u_numerical(t_)
        u.append(u_)
        t.append(t_)
        legends.append('# time steps per period: %d' % n)
    bokeh_plot(u, t, legends, u_e, t_e,
               I=1, w=w, t_range=[0, 4*P],
```

```
                filename='tmp.html')

demo_bokeh()
```

**Converting Matplotlib Plots to Bokeh.** Most Python users apply Matplotlib to create line drawings. Bokeh has a conversion utility from Matplotlib to Bokeh that works well for standard curve plots. The script below demonstrates how to generate a plot in Matplotlib and convert it to a Bokeh `tmp.html` file.

```
import numpy as np
import matplotlib.pyplot as plt

x = np.linspace(0, 2*np.pi, 1001)
y1 = np.exp(-x)*np.sin(2*x)
y2 = np.exp(-0.5*x)*np.sin(2*x)

plt.plot(x, y1, 'r-', x, y2, 'b--')
plt.xlabel('x');  plt.ylabel('y')
# legends do not work in Bokeh
#plt.legend([r'$e^{-x}\sin 2x$', r'$e^{-\frac{1}{2}x}\sin 2x$'])
plt.title('Damped sine functions')
plt.savefig('tmp.pdf');  plt.savefig('tmp.png')

# Convert to Bokeh
import bokeh.mpl, bokeh.plotting as bpl
p = bokeh.mpl.to_bokeh(notebook=False, xkcd=False)
#p = bokeh.mpl.to_bokeh()
bpl.output_file('tmp.html', mode='cdn')
bpl.save(p)
#bpl.show(p)

plt.show()
```

## 2.8 Movies

Movies/videos are inserted using the `MOVIE:` keyword. This feature works well for the `latex`, `html`, `rst`, and `sphinx` formats. Other formats try to generate some HTML file and link to that file for showing the movie. If such a link is not appropriate and one wants a figure instead of the movie, use the preprocessor as explained in the box *Recommendations* below.

**The Basic Command.** As with `FIGURE`, the `MOVIE` command expands just *one line* and is of the form

```
MOVIE: [filename, height=xxx width=yyy] possible caption
```

Note that there must be a blank line after every `MOVIE:` command. The width and height parameters are not required, but leaving them out may lead to movie sizes you do not want.

Here is a movie in the Ogg format:

Movie 1: A movie in Ogg format. `mov/wave.ogg`

realized by the command

```
MOVIE: [mov/wave.igg, width=600] A movie in Ogg format.
```

A URL works too as movie address:

```
MOVIE: [http://hplgit.github.io/animate/doc/pub/mov-animate/demo.ogg] Ogg movie in cyberspace.
```

Movie 2: Ogg movie in cyberspace. http://hplgit.github.io/animate/doc/pub/mov-animate/demo.ogg

**Important.**

Movies will not work properly in `sphinx` format unless they are located in a directory (tree) with a name starting with `mov`. Make it a habit to place figures in `fig-X` and movies in `mov-X` directories, where `X` is a short logical name for the current document (or let the names of the directories be just `fig` and `mov`).

**MP4, WebM, and Ogg Movies in HTML.** If a movie is in Ogg, MP4, or WebM format, and the output format is `html`, DocOnce will check if the movie file is also in the other formats among Ogg, MP4, and WebM, and include these as well such that the movie has backup formats in case the browser does not support a particular format. Providing a movie in Ogg, MP4, *and* WebM format is therefore the safest way to ensure that the movie can be played in any browser on any device.

**Notice.**

If you specify a movie in Ogg or WebM format and it also exists in MP4 format, the MP4 format will be loaded first. To avoid having alternative movie formats in HTML, use the `--no_mp4_webm_ogg_alternatives` command-line option when running `doconce format`.

**Movie Handling in Various Formats.** Movies are easiest shown in the HTML format. The reST and Sphinx formats apply the same raw HTML code as the HTML format and therefore have the same capabilities. The LaTeX format supports different methods for embedding movies via the option `-latex_movie=...`. Proper values are listed below.

1. `href`: the `\href{run:file}{link}` is used for all movies (default), typeset in a one-line `quote` environment with the movie caption (if present) and a movie counter.
2. `media9`: the `media9` package is used for Flash and MP4 movies, `movie15` for MPEG and AVI files, and a simple `\href{run:file}{link}` command for other formats. Only Acrobat Reader supports displaying these type of movies.
3. `multimedia`: the `\movie` command (known from LaTeX Beamer) is used for movies.
4. `movie15`: the old `movie15` package is used.

**Where to put the movie file for a PDF document?**

A major concern when using the default (`href`) link to a movie in a PDF document, is where to store the movie file. If your document is in a repository at GitHub or Bitbucket, one can use this address for the movie file. However, for the HTML and Sphinx formats, we would like to use some short, local address `mov/mymovie.ogg`. For LaTeX PDF we can then use the command-line option `--prefix_movie=` to prefix the local address with the proper address in the repository in the cloud. Suppose the `mov` directory is found in

```
https://github.com/n/p/blob/master/doc/mov
```

We need, however, the raw movie file, which has the address

```
https://raw.githubusercontent.com/n/p/master/doc/mov/m.ogg
```

We can then use the line

```
MOVIE: [mov/m.ogg]
```

in the document, but compile to LaTeX with the command-line option

```
--movie_prefix=https://raw.githubusercontent.com/n/p/master/doc/
```

All links to movies in the PDF file will then be links to the repository file in the cloud while for HTML and Sphinx we link to the local movie files that are stored together with the `.html` files for the document.

For all other formats, an HTML file that acts as a movie player is generated and linked from the output document. This movie player has essentially the same code as the HTML format would have, except that the `video` tag is not used, only the `embed` tag. Some wiki types do have support for videos,

e.g., Wikipedia can work with Ogg files, but DocOnce has not yet implemented robust schemes for anything but LaTeX, HTML, and Sphinx output.

**YouTube and Vimeo Movies.** Many publish their scientific movies on YouTube or Vimeo, and DocOnce recognizes YouTube and Vimeo URLs as movies. When the output from DocOnce is an HTML file, the movie will be embedded, otherwise a URL to the YouTube or Vimeo page is inserted. You should equip the `MOVIE:` command with the right width and height of *embedded* YouTube and Vimeo movies. The recipe goes as follows:

1. click on *Share* (and on YouTube then *Embed*)
2. note the height and width of the embedded movie

A typical `MOVIE` command with a YouTube movie is then

```
MOVIE: [http://www.youtube.com/watch?v=sI2uCHH3qIM, width=420 height=315]

MOVIE: [http://vimeo.com/55562330, width=500 height=278] CFD.
```

**Animation Based on Filename Generators.** It is possible to define a movie from a set of files, usually plot files, which can be shown in sequence to create an animation. If the files are local on the computer, one can specify them by a simple Unix wildcard notation, as in

```
MOVIE: [../experiments/frame_*.png]
```

Output in the HTML, reST, and Sphinx formats will make use of inline JavaScript code to show the frames in sequence. LaTeX employs the `animate` package for the same purpose. Other formats generates a file (`movie_playerX.py`, where `X` is a number) containing the HTML code with JavaScript to show and control the animation. The DocOnce document has a link to this movie viewer.

There is an alternative syntax to the Unix wildcard notation:

```
MOVIE: [../experiments/frame_%04d.png:0->320]
```

The filename is specified via printf syntax (typically the same syntax as used to generate the individual frame files). The postfix `:0->320` specifies the lower and upper limit of the counter that is used in the printf specification `%04d`. This latter syntax must be used if the plot files reside on some web server, e.g.,

```
MOVIE: [http://some.where.net/experiments/frame_%04d.png:0->320]
```

Here is an example:

`http://hplgit.github.io/animate/doc/pub/mov-animate/frames/frame_%04d.png:0->320`: load `movie_player1.html` into a browser

**Recommendations.**

It is challenging to write robust DocOnce code with movies. The recommended formats in HTML are MP4, WebM, and Ogg. One should preferably make all three. These also works in reST and Sphinx.

The filename generation works very well in LaTeX, while true movie formats pose big challenges. On Linux systems, the `media9` does not work well because a proper Flash player for embedding in the PDF file is not always available. The `movie15` package also leads to problems because Acrobat Reader depends on an external player to show the files, and the correct plugins to launch players with support for a given format are not trivial to install. Even the plain `href{run:file}` command relies on an external player and not all formats will be supported on a given computer.

To have really robust code, use filename generators and not movie files.

```
MOVIE: [../experiments/frame_*.png]
```

One can write flexible DocOnce code and decide at run time if HTML output should have movie files or filename generators. A relevant snippet using Mako and a user-defined variable `HTMLMOVIE` is

```
% FORMAT in ("latex", "pdflatex") or HTMLMOVIE == "files":
MOVIE: [../experiments/frame_*.png]

% else:
MOVIE: [../experiments/movie.ogg]

% endif
```

With the `-DHTMLMOVIE=files` flag, animation of individual files will be performed, while any other value than `files` leads to use of the `movie.ogg` in all but LaTeX formats. In HTML one will try to load `movie.mp4` (if it exists) and then `movie.webm` (if it exists) and then finally `movie.ogg`.

There is no way to control the number of frames per second in LaTeX animations based on filename generators such as `myframes*.png`. However, with a little auto editing in a script one can control the frame rates of the various movies. The rate is specified as `2` in lines on the form

```
\begin{animateinline}[controls,loop]{2} % frames: f000.png -> f098.png
```

Setting the rate to 12 instead for this particular movie based on the `f%03.png` files, the following `doconce subst` command does the job in a script:

```
doconce subst ',loop]{2}( .+: f000)' ',loop{12}\g<1>' mydoc.do.txt
```

Sometimes it is desired to use true movies in web formats and a figure in LaTeX, e.g., a figure with four snapshots from the movie combined into

a single figure file with `doconce combine_images`. A preprocessor test is appropriate for this:

```
% if FORMAT in ("latex", "pdflatex"):

FIGURE: [myfig, frac=1] caption

% else:

MOVIE: [mymov] caption

% endif
```

If you encounter a large number of such if-else statements, it is advantageous to write a Mako function in Python:

```
<%
def figmov(figfile, movfile, caption):
    if FORMAT in ("latex", "pdflatex"):
        return "FIGURE: [%s, frac=1] %s" % (figfile, caption)
% else:
        return "MOVIE: [%s] %s" % (movfile, caption)
% endif
%>
```

The one can avoid if-else tests in the running code and instead write just

```
${figmov('myfig', 'mymov', 'caption')}
```

to insert a movie or figure file, depending on the output format.

## 2.9 Copying Computer Code from Source Files

Another type of special lines starts with `@@@CODE` and enables copying of computer code from a file directly into a verbatim environment, see Section 5.1 below.

## 2.10 Inserting the Output from Operating System Commands

When DocOnce is used to document computer program and results from computer code it is important to ensure that the document contains the latest version of the code and the corresponding output. The former is handled by the `@@@CODE` directive, while the latter has its own directive `@@@OSCMD`. The syntax reads

```
@@@OSCMD cmd
```

where `cmd` is any text that can be run in the operating system. The output is copied into the DocOnce source. For example,

```
@@@OSCMD python -c 'print("Hello,\nWorld!")'
```

results in

```
Terminal> python -c 'print("Hello,\nWorld!")'
Hello,
World!
```

There is a command-line option `--os_prompt=` that can be used to set the (terminal) prompt that prefixes the command:

- `--os_prompt=None` results in no prompt, just the command.
- `--os_prompt=nocmd` results in no prompt and no command, just the output.
- `--os_prompt=Terminal>` is the default setting (as in the example above).

## 2.11 Comments

Comments intended to be (sometimes) visible in the output document and read by readers are known as *inline comments* in DocOnce and described in Section 3.

Here we address comments in the DocOnce source file that are not intended to be visible in the output document. Basic comment lines start with the hash `#`:

```
#
# Here are some comment lines that do not affect any formatting.
# These lines are converted to comments in the output format.
#
```

Such comment lines may have some side effects in the `rst` and `sphinx` formats because following lines are taken as part of the comment if there is not a blank line after the comment.

The Mako preprocessor supports comments that are filtered out *before* DocOnce starts translating the document. Such comments are very valuable as they will never interfere with the output format and they are only present in the DocOnce source. Mako has two types of comments: lines starting with a double hash `##` and multiple lines enclosed by the `<%doc>` (beginning) and `<%doc/>` (closing) tags.

If you need a lot of comments in the DocOnce file, consider using Mako comments instead of the single hash, unless you want the comments to be in the source code of the output document.

To comment out or remove large sections, consider using the Preprocess preprocessor and an if-else block with a variable that is undefined (typically something like a test `# #ifdef EXTRA` in Preprocess, or the Mako equivalent `% if EXTRA:`).

## 2.12 Tables

**Basic Syntax.** A table like

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

is built up of pipe symbols and dashes:

```
|------------------------------|
|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    |
|------------------------------|
```

- The pipes and column values do not need to be aligned (but why write the DocOnce source in an ugly way?).
- In the line below the heading, one can insert the characters `c`, `r`, or `l` to specify the alignment of the columns (centered, right, or left, respectively). One can also use `X` for potentially very wide text that must be wrapped and left-adjusted (will only affect `latex` and `pdflatex` where the `tabularx` package is then used; `X` means `l` in all other formats).
- Similar character can be inserted in the line above the header to align the headings.
- There must be a blank line before and after the table.
- Tables are *inlined* in the text, without numbers or labels for reference.
- Some CSS files used by some HTML styles may overrule the alignment characters `c`, `r`, and `l` and, e.g., center all text.
- For output in LaTeX one can control certain aspects of the typesetting of tables: the text size (`--latex_table_format=`), the color of every two rows (`--latex_colored_table_rows=`), and the space between rows (`--latex_table_row_sep=`).

Here is an example with centered headings (which is default anyway), and the numbers are left-adjusted in the first column and right-adjusted in the two others.

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

Typeset result:

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

Pipes | can also be inserted to indicate vertical rules in LaTeX tables (they are ignored for other formats):

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

**Notice.**

- Not all formats offer alignment of heading or entries in tables (`rst` and `sphinx` are examples).
- DocOnce tables are very simple: neither entries nor headings can span several columns or rows. When that functionality is needed, one can make use of the preprocessor and if-tests on the format and insert format-specific code for tables.

**Quick way of creating tables.** It takes some efforts to put the pipes and dashes correctly in the table format. A quick way of generating a DocOnce table is to first put the table entries in a file with comma between the entries. This is essentially a file in the famous CSV format. Data in CSV format can be transformed to DocOnce table format by the `doconce csv2table` utility:

```
Terminal> doconce csv2table somefile.csv > table.do.txt
```

For example, we can write a text file `tmp.csv` with

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

Running `doconce csv2table tmp.csv` creates the table

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

If the output from `doconce csv2table` is redirected to a file:

```
Terminal> doconce csv2table data.csv > mytable.do.txt
```

one can easily include this file by `# #include "mytable.do.txt"` in the DocOnce source file. This is an efficient method for generating DocOnce tables directly from data.

**Tables from DocOnce to CSV Data Files.** The command-line option `-tables2csv` (to `doconce format`) makes DocOnce dump each table to CSV format in a file `table_X.csv`, where `X` is a generated table number. This feature makes it easy to load tables from DocOnce documents into spreadsheet programs for further analysis.

## 2.13 Lists

An unordered bullet list makes use of the `*` as bullet sign and is *consistently indented* by some chosen spaces as follows

```
* item 1
* item 2
  * subitem 1, if there are more
    lines, each line must
    be exactly intended as shown here
    (i.e., start in the same column)
  * subitem 2,
    also spans two lines
* item 3
```

This list gets typeset as

- item 1
- item 2
  - subitem 1, if there are more lines, each line must be exactly intended as shown here (i.e., start in the same column)
  - subitem 2, also spans two lines
- item 3

In an ordered list, each item starts with an `o` (as the first letter in *ordered*):

```
o item 1
o item 2
  * subitem 1
  * subitem 2
o item 3
```

resulting in

1. item 1
2. item 2
   - subitem 1
   - subitem 2
3. item 3

Ordered lists cannot have an ordered sublist, i.e., the ordering applies to the outer list only.

In a description list, each item is recognized by a dash followed by a keyword followed by a colon:

```
- keyword1: explanation of keyword1

- keyword2: explanation
  of keyword2 (remember to indent properly
  if there are multiple
  lines)
```

The result becomes

**keyword1:** explanation of keyword1

**keyword2:** explanation of keyword2 (remember to indent properly if there are multiple lines)

**No indentation - except in lists!**

DocOnce syntax is sensitive to whitespace! No lines should be indented, only lines belonging to lists. Indented lines may give strange output in some formats. Also note that extra whitespace after "item" indicators (`*`, `o`, or `-`) in lists may give strange behavior.

# 3 Inline Tagging

DocOnce supports tags for *emphasized phrases*, **boldface phrases**, and `verbatim text` (also called type writer text, for inline code), colored words, plus LaTeX/-TeX inline mathematics, such as $\nu = \sin(x)$. Links are easy to define, either with a text or just a plain `http://google.com`. Also a non-breaking space (to avoid linebreak), linebreak,
m-dash (as in m—dash), and horizontal rule can be specified (below).

———-

**Limitation of inline tagging.**

Since DocOnce applies regular expressions to recognize inline tagging, there might be cases where the tags are not correctly interpreted and translated. Fortunately, most such pitfalls are easily circumvented. The troubleshooting document shows some examples.

## 3.1 Emphasized Words

Emphasized text is typeset inside a pair of asterisk, and there should be no spaces between an asterisk and the emphasized text, as in

```
*emphasized words*
```

Boldface font is recognized by an underscore instead of an asterisk:

```
_several words in boldface_ followed by *emphasized text*.
```

The line above gets typeset as **several words in boldface** followed by *emphasized text*. One should only have pure text (no mathematical formulas) between the boldface or emphasize markers, and no leading or trailing blanks (with such blanks, the text will not be recognized as boldface or emphasize).

Colored text is formatted as

```
some text color{red}{more text in red}
```

## 3.2 Inline Verbatim Text

Verbatim text, typically used for short inline code, is typeset between backticks:

```
‘call myroutine(a, b)‘ looks like a Fortran call
while ‘void myfunc(double *a, double *b)‘ must be C.
```

The typesetting result looks like this: `call myroutine(a, b)` looks like a Fortran call while `void myfunc(double *a, double *b)` must be C. Note that there must be no leading or trailing spaces inside the backticks.

It is recommended to have inline verbatim text on the same line in the DocOnce file, because some formats (LaTeX in combination with the `ptex2tex` program (but not `doconce pretex`)) will have problems with inline verbatim text that is split over two lines.

**Notice.**

Watch out for mixing backticks and asterisk (i.e., verbatim and emphasized code): the DocOnce interpreter is not very smart in detecting such errors. A missing backtick will also quickly create strange output. If you suspect inline code to be the source of problems in the final format, examine the DocOnce source and the output.

## 3.3 Links to Web Addresses

Web addresses with links are typeset as

```
some URL like "Search Google": "http://google.com".
```

which appears as some URL like Search Google. The space after colon is optional, but it is important to enclose the link and the URL in double quotes.

To have the URL address itself as link text, put an "URL" or URL before the address enclosed in double quotes:

```
Click on this link: URL: "https://github.com/hplgit/doconce".
```

which gets rendered as Click on this link: https://github.com/hplgit/doconce.

(There is also support for lazy writing of URLs: any http or https web address with a leading space and a trailing space, comma, semi-colon, or question mark (but not period!) becomes a link with the web address as link text.)

## 3.4 Links to Mail Addresses

Links that launches a mail to a specified address is written as ordinary URLs, typically as

```
Send "mail": "mailto:hpl@simula.no"
# Alternative:
to "‘hpl@simula.no‘": "mailto:hpl@simula.no".
```

which appears as Send mail to hpl@simula.no.

## 3.5 Links to Local Files

Links to files ending in `.txt`, `.html`, `.pdf`, `.py`, `.f`, `.f77`, `.f90`, `.f95`, `.sh`, `.csh`, `.ksh`, `.zsh`, `.c`, `.cpp`, `.cxx`, `.pl`, and `.java` follows the same setup:

```
see the "DocOnce Manual": "manual.do.txt".
```

which appears as see the DocOnce Manual. However, linking to local files like this needs caution:

- In the `html` format the links work well if the files are supplied with the `.html` with the same relative location.
- In the `latex` and `pdflatex` formats, such links in PDF files will unless the `.tex` file has a full URL specified through a `\hyperbaseurl` command and the linked files are located correctly relative to this URL. Otherwise full URL must be used in links.
- In the `sphinx` format, links to local files do not work unless the files reside in a `_static` directory (a warning is issued about this).

As a consequence, we strongly recommend that one copies the relevant files to a `_static` or `_static-name` directory and makes links to files in this directory only (`name` is the nickname of the DocOnce document, usually the name of the parent directory or main document). Other links to files should use the full URL. If DocOnce is used for HTML output only, then plain links to local files work fine.

If you want a link to a local source code file and have it viewed in the browser rather than being downloaded, we recommend to transform the source code file to HTML format by running `pygmentize`, e.g.,

```
Terminal> pygmentize -l bash -f html -O full,style=emacs \
          -o _static/make.sh.html subdir/make.sh
```

Then you can link to `_static/make.sh.html` instead of `subdir/make.sh`. Here is an example where the reader has the file available as `src/myprog.py` in her software and the document links to `_static/myprog.py`:

```
See the code URL:"src/myprog.py" ("view: "_static/myprog.py.html").
```

Links to files with other extensions are typeset with *the filename as link text*. The syntax consists of the keyword URL, followed by a colon, and then the filename enclosed in double quotes:

```
URL: "manual.html"
```

resulting in the link `manual.html`.

## 3.6 Quotes

Quotations employ either the emphasized font or double quotation marks. In the latter case, one should not use the character `"` but rather the (LaTeX-inspired) construction with double backticks and two single quotes:

```
This is a sentence with ``words to be quoted''.
```

To candidates for find double quotes that should be transferred to the above type of quotation (which is a common mistake), one can run a regular expression search like

```
Terminal> find . -name '*.do.txt' -exec grep -E \
          '[^("]"[A-Za-z0-9 ,]+" *[^:‘)"]' {} \; -print
```

This search may give many false hits as double quotes are frequently used in computer code and preprocessor instructions (URLs and hyperlinks should not give hits in the above regular expressions).

## 3.7 Non-Breaking Space

The non-breaking space character is tilde:

```
Here comes a long line with a specification of a number with unit at the end,
which is an example that requires a "non-breaking space character":
"http://en.wikipedia.org/wiki/Non-breaking_space": 7.4~km is traveled
in~$7.4/5.5\approx 1.345$~s. (Computer code, where the tilde has a
meaning, as in ‘y = ~x‘, is not affected. The non-breaking character only
works between characters, numbers, and the math dollar sign.)
```

This is rendered as

> Here comes a long line with a specification of a number with unit at the end, which is an example that requires a non-breaking space character: 7.4 km is traveled in $7.4/5.5 \approx 1.345$ s. (Computer code, where the tilde has a meaning, as in `y = ~x`, is not affected. The non-breaking character only works between characters, numbers, and the math dollar sign.)

## 3.8 Horizontal rule

A horizontal rule for separating content vertically, like this:

---

is typeset as four or more hyphens on a single line:

```
---------
```

## 3.9 Em-dash

The `latex`, `pdflatex`, `sphinx`, `html`, `pandoc`, and `ipynb` formats support em-dash, indicated by three hyphens: `---`. Other formats print just the three hyphens. The em-dash has two applications:

- as alternative to an ordinary single hyphen (with space around) in a sentence—except that there are no spaces around the em-dash (this is common, cf. Wikipedia), and

- origin of quotes (where there is no space between the end of the quote and the m-dash):

  *Premature optimization is the root of all evil.*—Donald Knuth.

  The associated DocOnce source reads

```
!bquote
*Premature optimization is the root of all evil.*---Donald Knuth.
!equote
```

## 3.10 En-dash

The en-dash constists of two hyphens, as in `--`, and can be used instead of a single hyphen to get a slightly longer hyphen (LaTeX writers are especially used to this). Common applications are

- hyphen in compound words as the Navier–Stokes equations (here written as `Navier-Stokes`)
- hyphen in number ranges like 1–9
- hyphen around a sentence in sentence: To be precise – but not to detailed – we should ... (here the hyphen is written as `--`), as an alternative to em-dash (see section above)

The `latex`, `pdflatex`, `sphinx`, `html`, `pandoc`, and `ipynb` formats support en-dash (basically this means that HTML output has `&ndash` and LaTeX output is not altered). Other formats just show the raw double hyphen.

## 3.11 Ampersand

An ampersand, as in Guns & Roses or,Texas A & M, is written as a plain `&` *with space(s) on both sides*. Single upper case letters on each side of `&`, as in `Texas A {\&} M`, remove the spaces and result in,Texas A & M, while words on both sides of `&`, as in `Guns {\&} Roses`, preserve the spaces: Guns & Roses. Failing to have spaces before and after `&` will result in wrong typesetting of the ampersand in the `html`, `latex`, and `pdflatex` formats. If special quoting of the ampersand is undesired, e.g., when one has inserted native LaTeX code for tables, the command-line option `--no_ampersand_quote` for `doconce format` turns off the ampersand treatment for all formats.

## 3.12 Footnotes

Typesetting of footnotes employs a common email or Extended Markdown syntax:

```
Footnotes are typeset according to the output format[^typesetting].
The syntax is optional spaces, opening bracket, hat, a footnote name
without spaces[^remedy-for-name-with-spaces], and closing bracket. The
logical name of the footnote is not used in LaTeX, HTML,
reStructuredText, or Sphinx, because these languages employ numbered
footnotes. Other formats employ the logical name.

[^typesetting]: Typesetting of the footnote depends on the format.
Plain text does nothing, LaTeX removes the definition and inserts the
footnote as part of the LaTeX text.  reStructuredText and Sphinx
employ a similar type of typesetting as Extended Markdown and DocOnce,
and in HTML we keep the same syntax, just displayed properly in HTML.

Footnotes are preferably defined after the paragraph they are used.
The definition is the footnote syntax (some optional space, bracket,
hat, name, bracket) followed by colon and a text.
A new paragraph marks the end of a footnote.

[^remedy-for-name-with-spaces]: Just put in dashes or underscores in
case of spaces.
```

The text above looks as follows.

Footnotes are typeset according to the output format[1]. The syntax is optional spaces, opening bracket, hat, a footnote name without spaces[2], and closing bracket. The logical name of the footnote is not used in LaTeX, HTML, reStructuredText, or Sphinx, because these languages employ numbered footnotes. Other formats employ the logical name.

Footnotes are preferably defined after the paragraph they are used. The definition is the footnote syntax (some optional space, bracket, hat, name, bracket) followed by colon and a text. A new paragraph marks the end of a footnote.

## 3.13 Inline Comments

DocOnce also supports inline comments in the text:

```
[name: comment]
```

where `name` is (e.g.) the name of the author of the comment, and `comment` is a plain text text. Note that *there must be a space after the colon*, otherwise the comment is not recognized. The name can contain upper and lower case characters, digits, single quote, + and -, as well as space. Next is an example. **hpl's comment 1**: Inline comments can span several lines, if desired.

The name and comment are visible in the output unless `doconce format` is run with a command-line argument `--skip_inline_comments` (see Section 12 for an example). Inline comments are helpful during development of a document since different authors and readers can comment on formulations, missing points, etc. All such comments can easily be removed from the `.do.txt` file by `doconce remove_inline_comments` (see Section 12).

[1] Typesetting of the footnote depends on the format. Plain text does nothing, LaTeX removes the definition and inserts the footnote as part of the LaTeX text. reStructuredText and Sphinx employ a similar type of typesetting as Extended Markdown and DocOnce, and in HTML we keep the same syntax, just displayed properly in HTML.

[2] Just put in dashes or underscores in case of spaces.

Inline comments are typeset in a simple way: boldface name, a numbering of the comment, and then the comment, all in red and in parenthesis. However, with the `--latex_todonotes` option, LaTeX will apply the `todonotespackage` to typeset the comments in very visible color boxes.

## 3.14 Inline Comments for Editing

**Notice.**

The inline editing syntax in DocOnce was implemented before the invention of CriticMarkup. Now it would make sense to use the CriticMarkup syntax and associated tools. (DocOnce needs proper rendering of CriticMarkup

Inline comments can also be used to markup editing of the text. The following syntax is supported:

```
[add: ,]
[add: .]
[add: ;]
[del: ,]
[del: ,]
[del: .]
[del: ;]
[add: some text]
[del: some text]
[edit: some text -> some replacement for text]
[name: some text -> some replacement for text]
```

That is, one can add, delete, and replace text, and adding or deleting a comma, period, or semicolon leads to special typesetting where such a small edit is highlighted. Below is an example of a text with inline editing.

Originally, we have the text

```
First consider a quantity $Q$. Without loss of generality, we assume
$Q>0$. There are three, fundamental, basic property of $Q$.
```

Then, some reader wants to change this text and explicitly demonstrate what is deleted, added, and replaced (as when using track changes in Microsoft Word). The use of the `add`, `del`, and replacement construction with `->` may look as follows.

```
First[add: ,] consider [edit: a quantity -> the flux]
[del: $Q$. Without loss of generality,
we assume] $Q>0$. There are three[del: ,] fundamental[del: , basic]
[edit: property -> properties] of $Q$. [add: These are not
important for the following discussion.]
```

The text gets rendered as

> First, (**edit 2**: add comma) consider (edit 3:) ~~a quantity~~ the flux (**edit 4**:) ~~$Q$. Without loss of generality, we assume~~ $Q > 0$. There are

three (**edit 5**: delete comma) fundamental(**edit 6**:) ~~, basic~~ (edit 7:) ~~property~~ properties of $Q$. (**edit 8**:) These are not important for the following discussion.

Such inline comments with edits are only given special typesetting in the output formats `latex`, `pdflatex`, `html`, and `sphinx`. Otherwise, just the DocOnce syntax is shown (but that is also quite readable as edit instructions.)

The editing implied by the edit comments can be implemented in the DocOnce file by the command

```
Terminal> doconce apply_edit_comments mydoc.do.txt
```

## 3.15 Forced Line Breaks

By *ending* a line in the DocOnce file with `<linebreak>` the output format has a forced linebreak at this point. This can be used to typeset poems, songs (if not in a verbatim block), or the origin of quotes. Here is an example:

```
!bquote
*Program writing is substantially more demanding than book
writing. Why is it so? I think the main reason is that a larger
attention span is needed when working on a large computer program
than when doing other intellectual tasks.* <linebreak>
Donald Knuth cite[p. 18]{Knuth85}, computer scientist, 1938-.
!equote
```

is rendered as

> *Program writing is substantially more demanding than book writing. Why is it so? I think the main reason is that a larger attention span is needed when working on a large computer program than when doing other intellectual tasks.*
> Donald Knuth [1, p. 18], computer scientist, 1938-.

The `<linebreak>` is a newline in LaTeX if it has preceding text, otherwise it is a `\vspace{3mm}`. In HTML, `<linebreak>` is `<br>`. Both constructions can be used to either force a linebreak or add vertical space.

**Tip on using forced linebreaks.**

The `<linebreak>` tag is often useful in slides to avoid overfull lines in bullet lists, portion such lines into separate lines, or to insert vertical space. It can be used in admonitions too to get more space between the title and the text. Remember to have `<linebreak>` at the end of the line.

## 3.16 Inline Mathematics

Inline mathematics is written as in LaTeX, i.e., inside dollar signs. Many formats leave this syntax as it is (including the two dollar signs), hence nice math formatting is only obtained in LaTeX, HTML, MediaWiki, and Sphinx (Epytext has some inline math support that is utilized).

The following text

```
Let $a=\sin(x) + \cos(x)$. Then $a^2 = 2\sin(x)\cos(x)$
because $\sin^2x + \cos^2x = 1$.
```

is rendered as "Let $a = \sin(x) + \cos(x)$. Then $a^2 = 2\sin(x)\cos(x)$ because $\sin^2 x + \cos^2 x = 1$."

Mathematical expressions in LaTeX syntax often contains special formatting commands, which may appear annoying in plain text. DocOnce therefore supports an extended inline math syntax where the writer can provide an alternative syntax suited for formats close to plain ASCII:

```
Here is an example on a linear system
${\bf A}{\bf x} = {\bf b}$|$Ax=b$,
where $\bf A$|$A$ is an $n\times n$|$nxn$ matrix, and
$\bf x$|$x$ and $\bf b$|$b$ are vectors of length $n$|$n$.
```

That is, we provide two alternative expressions, both enclosed in dollar signs and separated by a pipe symbol, the expression to the left is used in formats with LaTeX support (`latex`, `pdflatex`, `html`, `sphinx`, `mwiki`), while the expression to the right is used for all other formats. The above text is typeset as "Here is an example on a linear system $\mathbf{A}\mathbf{x} = \mathbf{b}$, where $\mathbf{A}$ is an $n \times n$ matrix, and $\mathbf{x}$ and $\mathbf{b}$ are vectors of length $n$."

## 3.17 Cross-Referencing

References and labels are supported. The syntax is simple:

```
label{section:verbatim}   # defines a label
For more information we refer to Section ref{section:verbatim}.
```

The DocOnce label syntax is close that that of labels and cross-references in LaTeX, but note that *labels cannot contain whitespace and cannot have a backslash*.

When the label is placed after a section or subsection heading, the `plain` text, `epytext`, and `st` formats will simply replace the reference by the title of the (sub)section. All labels will become invisible, except those in math environments. (In the `rst` and `sphinx` formats, the end effect is the same, but the `label` and `ref` commands are first translated to the proper reST commands by `doconce format`.) In the `html`, `ipynb`, and wiki formats, labels become anchors and references become links, and with LaTeX `label` and `ref` are just equipped with backslashes so these commands work as usual in LaTeX.

Since references to sections appear differently in different formats, we provide an example.

```
..., we refer to Section ref{sec:theory}.

======= Basic Theory =======
label{sec:theory}

A first discovery was that 1+1 is 2.
```

The reference appears as follows in various output formats:

- `latex` and `pdflatex`: "we refer to Section 2.3" with LaTeX code
  `we refer to Section~\ref{sec:theory}`
- `html`: "we refer to the section Basic Theory" with the HTML code
  `we refer to the section <a href="#sec:theory">Basic Theory</a>`
- `rst`, `sphinx`: "we refer to the section Basic Theory"
- `plain`: "we refer to the section "Basic Theory""
- `ipynb`: "we refer to the section Basic Theory" with Markdown code
  `we refer to the section [Basic Theory](#sec:theory)`
- `mwiki`: "we refer to the section Basic Theory" with MediaWiki code
  `We refer to the section [#Basic_Theory]`

Labels and references should only be used for (sub)sections, equations, figures, and movies (since DocOnce does not support references to tables and algorithms, for instance). By the way, here is an example on referencing Figure 1. Additional references to Sections 5.2 and 5.3 are nice to demonstrate, as well as a reference to equations, say (1)-(2).

**References to equations must be in parentheses!**

LaTeX writers who are used to `\eqref{}` should observe that there is only one type of reference syntax in DocOnce, `ref`, without backslash, and that references to an equation with label `my:special:eq` must feature parentheses and look like

```
..., see (ref{my:special:eq}).
```

Hyperlinks to files or web addresses are handled as explained in Section 3.

References to equations and sections in other documents can be done by the *generalized cross-referencing* syntax explained in the next section. However, sometimes one wants in an HTML document or notebook to make references to equations and sections in a LaTeX textbook. This is not well handled by the generalized cross-referencing technique, but DocOnce has a special option for this feature: `--replace_ref_by_latex_auxno=../book.aux` will read the label and numbering information from `../book.aux` and replace all references (`ref`) by the corresponding number found in the `../book.aux` file. Sometimes

one wants to use this feature for selected references. In that case, use `refaux` instead of `ref`. If there one or more `refaux` commands in the DocOnce source, only `refaux` references will be replaced by numbers from the `.aux` file. Otherwise, all `ref` commands corresponding to labels in the `.aux` file will be replaced. In any case, the `--replace_ref_by_latex_auxno=` option is needed to specify one `.aux` file.

## 3.18 Generalized Cross-Referencing

Sometimes a series of individual documents may be assembled to one large document, typically a book. In the book one wants to make cross references between chapters and sections, while these become references to external documents when the chapters (or sections) are compiled as stand-alone documents. For example, one can in a DocOnce file `file1.do.txt` have text like

```
...as shown in Section ref{sec:eqs}.
```

with the label `sec:eqs` defined in another file `file2.do.txt`. If `file1.do.txt` and `file2.do.txt` are combined to a single document, the reference is treated correctly, but if `file1.do.txt` is compiled as a single document, the label `sec:eqs` becomes undefined. Then one would instead write

```
...as shown in the document "Mathematical Equations":
"http://some.net/doc/matheqs.html" cite{math_eqs_2020}.
```

LaTeX has functionality for referring to labels in external documents. One must use the `xr` package and list external documents with a command `\externaldocument{name}` such that LaTeX can extract label information from the `name.aux` file. We are then able to write the above reference as

```
\externaldocument{file2}
...
...as shown in Section ref{sec:eqs} in cite{math_eqs_2020}.
```

and get output like "...as shown in Section 3.4 in [12]." When the numbering of sections in `file2.tex` changes later, the output from the shown line in `file1.tex` will automatically be changed if `file2.aux` is recently compiled (so `file2.aux` with the mapping from labels to section numbers is updated).

**Generalized References.** DocOnce mimics a generalization of the LaTeX functionality in the `xr` package such that one can refer to external documents in other formats than LaTeX (HTML, Sphinx, IPython notebooks, wikis, etc.). This feature is called a *generalized reference* and involves a reference with *three* values. The syntax of generalized references reads

```
ref[internal][cite][external]
```

If all references in the text `internal` are to labels defined in the present DocOnce document, the generalized reference becomes the text `internal`. If one or more references in `internal` are not labels present in the document and `latex` or `pdflatex` is the output format, the generalized reference becomes the text `internal` followed by `cite`, while for all other formats the text in `external` is used.

The example above can now be written as the generalized reference

```
...as shown in ref[Section ref{sec:eqs}][ in cite{math_eqs_2020}][
the document "Mathematical Equations":
"http://some.net/doc/matheqs.html" cite{math_eqs_2020}].
```

(Note that there must be no spaces between closing and opening brackets: `][`.) When the label `sec:eqs` is found in the current DocOnce document, this generalized reference becomes

```
Section ref{sec:eqs}
```

If not, and `latex` or `pdflatex` is the output format, the reference becomes

```
Section ref{sec:eqs}] in cite{math_eqs_2020}
```

while in all other cases the reference becomes

```
the document "Mathematical Equations":
"http://some.net/doc/matheqs.html" cite{math_eqs_2020}
```

For the reference to a label in an external document to work in the LaTeX case it is required to list this document in the DocOnce file as

```
# Externaldocuments: file2
```

Several external documents can be listed with comma as delimiter:

```
# Externaldocuments: file2, file3, myfile
```

on *a single line*. The `Externaldocuments` comment leads to use of the `xr` package and insertion of `\externaldocument{file2}` in the `.tex` output file. It is a good habit to place the `Externaldocument` comment after the title, author, and date.

**External documents must be recently compiled.**

When compiling DocOnce documents with generalized references to `latex` or `pdflatex`, all documents listed in the `Externaldocuments` comment must have been recently compiled such that their `.aux` files *are available and updated*.

Note that cleaning (`doconce clean`) of the directory holding an external document will destroy the `.aux` file, and `latex` or `pdflatex` may then complain that a file listed as `\externaldocument{}` has no `.aux` file. This is just a warning - the result is question marks in the PDF document.

**Generalized References to Chapters.** A reference to a chapter in a book becomes just a reference to a complete stand-alone document if chapters are compiled individually. Here is an example:

```
...as shown in Chapter ref{ch:model}.
```

This reference works fine if the present document is a book and `ch:model` is a label of a chapter in the book. However, if the chapter with label `ch:model` is compiled separately, we would rather write

```
...as shown in cite{math_eqs_2020}.
```

where `math_eqs_2020` is the citation label for the external document as listed in the Publish database. Or if the output format supports hyperlinks, we would perhaps add such a link:

```
the document "Mathematical Equations":
"http://some.net/doc/matheqs.html" cite{math_eqs_2020}.
```

Such references to chapters or complete documents are very much like the previously generalized references, but written with `refch` instead of `ref`:

```
refch[internal][cite][external]
```

The only difference between `refch` and `ref` is that the former, for `latex` and `pdflatex` output, just use the `cite` text and not `internal` if the labels in the `internal` text are not found in the document. To be precise, the reference

```
...as shown in refch[Chapter ref{ch:eqs}][cite{eqs_doc_2008}][
the document "Some Equations": "http://some.net/someeqs/"].
```

will be

```
...as shown in Chapter ref{ch:eqs}.
```

if `ch:eqs` is a label defined in the present document. It becomes

```
...as shown in Chapter cite{eqs_doc_2008}.
```

if `ch:eqs` is not found in the present document *and* the output format is `latex` or `pdflatex`. In all other cases the result becomes

```
...as shown in
the document "Some Equations": "http://some.net/someeqs/"].
```

**Generalized References to LaTeX Documents.** It is difficult in the `[external]` part of the generalized reference to refer to equation numbers in an external document. If one wants to refer to a LaTeX document, say a textbook, from some HTML or notebook, then one can use the `refaux` reference and an `.aux` file as explained at the end of the previous section on *Cross-Referencing*. Here is one example:

```
From ref[(ref{eq1})][ in cite{Langtangen_2045}][
equation (refaux{eq1}) in cite{Langtangen_2045}], we realize that...
```

For LaTeX output, the reference to `eq1` will remain, but for other formats

```
(refaux{eq1})
```

will be replaced by (say) `(1.5)` if we provide the option `--replace_ref_by_latex_auxno=mybook.aux` and `mybook.aux` defines label `eq1` to have number `1.5`. Replacing `refaux` by `ref` above will lead to hardcoding of `ref{eq1}` as `1.5` also in LaTeX output (which is okay, the `xr` package and giving `Externaldocuments: mybook` results in the same).

The example above is particularly relevant if one writes exercises that are to be filtered out as notebooks. The notebooks can then refer to a LaTeX book, while in the LaTeX version of the document, the exercises make references to the LaTeX book via the `xr` package the usual way.

Sometimes one does not want to refer to a LaTeX document in the `[external]` part of a generalized reference, but to a web document. Then the text must be written in a different way if one has equation or section references. For example,

```
From ref[(ref{eq1})][ in cite{Langtangen_2045}][
the differential equation for $u(t)$ in the section
"Setting up the model": "http://some.where.net/doc#model"
in cite{Langtangen_2045}], we realize that...
```

**Tool for Generating Generalized References.** The `doconce ref_external` command will read all the labels in the external documents listed in the `Externaldocuments:` comment and use the Publish database file of the current document (specified by `BIBFILE:`) to automatically generate substitution commands that translate ordinary LaTeX-style internal references to generalized references in DocOnce syntax. For example, `doconce ref_external file1` will find the reference

```
......as shown in Section ref{sec:eqs}.
```

as a reference to a label `sec:eqs` defined in `file2`, grab the title of `file2.do.txt`, find the bibliographic data in the Publish file, and make a substitution command

```
doconce subst "Section\s+ref{sec:eqs}" "..." $files
```

where `"..."` is the complete generalized reference for this particular reference. In other words, with `doconce ref_external` one can automatically generate generalized references between, for example, chapters in a book that exist as stand-alone documents.

**References to equations.**

Generalized references to equations work well in LaTeX, but not in other formats as one cannot resolve the equation number in the external document. It is then better to write different text using the `FORMAT` variable in Mako:

```
% if FORMAT in ("pdflatex", "latex"):
By combining ref[(ref{eqs:g1})-(ref{eqs:g4})][ in cite{some_doc}][
dummy] we can derive the expression ...
% else:
One can from cite{some_doc} derive the expression
% endif
```

The `doconce ref_external` tool generates an `external` text in case of references to equations that says "reference to specific **equations** (label eqs:g1 and eqs:g4) in external document "name": "link" is not recommended". One can then search for this text and make a Mako if-else rewrite as shown above.

**Limited support.**

The `doconce ref_external` tool cannot correctly handle references to a range of sections like

```
Sections ref{mydoc:sec1}-ref{mydoc:sec2}
```

The automatically generated generalized references should always be manually checked and edited!

**A Worked Example.** Here is an example on a specific working generalized reference where the LaTeX output also has a hyperlink:

```
As explained in
ref[Section ref{subsec:ex}][in "Langtangen, 2012":
"http://hplgit.github.io/doconce/test/demo_testdoc.html#subsec:ex"
cite{DocOnce:test}][a "section":
"http://hplgit.github.io/doconce/test/demo_testdoc.html#subsec:ex" in
the document "A Document for Testing DocOnce":
"http://hplgit.github.io/doconce/test/demo_testdoc.html"
cite{DocOnce:test}], DocOnce documents may include tables.
```

With `latex` or `pdflatex` as output, this translates to

```
As explained in
Section ref{subsec:ex}, DocOnce documents may include tables.
```

if the label `{subsec:ex}` appears in the present DocOnce source, and otherwise

```
As explained in
Section ref{subsec:ex} in "Langtangen, 2012":
"http://hplgit.github.io/doconce/test/demo_testdoc.html#subsec:ex"
cite{DocOnce:test}, DocOnce documents may include tables.
```

The latter DocOnce code is translated to the following LaTeX code:

```
As explained in
Section~\ref{subsec:ex} in
\href{{http://hplgit.github.io/doconce/...}}{Langtangen, 2012}
\cite{DocOnce:test}, DocOnce documents may include tables.
```

In a format different from `latex` and `pdflatex`, the effective DocOnce text becomes

```
As explained in
a "section":
"http://hplgit.github.io/doconce/test/demo_testdoc.html#subsec:ex" in
the document "A Document for Testing DocOnce":
"http://hplgit.github.io/doconce/test/demo_testdoc.html"
cite{DocOnce:test}, DocOnce documents may include tables.
```

The rendered text in the current format becomes

> As explained in Section **??**in Langtangen, 2012 [2], DocOnce documents may include tables.

A complete "chapter" reference may look like

```
As explained in
refch[Chapter ref{ch:testdoc}]["Langtangen, 2012":
"http://hplgit.github.io/doconce/test/demo_testdoc.html"
cite{DocOnce:test}][the document
"A Document for Testing DocOnce":
"http://hplgit.github.io/doconce/test/demo_testdoc.html"
cite{DocOnce:test}], DocOnce documents may include tables.
```

The output now, if `ch:testdoc` is not a label in the document, becomes in the `latex` and `pdflatex` case

```
As explained in
"Langtangen, 2012":
"http://hplgit.github.io/doconce/test/demo_testdoc.html"
cite{DocOnce:test}, DocOnce documents may include tables.
```

That is, the internal reference `Chapter ...` is omitted since it is not meaningful to refer to an external document as "Chapter". The resulting rendered text in the current format becomes

> As explained in Langtangen, 2012 [2], DocOnce documents may include tables.

Note that LaTeX cannot have links to local files, so a complete URL on the form `http://...` must be used.

**Tip.**

Use `doconce ref_external` to get an overview of the external references in a file. Very often you want to rewrite the text to reduce the amount of external referencing. Remember then to compile your document before running `doconce ref_external` again since the command applies the compiled files to get information (`tmp_preprocess_*` or `tmp_mako_*`) if you use any of the Preprocess or Mako preprocessors.

**Splitting documents into smaller parts is easy!**

The generalized references and the `doconce ref_external` are great tools for splitting an existing document into smaller parts, say one chapter into two or one book into two books. Such a split will normally create a lot of difficulties with cross-document referencing (unless you just write directly in LaTeX with the `xr` packcage).

## 3.19 Index

An index can be created for the `latex`, `rst`, and `sphinx` formats by the `idx` keyword, following a LaTeX-inspired syntax:

```
idx{some index entry}
idx{main entry!subentry}
idx{‘verbatim_text‘ and more}
```

The exclamation mark divides a main entry and a subentry. Backquotes surround verbatim text, which is correctly transformed in a LaTeX setting to

```
\index{verbatim\_text@\texttt{\rm\smaller verbatim\_text and more}}
```

Everything related to the index simply becomes invisible in plain text, Epytext, StructuredText, HTML, and wiki formats. Note: `idx` commands should be inserted outside paragraphs and admonitions, not in between the text as this may cause some strange behaviour of reST and Sphinx formatting. As a recommended rule, index items are naturally placed right after section headings, before the text begins, while index items related to a paragraph should be placed above the paragraph one a separate line (and not in between the text or between the paragraph heading and the text body, although this works fine if LaTeX is the output format). For paragraphs with === heading, the index keywords should be placed above the heading.

The keywords in the index are automatically placed in a meta tag in `html` output such that search engines can make use of the them.

SIAM has developed a very useful document on how to create an effective index in a book.

### 3.20 Emojis

Emojis are specified by syntax like `:sweat_smile:`, followed by whitespace (blank or newline) before and after. The available emoji names are shown at http://www.emoji-cheat-sheet.com. Here is an example: 

DocOnce supports emojis for the `html`, `pdflatex`, and `pandoc` formats. All other formats will just print the raw emoji name (like `:sweat_smile:`). The command-line option `--no_emoji` removes all emojis from the output so you can get serious in a second.

# 4 Exercises, Problems, Projects, and Examples

DocOnce has special support for four types of "exercises", named *exercise*, *problem*, *project*, or *example*. These are all typeset as special kind of subsections. Such subsections start with a subsection headline surrounded by 5 = characters, and last up to the next headline or the end of the file. The headline itself must consists of the word *Exercise*, *Problem*, *Project*, or *Example*, followed by a colon and a title of the exercise, problem, or project.

## 4.1 Examples on Exercise Syntax

**Elements in an Exercise.** The next line(s) may contain a label and specification of the name of the result file(s) (if the answer to the exercise is to be handed in) and a solution file. The DocOnce code looks like this:

```
===== Project: Determine the Distance to the Moon =====
label{proj:moondist}
file=earth2moon.pdf
solution=eart2moon_sol.do.txt

Here goes the running text of the project....
```

DocOnce will recognize the exercise, problem, project, or example *title*, the optional *label*, the optional *name of the answer file* (`file=`), the optional name of the *solution* file (`solution=`), and the *running text*. In addition, one can add subexercise environments, starting with `!bsubex` and ending with `!esubex`, on the beginning of separate lines. Within the main exercise or a subexercise, three other environments are possible: (full) solution, (short) *answer*, and *hints*. The environments have begin-end directives `!bans`, `!eans`, `!bsol`, `!esol`, `!bhint`, `!ehint`, which all must appear on the beginning of a separate line (just as `!bc` and `!ec`).

The `file=` or `files=` command accepts a comma-separated list of filenames. Sometimes it is appropriate to skip the file extension and just give a filestem, as in `file=earth2moon`.

**Solutions.** The solution environment with `!bsol` and `!esol` allows inline solution as an alternative to the `solution=...` directive mentioned above (which requires that the solution is in a separate file). Comment lines are inserted so that the beginning and end of answers and solutions can be identified and removed if desired. It seems that DocOnce authors prefer `!bsol` and `!esol` over a separate solution file.

The command line options `--without_answers` and `--without_solutions` turn off output of answers and solutions, respectively, except for examples. The command line options `--answers_at_end` and `--solutions_at_end` write all answers and solutions to exercises to a separate section in the end of the document, respectively. Combine with `--without_answers` and `--without_solutions` to remove answers and solutions from the main text.

The commands `!anshide` and `!solhide` can be used to hide from the main text answers and solutions, respectively, until the `!ansoff` and `!soloff` commands are encountered. Similarly, the `!ansdocend` and `!soldocend` commands move answers and solutions to the end of the book.

**Avoid headings in solutions.**

Headings in solutions in exercises will appear in table of contents, but if solutions are left out of the document (using the `--without_solutions` option), the table of contents will be wrong and contain non-existing headings from the solution parts. Therefore, *never use headings in solutions*, just use *paragraph headings* (double underscores) if you feel the need for headings.

**Avoid numbered equations in solutions.**

Numbered equations in solutions will influence the global numbering of equations in a document (unless exercises always come at the end of chapters). If you compile versions of the document with and without solutions, the equation numbering may differ between the versions and may cause confusion among readers.

**Example.** A full exercise set-up can be sketched as follows:

```
===== Exercise: Determine the Distance to the Moon =====
label{exer:moondist}
file=earth2moon.pdf

Here goes main body of text describing the exercise...

!bsubex
Subexercises are numbered a), b), etc.
```

```
!bans
Short answer to subexercise a).
!eans

!bhint
First hint to subexercise a).
!ehint

!bhint
Second hint to subexercise a).
!ehint
!esubex

!bsubex
Here goes the text for subexercise b).

!bhint
A hint for this subexercise.
!ehint

!bsol
Here goes the solution of this subexercise.
!esol
!esubex

!bremarks
At the very end of the exercise it may be appropriate to summarize
and give some perspectives. The text inside the !bremarks-!eremarks
directives is always typeset at the end of the exercise.
!eremarks

!bsol
Here goes a full solution of the entire exercise, if solutions to
subexercises are not appropraite.
!esol
!ec
```

**Exercise versus Problem and Project.** Recommended rules for using the different "exercise" types goes as follows:

- Exercises are smaller problems directly related to the present chapter (e.g., with references to the text).
- Problems are sufficiently independent of the chapter's text that they make sense on their own, separated from the rest of the document.
- Projects are larger problems that also make sense on their own.
- Examples are exercises, problems, or projects, but with full solutions not typeset with `!bsol` and `!esol` but as running text

Authors may use `Exercise` everywhere or make use of the convention in the first three points.

**Modified Heading.** Sometimes one does not want the heading of an exercise, problem, project, or example to contain the keyword `Exercise:`, `Problem:`, `Project:`, or `Example:`. By enclosing the keyword in braces, as in

```
===== {Problem}: Find a solution to a problem =====
```

the keyword is marked for being left out of the heading, resulting in the heading "Find a solution to a problem". In this case, there is no numbering of exercises, problems, projects, or examples, so `--section_numbering=on` for numbering *all* sections in the document may be a desired option.

**Data Structure for all Exercises.** The various elements of exercises are collected in a special data structure (list of dictionaries) stored in a file `.mydoc.exerinfo`, if `mydoc.do.txt` is the name of the DocOnce file. The file contains a list of dictionaries, where keys in the dictionary corresponds to elements in the exercise: filename, solution file, answer, label, list of hints, list of subexercises, closing remarks, and the main body of text.

## 4.2 Typesetting of Exercises

Tailored formatting of exercises in special output formats can make use of the elements in an exercise. For example, one can imagine web formats where the hints are displayed one by one when needed and where the result file can be uploaded. One can also think of mechanisms for downloading the solution file if the result file meets certain criteria. DocOnce does not yet generate such functionality in any output format, but this is an intended future feature to be implemented.

For now, exercises, problems, projects, examples are typeset as ordinary DocOnce sections (this is the most general approach that will work for many formats). One must therefore refer to an exercise, problem, project, or example by its label, which normally will translate to the section number (in LaTeX, for instance) or a link to the title of the section. The *title* is typeset without any leading *Exercise:*, *Problem:*, or *Project:* word, so that references like

```
see Problem ref{...}
```

works well in all formats (i.e., no double `Problem Problem` appears).

**Remark on Typesetting of Examples.** Examples are *not* typeset similarly to exercises unless one adds the command-line option `--examples_as_exercises`. That is, without this option, any heading and starting with `Example:` makes DocOnce treat the forthcoming text as ordinary text without any interpretation of exercise-style instructions. This is usually what you want. With the command-line option `--examples_as_exercises`, one can use the `!bsubex` and `!bsol` commands to indicate a subproblem and a solution in an example. In this way, the typesetting of the example looks like an exercise equipped with a solution. As for exercises, the content of the example runs from the heading until the next subsection.

**Examples and exercises share the same counter!**

If you use the `--examples_as_exercises`, any subsection starting with `Example:` will get a number for the example, and this number corresponds to a counter that is shared with Exercise, Problem, and Project. This may work well if you look at Example, Exercise, Problem, and Project as much of the same thing, basically Example is then an Exercise with solution. However, the same numbering of examples and exercises may look quite odd too, so be careful with the `--examples_as_exercises` option.

## 4.3 List of Exercises, Problems, and Projects

DocOnce also supports listing all exercises, problems, and projects with corresponding page numbers. By default, no such listing is enabled. When running `doconce format pdflatex` (or `latex`) there is a command-line option `--list_of_exercises` that can be set to

- `toc`: include exercises, problems, and projects as part of the table of contents
- `loe`: make a separate list of exercises, problems, and projects, which appears after the table of contents

There is a special LaTeX environment for the exercises that one can use to further tailor the appearance of exercises (given that one edits the `.tex` file, preferably by a script after each `doconce format` command).

There is also a command `doconce latex_exercise_toc` that makes a special table of contents of the exercises. It truncates too long exercise headings, but by inserting `# Short title: Shorter title` right after the heading, the `Shorter title` will be used as title. Usually, this option is used if the automatic truncation of the title of the exercise fails (truncation in the middle of a formula, for instance).

```
Terminal> doconce latex_exercise_toc mydoc.do.txt "List of Exercises"
```

Try it out and compare with other methods for listing the exercises.

## 4.4 Numbering of Extra Equations in Solutions

A potential problem arises if you produce two versions of your document, one with answers or solutions and one without answers or solutions (`--without_answers`, `--without_solutions`), and there are numbered equations in the solutions. Equations in the text of the document *after* these exercises sections might then be numbered differently in the different versions you produce of the text. There are two ways out of this problem.

**Book.** In a book with chapters, collect all exercises at the end in a separate section "Exercises". Equations are numbered chapter-wise, and equations in solutions will not influence the numbering of equations before this exercise section. However, if some of the exercises contain numbered equations in the exercise text, numbered equations in solutions to previous exercises will influence the numbering of equations in forthcoming exercise texts. In such cases, either avoid numbered equations in a solution or in the exercise text.

**Use the tag command.** Equations can be given explicit numbers, completely governed by the writer. The following equation is given the number `11.5.3` and a label `myeq`:

```
!bt
\[ 1 + 1 = 2 \tag{11.5.3}
label{myeq}
!et
```

Equations in solutions can then be given their own numbers (here, `11.5` could be chapter 11, section 5). One can use a Mako variable to automatically assign appropriate numbers in the `tag` command.

## 4.5 Typesetting of solutions to exercises

There is an option `--exercise_solution=` option for controling the typesetting of solutions. Three values are legal: `paragraph` means that the solution just gets a paragraph heading, `admon` means that the solution is typeset within a notice admonition environment (`!bnotice`), while `quote` means typesetting within a quote environment.

**Suggestion for HTML Bootstrap.** If your choice is `--exercise_solution=admon`, and you want the Boostrap HTML output format, use `--html_admon=bootstrap_panel`. It makes the solutions stand out nicely in the text.

**Suggestion for LaTeX.** Sometimes the standard admons are not so suitable for typesetting solutions because they may have a background color, or they may be too eye catching. Here is a trick for LaTeX output where we 1) change the admon environment in solutions from notice to question type, 2) change the parameters in the question admon so there is no catchy background color and also a thinner frame, 3) typeset code inside solution environment without any background color. These modifications can be done by editing the `mydoc.tex` file in the compilation script (if `mydoc` is the name of the document).

We can identify all begin and end of question admons in solutions because both are tagged with the title (`Solution`). Looking at the `mydoc.tex` file, we can therefore accomplish change number 1 by the replacements

```
doconce replace 'notice_mdfboxadmon}[Solution.]' \
    'question_mdfboxadmon}[Solution.]' mydoc.tex
doconce replace 'end{notice_mdfboxadmon} % title: Solution.' \
    'end{question_mdfboxadmon} % title: Solution.' mydoc.tex
```

Change number 2 is done with a regular expression edit that replaces the complete definition of question admons:

```
doconce subst -s '% "question"
    admon.+?question_mdfboxmdframed\}' \
    '% "question" admon
\colorlet{mdfbox_question_background}{gray!5}
\\newmdenv[        % edited for solution admons in exercises
  skipabove=15pt,
  skipbelow=15pt,
  outerlinewidth=0,
  backgroundcolor=white,
  linecolor=black,
  linewidth=1pt,       % frame thickness
  frametitlebackgroundcolor=blue!5,
  frametitlerule=true,
  frametitlefont=\\normalfont\\bfseries,
  shadow=false,        % frame shadow?
  shadowsize=11pt,
  leftmargin=0,
  rightmargin=0,
  roundcorner=5,
  needspace=0pt,
]{question_mdfboxmdframed}' mydoc.tex
```

Change number 3 involves mapping `pycod` and `pypro` environments inside admons to `pycod2` and `pypro2` and define these environments by the simpler listing style `greenblue`, which does not have any background color. Mapping of an environment to another variant inside admons is described in *LaTeX code Environments Inside Admonitions* in Section 5.6. For this purpose one employs the `--latex_admon_envir_map=` option.

Here is a possible command (that employs a blue background for all boxes, except `pypro` that gets a frame to indicate "program" and `sys` and `dat` that get a completely different typesetting):

```
doconce format pdflatex mydoc \
  "--latex_code_style=default:lst[style=blue1_bluegreen]@
  pypro:lst[style=blue1bar_bluegreen]@
  pypro2:lst[style=greenblue]@
  pycod2:lst[style=greenblue]@
  dat:lst[style=gray]@
  sys:vrb[frame=lines,label=\\fbox{{\tiny Terminal}},
  framesep=2.5mm,framerule=0.7pt,fontsize=\fontsize{9pt}{9pt}]" \
  --exercise_solution=admon --latex_admon_envir_map=2
```

(Note that we had to split the `--latex_code_style=` option over several lines – everything should be on one line in the compilation script!)

The `--latex_admon_envir_map=2` option renames an environment like `pycod` inside an admon to `pycod2`, and the `--latex_code_style=` option defines the

new pycod2 environment to be bluegray syntax highlighting, but no background color. Note that this applies to all question admons, but usually there are few question admons, so very often this will be a specific typesetting for solutions to exercises.

Note that when you use --exercise_solution=admon and --latex_admon=mdfbox (default), you cannot have figures with captions inside the admons, i.e., inside !bsol and !esol in the present problem setting. Only *inline figures* will work. Write these as FIGURE: the usual way, but drop the caption.

The current example shows how we can tailor DocOnce output to a level far beyond what DocOnce itself can output!

## 4.6 Extracting Selected Exercises in a Separate Document

The command

```
Terminal> doconce extract_exercises tmp_mako__mydoc.do.txt --filter=key1;key2
```

extracts all exercises in mydoc.do.txt with keywords key1 or key2 in a separate document mydoc_exer.do.txt. For example, this feature can be used to extract all exercises suitable for being published as IPython/Jupyter notebooks (and perhaps automatically graded by nbgrader). Just attach the keyword ipynb to all exercises suitable for the IPython/Jupyter notebook and run the command with -filter=ipynb. Without -filter=, the extract_exercises utility extracts all exercises such that one can publish this document separately, with or without solutions and/or short answers. By "exercise" we here mean all exercises, problems, and projects.

The numbering of the exercises in the new document follows the numbering in the original document[3], but you must use the --exercise_numbering=chapter option in addition if you want a chapter-based numbering when extracting exercises from a book.

It is also possible to extract examples along with exercises: just add --examples_as_exercises (to extract the examples only, equip them with a unique keyword that you can use in the -filter= option).

**Note:** Instead of having all filtered exercises in one document, you may (especially for notebooks) want stand-alone documents for each exercise, see the next section.

## 4.7 Extracting Exercises as Stand-Alone Documents

It is sometimes convenient to publish exercises from a larger document as *individual documents*. With the --exercises_in_zip option, DocOnce will generate a zip file mydoc_exercises.zip (for mydoc.do.txt) with each exercise

[3] If you want a new natural numbering of the extracted exercises only, you must go into the DocOnce source file with the extracted exercises and remove the comment line that contains the labels2numbers dictionary.

(problem, project, or example) in a separate `.do.txt` file. The zip archive also contains a script `make.py` for translating the `.do.txt` files to various formats. In university courses it may be attractive to give the students `.tex` with the exercise text such that the students can fill in the answers and extend the text to a report. Or one may distribute the exercises as IPython/Jupyter Notebook files and let the students fill in answers in the notebooks. This approach can be combined with `nbgrader` for automatic grading.

The zip archive also contains a file `index.do.txt` with a list of all the exercise files that can be published on the Internet and used for download of the exercises. The `index.do.txt` file contains a variable `FILE_EXTENSIONS` for the type of formats the exercises are available in. The user must edit `make.py` accordingly so the right set of formats are compiled as desired.

**Note:** Unzipping the archive packs out the files in a subdirectory `standalone_exercises`. For figure and movie references to work one needs the `--figure_prefix=../` and `--movie_prefix=../` options. If the exercise files are distributed to students, make sure figure files are also available (check by compiling the exercises!).

**References in stand-alone exercises may not work!**

Exercises with references to sections in the running text of the original document cause trouble when the exercises are compiled as stand-alone documents. For LaTeX this may work if the original document is compiled in the parent directory of `standalone_exercises` and the corresponding `.aux` file is available (the exercise will in such cases make use of the `# Externaldocuments:` command in the file and use the `xr` package for cross-referencing between documents). All other formats will face problems with references to the original parent document. When missing references are encountered, a comment about the issue is inserted in the exercise file.

**Naming of Exercise Files.** The option `--exercises_in_zip_filename=X` can be used to determine the name of the exercise files. With `X=logical`, the logical name specified by the `file=` command in the exercise is used. With `X=number`, the filename contains the exercise number, either an absolute number (integer) like `132` or a `chapter.local_number` like `5.2` or `B.4` (in case of an appendix), depending on the option `--exercise_numbering=X`, with `X=absolute` or `X=chapter`, respectively.

## 4.8 Example of an Exercise

The next section show the typesetting of the following exercise. For output in HTML with various Bootstrap styles, hints and answers appear as unfolded sections - one must click to open the text.

```
===== Exercise: Compute integrals =====
label{doconce:manual:exercise:ex}
files=integrals.py, integrals.pdf
keywords=1+1; integrals; SymPy

Use the most appropriate tools to answer the various subexercises.

!bsubex
What is 1+1?

!bhint
Your brain is a perfectly appropriate tool for this task.
!ehint
!esubex

!bans
2
!eans

!bsubex
What is the integral of $e^{-ax}\sin(wx)$?

!bhint
Assume $a$ and $w$ real.
!ehint

!bsol
This is an easy task for SymPy:

!bc pyshell
>>> import sympy as sp
>>> x = sp.symbols('x')
>>> a, w = sp.symbols('a w', real=True,positive=True)
>>> F = sp.integrate(sp.exp(-a*x)*sp.sin(w*x), x)
>>> F
-a*sin(w*x)/(a**2*exp(a*x) + w**2*exp(a*x)) -
w*cos(w*x)/(a**2*exp(a*x) + w**2*exp(a*x))
>>> sp.simplify(F)
-(a*sin(w*x) + w*cos(w*x))*exp(-a*x)/(a**2 + w**2)
!ec
That is, $-\frac{e^{- a x}}{a^{2} + w^{2}}
\left(a \sin{\left (w x \right )}
+ w \cos{\left (w x \right )}\right)$.
!esol
!esubex

!bsubex
Compute $\int_{-\infty}^1 e^{-x^4}dx$.

!bsol
Continuing the last session,

!bc pyshell
>>> F = sp.integrate(sp.exp(-x**4), (x, -sp.oo, 0))
>>> F
gamma(1/4)/4
>>> F.evalf()
```

```
0.906402477055477
!ec
!esol
!esubex

!bsubex
!bquiz
Q: What is correct about the integral $\int e^{-t^2}dt$?

Cw: The integral is the error function.
E: Almost correct, but the error function has a slightly different
definition:

!bt
\[ \hbox{erf}(x) = \frac{2}{\sqrt{2}}\int_{0}^x e^{-t^2}dt.\]
!et

Cw: It cannot be computed.
E: That would be correct if computed means ``calculated as
a closed-form formula by hand'', but the integral
$\int_a^b e^{-t^2}dt$ can be easily computed numerical
methods.

Cr: It equals

!bt
\[ \frac{\Gamma{\left(\frac{1}{4} \right)}
\gamma\left(\frac{1}{4}, x^{4}\right)}{16
\Gamma{\left(\frac{5}{4} \right)}},\]
!et
where $\Gamma(x)$ is the (upper) incomplete gamma function
and $\gamma(x)$ is the lower incomplete gamma function
(see "Wikipedia":
"http://en.wikipedia.org/wiki/Incomplete_gamma_function"
for definition).
E: This is correct, as proved by SymPy:

!bc pyshell
>>> import sympy as sym
>>> F = sym.integrate(sym.exp(-x**4), x)
>>> F
gamma(1/4)*lowergamma(1/4, x**4)/(16*gamma(5/4))
!ec

Cw: It equals the cumulative normal density function.
E: The cumulative normal density function, with mean $\mu$ and
standard deviation $\sigma$, is defined as

!bt
\[ \Phi(x) = \int_{-\infty}^x \frac{1}{\sqrt{2\pi}\sigma}
e^{-\frac{(t-\mu)^2}{2\sigma}}dt.\]
!et
!equiz
!esubex

!bremarks
This exercise demonstrates subexercise, hint, solution, short answer,
multiple-choice question (quiz), and final remark - combined with
mathematics and computer code.
!eremarks
```

## Exercise 1: Compute integrals

Use the most appropriate tools to answer the various subexercises.

**a)** What is 1+1?

**Hint.** Your brain is a perfectly appropriate tool for this task.

**Answer.** 2

**b)** What is the integral of $e^{-ax}\sin(wx)$?

**Hint.** Assume $a$ and $w$ real.

**Solution.** This is an easy task for SymPy:

```
>> import sympy as sp
>> x = sp.symbols('x')
>> a, w = sp.symbols('a w', real=True,positive=True)
>> F = sp.integrate(sp.exp(-a*x)*sp.sin(w*x), x)
>> F
-a*sin(w*x)/(a**2*exp(a*x) + w**2*exp(a*x)) -
w*cos(w*x)/(a**2*exp(a*x) + w**2*exp(a*x))
>> sp.simplify(F)
-(a*sin(w*x) + w*cos(w*x))*exp(-a*x)/(a**2 + w**2)
```

That is, $-\frac{e^{-ax}}{a^2+w^2}\left(a\sin\left(wx\right)+w\cos\left(wx\right)\right)$.

**c)** Compute $\int_{-\infty}^{1} e^{-x^4}dx$.

**Solution.** Continuing the last session,

```
>> F = sp.integrate(sp.exp(-x**4), (x, -sp.oo, 0))
>> F
gamma(1/4)/4
>> F.evalf()
0.906402477055477
```

**d)**

**Question:** What is correct about the integral $\int e^{-t^2}dt$?

**A**. The integral is the error function.
**B**. It cannot be computed.
**C**. It equals

$$\frac{\Gamma\left(\frac{1}{4}\right)\gamma\left(\frac{1}{4},x^4\right)}{16\Gamma\left(\frac{5}{4}\right)},$$

where $\Gamma(x)$ is the (upper) incomplete gamma function and $\gamma(x)$ is the lower incomplete gamma function (see Wikipedia for definition).

**D**. It equals the cumulative normal density function.

**Answer:** C.
**Solution:**

**A**: Wrong. Almost correct, but the error function has a slightly different definition:

$$\text{erf}(x) = \frac{2}{\sqrt{2}} \int_0^x e^{-t^2} dt.$$

**B**: Wrong. That would be correct if computed means "calculated as a closed-form formula by hand", but the integral $\int_a^b e^{-t^2} dt$? can be easily computed numerical methods.

**C**: Right. This is correct, as proved by SymPy:

```
>> F = sp.integrate(sp.exp(-x**4), x)
>> F
gamma(1/4)*lowergamma(1/4, x**4)/(16*gamma(5/4))
```

**D**: Wrong. The cumulative normal density function, with mean $\mu$ and standard deviation $\sigma$, is defined as

$$\Phi(x) = \int_{-\infty}^x \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{(t-\mu)^2}{2\sigma}} dt.$$

Filenames: `integrals.py`, `integrals.pdf`.

**Remarks.** This exercise demonstrates subexercise, hint, solution, short answer, multiple-choice question (quiz), and final remark - combined with mathematics and computer code.

# 5 Other Environments

## 5.1 Blocks of Verbatim Computer Code

Blocks of computer code, to be typeset verbatim, must appear inside a "begin code" `!bc` keyword and an "end code" `!ec` keyword. Both keywords must be on a single line and *start at the beginning of the line*. Before such a code block there must be a plain sentence (at least if successful transformation to reST and ASCII-type formats is desired). For example, a code block cannot come directly after a section/paragraph heading or a table.

Here is a plain code block:

```
!bc dat
% Could be a comment line in some file
% And some data
1.003 1.025
2.204 1.730
3.001 1.198
!ec
```

which gets rendered as

```
% Could be a comment line in some file
% And some data
1.003 1.025
2.204 1.730
3.001 1.198
```

**Tip: let code lines be shorter than 67 characters.**

Most output formats from DocOnce will get nice-looking code environments if you keep the length of lines in source code below or equal to 67 characters.

**Typesetting Styles.** There may be an argument after the `!bc` tag to specify a certain environment (in LaTeX, HTML, or Sphinx) for typesetting the verbatim code. For instance, `!bc dat` corresponds to the data file environment and `!bc cod` is typically used for a code snippet. There are some predefined environments explained below. If there is no argument specifying the environment, one assumes some plain verbatim typesetting (usually just the most plain verbatim style in LaTeX or HTML, or `python` in Sphinx, or if `ptex2tex` is used, the environment corresponds to `ccq` which is defined in the config file `.ptex2tex.cfg`).

By default, `pro` is used for complete programs, `cod` is for a code snippet. The syntax `Xcod` and `Xpro` imply a program or snippet in computer language `X`, where `X` can be `f` for Fortran, `c` for C, `cpp` for C++, `sh` for Unix shells, `pl` for Perl, `m` for Matlab, `cy` for Cython, `r` for Ruby, `js` for JavaScript, `latex` for LaTeX, `html` for HTML, and `py` for Python. With no `X` prefix, `cod` and `pro` implies Python code. The argument `sys` after `!bc` means a verbatim environment suitable for operating system commands (and output). As mentioned, `dat` is for a data file or print out, `pyshell` is for plain interactive Python shell sessions, `ipy` for interactive IPython sessions, and `pysc` turns on interactive Python code in executable HTML windows (using a SageMathCell server) while being equivalent to `pycod` in other formats.

Notebooks and other executable code snippets in HTML may need some initializing code before a snippet works, and if such code is not intended for being shown in the text, one can use the `Xhid` argument to `!bc`, where `hid` indicates a hidden snippet. It becomes executable in live code environments but is otherwise not shown.

All these definitions of the arguments after `!bc` can be redefined in command-line arguments for the `--latex_code_style=` option, the `.ptex2tex.cfg` configuration file for `ptex2tex`, and in the `sphinx code-blocks` comments for Sphinx, see below.

idx `-t` code envir postfix

**Executable and Non-Executable Code.** The `ipynb` and `matlabnb` formats create notebooks where computer code can be executed. Sometimes one wants to show code that is *not* to be executed, but just shown as a text block. Any code environment with a postfix `-t` indicates that the code is not to be executed, only displayed. For example, `!bc pycod-t` is a Python snippet not intended for execution. All other formats than the notebook formats ignore the `-t` postfix.

idx `-h` code envir postfix

**Hiding code blocks in HTML.** Code blocks in HTML can be visible or not by clicking on an associated button **Show**/**hide code**. The behavior is triggered by a postfix `-h` to the code environment, e.g., `!bc pycod-h` or `!bc pro-h`. The `-h` postfix has no impact on other output formats.

**Customizing Code Environments Types for Sphinx.** The argument after `!bc` can in case of Sphinx output be mapped onto any valid Pygments language for typesetting of the verbatim block by Pygments, if you do not want to rely on the defaults. This mapping takes place in an optional comment to be inserted in the DocOnce source file. Here is an example on such a comment line:

```
# sphinx code-blocks: pycod=python cod=fortran cppcod=c++ sys=console
```

Three arguments are defined: `!bc pycod` maps on to the Pygments style `python` for Python code, `!bc cod` maps on to the Pygments style `fortran` for Fortran code, `!bc cppcod` maps on to the Pygments style `c++` for C++ code, and `!bc sys` maps on to the Pygments `console` style for terminal sessions. The same arguments would be defined in `.ptex2tex.cfg` or on the command line for `doconce ptex2tex` for how to typeset the blocks in LaTeX using various verbatim styles (Pygments can also be used in a LaTeX context).

**Examples.** Here is a verbatim code block with Python code (`pycod` style):

```
!bc pycod
def f(x, y):
    return x + y

# Main program
from math import pi
print('Testing f:', f(pi, 0))
!ec
```

The typeset result of this block becomes

```
def f(x, y):
    return x + y

# Main program
from math import pi
print('Testing f:', f(pi, 0))
```

**Tip.**

The enclosing `!ec` tag of verbatim computer code blocks must be followed by a newline. A common error in list environments is to forget to indent the plain text surrounding the code blocks. In general, we recommend to use paragraph headings instead of list items in combination with code blocks (it usually looks better, and some common errors are naturally avoided).

And here is a C++ code snippet (`cppcod` style):

```
!bc cppcod
void myfunc(double* x, const double& myarr) {
    for (int i = 1; i < myarr.size(); i++) {
        myarr[i] = myarr[i] - x[i]*myarr[i-1]
    }
}
!ec
```

with the rendered result

```
void myfunc(double* x, const double& myarr) {
    for (int i = 1; i < myarr.size(); i++) {
        myarr[i] = myarr[i] - x[i]*myarr[i-1]
    }
}
```

**Copying Code from Source Files.** Computer code can be copied directly from a file, if desired. The syntax is then

```
@@@CODE myfile.f
@@@CODE myfile.f fromto: subroutine\s+test@^C\s{5}END1
```

The first line implies that all lines in the file `myfile.f` are copied into a verbatim block, typset in a `!bc Xpro` environment, where `X` is the extension of the filename, here `f` (i.e., the environment becomes `!bc fpro` and will typically lead to some Fortran-style formatting). The second line has a `fromto:` directive, which implies copying code between two lines in the code, typset within a `!bc Xcod` environment (again, `X` is the filename extension, implying the type of file). Note that the `pro` and `cod` arguments are only used for LaTeX and Sphinx output, all other formats will have the code typeset within a plain `!bc` environment.) Two regular expressions, separated by the `@` sign, define the "from" and "to" lines. The "from" line is included in the verbatim block, while the "to" line is not. In the

example above, we copy code from the line matching `subroutine test` (with as many blanks as desired between the two words) and the line matching `C END1` (C followed by 5 blanks and then the text END1). The final line with the "to" text is not included in the verbatim block.

One can also specify the code environment explicitly rather than relying on the file extension:

```
@@@CODE somefile.py envir=X fromto: def myfunc@def yourfunc
```

This is the same as writing `!bc X` and copying parts of the `somefile.py` text into the DocOnce source file, followed by `!ec`. For example, if the lines between the `myfunc` and `yourfunc` functions actually work as a complete Python program, one could specify `envir=pypro` to indicate that it is a complete program that can be run as is. By default, copying a part of a `.py` file will lead to `!bc pycod`, which indicates a code snippet that normally needs additional code to be run.

Using `envir=None` results in a pure include of the file, without any surrounding code environment (i.e., no `!bc` or `!ec` directives around the contents of the file). Section 11.3 shows an example.

Let us demonstrate the result of copying a whole file, as specified in the first line above:

```
C      a comment

       subroutine test()
       integer i
       real*8 r
       r = 0
       do i = 1, i
          r = r + i
       end do
       return
C      END1

       program testme
       call test()
       return
```

Let us then copy just a piece in the middle as indicated by the `fromto:` directive above:

```
       subroutine test()
       integer i
       real*8 r
       r = 0
       do i = 1, i
          r = r + i
       end do
       return
```

**The `fromto` and `from-to` directives.** Note that the "to" line is never copied into the DocOnce file, but the "from" line is. Sometimes it is convenient to

also neglect the “from” line, a feature that is allowed by replacing `fromto:` by `from-to` (“from with minus”). This allows for copying very similar code segments throughout a file, while still distinguishing between them. Copying the second set of parameters from the text

```
# --- Start Example 1 ---
c = -1
A = 2
p0 = 4
simulate_and_plot(c, A, p0)
# --- End Example 1 ---

# --- Start Example 2 ---
c = -1
A = 1
p0 = 0
simulate_and_plot(c, A, p0)
# --- End Example 2 ---
```

is easy with

```
from-to: Start Example 2@End Example 2
```

With only `fromto:` this would be impossible.

Remark for those familiar with `ptex2tex`: The from-to syntax is slightly different from that used in `ptex2tex`. When transforming DocOnce to LaTeX, one first transforms the document to a `.p.tex` file to be treated by `ptex2tex` or `doconce ptex2tex`. However, note that the `@@@CODE` line is always interpreted by DocOnce first.

Remark for those familiar with the `listings` package in LaTeX: the `listing` package can copy code from files, but snippets must be specified through exact line numbers. The `@@@CODE` directive above works with regular expressions which are much less sensitive to edits of the source code file than the line numbers. Moreover, copy of code from file works in DocOnce across formats (HTML, Sphinx, Markdown, etc.).

The `--code_prefix=text` option adds a path `text` to the filename specified in the `@@@CODE` command. For example

```
@@@CODE src/myfile.py
```

and `--code_prefix=http://some.place.net`, the file

```
http://some.place.net/src/myfile.py
```

will be included. If source files have a header with author, email, etc., one can remove this header by the option `'--code_skip_until=# ---'`. The lines up to and including (the first) `# ---` will then be excluded.

**The regular expressions in `CODE` commands are non-greedy!**

The copying of code from file will search for the first occurrence of the “from” regular expression and then continue up to the first occurrence of the “to” expression. This means a non-greedy regular expression. A

to make the expression greedy is to insert a comment statement as the "to" expression to make a special end of the snippet to be copied. For example, you have the code

```
compute(x)
print(x)
x = new(x)
compute(x)
print(x)
x = new(x)
compute(x)
```

and you want to copy from the first `compute` and include the second, but not the following `print(x)` statement, i.e.,

```
compute(x)
print(x)
x = new(x)
compute(x)
```

`fromto: compute@compute` will not work. The way to do this is to insert a comment statement after the desired "to" expression:

```
compute(x)
print(x)
x = new(x)
compute(x)
# dummy comment
print(x)
x = new(x)
compute(x)
```

The regular expressions are then `fromto: compute@# dummy comment` ("from" and "to" are actually plain text here – no use of special regular expressions).

**Removing indentation in copied code.** In general, it is not recommended to have a code block where all lines are indented, because in some output formats the indentation is respected (e.g., LaTeX) while others ignore it (e.g., Sphinx). Therefore, at least one line of the code should start in column 1.

Sometimes you want to copy a part of a function where all code is indented. Then you also want to remove the indentation. This is enabled by `@@@CODE-X`, where `X` is the number of blanks in the indentation to be removed. For example, `@@@CODE-4` will copy the code and remove the first 4 characters from each line.

## 5.2 LaTeX Blocks of Mathematical Text

Blocks of mathematical text are like computer code blocks, but the opening tag is `!bt` (begin TeX) and the closing tag is `!et`. It is important that `!bt` and `!et` appear on the beginning of the line and followed by a newline.

```
!bt
\begin{align}
{\partial u\over\partial t} &= \nabla^2 u + f,
label{myeq1}\\
{\partial v\over\partial t} &= \nabla\cdot(q(u)\nabla v) + g.
label{myeq2}
\end{align}
!et
```

Here is the result:

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

$$\frac{\partial v}{\partial t} = \nabla \cdot (q(u)\nabla v) + g. \tag{2}$$

**Support of LaTeX Math in Various Output Formats.** The support of LaTeX mathematics varies among the formats:

- Output in LaTeX (`latex` and `pdflatex` formats) has full support of all LaTeX mathematics, of course.
- The `html` format supports single equations and multiple equations via the align environment, also with labels.
- Markdown (`pandoc` format) allows single equations and inline mathematics, but does not allow references to equations (the generated DocOnce code simulates such references, however).
- MediaWiki (`mwiki` format) does not enable labels in equations and hence equations cannot be referred to.

**Important!**

The main conclusion is that for output beyond LaTeX (`latex` and `pdflatex` formats), stick to simple `\[` and `\]` or `equation` and `align` or `align*` environments, and avoid referring to equations in MediaWikis.

Going from DocOnce to MS Word is most easily done by outputting in the `latex` format and then using the Pandoc or latex2rtf programs to translate from LaTeX to MS Word. Note that only a subset of LaTeX will be translated correctly, and mathematics is notoriously difficult and unpredictable.

**ePub and Mobi.** Conversion to the ePub and Mobi formats, popular for reading on Kindle devices, can go via HTML and the Calibre tools. On Debian/GNU Linux, install `sudo apt-get install calibre`, and run (e.g.)

```
Terminal> ebook-convert mydoc.html mydoc.epub
Terminal> ebook-convert mydoc.html mydoc.mobi
Terminal> ebook-convert mydoc.pdf  mydoc.epub
Terminal> calibre mydoc.epub  # view ebook
```

Unfortunately, it seems that HTML and PDF documents with mathematics cannot be converted to ePub by Calibre (PDF looks strange, MathJax is not used to render formulas in HTML). For documents with mathematics, `ebook-convert` is a fine tool, but blocks of computer code may need reformatting in terms of shorter lines.

Pandoc is another program that can generate ePub (not tested). The ePub3 format supports mathematics via MathML. Some dicussions of this topic appear in http://tex.stackexchange.com/questions/1551/use-latex-to-produce-epub. The LaTeXML program can convert LaTeX to XML and XHTML and can be a good starting point for further conversion to ePub, but the plain `latexml` fails miserably on LaTeX documents generated from DocOnce (the present manual to be precise).

Sphinx is seemingly good support for compiling the document to the ePub and MOBI formats, but this author has not yet tried it out. One should definitely test Sphinx along with `ebookmaker.py` (see next paragraph) if the ePub or MOBI is a requested format.

What has been successfully used to convert DocOnce documents with mathematics and code to ePub is the `ebookmaker.py` script (use this fork by the author for a version of this script that actually works). HTML, in particular with Bootstrap styles, translates well to ePub by this script. The script requires a JSON file describing the content of the book. A typical file for a DocOnce document `mydoc.do.txt` that is translated to HTML and split into a series of files `._mydoc*.html` goes as follows:

```
{
    "filename" : "mydoc",
    "title" : "Title of the document",
    "authors" : [
        {
            "name" : "Hans Petter Langtangen",
            "sort" : "Langtangen, Hans Petter"
        }
    ],
    "rights" : "Public Domain",
    "language" : "en",
    "publisher": "hpl",
    "subjects" : [ "Science" ],
    "contributors" : [
        {
            "name" : "Hans Petter Langtangen",
            "role" : "author"
        }
    ],
    "identifier" : {
        "scheme" : "URL",
        "value" : "http://somewhere.net"
    },
    "contents" : [
        {
            "type" : "text",
```

```
            "source" : "._mydoc*.html"
        }
    ],
    "toc" : {
        "depth" : 2,
        "parse" : [ "text" ],
        "generate" : {
            "title" : "Index"
        }
    }
}
```

Just edit this file, save it as `mydoc.json` and run `python3 /some/path/to/epubmaker.py mydoc.json` to produce `mydoc.epub`.

If you want to read your DocOnce document on Kindle, sending the PDF file to the email address for the device seems to be a satisfactory option.

**Apple iBook Format.** A converter to iBooks would be nice. In theory, ePub documents can be imported and converted to iBooks in the iBooks Author application, but ePub files created by `ebookmaker.py` do not translate well. The `.iba` files of iBooks documents can be unzipped and the XML code for the book is available in `index.xml`. However, the XML is undocumented and must be manipulated and filled with the contents of a DocOnce document, e.g., by first translating DocOnce to HTML, and then using BeautifulSoup to get an XHTML version of the HTML that can act as a starting point for filling the XML file for an iBook. See also other ideas.

**Dealing with Mathematics in Formats without LaTeX Math Support.** If the document targets formats with and without support of LaTeX mathematics, one can use the preprocessor to typeset the mathematics in two versions. After `#if FORMAT in ("latex", "pdflatex", "html", "sphinx", "mwiki", "pandoc")` one places LaTeX mathematics, and after `#else` one can write inline mathematics in a way that looks nice in plain text and wiki formats without support for mathematical typesetting. Such branching can be used with mako if-else statements alternatively:

```
% if FORMAT in ("latex", "pdflatex", "html", "sphinx", "mwiki", "pandoc"):
!bt
\[ \sin^2x + \cos^2x = 1,\]
!et
% else:
!bc
              sin^2(x) + cos^2(x) = 1,
!ec
% endif
```

**Mathematics for PowerPoint/OpenOffice.** If you have LaTeX mathematics written in DocOnce, it is fairly easy to generate PNG images of all mathematical formulas and equations for use with PowerPoint or OpenOffice presentations.

1. Make a Sphinx version of the DocOnce file.

2. Go to the Sphinx directory and load the `conf.py` file into a browser.
3. Search for "math" and comment out the `'sphinx.ext.mathjax'` (enabled by default) and `'matplotlib.sphinxext.mathmpl'` (disabled by default) lines, and uncomment the `'sphinx.ext.pngmath'` package. This is the package that generates small PNG pictures of the mathematics.
4. Uncomment the line with `pngmath_dvipng_args =` and set the PNG resolution to `-D 200` when the purpose is to generate mathematics pictures for slides.
5. Run `make html`.
6. Look at the HTML source file in the `_build/html` directory: all mathematics are in `img` tags with `src=` pointing to a PNG file and `alt=` pointing to the LaTeX source for the formula in question. This makes it very easy to find the PNG file that corresponding to a particular mathematical expression.

## 5.3 Macros (Newcommands)

DocOnce supports a type of macros via a LaTeX-style *newcommand* construction, but only inside mathematical expressions (inline LaTeX math or LaTeX math blocks). Newcommands are not allowed in the running text. Here is an example:

```
\newcommand{\beqa}{\begin{eqnarray}}
\newcommand{\eeqa}{\end{eqnarray}}
\newcommand{\ep}{\thinspace . }
\newcommand{\uvec}{\vec u}
\newcommand{\Q}{\pmb{Q}}
```

**Notice.**

If you desire a newcommand for the running text, using a Mako function (written in plain Python) is much more flexible. See Section 11.

The newcommands must be defined by the standard LaTeX command

```
\newcommand{name}{definition}
```

in a separate file with name `newcommands*.tex`. Use of `\def` is ignored. Each newcommand definition *must* appear on a single line.

Newcommands in a file with name `newcommand_replace.tex` are expanded when DocOnce is translated to other formats, except for LaTeX (since LaTeX performs the expansion itself). Newcommands in files with names `newcommands.tex`

and `newcommands_keep.tex` are kept unaltered when DocOnce text is translated to other formats, except for the Sphinx format. (Since Sphinx understands LaTeX math, but not newcommands if the Sphinx output is HTML, it makes most sense to expand all newcommands.) Normally, a user will put all newcommands that appear in math blocks surrounded by `!bt` and `!et` in `newcommands_keep.tex` to keep them unchanged, at least if they contribute to make the raw LaTeX math text easier to read in the formats that cannot render LaTeX.

## 5.4 Writing Guidelines (Especially for LaTeX Users!)

LaTeX writers often have their own writing habits with use of their own favorite LaTeX packages. DocOnce is a much simpler format and corresponds to writing in quite plain LaTeX and making the ascii text look nice (be careful with the use of white space!). This means that although DocOnce has borrowed a lot from LaTeX, there are a few points LaTeX writers should pay attention to. Experience shows that these points are so important that we list them *before* we list typical DocOnce syntax!

Any LaTeX syntax in mathematical formulas is accepted when DocOnce translates the text to LaTeX, but if output in the `sphinx`, `pandoc`, `mwiki`, `html`, or `ipynb` formats is also important, one should follow the rules below.

- AMS LaTeX mathematics is supported, also for the `html`, `sphinx`, and `ipynb` formats.
- If you want LaTeX math blocks to work with `latex`, `html`, `sphinx`, `markdown`, and `ipynb`, it is recommended to use only the following equation environments: `\[ ... \]`, `equation*`, `equation`, `align*`, `align`. `alignat*`, `alignat`. Other environments, such as `split`, `multiline`, `gather` are supported in modern MathJax in HTML and Sphinx, but may face rendering problems (to a larger extent than `equation` and `align`). DocOnce performs extensions to `sphinx`, `ipynb`, and other formats such that labels in `align` and `alignat` environments work well. If you face problems with fancy LaTeX equation environments in web formats, try rewriting with plain `align`, `nonumber`, etc.
- Do not use comments inside equations.
- Newcommands in mathematical formulas are allowed, but not in the running text. Newcommands must be defined in files with names `newcommands*.tex`. Use `\newcommands` and not `\def`. Each newcommand must be defined on a single line. Use Mako functions if you need macros in the running text.
- Use labels and refer to them for sections, figures, movies, and equations only. MediaWiki (`mwiki`) does not support references to equations.
- Spaces are not allowed in labels.

- There is just one `ref` command (no `\eqref` for equations) and references to equations must use parentheses. Never use the tilde (non-breaking space) character before references to figures, sections, etc., but tilde is allowed for references to equations.
- Never use `\pageref` as pages are not a concept in web documents (there is only a `ref` command in DocOnce and it refers to labels).
- Only figures and movies are floating elements in DocOnce, all other elements (code, tables, algorithms) must appear *inline* without numbers or labels for reference[4] (refer to inline elements by a section label). The reason is that floating elements are in general not used in web documents, but we made an exception with figures and movies.
- Keep figure captions shorts as they are used as references in the Sphinx format. Avoid inline mathematics since Sphinx will strip it away in the figure reference. (Many writing styles encourage rich captions that explains everything about the figure, but this will work well only in the HTML and LaTeX formats.)
- You cannot use `subfigure` to combine several image files in one figure, but you can combine the files to one file using the `doconce combine_images` tool. Refer to individual image files in the caption or text by (e.g.) "left" and "right", or "upper left", "lower right", etc.
- Footnotes can be used as usual in LaTeX, but some HTML formats are not able to display mathematics or inline verbatim or other formatted code (emphasis, boldface, color) in footnotes - have that in mind.
- Use plain `cite` for references (e.g., `\citeauthor` has no counterpart in DocOnce). The bibliography must be prepared in the Publish format, but import from (clean) BibTeX is possible.
- Use `idx` for index entries, but put the definitions between paragraphs, not inside them (required by Sphinx).
- Use the `\bm` command (from the `bm` package, always included by DocOnce) for boldface in mathematics.
- Make sure all ordinary text starts in column 1 on each line. Equations can be indented. The `\begin{}` and `\end{}` directives should start in column 1.
- If you depend on various LaTeX environments for your writings, you have to give up these, or implement *user-defined environments* in DocOnce.

[4] There is an exception: by using *user-defined environments* within `!bu-name` and `!eu-name` directives, it is possible to label any type of text and refer to it. For example, one can have environments for examples, tables, code snippets, theorems, lemmas, etc. One can also use Mako functions to implement enviroments.

For instance, examples are normally typeset as subsections in DocOnce, but can also utilize a user-defined example environment. Learn about the exercise support in DocOnce for typesetting exercises, problems, and projects.

- Learn about the preprocessors Preprocess and Mako - these are smart tools for, e.g., commenting out/in large portions of text and creating macros.
- Use *generalized references* when referring to companion documents that may later become part of this document (or migrated out of this document).
- Follow recommendations for DocOnce books if you plan to write a book.

**Use the preprocessor to tailor output.**

If you really need special LaTeX constructs in the LaTeX output from DocOnce, you may use use preprocessor if-tests on the format (typically `#if FORMAT in ("latex", "pdflatex")`) to include such special LaTeX code. With an else clause you can easily create corresponding constructions for other formats. This way of using Preprocess or Mako allows advanced LaTeX features, or HTML features for the HTML formats, and thereby fine tuning of the resulting document. More tuning can be done by automatic editing of the output file (e.g., `.tex` or `.html`) produced by DocOnce using your own scripts or the `doconce replace` and `doconce subst` commands.

**Autotranslation of LaTeX to DocOnce?**

The tool `doconce latex2doconce` may help you translating LaTeX files to DocOnce syntax. However, if you use computer code in floating list environments, special packages for typesetting algorithms, example environments, `subfigure` in figures, or a lot of newcommands in the running text, there will be need for a lot of manual edits and adjustments.

For examples, figure environments can be translated by the program `doconce latex2doconce` only if the label is inside the caption and the figure is typeset like

```
\begin{figure}
  \centering
  \includegraphics[width=0.55\linewidth]{figs/myfig.pdf}
  \caption{This is a figure. \labe{myfig}}
\end{figure}
```

If the LaTeX is consistent with respect to placement of the label, a simple script can autoedit the label inside the caption, but many LaTeX writers put the label at different places in different figures, and then it becomes more difficult to autoedit figures and translate them to the DocOnce `FIGURE:` syntax.

Tables are hard to interpret and translate, because the headings and caption can be typeset in many different ways. The type of table that is recognized looks like

```
\begin{table}
\caption{Here goes the caption.}
\begin{tabular}{lr}
\hline
\multicolumn{1}{c}{$v_0$} & \multicolumn{1}{c}{$f_R(v_0)$}\\
\hline
1.2 & 4.2\\
1.1 & 4.0\\
0.9 & 3.7
\hline
\end{tabular}
\end{table}
```

Recall that table captions do not make sense in DocOnce since tables must be inlined and explained in the surrounding text.

Footnotes are also problematic for `doconce latex2doconce` since DocOnce footnotes must have the explanation outside the paragraph where the footnote is used. This calls for manual work. The translator from LaTeX to DocOnce will insert `_PROBLEM_` and mark footnotes. One solution is to avoid footnotes in the LaTeX document if fully automatic translation is desired.

## 5.5 Typesetting of Algorithms

DocOnce has no support for typesetting of algorithms, while LaTeX has quite sophisticated support. LaTeX writes need some strategy with dealing with algorithms in DocOnce: they should be sophisticated when the output is in LaTeX and they should be readable when the output is in other formats that have no native support for algorithms.

The simplest solution is to use the preprocessor (Preprocess or Mako) to allow different solutions for different formats. There are basically three typesetting styles available: LaTeX algorithm environments, pseudo code in a verbatim block, and a nested list. A preprocessor variable, say `ALG` can be used to select the typesetting. With Mako we can write

```
% if ALG == 'latex':
# Write native LaTeX code for the algorithm
% elif ALG == 'code':
# Write pseudo code in (e.g.) a python-like style
!bc pycode
```

```
if feature in element:
...
!ec
% elif ALG == 'list':
# Use lists to express the algorithm
  o if this element has the feature:
    * ...
% endif
```

## 5.6 Admonitions

DocOnce offers strong support for admonition environments, such as warning boxes, notification boxes, question boxes, and summary boxes. The boxes normally have an icon, a heading, and may also have a background color. A special box, the block, has never any icon and can be used when an icon would be disturbing or misleading. The variety of admonitions and their many typesetting styles are available through a demo.

**Examples on Admonition Types.** The following admonition environments are available: `block`, `warning`, `notice`, `question`, and `summary`. The box is defined by begin and end tags such as `!bnotice` and `!enotice`. The title of the box is fully customizable. This means that if you want different types of boxes, e.g. a *detour* box and a *tip* box, you can just open introduce the convention that detour applies the summary box and starts with 'Detour:' in the title, while the notice box is used for tip boxes and as a title starting with 'Tip:'.

Here are a few examples:

```
!bwarning
Here is a warning!
!ewarning

!bnotice
This is a notice box with default title.
!enotice

!bnotice Hint
A *Hint* or *Tip* box can use the ‘notice‘ box.
!enotice

!bquestion
How many admonition types are there in DocOnce?
!equestion

!bblock This is a block.
A block never has any icon. A block has never any icon,
but may feature a title. It is often used in slides.
!eblock

!bnotice Going deeper
This is text meant to provide more details. The box has the
layout of the notice box, but a custom title, here *Going deeper*.
!enotice

Finally some summary:

!bsummary
```

```
The main message is to utilize the admonition styles for
marking different parts of the text
!esummary
```

The above DocOnce code is in the present format rendered as

**Warning.**

Here is a warning!

**Notice.**

This is a notice box with default title.

**Hint.**

A *Hint* or *Tip* box can, e.g., use the `notice` box.

**Question.**

How many admonition types are there in DocOnce?

**This is a block.**

A block never has any icon. A block has never any icon, but may feature a title. It is often used in slides.

**Going deeper.**

This is text meant to provide more details. The box has the layout of the notice box, but a custom title, here *Going deeper*.

Finally some summary:

**Summary.**

The main message is to utilize the admonition styles for marking different parts of the text

The layout of admonitions depend on the format. In the `rst` and `sphinx` formats one applies the native admonitions, but in `sphinx` the `automake_sphinx.py` script manipulates the HTML file to set a gray background for all admonitions. In `html`, `latex` and `pdflatex` there is quite some functionality to control the layout of admonitions.

**Layout of Admonitions in HTML.** The command-line argument `--html_admon` sets the admonition style for the `html` format (see demo):

- `--html_admon=gray` for icons with gray background and small font,
- `--html_admon=yellow` and `--html_admon=apricot` are similar, but the icons and colors are different,
- `--html_admon=colors` has quite bright colors as backgrounds for the different admonitions,
- `--html_admon=lyx` gives a white background and small icons,
- `--html_admon=bootstrap_alert` gives the common colored admonition boxes associated with the Bootstrap HTML styles (only effective if `--html_style=boots*`),
- `--html_admon=bootstrap_panel` applies the panel construction in Bootstrap to make admonition boxes with (normally) white background but a colored background for the title (only effective if `--html_style=boots*`),
- `--html_admon=paragraph` results in a simple paragraph with the admon title as heading. With `--html_admon=paragraph-X`, where `X` is `small` or `large` (or a number less than 100 or grater than 100, resp.). The admon text is then typeset with a small or large font.

The options `--html_admon_bg_color=...` and `--html_admon_bd_color=...` can be used to override the default background and boundary frame colors of the admon styles (respectively). These options have only effect for the `apricot`, `yellow`, and `gray` styles.

Some recommended combinations for admonitions in HTML are

- `--html_style=bloodish`, `--html_admon=gray`, `--pygments_html_style=none` or `--pygments_html_style=default`
- `--html_style=blueish2`, `--html_admon=yellow`, `--pygments_html_style=none` or `--pygments_html_style=default`
- `--html_style=boots*`, `--html_admon=bootstrap_alert` or `--html_admon=bootstrap_panel`

**Layout of Admonitions in LaTeX.** In `latex` and `pdflatex`, the type of admonition style is set by the command-line option `--latex_admon=`. Several values are available (see demo):

- `paragraph` is the simplest type of admonition and typeset as plain text with an optional paragraph heading. The variant `paragraph-X` typesets the paragraph with font size `X`, where `X` can be `large`, `small`, `footnotesize`, or `tiny`. With the `X` specification there is also some small space above and below the admon.
- `colors1` (inspired by the original NumPy User Guide in LaTeX/PDF) applies different colors for the different admons with an embedded icon.
- `colors2` is like `colors1` but the text is wrapped around the icon.
- `mdfbox` is the default and gives rounded white boxes with a potential title and no icon (using the very flexible `mdframed` packaged in LaTeX).
- `graybox2` has square corners, gray background, and is narrower than `mdfbox`. One special feature of `graybox2` is the summary admon, which has a different look with horizontal rules only, and for A4 format, the summary box is half of the text width and wrapped with running text around (if it does not contain verbatim text, in that case the standard `graybox2` style is used). This small summary box is effective in proposals to disperse small paragraphs of key points around.
- `grayicon` has icons and a light gray background.
- `yellowicon` has icons and a light yellow background.

There is also an option `--latex_admon_color=...` that can be used to override the default color. Values are either saturated colors like `gray!10` or an RGB tuple `0.95,0.91,0.97`. The chosen color replaces all default colors for all admon styles except `paragraph`. For example, an oval gray box is produced by `--latex_admon=mdfbox` and `'--latex_admon_color=gray!10'` (note the quotes: they are necessary to avoid a Bash error due to the exclamation mark in the color specification).

The `mdfbox` admonition styles has boxes with many possibilities for customization by editing the `.tex` file. For example, `linecolor` sets the color of the frame border and `frametitlebackgroundcolor` sets the background color of the title area. A dark blue frame and a light blue background for the title is produced by this automatic edit:

```
doconce replace 'linecolor=black,' 'linecolor=darkblue,'
    mydoc.tex
doconce subst 'frametitlebackgroundcolor=.*?,'
    'frametitlebackgroundcolor=blue!5 mydoc.tex
```

Admonition titles without a period, exclamation mark, or colon at the end will by default get a period at the end. For some LaTeX admonitions (e.g., `mdfbox`),

it may be natural to view the title with a heading *without* any period. The command-line option `--latex_admon_title_no_period` avoids appending a period.

**LaTeX code Environments Inside Admonitions.** Sometimes one sets a special background color in the admonitions, and colored code blocks, which look fine in the running text, may then have inappropriate colors inside admonitions. The option `--latex_admon_envir_map=...` is used to map an environment (usually for code) to a new style inside admonitions. Specifying a number, say 2, as in `--latex_admon_envir_map=2`, appends the number to all environments inside admonitions, so `!bc pycod` becomes effectively `!bc pycod2`. One can then in `doconce ptex2tex` (or in the `ptex2tex` configuration file) specify the typesetting of the `pycod2` environment. Otherwise the specification must be a mapping for each envir that should be changed inside the admons:

```
--latex_admon_envir_map=pycod-pycod_yellow,fpro-fpro2
```

i.e., a from-to, from-to type of syntax. In this particular example, the `!bc pycod` environment becomes `!bc pycod_yellow` and `!bc fpro` becomes `!bc fpro2` inside admonitions.

**The Box Environment.** A plain box without any title or colored background, just a rectangular frame, is also available. The syntax goes like

```
!bbox
!bt
\[ \nabla\cdot\bm{u} = 0  \quad\hbox{(mass balance)}\]
!et
!ebox
```

resulting in

$$\nabla \cdot \boldsymbol{u} = 0 \quad \text{(mass balance)}$$

Admonitions are usually used to typeset something that should be distinct from the running text: a warning, a remark, a notification, a question, a summary, while a box is often used to highlight a key finding in the running text: an equation, a hypothesis, a theorem, a rule, or a conclusion.

## 5.7 User-Defined Environments

LaTeX writers are often fond of their favorite environments and think that formats like DocOnce, Markdown, and HTML are primitive without these favorite environments. DocOnce, however, offers *user-defined* environments with begin and end tags, as typical in LaTeX. This section explains how to define such user-defined environments.

**Remark.** Special environments can always be implemented by Mako code as illustrated in Section 11.6, but the DocOnce user-defined environments are easier to use.

For example, suppose you want to typeset examples using a native *example* environment in LaTeX, while other formats can simply typeset examples as subsections. You can then introduce your own example environment in DocOnce and write the environment like this:

```
!bu-example Addition label=ex:math:1p1
We have

!bt
\[ 1 + 1 = 2 \]
!et
|!eu-example
```

The convention for this type of examples is to have a title, and the title line may feature `label=xxx`, where we can use `xxx` as a label for the example. The example environment above is in the present output format typeset like this:

**Example 5.1.** *Addition*.
We have

$$1 + 1 = 2$$

or in tabular form:

| Problem | Result |
|---|---|
| $1 + 1$ | $2$ |

The definition of the example environment must be done in a Python module `userdef_environments`, located in the same directory as the DocOnce source code or the parent directory. In this file (`userdef_environments.py`), we must provide a dictionary `envir2format` for translating an environment into the right code for a specific format:

```
envir2format = {
    'intro': {
        'latex': r"""
\usepackage{amsthm}
\theoremstyle{definition}
\newtheorem{example}{Example}[section]
""",},
    'example': {
        'latex': example,
        'do': do_example,
        },
}
```

The `intro` key contains initializing statements for the LaTeX and HTML formats (the preamble and the `head` tag, respectively). Here, we need the `amsthm` package and a definition of the `example` environment in LaTeX. No initialization is

needed for HTML. The other keys are the names of the environments. For each environment, we use a function to format the code for a specific output format. The `do` key is a default DocOnce formatting, expressed in DocOnce syntax and applied if the output format is not present among the other keys. The LaTeX output is here defined by the function `example`:

```
def example(text, titleline, counter, format):
    """LaTeX typesetting of example environment."""
    label, titleline = get_label(titleline)
    s = r"""
\begin{example}
"""
    if label:
        s += 'label{%s}\n' % label  # no \ (is added by DocOnce)
    s += r"""
\noindent\emph{%s}.

%s
\end{example}
""" % (titleline, text)
    return s

def get_label(titleline):
    """
    Extract label from title line in begin environment.
    Return label and title (without label).
    """
    label = ''
    if 'label=' in titleline:
        pattern = r'label=([^\s]+)'
        m = re.search(pattern, titleline)
        if m:
            label = m.group(1)
            titleline = re.sub(pattern, '', titleline).strip()
    return label, titleline
```

The arguments are `text` for the body of the environment, `titleline` for the title (everything that comes after `!bc-example` on the line), an integer `counter` that counts the number of the current environment (1, 2, and so on, which can be used for reference as an alternative to the label), and the `format` string holding the user's output format. In the present case, we add the label inside the example environment if we have a label in the title, and we typeset the title in the emphasize font. Otherwise, we rely on the standard `example` (or `newtheorem`) LaTeX environment.

In HTML and other formats, we simply typeset the example as a subsection:

```
def do_example(text, titleline, counter, format):
    """General typesetting of example environment via a
        section."""
    label, titleline = get_label(titleline)
    s = """

===== Example %d: %s =====
""" % (counter, titleline)
    if label:
```

```
        s += 'label{%s}\n' % label
    s += '\n%s\n\n' % text
    return s
```

We quickly encounter a problem when referring to a specific example. In LaTeX, we want to write `Example~\ref{label}`, using the label defined in the example heading. In other formats, this label is a section number, or usually the section (example) heading. Different wording is needed for different formats. This is easiest accomplished by a little Mako function in the top of the DocOnce source:

```
<%
def refex(label, capital=False):
    if FORMAT in ('latex', 'pdflatex'):
        return 'Example ref{%s}' % label
    else:
        s = 'The ' if capital else 'the '
        s += 'example in Section ref{%s}' % label
        return s
%>
```

We can then write something like

```
${refex('ex:test:1p1', capital=True)} demonstrates how to do 1+1.
That is, the calculation 1+1 appears in ${refex('ex:test:1p1')}.
```

Note that we distinguish between `capital=True`, which means that the example reference opens a sentence, and `capital=False`, which refers to a reference later in the sentence. In HTML we see the difference:

```
The example in the section
<a href="#ex:test:1p1">Example 1: A test function</a>
demonstrates how to do 1+1.
That is, the calculation 1+1 appears in the example in the section
<a href="#ex:test:1p1">Example 1: A test function</a>.
```

while there is no difference in LaTeX since we refer to *Example* with capital E anyway:

```
Example~\ref{ex:test:1p1} demonstrates how to do 1+1.
That is, the calculation 1+1 appears in Example~\ref{ex:test:1p1}.
```

To summarize, the *example* environment together with the `refex` Mako function allows you to work with native LaTeX example environments, while there is a neat alternative solution for all other formats.

**Enumerated environments.**

It is also possible to make enumerated environments such that their 'ref's use numbers instead of section headings in HTML format (just like Figures do). This mimics LaTeX behaviour on theorem-style environments. See the example in DocOnce repository.

You may take a look at a complete `userdef_environments.py` file to see this example environment and another *highlight* environment where we define blue boxes in LaTeX and HTML and rely on a standard notice admon for all other formats. The highlight environment is written like

```
!bu-highlight Highlight box!
This environment is used to highlight something:

!bt
\[ E = mc^2 \]
!et
!eu-highlight
```

and typeset as

**Highlight box!**

This environment is used to highlight something:

$$E = mc^2$$

**Tip: Test `userdef_environments.py`!**

Make sure you run the `userdef_environments.py` file to check that all syntax is correct:

```
Terminal> python userdef_environments.py
```

A common error is to have the `envir2format` dictionary defined before the functions it refers to.

A complete example showing how one can create tailored environments for computer code, using `--latex_code_style`, in particular the following one (with a caption),

**Python code 3.1.** `process.f`: Return a multiplied by c

```
      subroutine process(a, n, c, r)
C     Return array r = c*a
      integer n
      real*8 a(n), c, r(n)
      integer i
      do i = 1,n
         r(i) = c*a(i)
      end do
      return
      end
```

appears at the end of the document Demonstration of DocOnce support for LaTeX code block environments.

Other examples are available in the DocOnce repository.

# 6 Bibliography (References)

DocOnce applies the software tool Publish to handle the bibliography in a document. With Publish it is easy to import BIBTEX data and maintain a database in a clean, self-explanatory textual format. From the Publish format it is easy to go BIBTEX and reST or straightforward DocOnce typesetting (and from there to HTML, plain text, wiki formats, and so on).

Installing Publish is trivial: either do

```
Terminal> pip install -e \
   hg+https://bitbucket.org/logg/publish#egg=publish#egg=publish
```

or checkout the code on `bitbucket.org`:

```
Terminal> hg clone https://bitbucket.org/logg/publish
Terminal> cd publish
Terminal> sudo python setup.py install
```

## 6.1 Importing your data to the Publish database

Many scientists have their bibliographic data in the BibTex format. Here we assume that you have two files, `refs1.bib` and `refs2.bib`. These can be imported to a Publish database, residing in the file `papers.pub`, by the commands

```
publish import refs1.bib
publish import refs2.bib
```

During import, Publish may ask you for accepting the name of new institutions or journals. Publish already have a database of journals and institutions/departments, but when you add new, you also get a file `venues.list` (in the current working directory) which will be used for future imports in this directory. Make sure you store `publish.pub` and `venues.list` along with your DocOnce document files (they do not need to reside in the same directory, but make sure you add them to your version control system).

**Importing big BIBTEX databases may imply a lot of work.**

If your BIBTEX database does not confirm to the strict BIBTEX syntax required by Publish (entry names must be in lower case, their values must be surrounded by curly braces), you will get error messages. Publish will also check the names of all journals and detect duplicate entries. For databases automatically created by some of the modern web tools for references, the BIBTEX file may need a lot of edits before it can be accepted by Publish. Consider using a script to automate many of the edits.

## 6.2 Requirements to input data

**Notice.**

Note that Publish only accepts BIBTEX files where the keys (author, title, etc.) are in lower case and where the data are enclosed in curly braces. You may need to edit your BIBTEX files to meet this demand.

The utility `doconce fix_bibtex4publish file.bib` fixes several known issues with BIBTEX files such that Publish has a better chance of accepting the entries. Run this utility first, then run Publish, respond to any requirements that Publish spits out, remove `papers.pub` if it exists, and run the import statements again.

Although references are visible as numbers only in the output, it is recommended to have apply a nice, consistent typesetting of your keys. It is suggested to use the following scheme:

```
Langtangen_2003a          # single author
Langtangen_Pedersen_2002  # two authors
Langtangen_et_al_2002     # three or more authors
```

One can add a, b, c, and so forth if several keys feature the same authors and year.

## 6.3 Adding new references to the database

When you get some new BIBTEX references you simply put them in a file, say `refs3.pub` and run the `publish import refs3.pub` command to update the database. You may also consider editing the `papers.pub` file directly when adding new references.

## 6.4 Exporting the database

Export of everything in the database to BIBTEX is done by

```
publish export mybibtexfile.bib
```

You can easily export subsets of the database, e.g., only papers associated with a particular author (the Publish manual has details on how this is done). DocOnce will automatically export the database to BIBTEX if the output format is `latex` or `pdflatex`.

## 6.5 Referring to publications

We use the command

```
cite{key}
```

to refer to a publication with bibliographic key `key`. Here is an example: [6] discussed propagation of large destructive water waves, [5] gave an overview of numerical methods for solving the Navier-Stokes equations, while the use of Backward Kolmogorov equations for analyzing random vibrations was investigated in [4]. The book chapter [7] contains information on C++ software tools for programming multigrid methods. A real retro reference is [3] about a big FORTRAN package. Multiple references are also possible, e.g., see [6, 7].

A LaTeX-style cite command with additional detailed reference is also possible,

```
cite[details]{key}
```

for example as in [5, Section 2] or [5, Equation (4.2)].

In LaTeX, the `cite` command is directly translated to the corresponding LaTeX version of the command with a backslash; in reST and Sphinx the citations becomes links, with the citation keys as names; in HTML the citations are numbered from 1, 2, and so forth according to their appearance, and the numbers appear as links; while in other formats the citations are simply the keys inside square brackets and the corresponding references are listed in the order they are cited.

## 6.6 Specifying the Publish database

The specification of the Publish database file in the DocOnce document is done one a line containing `BIBFILE: papers.pub` (you may give the database file another name and store it in another directory). The references will be inserted at the place where this command appears. Before the command you will often want to have a headline with "References", "Bibliography", or similar. Here is an example:

```
======= References =======

BIBFILE: papers.pub
```

In LaTeX and `PDF`LaTeX the `papers.pub` file is exported to BibTeX format and included in the document, while in all other formats, suitable text is produced from the database.

## 6.7 LaTeX Bibliography Style

The bibliography style is "plain" in LaTeX output. To change this, just edit the `.p.tex` file. For example,

```
doconce format latex mydoc
doconce replace 'bibliographystyle{plain}' 'bibliographystyle{abbrev}' mydoc.p.tex
```

# 7 Preprocessing and Postprocessing

DocOnce allows preprocessor commands for, e.g., including files, leaving out text, or inserting special text depending on the format. These commands are run prior to translation of the document. After translation, there are `doconce split_*` commands available for splitting HTML and Sphinx documents into smaller pieces (web pages) as a postprocess. Each split is performed where the document writer has inserted a `!split` command (starting in the first column of a line and being the only text on that line):

```
# Split document here
!split
======= New section =======
```

## 7.1 The Preprocess and Mako Preprocessors

Two preprocessors are supported: preprocess (https://github.com/doconce/preprocess) and mako (http://www.makotemplates.org/). The former allows include and if-else statements much like the well-known preprocessor in C and C++ (but it does not allow sophisticated macro substitutions). The latter preprocessor is a very powerful template system. With Mako you can automatically generate various type of text and steer the generation through Python code embedded in the DocOnce document. An arbitrary set of `name=value` command-line arguments (at the end of the command line) automatically define Mako variables that are substituted in the document.

DocOnce will detect if preprocess or Mako commands are used and run the relevant preprocessor prior to translating the DocOnce source to a specific format.

The preprocess and mako programs always have the variable `FORMAT` defined as the desired output format of DocOnce (`html`, `latex`, `plain`, `rst`, `sphinx`, `epydoc`, `st`). It is then easy to test on the value of `FORMAT` and take different actions for different formats. Below is an example:

```
First some math:

!bt
\begin{align}
x &= 3
label{x:eq1}\\
y &= 5
label{y:eq1}
\end{align}
!et
Let us now reason about this.

# Sphinx cannot refer to labels in align environments

# #if FORMAT in ("latex", "pdflatex", "html")
From (\ref{x:eq})-(\ref{y:eq1}) we get that
# #elif FORMAT == "sphinx"
From
```

```
!bt
\[ x = 3 \]
!et
and
!bt
\[ y= 5 \]
!et
it follows that
# #else
From the above equations it follows that
# #endif
$x+y$ is 8.
```

A variable `DEVICE` is also defined. It equals `screen` by default, but the command-line argument `-device=paper` can set `DEVICE` to `paper` (or another value). Testing on `DEVICE` inside the document makes it possible to test if the output is on paper media, a screen, or a particular device.

Other user-defined variables for the preprocessor can be set at the command line as explained in Section 12.

More advanced use of mako can include Python code that may automate the writing of parts of the document.

**On the type of a Mako variable from the command line.**

You define Mako variables as in this example:

```
Terminal> doconce format html mydoc LANG=C NO=4 COMMENTS=False
```

The variable `LANG` gets the value `'C'` as a Python string inside the document. All values are treated as strings, except if the value is `True` or `False` or if it is an integer. Therefore, `NO` becomes the integer `4` and you can test like `% if NO > 4:`. The variable `COMMENTS` gets the boolean value `False` and `% if not COMMENT:` is a positive test. With Mako such variables set on the command-line you can easily leave out portions of the document or choose between different versions of the text in a very flexible and fine-tuned way.

**Advanced setting of Mako variables.**

Mako variables can also be run through `eval` before being sent to Mako. For example,

```
Terminal> doconce format latex mydoc \
          SOMEVAR="eval(['problem', 'data', 'results'])"
```

Now, `SOMEVAR` will be defined by

```
SOMEVAR = eval("['problem', 'data', 'results']")
```

and result in the list `['problem', 'data', 'results']`. In a DocOnce document, we can write

```
% for element in SOMEVAR:
 * "`${element}.pdf`": "http://some.net/pdf/${element}.pdf"
% endfor
```

and produce the following LaTeX code:

```
\begin{itemize}
 \item
     \href{{http://some.net/pdf/problem.pdf}}{\nolinkurl{problem.pdf}}

 \item
     \href{{http://some.net/pdf/data.pdf}}{\nolinkurl{data.pdf}}

 \item
     \href{{http://some.net/pdf/results.pdf}}{\nolinkurl{results.pdf}}
\end{itemize}
```

Instead of giving the `SOMEVAR` list on the command line, we can hardcode it inside the document:

```
<%
SOMEVAR = ['problem', 'data', 'results']
%>
```

The flexibility enabled by Mako variables and statements is one of the major reasons to adopt DocOnce.

## 7.2 Splitting Documents into Smaller Pieces

Long documents are conveniently split into smaller DocOnce files. However, there must be a master document including all the pieces, otherwise references to sections and the index will not work properly. The master document is preferably a file just containing a set of preprocessor include statements of the form `#include "file.do.txt"`. The preprocessor will put together all the pieces so that DocOnce sees a long file with the complete text.

For web documents it is often desired to split long pages into shorter ones. This is done by the DocOnce command `!split` placed at the beginning of a line. The `!split` commands works with output in `html`, `rst`, `sphinx`, `latex`, and `pdflatex`. The `!split` command are normally placed before section headings. It is very actively used when writing slides with DocOnce. The `doconce format` command does not recognize `!split` instructions: one needs to run `doconce split_*` as a postprocess, where the `*` means `html`, `rst`, or `beamer`.

**HTML.** Splitting an HTML document is done by

```
Terminal> doconce format html mydoc
Terminal> doconce split_html mydoc
```

The `mydoc.html` document created by the first command is replaced by a new HTML file, representing the first part of the document, after the second command. The various files that constitute the parts of the document are listed after the `split_html` command. The files have names `mydoc.html`, `._mydoc000.html` (equal to `mydoc.html`), `._mydoc001.html`, `._mydoc002.html`, and so on. Recall that all the parts are needed if the HTML document is to be moved to another location (you can always check `.mydoc_html_file_collection` for a list of all the files that are needed to display this HTML document).

MathJax cannot refer to equations defined in other HTML files, but the `doconce split_html` fixes this problem. Note, however, that running `doconce split_html` leads to another equation numbering than in the original HTML document. In the latter, we use AMS equation numbering, which means that the standard LaTeX conventions are followed, while in the split document only the subset of equations with labels are given numbers.

The HTML documents have by default very simple navigation buttons for the previous and next document. These buttons are customizable:

```
Terminal> doconce split_html mydoc.html --nav_buttons=X
```

where `X` can be `text` (pure text "Previous" and "Next", no buttons), `gray1`, `gray2`, `bigblue`, `blue`, or `green` as shown here, respectively (from left to right):

However, if `--html_theme=` is set any theme starting with `bootstrap` or `bootswatch`, the navigation buttons are ignored, and Bootstrap-style buttons are used.

**reStructuredText and Sphinx.** Here is a typical split of a large Sphinx document `mydoc.rst` into smaller pieces:

```
Terminal> doconce format sphinx mydoc
Terminal> doconce split_rst mydoc
Terminal> doconce sphinx_dir author="Some Author" \
          title="Short title" theme=fenics dirname=mydir mydoc
Terminal> python automake_sphinx.py
```

The `doconce format sphinx mydoc` command is needed to produce `mydoc.rst`, which is the starting point for the `doconce split_rst` command. The various files that constitute the complete Sphinx document are `mydoc.rst`, `._mydoc000.rst`, `._mydoc001.rst`, `._mydoc002.rst`, and so on. The `automake_sphinx.py` script ensures that the Sphinx document is compiled correctly. If all links to local files are in a `_static` directory, the whole Sphinx document exists in a complete version in the compiled directory (usually `sphinx-rootdir/_build/html`) and can easily be moved around.

**Split and LaTeX.** LaTeX Beamer slides generated from DocOnce source also apply `!split` to indicate the start of individual slides. However, the split is performed by the `doconce slides_beamer` command and does not result in individual files like `split_rst` and `split_html` do.

# 8 Writing Slides

It is a potentially fast procedure to make slides from large amounts of DocOnce text, in particular for condensing material for lectures or for providing the slide set as an overview or study guide. The slides can either be ordinary, separate slides - or just a document with much briefer text and emphasis on bullet lists, figures, mathematical formulas, admonitions, etc.

Points to consider (just sketches...):

- Only some pygments styles are suited for a particular reveal.js/deck.js theme
- Only some admon styles are appropriate
- Admon styles are erased in reveal
- Use `--keep_pygments_html_bg` to avoid big changes in background color for code
- pause command for pop-up in Beamer slides (ignored in other formats).
- Can use PowerPoint or Google Presenter to design a slide and then save as image (GP directly, PP via Save as Picture or Save As + choosing image type, and then all or present slide only), then import image in doconce. LaTeX formulas in image are easiest created as PNGs using http://www.codecogs.com/latex/eqneditor.php.
- From doconce to PP or GP: use the latexslides script to convert to PDFs and odp format, convert odp to ppt interactively or with `unoconv`.
- Sections (7 =) are used to indicate sections in slides (gives a toc in beamer slides), while subsections (5 =) are used for slide headings. Remember `!split` before each slide (subsection). A comment `# Short title: title` after a section is interpreted in `latex` and `pdflatex` output as a short title for the section. (Short titles for sections in ordinary text files are not supported.)

## 8.1 Overview

**Slide Types.** DocOnce can generate two types of slides: HTML5+CSS3 type of slides to be presented through a web browser, and classical LaTeX Beamer slides. A comprehensive demo shows the range of possible layouts.

The following specific types of output is supported:

- LaTeX:
  - Beamer slides
- HTML5:
  - reveal.js
  - deck.js
  - CSSS
  - dzslides
- Markdown:
  - Remark

**Syntax.** Basically, DocOnce slides are ordinary DocOnce text with `!split` inserted before each slide. Nevertheless, contents of slide differ considerably from ordinary running text. Some guidelines on the elements within each slide are necessary to produce effective slide sets:

- Use a section heading (7 =) for dividing a presentation into parts. There can be text of figure(s) after the heading to illustrate the part.
- Use a subsection heading as slide heading (5 =).
- Limit the amount of running text (as always).
- Limit the amount of material so it fits within a slide (inspect slides visually to move or delete content - just an extra `!split` and a new heading is enough to make a new slide).
- Use the `pop` environment to pop up list items or blocks one by one.
- You can use `\pause` prefixed by `(*@` and postfixed by `@*)` inside code or math blocks to pop up code lines or formulas in Beamer slides (the pause command is simply ignored in other formats).
- Use the `slidecell` environment (see below) to create a grid of slide cells (makes it easy to move figures and bullet lists or text around).
- Adjust the size of figures (`width` parameter for HTML, `frac` parameter for LaTeX Beamer) so they become effective on the slide.

## 8.2 Slide Elements

**Title page.** Here is a typical title page:

```
TITLE: On Something Interesting
AUTHOR: O. Nordmann at Seg. Fault Ltd. & D. Bug Inc.
AUTHOR: John Doe Email: john.doe@mail.com at Progress Ltd.
AUTHOR: Chan Siu Ming at Progress Ltd & Moon University
DATE: today

FIGURE: [fig/logo, width=300 frac=0.3]
```

**Parts Page.** Parts of the presentation are divided by section headings. Here we also add some keywords in a bullet list on the left and a figure on the right. The `!bslidecell XY f` command starts the definition of a cell in a grid of cells in the slide. The `XY` part defines the coordinates of the cell, `00` is upper left, `01` is upper right. The `f` parameter specifies the fraction of the width occupied by this column of cells (can be left out, which results in columns of equal widths).

```
!split
======= Problem setting and methods =======
# Short title: Problem

!bslidecell 00 0.4

 * Scope
 * Focus
 * Approach

!eslidecell

!bslidecell 01 0.6
FIGURE: [fig/method, width=600 frac=0.7]
!eslidecell
```

The `# Short title: ...` line can be used to define a short title for slide formats with navigation (where long titles are inappropriate), e.g., Beamer PDF slides.

**Standard bullet list page.** Bullet lists are typeset as usual in DocOnce:

```
!split
===== Methods =====

 * Slow:
   * Pick-and-choose
   * Foxtrot
 * Fast:
   * Quickstep
   * MMST
   * PQR
```

Some prefer the bullet list or other contents of the slide to appear in a frame or Beamer block (potentially with shadows in some Beamer styles). This design is enabled by putting the contents inside the `block` environment:

```
!split
===== Methods =====

!bblock Methods are slow or fast:
 * Slow:
   * Pick-and-choose
   * Foxtrot
 * Fast:
   * Quickstep
   * MMST
   * PQR
!eblock
```

The block title is optional.

One can easily pop up one item at a time using `!bpop` and `!epop`:

```
!split
===== Methods =====

!bblock Methods are slow or fast:
!bpop
 * Slow:
   * Pick-and-choose
   * Foxtrot
 * Fast:
   * Quickstep
   * MMST
   * PQR
!epop
!eblock
```

**Equations, movies, figures.** Standard DocOnce elements and formatting work in slides too:

```
!split
===== Key formulas =====

!bt
\[ a = b \]
!et

FIGURE: [fig/a_eq_b, width=500 frac=0.4]

MOVIE: [mov/animate_a_eq_b]
```

Here is another example on math and code:

```
!split
===== Example =====

!bblock Problem:
Solve $ax+b=0$.
!eblock

!bblock Solution:
$x=-b/a$
!eblock

!bblock Implementation:
!bc pypro
```

```
import sys
a = float(sys.argv[1])
b = float(sys.argv[2])
x = -b/a
print(x)
!ec
!eblock
```

## 8.3 HTML5 Slides

Not yet written...

Just a very preliminary sketch of commands:

```
Terminal> doconce format html myslides \
          --pygments_html_style=native --keep_pygments_html_bg
Terminal> doconce slides_html myslides reveal \
          --html_slide_theme=darkgray
```

**Potential Problems.**

- Some newer Firefox does not show rounded corners of the admonition boxes, e.g., notice and warning (tested on Ubuntu)
- DocOnce performs some adjustments of the spacing around equations. More edits (automate with `doconce subst`) might be needed.

## 8.4 LaTeX Beamer Slides

**Themes.** Four themes come with DocOnce: `X_Y`, where `X` is `blue` or `red` (the main color of the slides) and `Y` is `plain` for simple layout and `shadow` for shadowed boxes and more visual structure in the slides.

**Pop of list items and blocks.** The `!bpop` and `!epop` directives have the following effect in Beamer slides:

- If `!bpop` comes right before the beginning of a list, each list item is popped up, one at a time.
- Otherwise, the rest of the slide, or the text until the next `!bpop` pops up all at once.

**Compilation.** The cycle is

- `doconce format pdflatex mydoc` for producing `mydoc.p.tex`
- `doconce ptex2tex` or `ptex2tex` for translating `mydoc.p.tex` to `mydoc.tex`
- `doconce slides_beamer mydoc.tex` to produce a Beamer version `mydoc.tex`
- standard PDFLaTeX compilation of `mydoc.tex`

# 9 Support for non-English

DocOnce can handle documents in other languages than English. At the time of this writing there is support for Basque, German and Norwegian. Please create an issue at https://github.com/hplgit/doconce/issues to request support for additional languages.

A demo directory with files is locale. For example, norsk.do.txt contains a simple document in Norwegian. To compile, one must supply the options -encoding=utf-8 -language=Norwegian:

```
Terminal> doconce format html norsk \
          --html_style=bootstrap_FlatUI \
          --encoding=utf-8 --language=Norwegian
```

# 10 Misc

## 10.1 Missing Features

DocOnce does not aim to support sophisticated typesetting, simply because sophisticated typesetting usually depend quite strongly on the particular output format chosen. When a particular feature needed is not supported by DocOnce, it is recommended to hardcode that feature for a particular format and use the if-else construction of the preprocessor. For example, if a sophisticated table is desired in LaTeX output, do something like

```
# #if FORMAT in ("latex", "pdflatex")
# insert native LaTeX code for fancy table
# #else
# insert a DocOnce-formatted "inline" table
# #endif
```

Similarly, if certain adjustments are needed, like pagebreaks in LaTeX, hardcode that in the DocOnce format (and recall that this is really LaTeX dependent - pagebreaks are not relevant HTML formats).

Instead of inserting special code in the DocOnce document, one can alternatively script editing of the output from DocOnce. That is, we develop a Python or Bash script that runs the translation of a DocOnce document to a ready document in another format. Inside this script, we may edit and fine-tune the output from DocOnce.

## 10.2 Git .gitignore File

For DocOnce repositories using the Git version control system, the following .gitignore file is useful:

```
syntax: glob
# doconce files:
*.rst
```

```
*.ipynb
*.gwiki
*.cwiki
*.mwiki
*.pdf
*.tex
automake_sphinx.py
.*_html_file_collection
.*.exerinfo
.*.copyright
sphinx-rootdir
Trash
papers.bib
# compiled files:
*.o
*.so
*.a
# temporary files:
build
*.bak
*.swp
*~
.*~
*.old
tmp*
temp*
.#*
\#*
# tex files:
*.log
*.dvi
*.aux
*.blg
*.bbl
*.idx
*.ilg
*.ind
*.loe
*.nav
*.out
*.toc
*.snm
*.vrb
# eclipse files:
*.cproject
*.project
# misc:
.DS_Store
.idea
__pycache__
_minted-*
```

## 10.3 Emacs DocOnce Formatter

The file .doconce-mode.el in the DocOnce source distribution gives a "DocOnce Editing Mode" in Emacs.

Here is how to get the DocOnce Editing Mode in Emacs: Download .doconce-mode.el and save it in your home directory, then add these lines to `/.emacs`:

```
(load-file "~/.doconce-mode.el")
```

Emacs will now recognize files with extension `.do.txt` and enter the DocOnce Editing Mode.

The major advantage with the DocOnce Editing Mode in Emacs is that many keyboard shortcuts are defined:

| Emacs key | Action |
|---|---|
| Ctrl+c f | figure |
| Ctrl+c v | movie/video |
| Ctrl+c h1 | heading level 1 (section/h1) |
| Ctrl+c h2 | heading level 2 (subsection/h2) |
| Ctrl+c h3 | heading level 2 (subsection/h3) |
| Ctrl+c hp | heading for paragraph |
| Ctrl+c me | math environment: `!bt` equation `!et` |
| Ctrl+c ma | math environment: `!bt` align `!et` |
| Ctrl+c ce | code environment: `!bc` code `!ec` |
| Ctrl+c cf | code from file: `@@@CODE` |
| Ctrl+c table2 | table with 2 columns |
| Ctrl+c table3 | table with 3 columns |
| Ctrl+c table4 | table with 4 columns |
| Ctrl+c exer | exercise outline |
| Ctrl+c slide | slide outline |
| Ctrl+c help | print this table |

Typing `Ctrl+c help` prints the above table in Emacs. Try out the different shortcuts and see how handy they are in learning DocOnce and saving much typing!

### 10.4 Atom Syntax Highlighting for DocOnce

There is a package for the Atom editor available at `https://atom.io/packages/language-doconce` which provides syntax highlighting for DocOnce.

## 11 Mako Programming

The Mako templating engine is used as preprocessor for DocOnce documents, but the Preprocess is run prior to Mako and is recommended for including other files via `# #include "filename"`. Preprocess is also sufficient for if-else tests to steer which parts of the text that are to be compiled. For more demanding tasks, use Mako, which resembles a real programming language.

**Warning.**

Unfortunately, the combination of Mako and LaTeX mathematics may lead to problems because Mako applies syntax like `${var}` to extract variables or call functions, while LaTeX mathematics sometimes applies the same

syntax, e.g., `${\cal O}(\Delta x^2)$` which looks like a Mako function call. This problem can give rise to strange error messages from Mako, usually that a variable is not defined. The solution is to avoid such Mako-style syntax when writing LaTeX mathematics, e.g., by defining newcommands if it is otherwise problematic.

## 11.1 The Basics of Mako

Just a preliminary sketch of some Mako code (next example is better!):

```
# Define variables
<%
mycounter = 1
mydict = {}
%>

# Assume MYVAR is given on the command line as MYVAR=mytext (e.g.)
% if MYVAR is not UNDEFINED:
The value of MYVAR is ${MYVAR}.
% endif

<%
## Manipulation of variables
mycounter += 1
%>

% if MYVAR in (2,4,6):
MYVAR is even integer in [2,6].
% elif MYVAR > 1000000:
MYVAR is big.
% else:
MYVAR=${MYVAR}, mycounter=${mycounter}.
% endif

# Function
<%
# Define Python function: FORMAT and DEVICE
# are always defined

def link(filename):
    url = "https://github.com/some/path/to/' + filename + '"'
    if DEVICE == 'screen':
        # make link to url
        return '"filename":' + url
    elif DEVICE == 'paper':
        # write URL explicit on paper
        return 'URL:' + url
%>

<%doc>
This
is
a
block
comment in Mako.
<%doc/>
```

## 11.2 Debugging Python code in Mako

Although it is easy to put in Python code inside <% and %> directives, it may quickly become a nightmare to debug the Python code. If Mako reports a syntax error in the Python code, it is recommended to debug the Python code outside of Mako. That is, copy all Python code to a separate file and run it as standard Python code. This will give much more precise (and familiar) error messages.

A setup that is easy for developing and maintaining the Python code used in Mako goes as follows. Different pieces of Python code in Mako is placed in separate files and included via the Preprocess preprocessor in the DocOnce document. For instance,

```
## Define Mako variables and basic functions
<%
# #include "variables.py"
# #include "basic_functions.py"
%>

Some DocOnce text ....

## Define more functions
<%
# #include "more_functions.py"
%>
```

Here, we have separated the Python code in Mako into three files: `variables.py`, `basic_functions.py`, and `more_functions.py`. With the `# #include` statements, Mako sees the `.py` files inserted as text inside the <% and %> directives (check the file `tmp_preprocess__mydoc.do.txt` for the result of running Preprocess and the complete DocOnce file that Mako sees).

To debug the `.py` files, collect all their text in one single `.py` file and run it. The recommended way is to use Preprocess to copy all the text in the `.py` files into a single file, named (say) `all_code.p.py`:

```
# --*-- coding: utf-8 -*-
# (Encoding info cannot be in mako code, but required here
# in Python code if we use non-ascii characters)

# #include "variables.py"
# #include "basic_functions.py"
# #include "more_functions.py"

# Test the code included above
from __future__ import print_function
print(some_func(1, 'arg'))
```

Note that after including the `.py` files one can insert calls to functions, print variables, etc., as desired to debug and experiment.

Run Preprocess on `all_code.p.py` to produce an ordinary Python file `all_code.py` and run that code to test and debug. A little shell script `all_code.sh` doing both these things is convenient:

```
#!/bin/sh
```

```
preprocess all_code.p.py > all_code.py
python all_code.py
```

Especially when the Python code in Mako grows and becomes non-trivial, this setup for having the code external to the DocOnce document is very effective.

**Things to remember when programming Mako.**

- Do not use continuation character (backslash) in Python code.
- When a Mako error refers to a line in the text, invoke the file that Mako sees: `tmp_preprocess__mydoc.do.txt` if the DocOnce file has name `mydoc.do.txt`.
- Use double `##` (Mako comment) to comment out Mako calls of the form `${name...}`.

And to be repeated: keep the Python code in separate files!

One can use Mako to extend the DocOnce syntax. Four examples are given next.

## 11.3 Example: Nomenclature functionality

LaTeX has a package for nomenclatures (see documentation) that allows a user to issue a simple command

```
\nomenclature{symbol}{definition}
```

to add a symbol and its definition to a nomenclature. The command `\printglossary` inserts the nomenclature table in the document.

We can easily create something similar in DocOnce with the aid of Mako. Here are the basic ideas:

- Collect the nomenclature definitions in a table in a file `.nomenclature.do.txt`.
- Introduce a command `${insert_nomenclature()}` to make a fresh `.nomenclature.do.txt` file and return a `@@@CODE` command for inserting the nomenclature table.
- Introduce a command `${nomenclature(symbol, definition)}` for adding a new line in the nomenclature table in the file.
- Introduce a command `${end_nomenclature()}` to finish the nomenclature table, i.e., insert the last table line.

The Mako functions are defined by

```
<%
# Nomenclature functionality
```

```
def insert_nomenclature():
    # Make new file
    with open('.nomenclature.do.txt', 'w') as f:
        f.write("""\
|--------------------------------|
| symbol | definition            |
|---l---------l------------------|
""")
    # Use envir=None to make plain include
    return '@@@CODE .nomenclature.do.txt envir=None'

def nomenclature(symbol, definition):
    with open('.nomenclature.do.txt', 'a') as f:
        f.write('| ' + symbol + ' | ' + definition + ' |\n')
    return ''

def end_nomenclature():
    with open('.nomenclature.do.txt', 'a') as f:
        f.write('|--------------------------------|\n')
    return ''
%>
```

The typical application in a DocOnce document is

```
TITLE: ...
AUTHOR: ...
DATE: today

!split
TOC: on

!split
${insert_nomenclature()}

# Here comes a lot of text...

The equation becomes

!bt
\[ \nabla\cdot\sigma = \varrho f,\]
!et
where $\sigma$ is the stress tensor, $\varrho$ is the density,
and $f$ is a body force.
${nomenclature(r'$\sigma$', 'stress tensor')}
${nomenclature(r'$\varrho$', 'density')}
${nomenclature(r'$f$', 'body force')}

## More text....

## At the end:
${end_nomenclature()}
```

Make it a habit to use raw strings `r"..."` for the symbol in `${nomenclature(r"...", ....` (sometimes backslashes enter the definition too and raw strings are required).

Here is the resulting DocOnce after mako is run (found in `tmp_mako__mydoc.do.txt` if `mydoc.do.txt` is the file above):

```
TITLE: Test
AUTHOR: HPL
DATE: today

!split
```

```
TOC: on

!split
@@@CODE .nomenclature.do.txt envir=None

# Here comes a lot of text...

The equation becomes

!bt
\[ \nabla\cdot\sigma = \varrho f,\]
!et
where $\sigma$ is the stress tensor, $\varrho$ is the density,
and $f$ is a body force.
```

The file `.nomenclature.do.txt` reads

```
|---------------------------------|
| symbol | definition             |
|---l---------l-------------------|
| $\sigma$ | stress tensor |
| $\varrho$ | density |
| $f$ | body force |
|---------------------------------|
```

## 11.4 Example: Executing Python and using SymPy Objects in LaTeX

Here is an example where we want to illustrate how to calculate a double integral. All mathematics is to be done in SymPy, and results are supposed to be embedded in the document's text. We can include Python code to be executed, anywhere in the document, and a variable `var` in the Python code is reached by `${var}`. Here, we run SymPy and use SymPy's LaTeX converter to make LaTeX code out of computed SymPy expressions:

```
# Execute Python code
<%
import sympy as sm
x, y, a = sm.symbols('x y a')
f = a*x + sm.sin(y)
step1 = sm.Integral(f, x, y)
step2 = sm.Integral(sm.Integralf, x).doit(), y)
step3 = step2.doit()
%>

# Make use of results in the above block when writing LaTeX math
!bt
\begin{align*}
${sm.latex(step1)} &= ${sm.latex(step2)}\\
&= ${sm.latex(step3)}
\end{align*}
!et
```

The result of the LaTeX block above, after Mako is run, becomes

```
\begin{align*}
\iint a x + y^{2} \sin{\left (y \right )}\, dx\, dy &=
\int \frac{a x^{2}}{2} + x y^{2} \sin{\left (y \right )}\, dy\\
&= \frac{a y}{2} x^{2} + x \left(- y^{2} \cos{\left (y \right )}
    +
2 y \sin{\left (y \right )} + 2 \cos{\left (y \right )}\right)
\end{align*}
```

Debugging Python code in Mako is less convenient than debugging Python files directly, so one may prefer to just include the Python code that Mako is supposed to run by

```
<%
# #include "src/ex1.py"
%>
```

This is the recommended way to make use of SymPy to automate the mathematical derivations: first develop and test the SymPy code files, include the files in the document inside Mako's Python code environment.

**Remark.** Executing Python code inside the DocOnce document is closely related to *literate programming*. Tools supporting creating a document while running a Python programming cover Pweave, Python literate, PyWebTool, Antiweb, Literate Programming in Python, Pyreport, and also IPython notebooks.

## 11.5 Example: Extending Tables to Handle Figures

DocOnce tables cannot contain figures, since figures must appear on a single line with the special syntax `FIGURE: [file, ...]`. What if you want a table of thumbnail figures with hyperlinks?

**Solution for LaTeX and HTML.** We first restrict the attention to LaTeX and HTML. In those cases we can create an ordinary table and insert a call to a Mako function in cells in the table to return the proper LaTeX or HTML code for displaying a figure.

The Mako call syntax in a cell is decided to be `${tfig('080')}`, which insert the figure `mov/wave_frames/frame_0080.png`. A 3x3 table of figures then look like

```
|-------------------------------------------------|
|               |               |                 |
|-------c---------------c---------------c---------|
|${tfig('080')} | ${tfig('085')} | ${tfig('090')} |
|${tfig('095')} | ${tfig('100')} | ${tfig('105')} |
|${tfig('110')} | ${tfig('115')} | ${tfig('120')} |
|-------------------------------------------------|
```

We do not want a heading, just a grid of figures, but a heading is required in DocOnce figures, so the solution is to provide empty column names in the heading. This solution gives acceptable results in HTML and LaTeX.

The Mako function can be a plain Python function:

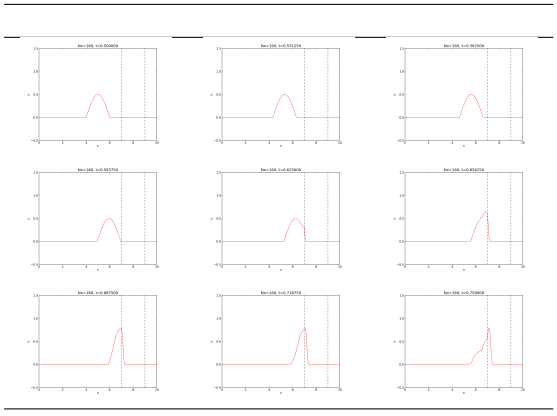
```
<%
def tfig(fileno):
    p = 'mov/wave_frames/frame_0' + fileno + '.png'  # path
    if FORMAT in ("latex", "pdflatex"):
        text = r'\includegraphics[width=2cm]{%s}' % p
    elif FORMAT == "html":
        text = '<a href="%s"><img src="%s" width="300"></a>' %
            (p, p)
    else:
        text = '"`%s`": "%s"' % (fileno, p)  # plain link
    return text
%>
```

Note that for other formats than LaTeX and HTML we just return a link to the figure.

**Notice.**

A corresponding solution for Sphinx will not work because inline figures in Sphinx has a syntax with pipe symbols ('|') that interfere with the column separator in tables in DocOnce. Returning the HTML code in case of Sphinx will just display that HTML code in the cells, not the rendered HTML code. A solution that includes Sphinx is provided later.

The resulting table is displayed below.



**Generating the Entire Table.** The specific structure of this table also suggest using Mako to generate the entire table:

```
<%
def generate_table(start, end, step, no_of_columns):
```

```
    # Heading
    text = ''
    horizontal_rule = '|----|\n'
    text += horizontal_rule
    text += '|  '*no_of_columns + '|\n'
    text += horizontal_rule
    fig_counter = 0
    for counter in range(start, end+1, step):
        fig_counter += 1
        text += '| ' + tfig('%03d' % counter) + ' '
        if fig_counter % no_of_columns == 0:
            text += '|\n'
    text += horizontal_rule
    return text
%>

${generate_table(80, 120, 5, 3)}
```

The result is a table like the one above, except that the horizontal rules and the heading are very short lines (but this is legal syntax - it just does not look appealing in the DocOnce source).

**Generating the Entire Table in a Native Format via Mako.** To allow Sphinx and other formats, it is best to generate the entire table. This can be done either by a Mako function or as a post process after DocOnce has created the output file. We show the Mako solution here.

**Tip.**

A pure Python function Mako is easiest to develop in a separate Python program file because Python has better error messages than Mako. Also, Python has debugging facilities that make the development of the code much more efficient than writing in Mako. When the Python function works, it can be inserted in the DocOnce file inside the Mako directives <% and %>.

The Mako function for generating the entire table in LaTeX, HTML, and Sphinx format goes as follows.

```
<%
def generate_native_table(start, end, step, no_of_columns):
    text = ''
    # Heading
    if FORMAT in ("latex", "pdflatex"):
        text += r"""\begin{quote}\begin{tabular}{%s}
\hline
 \\
\hline
""" % ('c'*no_of_columns)
    elif FORMAT in ("sphinx", "rst", "html"):
        text += '<p><table border="1">\n<tr>'
```

```
    fig_counter = 0
    latex_columns = []
    for counter in range(start, end+1, step):
        fig_counter += 1
        if FORMAT in ("latex", "pdflatex"):
            latex_columns.append(r'\includegraphics[width=2cm]'\
                    '{mov/wave_frames/frame_%04d.png}\n' %
                        counter)
        elif FORMAT in ("sphinx", "rst", "html"):
            text += '<td align="center"> '\
            '<a href="mov/wave_frames/frame_%04d.png">'\
            '<img src="mov/wave_frames/frame_%04d.png"
                width="300">'\
            '</a> </td>\n' % (counter, counter)

        if fig_counter % no_of_columns == 0:  # new row
            if FORMAT in ("latex", "pdflatex"):
                text += '   ' + ' & '.join(latex_columns)
                if counter != end:
                    text += r'\\' + '\n'
                latex_columns = []
            elif FORMAT in ("sphinx", "rst", "html"):
                text += '</tr>\n'
                if counter != end:
                    text += '<tr>\n'  # begin new row
    # Footer
    if FORMAT in ("latex", "pdflatex"):
        text += r"""\hline
\end{tabular}\end{quote}
"""
    elif FORMAT in ("sphinx", "rst", "html"):
        text += '</table>\n'
    if FORMAT in ("sphinx", "rst"):
        # Wrap raw HTML code
        lines = text.splitlines()
        text = '\n.. raw:: html\n\n'
        for line in lines:
            text += '    ' + line + '\n'
        text += '\n'
    return text
%>

## Example on call in DocOnce source
${generate_native_table(80, 120, 5, 3)}
```

One can easily add support for various other formats, such as `pandoc`, `gwiki`, `mwiki`, etc. The output in format the current format is as above.

**Generating the Entire Table in a Native Format as a Post Process.** Instead of using Mako as shown above, we can invent our own syntax line for the table with figures and apply a script to the DocOnce output file to replace the special line with proper native code. We use the same `generate_native_table` function as above, but this time in a Python script. In the DocOnce source we place a line

```
@@@FIGTABLE 80 120 5 3
```

which is meant to generate a table with figures where the numbers correspond to arguments in the `generative_native_table` function.

Suppose we have run

```
Terminal> doconce format sphinx mydoc
```

In the resulting `mydoc.rst` file we have the magic line `@@@FIGTABLE ...`. Such lines can now be processed in our Python script:

```
# read mydoc.rst into the string filestr
pattern = r'@@@FIGTABLE (.+)'
def replacement(m):
    # m is a MatchObject
    args = m.group(1)
    # Convert args to a tuple of words with right type
    args = [eval(arg) for arg in args.split()]
    text = generate_native_table(*args)

filestr = re.sub(pattern, filestr, replacement)
# write filestr back to manual.rst
```

This code makes use of a function for creating the replacement string for the `re.sub` command and demands a knowledge of regular expression syntax and the workings or `re.sub`. A more plain Python version goes like this:

```
# read mydoc.rst into the string filestr
lines = filestr.splitsplines()
for i in range(len(lines)):
    if lines[i].startswith('@@@FIGTABLE'):
        args = lines[i][10:].strip()
        # Convert args to a tuple of words with right type
        args = [eval(arg) for arg in args.split()]
        text = generate_native_table(*args)
        lines[i] = text
filestr = '\n'.join(lines)  # make one string from all separate
    lines
# write filestr back to manual.rst
```

**Recommendation.**

This latter way of inserting specialized native text after DocOnce has generated the output file is easier than using Mako and usually also safer.

**Lesson Learned.**

The above examples show different techniques for extending the DocOnce capabilities. The ideas are not restricted to DocOnce: using Mako as a preprocessing step or inserting “magic” lines that you can later substitute

by a script is possible in all types of ASCII-based documents, e.g., LaTeX, Sphinx, and Markdown.

## 11.6 Example: Defining a Theorem Environment

DocOnce supports only basic formatting elements (headings, paragraphs, lists, etc.), while LaTeX users are used to fancy environments for, e.g., theorems. A flexible strategy is to typeset theorems using paragraph headings, which will look satisfactorily in all formats, but add comment lines that can be replaced by LaTeX environments via `doconce replace`. Theorems can be numbered using a variable in Mako. Here is an example on raw DocOnce code:

```
<%
theorem_counter = 4
%>

# begin theorem
label{theorem:fundamental1}
<%
theorem_counter += 1
theorem_fundamental1 = theorem_counter
%>

__Theorem ${theorem_counter}.__
Let $a=1$ and $b=2$. Then $c=3$.
# end theorem

# begin proof
__Proof.__
Since $c=a+b$, the result follows from straightforward addition.
$\Diamond$|$END$
# end proof

As we see, the proof of Theorem ${theorem_counter} is a modest
achievement.
```

The `.p.tex` output file now reads

```
% begin theorem
label{theorem:fundamental1}


\paragraph{Theorem 5.}
Let $a=1$ and $b=2$. Then $c=3$.
% end theorem

% begin proof
\paragraph{Proof.}
Since $c=a+b$, the result follows from straightforward addition.
$\Diamond$
% end proof

As we see, the proof of Theorem 5 is a modest
achievement.
```

Note that with Mako variables we can easily create our own counters, and this works in any format. In LaTeX we can use both the generated numbers from Mako variables or we can use the labels.

The next step is to replace the `% begin ...` and `% end ...` lines with the proper LaTeX expressions in the `.p.tex` file. Moreover, we need to remove the paragraphs with *Theorem*. The following Bash script does the job:

```
file=mydoc.p.tex
thpack='\\usepackage{theorem}\n\\newtheorem{theorem}{Theorem}[section]'
doconce subst '% insert custom LaTeX commands\.\.\.' $thpack
    $file
doconce subst '\\paragraph\{Theorem \d+\.\}' '' $file
doconce replace '% begin theorem' '\begin{theorem}' $file
doconce replace '% end theorem' '\end{theorem}' $file
```

More heavy editing is better done in a Python script that reads the `mydoc.p.tex` file and performs string substitutions and regex substitutions as needed.

The resulting `mydoc.tex` file now becomes

```
\usepackage{theorem}
\newtheorem{theorem}{Theorem}[section]

...

\begin{theorem}
\label{theorem:fundamental1}



Let $a=1$ and $b=2$. Then $c=3$.
\end{theorem}

% begin proof
\paragraph{Proof.}
Since $c=a+b$, the result follows from straightforward addition.
$\Diamond$
% end proof

As we see, the proof of Theorem 5 is a modest
achievement.
```

Even better, HTML output looks nice as well.

Note that DocOnce supports fancy environments for verbatim code via the `ptex2tex` program with all its flexibility for choosing environments. Also `doconce ptex2tex` has quite some flexibility for typesetting computer code.

## 11.7 Tools for Writing DocOnce Documents

- Emacs (with the modest DocOnce syntax highlighting), Vim, Gedit, etc.
- TeXMaker and Kile can in theory be adapted to handle DocOnce compilation and maybe even DocOnce constructs.

## 11.8 Debugging

Given a problem, extract a small portion of text surrounding the problematic area and debug that small piece of text. DocOnce does a series of transformations of the text. The effect of each of these transformation steps are dumped to a logfile, named `_doconce_debugging.log`, if the to `doconce format` after the filename is `debug`. The logfile is intended for the developers of DocOnce, but may still give some idea of what is wrong. The section "Basic Parsing Ideas" explains how the DocOnce text is transformed into a specific format, and you need to know these steps to make use of the logfile.

# 12 From DocOnce to Other Formats

Transformation of a DocOnce document `mydoc.do.txt` to various other formats is done with the script `doconce format`:

```
Terminal> doconce format formatname mydoc.do.txt
```

or just drop the extension:

```
Terminal> doconce format formatname mydoc
```

## 12.1 Writing a Makefile

Producing HTML, Sphinx, and in particular LaTeX documents from DocOnce sources requires a few commands. Often you want to produce several different formats. The relevant commands should then be placed in a script that acts as a "makefile".

We here show how to make a Bash script. Alternatively, scripts can be coded in Python or Perl, for instance. Below is the skeleton of a typical Bash script, called `make.sh` and run as `bash make.sh` in a Terminal application on Mac or any of the many terminal or console applications on Linux. On Windows you normally cannot run Bash scripts, so you should go for Python instead (maybe as the language in Windows Script Host).

```
#!/bin/bash
set -x  # write out all commands prior to execution

function system {
# Run operating system command and if failure, report and abort

  "$@"
  if [ $? -ne 0 ]; then
    echo "make.sh: unsuccessful command $@"
    echo "abort!"
    exit 1
  fi
}

# Do a hard clean (remove all files that can be regenerated)
```

```
doconce clean
# Do a soft clean (keep compiled files)
#doconce lightclean

# Run spellcheck
system doconce spellcheck -c ispell -d .dict4spell.txt *.do.txt

name=mydoc # name of DocOnce master document

# Compile to PDF
system doconce pdflatex $name --latex_code_style=pyg  # + more
    options
system pdflatex -shell-escape $name
system bibtex $name
system makeindex $name
pdflatex -shell-escape $name
pdflatex -shell-escape $name

# Compile to HTML (two different styles)
styles="bootstrap solarized3"
for style in $styles; do
system doconce format html $name --html_style=$style \
       --html_output=${name}-${style}
system doconce split_html ${name}-${style}  # split at !split
    commands
done

# Compile to Sphinx
system doconce format sphinx $name
system doconce sphinx_dir theme=alabaster $name
python automake_sphinx.py
```

In addition, you are strongly encouraged to make a clean script. Here is a quick Bash version, called `clean.sh`:

```
#!/bin/sh
doconce clean
rm -f *.html
rm -rf Trash
rm -f automake_sphinx.py
```

If you host your files in a Git repository, you should also have a `.gitignore` file in the root directory of the repository:

```
*~
.*~
tmp*
temp*
.#*
\#*
# DocOnce files
.*_html_file_collection
*.p.tex
.*.exerinfo
.*.quiz
.*.quiz.html
automake_sphinx.py
Trash
# LaTeX files:
```

```
*.log
*.dvi
*.aux
*.blg
*.idx
*.nav
*.out
*.toc
*.snm
*.vrb
```

If you host your files on GitHub and use a gh-pages branch to publish your documents, make sure you have an empty file called `.nojeykyll` in the root directory or the repository and that this file is present in the gh-pages branch. Without `.nojekyll`, GitHub will not display files starting with an underscore or dot, with the result that HTML and Sphinx documents are not rendered correctly.

## 12.2 Generating a Makefile

The `doconce makefile` can be used to automatically generate such a makefile, more precisely a Python script `make.py`, which carries out the commands explained below. If our DocOnce source is in `main_myproj.do.txt`, we run

```
doconce makefile main_myproj html pdflatex sphinx
```

to produce the necessary output for generating HTML, PDFLaTeX, and Sphinx. Usually, you need to edit `make.py` to really fit your needs. Some examples lines are inserted as comments to show various options that can be added to the basic commands. A handy feature of the generated `make.py` script is that it inserts checks for successful runs of the many `doconce` commands, and if something goes wrong, the script aborts.

## 12.3 Spell checking

Despite not being a part of compiling DocOnce to some format, spell checking is often the first task done in a `make.sh` or `make.py` file. DocOnce comes with a convenient support for spell checking, `doconce spellcheck`, where all code and mathematics are stripped from the document, as well as all inline verbatim expressions, comments, etc. Then a spell checker program (`ispell` or `aspell`) is run on the stripped document, and a list of misspellings is reported.

Any DocOnce document has its own set of "legal words" (approved by the authors) in the file `.dict4spell.txt`. When `doconce spellcheck` reports new misspellings, some are corrected and some are added to `.dict4spell.txt`. The spell checker applies an American dictionary and the user's custom dictionary in `.dict4spell.txt`.

The workflow is simple:

1. Run `doconce spellcheck -c ispell -d .dict4spell.txt *.do.txt`

2. Examine `misspellings.txt` for misspellings and make corrections in the source files.

3. Rerun `doconce spellcheck` and repeat the procedure.

4. When all words in `misspellings.txt` are acceptable, add these to the current custom dictionary by `cp new_dictionary.txt~ .dict4spell.txt`.

Run `doconce spellcheck` without any arguments to get more description of what kind of files that are produced. For example, the text in `mydoc.do.txt`, stripped for math, code, and other special constructions, is available in `tmp_stripped_mydoc.do.txt` and can be copied into (e.g.) Microsoft Word for grammar check.

## 12.4 Preprocessing

The `preprocess` and `mako` programs are used to preprocess the file. The DocOnce program detects whether `preprocess` and/or `mako` statements are present and runs the corresponding programs, first `preprocess` and then `mako`.

Variables to `preprocess` and/or `mako` can be added after the filename with the syntax `-DMYVAR`, `-DMYVAR=val` or `MYVAR=val`.

- The form `-DMYVAR` defines the variable `MYVAR` for `preprocess` (like the same syntax for the C preprocessor - `MYVAR` is defined, but has not specific value). When running `mako`, `-DMYVAR` means that `MYVAR` has the (Python) value `True`. You can test for `# #ifdef MYVAR` in Preprocess and `% if MYVAR:` in Mako.

- The expressions `-DMYVAR=val` and `MYVAR=val` are equivalent. When running `preprocess`, `MYVAR` is defined and has the value `val` (`# #ifdef MYVAR` and `# #if MYVAR == "val"` are both true tests), while for `mako`, `MYVAR` exists as variable and has the value `val` (`% if MYVAR == "val"` is true).

Note that `MYVAR=False` defines `MYVAR` in `preprocess` and any test `# #ifdef MYVAR` is always true, regardless of the value one has set `MYVAR` to, so a better test is `# #if MYVAR == True`. In general, it is recommended to go with `preprocess` directives if the tests are very simple, as in `# #ifdef MYVAR` or `# #if FORMAT == "latex"`, otherwise use only `mako` syntax like `% if MYVAR or YOURVAR:` to incorporate `if` tests in the preprocessor phases.

Two examples on defining preprocessor variables are

```
Terminal> doconce format sphinx mydoc -Dextra_sections -DVAR1=5
Terminal> doconce format sphinx mydoc extra_sections=True VAR1=5
```

The variable `FORMAT` is always defined as the current format when running `preprocess` or `mako`. That is, in the above examples, `FORMAT` is defined as `sphinx`. Inside the DocOnce document one can then perform format specific actions through tests like `#if FORMAT == "sphinx"` (for `preprocess`) or `% if FORMAT == "sphinx":` (for `mako`).

The result of running `preprocess` on a DocOnce file `mydoc.do.txt` is available in a file `tmp_preprocess__mydoc.do.txt`. Similarly, the result of running `mako` is available in `tmp_mako__mydoc.do.txt`. By examining these files one can see exactly what the preprocessors have done.

The command-line arguments `--no_preprocess` and `--no_mako` turn off running `preprocess` and `mako`, respectively.

**Variable Substition with Preprocessors.** A variable `VAR=value` given on the command line (or `-DVar=value`) can be used in Preprocess and Mako tests. With Mako, the variable can also be used inside text, as `${VAR}`, and Mako will substitute the variable by its value. Preprocess can also substitute a variable by its value, but this is (on DocOnce's use of Preprocess) restricted to filenames in `#include` statements. With the command-line option `--preprocess_include_subst`, any `-DVAR=value` variable will lead to a susbtitution of `VAR` by `value` in included filenames. For example, `# #include "MYDIR/myfile.do.txt"` and `-DMYDIR=RN2` will lead to inclusion of the file `RN2/myfile.do.txt`. Note that for this Preprocess substitution, the variable in the filename must be `MYDIR`, not `${MYDIR}` as with Mako.

## 12.5 Removal of Inline Comments

Inline comments (inside square brackets) in the text are removed from the output by

```
Terminal> doconce format latex mydoc --skip_inline_comments
```

One can also remove all such comments from the original DocOnce file by running:

```
Terminal> doconce remove_inline_comments mydoc
```

This action is convenient when a DocOnce document reaches its final form and comments by different authors should be removed.

## 12.6 Notes

DocOnce does not have a tag for longer notes, because implementation of a "notes feature" is so easy using the `preprocess` or `mako` programs. Just introduce some variable, say `NOTES`, that you define through `-DNOTES` (or not) when running `doconce format ...`. Inside the document you place your notes between `# #ifdef NOTES` and `# #endif` preprocess tags. Alternatively you use `% if NOTES:` and `% endif` that `mako` will recognize. In the same way you may encapsulate unfinished material, extra material to be removed for readers but still nice to archive as part of the document for future revisions.

## 12.7 Demo of Different Formats

A simple scientific report is available in a lot of different formats. How to create the different formats is explained in more depth in the coming sections.

## 12.8 Tweaking the DocOnce Output

Occasionally, one would like to tweak the output in a certain format from DocOnce. One example is figure filenames when transforming DocOnce to reStructuredText. Since DocOnce does not know if the `.rst` file is going to be filtered to LaTeX or HTML, it cannot know if `.eps` or `.png` is the most appropriate image filename. The solution is to use a text substitution command or code with, e.g., sed, perl, python, or scitools subst, to automatically edit the output file from DocOnce. It is then wise to run DocOnce and the editing commands from a script to automate all steps in going from DocOnce to the final format(s). The `make.sh` files in `docs/manual` and `docs/tutorial` constitute comprehensive examples on how such scripts can be made.

## 12.9 Useful Options for `doconce format`

The `doconce format` command used to translate a DocOnce document to an output format performs some syntax check and to notify the user about common problems. There are some useful options for turning on additional checks:

- `-labelcheck=on` (or `off`) to check that every `ref` reference has a corresponding `label` definition within the document (this check may lead to wrong diagnostics, e.g., when a label is defined in an external document and referred via generalized references, so the check must be used with care)
- `-urlcheck` checks that all URLs referred to in the document are valid.

Other useful options are

- `--os_prompt=PROMPT>` sets the prompt, here `PROMPT>`, as terminal prompt in output from running OS commands with the `@@@OSCMD` instruction. The value `None` gives no prompt.
- `--code_prefix=X` prefixes all `@@@CODE` imports with some path `X` (if the source files are located in some other directory)
- `--figure_prefix=X` and `--movie_prefix=X` prefix figure/movie file names with a path or URL
- `--sections_down` and `--sections_up` move all sections down or up (e.g., sections become subsections or chapters).
- `-tables2csv` translates each table to a CSV file.

- `--short_title=X` sets a short title `X` for the document.
- `--toc_depth=X`: controls the depth of the table of contents in documents. Default value of `X` is 3, meaning chapters, sections, and subsections. `X` as 0 gives the table of contents as a nested list in Bootstrap styles.

Many more options, depending on the output format, are listed in the following sections. A list of all options is otbained by running `doconce format -help` (or preferably `doconce format -help | less` since the output is extensive).

# 13 HTML

## 13.1 Basic HTML Output

Making an HTML version of a DocOnce file `mydoc.do.txt` is performed by

```
Terminal> doconce format html mydoc
```

The resulting file `mydoc.html` can be loaded into any web browser for viewing.

## 13.2 Typesetting of Code

If the Pygments package (including the `pygmentize` program) is installed, code blocks are typeset with aid of this package. The command-line argument `--no_pygments_html` turns off the use of Pygments and makes code blocks appear with plain (`pre`) HTML tags. The option `--pygments_html_linenos` turns on line numbers in Pygments-formatted code blocks. A specific Pygments style is set by `--pygments_html_style=style`, where `style` can be `default`, `emacs`, `perldoc`, and other valid names for Pygments styles.

## 13.3 Handling of Movies

MP4, WebM, and Ogg movies are typeset with the HTML5 `video` tag and the HTML code tries to load as many versions among MP4, WebM, and Ogg as exist (and the files are loaded in the mentioned order). If just the specified file is to be loaded, use the `--no_mp4_webm_ogg_alternatives` command-line option. Other movie formats, e.g., `.flv`, `.mpeg` and `.avi`, are embedded via the older `embed` tag.

## 13.4 HTML Styles

The HTML style can be defined either in the header of the HTML file, using a named built-in style; in an external CSS file; or in a template file.

An external CSS file `filename` used by setting the command-line argument `-css=filename`. There available built-in styles are specified as `--html_style=name`, where `name` can be

- `solarized`: the famous solarized style (yellowish),
- `blueish`: a simple style with blue headings (default),
- `blueish2`: a variant of *bluish*,
- `bloodish`: as `bluish`, but dark read as color,
- `bootstrap*` or `bootswatch*` in a lot of variants, see `doconce format -help` for a list of all styles.

There is a comprehensive demonstration of almost all available styles!

Using `-css=filename` where `filename` is a non-existing file makes DocOnce write the built-in style to that file. Otherwise the HTML links to the CSS stylesheet in `filename`. Several stylesheets can be specified: `-ccs=file1.css,file2.css,file3.css`.

## 13.5 HTML templates

Templates are HTML files with ready-made headers, footers, and style specifications where plain HTML text can be inserted in "slots" in the template file. Typically, there is a slot `%(main)s` for the main body of text, `%(title)s` for the title, and `%(date)s` for the date. Templates are designed beforehand and `doconce format` puts the translated HTML text into the template to form the complete HTML document.

DocOnce comes with a few ready-made HTML templates. The usage of templates is described in a separate document. That document describes how you your DocOnce-generated HTML file can have any specified layout.

The HTML file can be embedded in a template with your own tailored design, see a tutorial on this topic. The template file must contain valid HTML code and can have three "slots": `%(title)s` for a title, `%(date)s` for a date, and `%(main)s` for the main body of text. The latter is the DocOnce document translated to HTML. The title becomes the first heading in the DocOnce document, or the title (but a title is not recommended when using templates). The date is extracted from the `DATE:` line. With the template feature one can easily embed the text in the look and feel of a website. DocOnce comes with two templates in `bundled/html_styles`. Just copy the directory containing the template and the CSS and JavaScript files to your document directory, edit the template as needed (also check that paths to the `css` and `js` subdirectories are correct - according to how you store the template files), and run

```
Terminal> doconce format html mydoc --html_template=mytemplate.html
```

The template in `style_vagrant` also needs an extra option `--html_style=bootstrap`.

## 13.6 Splitting HTML documents

The `!split` instruction (on separate lines) signifies a pagebreak. A command `doconce split_html` is needed after `doconce format` to actually perform the

split. The `doconce split_html` command has several options for setting the type of splitting, type of navigation buttons, etc. Just type `doconce split_html` to see the options. Here is an example with separate links for each page (pagination) at the top and bottom of each page:

```
Terminal> doconce format html mydoc --html_style=bootswatch_journal
Terminal> doconce split_html mydoc --nav_buttontop+bottom --pagination
```

**The HTML File Collection.** There are usually a range of files needed for an HTML document arising from a DocOnce source. The needed files are listed in `.basename_html_file_collection`, where `basename` is the filestem of the DocOnce file (i.e., the DocOnce source is in `basename.do.txt`).

**Filenames.** An HTML version of a DocOnce document is often made in different styles, calling for a need to rename the HTML output file. This is conveniently done by the `--html_output=mydoc` option, where `mydoc` is the filestem of the associated HTML files. The `.mydoc_html_file_collection` file lists all the needed files for the HTML document. Here is an example on making three versions of the HTML document: `mydoc_bloodish.html`, `mydoc_solarized`, and `mydoc_vagrant`.

```
Terminal> doconce format html mydoc --html_style=bloodish \
          --html_output=mydoc_bloodish
Terminal> doconce split_html mydoc_bloodish.html
Terminal> doconce format html mydoc --html_style=solarized \
          --html_output=mydoc_solarized \
          --pygments_html_style=perldoc --html_admon=apricot
Terminal> doconce format html mydoc --html_style=vagrant \
          --html_output=mydoc_vagrant --pygments_html_style=default \
          --html_template=templates/my_adapted_vagrant_template.html
Terminal> doconce split_html mydoc_vagrant.html
```

## 13.7 URL to files hosted on GitHub

The generated HTML code will have URLs to files in the DocOnce repo at GitHub. The type of URL is set with the `--html_raw_github_url=...` option:

- `--html_raw_github_url=safe` or `--html_raw_github_url=cdn.rawgit`: safe URL for high traffic production sites (default)
- `--html_raw_github_url=test` or `--html_raw_github_url=rawgit`: recommended URL for low traffic development sites - use this when developing HTML pages and the DocOnce GitHub links in the HTML files are also developed and subject to changes
- `--html_raw_github_url=github` or `--html_raw_github_url=raw.github`: URL directly to the raw GitHub file (`https://raw.github.com/hplgit/doconce/...`) that may fail to load properly in (e.g.) Internet explorer

- `--html_raw_github_url=githubusercontent` or `--html_raw_github_url=raw.githubusercontent`: as the one above, but using `https://raw.githubusercontent.com` instead

## 13.8 Other HTML options

The Bootstrap family of styles have become very popular since they provide responsive pages for phones and small tablets. There are several specific options for Bootstrap styles:

- `--html_code_style=on,off,inherit,transparent`: control the style of inline verbatim code `code` tags. With `off`, `inherit`, or `transparent` the verbatim text inherits foreground and background color from its surroundings, while `on` (default) means that the typesetting is css-specified. This option is most relevant for Bootstrap styles to avoid the redish typesetting of inline verbatim text.

- `--html_pre_style=on,off,inherit,transparent`: control the style of code blocks in `pre` tags. With `off`, `inherit`, or `transparent` the code blocks inherit foreground and background color from their surroundings, while `on` (default) means that code block colors are css-specified. This option is most relevant for Bootstrap styles to avoid white background in code blocks inside colorful admons.

- `--html_bootstrap_navbar=on,off`: turn the Bootstrap navigation bar on or off.

- `--html_bootstrap_jumbotron=on,off,h2`: turn the jumbotron intro on or off, and govern the size of the document title. Default is `on`, while `h2` means a jumbotron with `h2` (section) size of the title (normally the jumbotron has huge heading fonts so some jumbotrons look better with `h2` typesetting of the document title).

- `--html_quiz_button_text=X`: set a text on the answer button for Bootstrap-style quizzes. Without this option a small icon is used.

Other options:

- `--html_share=http://...` makes sharing buttons at the end of the document: email, Facebook, Google+, LinkedIn, Twitter, and print by default. `--html_share=http://...,twitter,linkedin` will make just to sharing buttons for Twitter and LinkedIn. Sites are separated by comma and valid names are `email`, `facebook`, `google+`, `linkedin`, `twitter`, and `print`. The URL `http://...` must be the URL where the document is published.

- `--html_toc_indent=X`: indent sections/subsections `X` spaces in the table of contents.

- `--html_body_font=`: specify font for text body. The value `?` lists available fonts.
- `--html_heading_font=`: specify font for headings. The value `?` lists available fonts.
- `--html_video_autoplay=True,False`: let videos play automatically (`True`, default) or not (`False`) when the HTML page is loaded.
- `--html_admon=X`: specify typesetting of admonitions. Values of `X` are `colors`, `gray`, `yellow`, `apricot`, `lyx`, `paragraph`. For Bootstrap styles only to other values are legal: `botstrap_panel` or `bootstrap_alert`. See demos for how these look like.
- `--html_admon_bg_color=X`: set the background color in admonitions.
- `--html_admon_bd_color=X`: set the boundary color in admonitions.
- `--html_admon_shadow`: add a shadow effect in admonitions.
- `--html_box_shadow`: add a shadow effect in box environments (`!bbox`).
- `--html_exercise_icon=X`: specify an icon to more easily notify exercises. `X` can be any filename `question_*.png` in the `bundled/html_images` directory in the DocOnce repo. With `X` as `default`, a default icon choice is made, based on the current style.
- `--html_exercise_icon_width=X`: set the width of the exercise icon image to `X` pixels.
- `--exercise_numbering=absolute, chapter`
- `--html_DOCTYPE`: insert `<!DOCTYPE HTML>` at the top of the HTML output file. This is normally recommended, but malformed CSS files will then not be loaded (so by default, the doctype is not specified). This option is necessary for correct rendering of Bootstrap styles in Internet Explorer.
- `--html_links_in_new_window`: open all links as new tabs.
- `--html_figure_hrule=X`: control the use of horizontal rules in figures. `X` is `top` by default; other values are `none` (no rules), `bottom` and `top+bottom`.
- `--allow_refs_to_external_docs` (do not abort if there are references whose labels are not found)

## 13.9 Blog Posts

DocOnce can be used for writing blog posts provided the blog site accepts raw HTML code. Google's Blogger service (`blogger.com` or `blogname.blogspot.com`) is particularly well suited since it also allows extensive LaTeX mathematics via MathJax.

1. Write the text of the blog post as a DocOnce document without any title, author, and date.
2. Generate HTML as described above.
3. Copy the text and paste it into the text area in the blog post (just delete the HTML code that initially pops up in the text area). Make sure the input format is HTML.

See a simple blog example and a scientific report for demonstrations of blog posts at `blogspot.no`.

**Warning.**

The comment field after the blog post does not recognize MathJax (LaTeX) mathematics or code with indentation. However, using a MathJax bookmarklet, e.g., at http://checkmyworking.com/misc/mathjax-bookmarklet/, one can get the mathematics properly rendered. The comment fields are not suitable for computer code, though, as HTML tags are not allowed.

**Notice.**

Figure files must be uploaded to some web site and the local filenames name must be replaced by the relevant URL. This is usually done by using the `--figure_prefix=http://project.github.io/...` option to give some URL as prefix to all figure names (a similar `--movie_prefix=` option exists as well).

Changing figure names in a blog post can also be done "manually" by some editing code in the script that compiles the DocOnce document to HTML format:

```
cp mydoc.do.txt mydoc2.do.txt
url="https//raw.github.com/someuser/someuser.github.com"
dir="master/project/dir1/dir2"
for figname in fig1 fig2 fig3; do
  doconce replace "[$figname," "[$site/$dir/$figname.png," \
          mydoc2.do.txt
done
doconce format html mydoc2
# Paste mydoc2.html into a new blog post page
```

Blog posts at Google can also be published automatically through email. A Python program can send the contents of the HTML file to the blog site's email address using the packages `smtplib` and `email`.

WordPress (`wordpress.com`) allows raw HTML code in blogs, but has very limited LaTeX support, basically only formulas. The `-wordpress` option to `doconce` modifies the HTML code such that all equations are typeset in a way that is acceptable to WordPress. Look at a simple doconce example and a scientific report to see blog posts with mathematics and code on WordPress.

Speaking of WordPress, the related project `http://pressbooks.com` can take raw HTML code (from DocOnce, for instance, but use the `-wordpress` option) and produce very nice-looking books. There is support for LaTeX mathematics as in WordPress blog posts, meaning that one cannot refer to equations.

[[[

# 14 Pandoc and Markdown

Output in Pandoc's extended Markdown format results from

```
Terminal> doconce format pandoc mydoc
```

or (equivalent)

```
Terminal> doconce format markdown mydoc
```

**Test on `FORMAT == 'pandoc'` for Markdown!**

Note that even though it works to write `doconce format markdown`, the `FORMAT` variable that is defined in all DocOnce documents has the value `pandoc` for all the Markdown formats. A test like `FORMAT == 'markdown'` will not work!

The name of the output file is `mydoc.md`. There are four supported dialects of Markdown (see sections below for more information):

- Pandoc-extended Markdown
- GitHub-flavored Markdown
- MultiMarkdown
- Strict Markdown

From the Markdown format one can go to numerous other formats using the `pandoc` program:

```
Terminal> pandoc -R -t mediawiki -o mydoc.mwk --toc mydoc.md
```

Pandoc supports `latex`, `html`, `odt` (OpenOffice), `docx` (Microsoft Word), `rtf`, `texinfo`, to mention some. The `-R` option makes Pandoc pass raw HTML or LaTeX to the output format instead of ignoring it, while the `-toc` option generates a table of contents. See the Pandoc documentation for the many features of the `pandoc` program.

## 14.1 Markdown to HTML conversion

The HTML output from `pandoc` needs adjustments to provide full support for MathJax LaTeX mathematics, and for this purpose one should use `doconce md2html`:

```
Terminal> doconce format pandoc mydoc
Terminal> doconce md2html mydoc
```

The result `mydoc.html` can be viewed in a browser.

## 14.2 Strict Markdown

The option `--strict_markdown_output` generates plain or strict Markdown without the many extension that Pandoc accepts in Markdown syntax.

## 14.3 GitHub-flavored Markdown

Adding the command-line option `github-md` turns on the GutHub-flavored Markdown dialect, which is used for the issue tracker on GitHub. A special feature is the support of task lists: unnumbered lists with `[x]` (task done) or `[ ]` (task not done). (Tables get typeset directly as HTML and the syntax for code highlighting is different from Pandoc extended Markdown.) Below is a typical response in a GitHub issue tracker where one first quotes the issue and then provides an answer:

```
!bquote
===== Problems with a function =====

There is a problem with the ‘f(x)‘ function

!bc pycod
def f(x):
    return 1 + x
!ec
This function should be quadratic.
!equote

OK, this is fixed:

!bc pycod
def f(x, a=1, b=1, c=1):
    return a*x**2 + b*x + c
!ec
```

```
===== Updated task list =====

   * [x] Offer an ‘f(x)‘ function
   * [ ] Extension to cubic functions
   * [x] Allowing general coefficient in the quadratic function

=== Remaining functionality ===

|-------------------------------------------------------------|
| function | purpose                          | state |
|----l----------l------------------------------l---------------|
|  ‘g(x)‘  | Compute the Gaussian function. | Formula ready. |
|  ‘h(x)‘  | Heaviside function.            | Formula ready. |
|  ‘I(x)‘  | Indicator function.            | Nothing done yet. |
|-------------------------------------------------------------|
```

Say this text is stored in a file `mycomments.do.txt`. Running

```
Terminal> doconce format pandoc mycomments --github_md
```

produces the Markdown file `mycomments.md`, which can be pasted into the Write field of the GitHub issue tracker. Turning on Preview shows the typesetting of the quote, compute code, inline verbatim, headings, the task list, and the table.

## 14.4 MultiMarkdown

The option `--multimarkdown_output` generates the MultiMarkdown version of Markdown (as opposed to Pandoc-extended Markdown (default), strict Markdown, or GitHub-flavored Markdown).

## 14.5 Strapdown rendering of Markdown text

Strapdown is a tool that can render Markdown text nicely in a web browser by just inserting an HTML header and footer in the Markdown file and load the file into a browser. The option `-strapdown` outputs the relevant header and footer. The output file must be renamed such that it gets the extension `.html`:

```
Terminal> doconce format pandoc mydoc --strict_markdown_output \
          --strapdown --bootstrap_bootwatch_theme=slate
Terminal> mv mydoc.md mydoc.html
```

The `--bootstrap_bootwatch_theme=theme` option is used to choose a Bootswatch theme whose names are found on the Strapdown page.

## 14.6 Using Pandoc to go from LaTeX to MS Word or HTML

Pandoc is useful to go from LaTeX mathematics to, e.g., HTML or MS Word. There are two ways (experiment to find the best one for your document): `doconce format pandoc` and then translating using `doconce md2latex` (which runs `pandoc`), or `doconce format latex`, and then going from LaTeX to the desired format using `pandoc`. Here is an example on the latter strategy:

```
Terminal> doconce format latex mydoc
Terminal> doconce ptex2tex mydoc
Terminal> doconce replace '\Verb!' '\verb!' mydoc.tex
Terminal> pandoc -f latex -t docx -o mydoc.docx mydoc.tex
```

When we go through `pandoc`, only single equations, `align`, or `align*` environments are well understood for output to HTML.

Note that DocOnce applies the `Verb` macro from the `fancyvrb` package while `pandoc` only supports the standard `verb` construction for inline verbatim text. Moreover, quite some additional `doconce replace` and `doconce subst` edits might be needed on the `.mkd` or `.tex` files to successfully have mathematics that is well translated to MS Word. Also when going to reStructuredText using Pandoc, it can be advantageous to go via LaTeX.

# 15 LaTeX

**Notice.**

XeLaTeX and `PDF`LaTeX are used very much in the same way as standard LaTeX. The minor differences are described in separate sections of the documentation of the DocOnce to LaTeX translation.

## 15.1 Overview

Making a LaTeX file `mydoc.tex` from `mydoc.do.txt` can be done in two ways:

1. direct translation to a `.tex` file
2. translation to a `.p.tex` file

In the latter case, one must apply the `ptex2tex` program or the simplified `doconce ptex2tex` program to translate the `.p.tex` file to a plain `.tex` file. This step involves the specification of how blocks of verbatim code should be typeset in LaTeX. Before 2015, DocOnce always translated to the `.p.tex` syntax and required the use of `ptex2tex` or `doconce ptex2tex`. Now, one can choose a direct translation, which is simpler and actually more versatile than even using the `ptex2tex` program.

Direct translation is specified by the `--latex_code_style=` command-line option. A separate document, Demonstration of DocOnce support for LaTeX code block environments, describes how this option is used and the demonstrates many possibilities that are available. One popular choice is

```
default:lst[style=blue1_bluegreen]@dat:lst[style=gray]@sys:vrb
```

This value gives syntax-highlighted blue-green code on a blue background and sets data files with gray background.

The `--latex_code_style=` option makes the use of `ptex2tex` or `doconce ptex2tex` redundant.

## 15.2 The old `ptex2tex` step

Here, we describe the old translation via a `.p.tex` file. New users should jump over this information and use the `--latex_code_style=` option to specify verbatim code environments.

First we compile the DocOnce source to the `ptex2tex` format, and then we compile the `ptex2tex` format to standard LaTeX. The `ptex2tex` format can be viewed as an extended LaTeX. For DocOnce users, the `ptex2tex` format essentially means that the file consists of

1. `if-else` statements for the `preprocess` processor such that LaTeX constructions can be activated or deactivated, and
2. all code environments can be typeset according to a `.ptex2tex.cfg` configuration file.

Point 2 is only of interest if you aim to use a special computer code formatting that requires you to use a configuration file and the `ptex2tex` program.

The reason for generating `ptex2tex` and not standard LaTeX directly from DocOnce was that the `ptex2tex` format shows a range of possible LaTeX constructions for controlling the layout. It can be instructive for LaTeX users to look at this code before choosing specific parts for some desired layout. Experts may also want to edit this code (which should be automated by a script such that the edits can be repeated when the DocOnce source is modified, see Step 2b below). (Direct control of the LaTeX layout in the `doconce format` program would not spit out alternative LaTeX constructs as is now done through the `ptex2tex` step.)

Going from `ptex2tex` format to standard LaTeX format is enabled by either the `ptex2tex` program or DocOnce's (simplified) version of it: `doconce ptex2tex`.

**Inline verbatim tries to use `texttt` and not `Verb` if possible.**

Inline verbatim code, typeset with backticks in DocOnce, is translated to

```
\texttt{text}
```

or similar constructions with other delimiters if the pipe is used in `text`. Thereafter, if `text` does not contain illegal characters for the `\texttt` command, the latter is used instead since then LaTeX can insert linebreaks in the inline verbatim text and hence avoid overfull hboxes.

## 15.3 LaTeX-PDF: Generate LaTeX (Step 1)

**The translation command.** Filter the doconce text directly to valid LaTeX using the `--latex_code_style=` option:

```
Terminal> doconce format pdflatex mydoc --latex_code_style=vrb
```

Without `--latex_code_style=`, the output will be a `mydoc.p.tex` file that has to be converted to a standard `mydoc.tex` LaTeX file via the programs `ptex2tex` or `doconce ptex2tex`.

**Newcommands.** LaTeX-specific commands ("newcommands") in math formulas and similar can be placed in files `newcommands.tex`, `newcommands_keep.tex`, or `newcommands_replace.tex` (see Section 5.3). If these files are present, they are included in the LaTeX document so that your commands are defined.

**Output for paper vs screen.** An option `-device=paper` makes some adjustments for documents aimed at being printed. For example, links to web resources are associated with a footnote listing the complete web address (URL). (Very long URLs in footnotes can be shortened using services such as `http://goo.gl/`, `http://tinyurl.com/`, and `https://bitly.com/`.) The default, `-device=screen`, creates a PDF file for reading on a screen where links are just clickable.

**Command-line options.** There are many additional options (run `doconce format -help` and look for options starting with `-latex` to get a more verbose description):

- `--latex_code_style=lst,vrb,pyg,any`
- `--latex_font=helvetica,palatino`
- `--latex_papersize=a4,a6`
- `--latex_bibstyle=plain` (name of BibTeX style)
- `--latex_title_layout=titlepage, std, beamer, doconce_heading, Springer_collection`
- `--latex_style=std, Springer_sv, Springer_lncse, Springer_llncs, Springer_lnup, Springer`
- `--latex_packages=package1,package2,package3` (list of extra packages to be included[5])
- `-draft` (turns on draft mode in documentclass, otherwise final mode)

[5] Listing `varioref` in as package automatically leads to references with page numbers, if the element referred to is not on the same page. This is often very helpful, e.g., "see Figure 5.3 on page 67".

- `--latex_copyright=everypage,titlepages` (copyright on every page or on titlepage and chapter pages)
- `--latex_list_of_exercises=loe,toc,none` (LaTeX list of exercises, integrated into the table of contents, or no list)
- `--latex_fancy_header` (chapter/section headings at top of pages, style depends on value of `--latex_section_headings`)
- `--latex_section_headings=std,blue,bookblue,strongblue,gray,gray-wide` (standard LaTeX, blue headings, blue headings for books, strong blue headings, white in gray box, white in gray box that fills the page width)
- `--latex_table_format=quote, center, footnotesize, tiny` (environment around tables)
- `--latex_colored_table_rows=blue, gray, no` (color of every two lines in tables)
- `--latex_table_row_sep=1.5` (increase the separation between table (and matrix) rows by a factor 1.5)
- `--latex_todonotes` (inline comments typeset as "bubbles")
- `--latex_double_spacing` (to ease hand-writing between the lines)
- `--latex_line_numbers` (to ease references to sentences)
- `--latex_labels_in_margin` (name of section, equation, citation labels in the margin)
- `--latex_preamble=filename` (user-specific preamble)
- `--latex_admon=mdfbox, graybox2, grayicon, yellowicon, paragraph, colors1, colors2`
- `--latex_admon_color=0.34,0.02,0.8` (background color in admons)
- `--latex_admon_envir_map=2` (code environment names in admons)
- `--exercise_numbering=absolute, chapter`
- `--latex_movie=media9, href, multimedia, movie15` (control typesetting of movies)
- `--latex_movie_controls=on`
- `--latex_external_movie_viewer` (for `movie15` package)
- `-xelatex` (prepare for XeLaTeX)

The overall LaTeX style is much governed by `--latex_title_layout` and `--latex_style`. For the former, `titlepage` gives a separate title page; `std` is just standard LaTeX handling of title, author, and date; `doconce_heading` is a more modern heading, `Springer_collection` is used with `--latex_style=Springer_lncse` for an edited book; `beamer` is needed if the DocOnce document is to be translated to LaTeX Beamer slides. For `--latex_style`, `std` gives standard LaTeX behavior; `Springer_lncse` is for Springer's LNCSE book series style (to be used with `--latex_title_layout=Springer_collection` if the book is an edited book); `Springer_llncs` is for Springer's Lecture Notes in Computer Science series (normally an edited book that also requres `--latex_title_layout=Springer_collection`); `Springer_lnup` for Springer's Lecture Notes for Undergraduate Physics books, `Springer_T2` for Springer's T2 book layout, `siamltex`, for the LaTeX style of papers in standard SIAM journals (also used far beyond SIAM journals and requires the stylefiles `siamltex.cls` and `siam10.clo`), `siamltexmm` for the new multimedia SIAM journal style (requires `siamltex.cls` and `siam10.clo`), `elsevier` for the style of papers to be submitted to Elsevier journals (`--latex_elsevier_journal=` can be used to set the journal name, and the style requires `elsarticle.cls` and `elsarticle-num.bst`).

**Syntax highlighting.** The style of verbatim blocks of computer code is specified by `--latex_code_style=X`, where `X` can be set in a very flexible way. There are three main values, corresponding to three LaTeX tools for verbatim type setting:

- `vrb` for plain `Verbatim` style (`fancyvrb` LaTeX package)
- `pyg` for the Pygments style (`mintex` LaTeX package)
- `lst` for the Listings styles (`listingsutf8` LaTeX package)
- `any` for any environment named `any` from any package

A separate demo explains the many possible settings of `X`. Popular choices are minimalistic plain verbatim,

```
--latex_code_style=vrb
```

maybe with an added light blue background color,

```
--latex_code_style=vrb-blue1
```

or the default Pygments style,

```
--latex_code_style=pyg
```

or the Listings-based style with yellow background color

```
--latex_code_style=lst-yellow2
```

It is easy to specify different styles for different code environments, say blue background with plain verbatim style for code but a special terminal window for the `sys` environment:

```
"--latex_code_style=default:vrb-blue1@
sys:vrb[frame=lines,label=\\fbox{{\tiny Terminal}},
framesep=2.5mm,framerule=0.7pt,fontsize=\fontsize{9pt}{9pt}]"
```

(but no linebreaks, as here, they are for formatting this document only).

**Drafts.** During development of a manuscript, may prefer line numbers, double line spacing, frequent use of inline comments, and label names printed in the margin. This is enabled by the options `--latex_line_numbers --latex_double_spacing --latex_todonote` One may also (automatically) edit the `final` argument in the `documentclass` heading to `draft` as this will mark overful lines (hboxes).

**Potential problems with ampersand.** Another useful option for LaTeX documents is `--no_ampersand_quote`, which prevents ampersands from getting a backskash. This is necessary if one inserts native latex code for tables inside `% if FORMAT in ('latex', 'pdflatex'):` (or similar `preprocess` syntax) tests.

**Part 2 of Step 1 (outdated).** In case you *did not* specify the `--latex_code_style=` option, you must run `ptex2tex` (if you have installed the Python ptex2tex package) to make a standard LaTeX file,

```
Terminal> ptex2tex mydoc
```

If you do not have `ptex2tex`, or do not bother to make the required configuration file for `ptex2tex` (you may of course rely on the default file), a (simplified) version of `ptex2tex` that comes with DocOnce can be run:

```
Terminal> doconce ptex2tex mydoc
```

The `ptex2tex` command can set two preprocessor variables:

- `PREAMBLE` to turn the LaTeX preamble on or off (i.e., complete document or document to be included elsewhere - and note that the preamble is only included if the document has a title, author, and date)
- `MINTED` for inclusion of the minted package for typesetting of code with the Pygments tool (which requires `latex` or `pdflatex` to be run with the `-shell-escape` option); not used for `doconce ptex2tex` only in the `ptex2tex` program

If you are not satisfied with the generated DocOnce preamble, you can provide your own preamble by adding the command-line option `--latex_preamble=myfile`. In case `myfile` contains a documentclass definition, DocOnce assumes that

the file contains the *complete* preamble you want (not that all the packages listed in the default preamble are required and must be present in `myfile`). Otherwise, `myfile` is assumed to contain *additional* LaTeX code to be added to the DocOnce default preamble.

The `ptex2tex` tool makes it possible to easily switch between many different fancy formattings of computer code in LaTeX documents. After any `!bc` command in the DocOnce source you can insert verbatim block styles as defined in your `.ptex2tex.cfg` file, e.g., `!bc sys` for a terminal session, where `sys` is set to a certain environment in `.ptex2tex.cfg` (e.g., `CodeTerminal`). There are about 40 styles to choose from, and you can easily add new ones.

The `doconce ptex2tex` allows specifications of code environments as well. Here is an example:

```
Terminal> doconce ptex2tex mydoc \
          "sys=\begin{quote}\begin{verbatim}@\end{verbatim}\end{quote}" \
          fpro=minted fcod=minted shcod=Verbatim envir=ans:nt
```

Note that `@` must be used to separate the begin and end LaTeX commands, unless only the environment name is given (such as `minted` above, which implies `\begin{minted}{fortran}` and `\end{minted}` as begin and end for blocks inside `!bc fpro` and `!ec`). Specifying `envir=ans:nt` means that all other environments are typeset with the `anslistings.sty` package, e.g., `!bc cppcod` will then result in `\begin{c++}`. A predefined shortcut as in `shcod=Verbatim-0.85` results in denser vertical spacing (baselinestretch 0.85 in LaTeX terminology), and `shcod=Verbatim-indent` implies indentation of the verbatim text. Alternatively, one can provide all desired parameters `\begin{Verbatim}` instruction using the syntax illustrated for the `sys` environments above.

If no environments like `sys`, `fpro`, or the common `envir` are defined on the command line, the plain `\begin{Verbatim}` and `\end{Verbatim}` instructions are used.

## 15.4 LaTeX-PDF: Edit the LaTeX File (Step 2, Optional)

You can *edit* the `mydoc.tex` file to your needs. For example, you may want to substitute `section` by `section*` to avoid numbering of sections, you may want to insert linebreaks (and perhaps space) in the title, etc. This can be automatically edited with the aid of the `doconce replace` and `doconce subst` commands. The former works with substituting text directly, while the latter performs substitutions using regular expressions. You will use `doconce replace` to edit `section{` to `section*{`:

```
Terminal> doconce replace 'section{' 'section*{' mydoc.tex
```

For fixing the line break of a title, you may pick a word in the title, say "Using", and insert a break after than word. With `doconce subst` this is easy employing regular expressions with a group before "Using" and a group after:

```
Terminal> doconce subst 'title\{(.+)Using (.+)\}' \
          'title{\g<1> \\\\ [1.5mm] Using \g<2>' mydoc.tex
```

A lot of tailored fixes to the LaTeX document can be done by an appropriate set of text replacements and regular expression substitutions. You are anyway encourged to make a script for generating PDF from the LaTeX file so the `doconce subst` or `doconce replace` commands can be put inside the script.

## 15.5 LaTeX-PDF: Generate PDF (Step 3)

Compile `mydoc.tex` and create the PDF file, using `pdflatex`:

```
Terminal> pdflatex mydoc
Terminal> pdflatex mydoc
Terminal> makeindex mydoc   # if index
Terminal> bibtex mydoc      # if bibliography
Terminal> pdflatex mydoc
```

One can also compile `mydoc` the "old way" with `latex` and `dvipdf`. Use `doconce format latex` in that case and proceed with `latex mydoc`.

If the minted style is used, `latex`, `pdflatex`, or `xelatex` *must* be run with the `-shell-escape` option:

```
Terminal> pdflatex -shell-escape mydoc
Terminal> pdflatex -shell-escape mydoc
Terminal> makeindex mydoc   # if index
Terminal> bibtex mydoc      # if bibliography
Terminal> pdflatex -shell-escape mydoc
```

## 15.6 XeLaTeX

XeLaTeX is an alternative to PDFLaTeX and is run in almost the same way, except for the `-xelatex` flag to `doconce format`:

```
Terminal> doconce format pdflatex mydoc --xelatex \
          --latex_code_style=lst
Terminal> xelatex mydoc
```

## 15.7 From PDF to e-book formats

PDF (as generated from LaTeX above) can be read on most devices today. However, for Kindle and other devices specialized for e-books you need to convert to ePub or MOBI. The Calibre program can produce epub, mobi, and other e-book formats from PDF, see a description. Unfortunately, Calibre cannot deal satisfactory with LaTeX math so the usefulness for DocOnce writers is limited. See Section 5.2 for more information on how to generate ePub.

## 15.8 Microsoft Word or LibreOffice

Transforming DocOnce files to Word format is best done with the aid of `pandoc`. A standard way is to first generate the Markdown format (`doconce format pandoc`) and then use `pandoc` to generate a `.docx` file:

```
Terminal> doconce format pandoc mydoc
Terminal> pandoc -t docx -o mydoc.docx mydoc.md
```

The transformation works well for simple text files, but LaTeX mathematics does not work.

# 16 Jupyter (IPython) Notebooks

DocOnce can generate json files for the Jupyter Notebook:

```
Terminal> doconce format ipynb mydoc  # results in mydoc.ipynb
```

## 16.1 Hidden code blocks

It is no guarantee that the notebook can be executed. For example, having the code

```
print(sys.version)
```

will not execute unless `sys` is imported. While a book may show such code and skip (potentially tedious) initializing statements, they must be present in the notebook. To this end, use the `!bc *hid` environment for hidden code. In the present example, we use `!bc pyhid` to specify Python code that needs to be executed, but that should normally be hidden (other formats, with the exception of certain interactive Sphinx documents, will hide such code).

```
!bc pyhid
import sys
!ec
```

The notebook will feature the `import sys` statement in a cell prior to the `print(sys.version)` cell, and the latter will work.

Similarly, if you import from your own modules, say `from mymod import hello`, the `mymod.py` must be accessible for the notebook. Suppose this file is in `src-test/mymod.py`. Then you need to add `src-test` to `sys.path` for the import statement to work:

```
!bc pyhid
sys.path.append('src-test')
!ec
```

## 16.2 Displaying code as plain text instead of executable cells

Some code blocks may just be there for explanation and are not meant to be executed. These can be marked by `!bc pycod-t` (or `!bc Xcod-t` for any supported programming language `X`):

```
!bc pycod-t
if isinstance(myvar, float):
    raise TypeError('myvar must be array, not %s' % type(myvar))
!ec
```

The code segment above will then be typeset as verbatim text and not an executable cell, and there is no need to worry about a missing definition of `myvar` (which would cause problems in an executable cell).

Interactive sessions with the `pyshell` or `ipy` environment will by default be broken up into many cells such that each output command ends a cell. By executing the cells, the input *and* output from the session is recovered. This is usually the behavior that is wanted, but there is an option `--ipynb_split_pyshell=off` that can be used to typeset the entire session with all input but no output in one cell (`print` statements will lead to output, but plain dumping of a variable will not lead to output like it does in a Python shell).

To have an interactive session typeset with input and output in plain text, use the `-t` extension to the environment: `pyshell-t` and `ipy-t`.

## 16.3 Figures

As with HTML files, you need to ensure that the notebook has access to figures and source code as requested.

Figures in notebooks can be typeset in various ways, specified by the `--ipynb_figure=` option, with the following values:

- `md`: plain Markdown syntax for a figure, with no possibility to adjust the size (default)
- `imgtag`: `<img ...>` tag in HTML taking the specified width into account
- `Image`: Python notebook cell with `Image` object

## 16.4 Movies

Typesetting of movies is specified by `--ipynb_movie=`, and valid options are

- `md`: raw HTML code with `iframe` tag - not relevant for the notebook
- `HTML`: raw HTML code with `iframe` tag embedded in the `HTML` object from the notebook (default)
- `HTML-YouTube`: as `HTML` but use an `IPython.display.YouTubeVideo` object to display YouTube videos
- `ipynb`: use `IPython.display.YouTubeVideo` object for YouTube videos, and use an `HTML` object with `video` tag for local movies

## 16.5 Admonitions

Typesetting of admonition is rather primitive in notebooks. We offer these different choices, set by the option `--ipynb_admon=`:

- `quote`: typeset admon as Markdown quote (special font and gray vertical bar on the left)
- `paragraph`: typeset admon as a plain paragraph with a heading if any (default)
- `hrule`: use a horozontal rule to surround the heading and the text

Note that quotes in `!bc quote` environments are always typeset as Markdown quotes.

## 16.6 References to an External Textbook

Sometimes one wants to refer to equations and sections in an external LaTeX book where a `book.aux` file is available. The references in the notebook to the LaTeX book can then be hardcoded from the `book.aux` file with this construction:

```
Terminal> doconce format ipynb mydoc \
          --replace_ref_by_latex_auxno=book.aux
```

## 16.7 Conversion from Notebook Back to DocOnce

A notebook generated from DocOnce can be converted back to DocOnce format again, even after being annotated in a web browser. Here is a trivial example:

```
Here is a code:

!bc pypro
a = 1
b = 2
print(a + b)
!ec
```

We translate this DocOnce document to a notebook:

```
Terminal> doconce format ipynb mydoc
```

We load `mydoc.ipynb` into the notebook application and add a code cell

```
print("Hello, World!")
```

before the original code cell. After executing the cells we download the new notebook as the file `mydoc2.ipynb`. We can then generate the corresponding DocOnce document `mydoc2.do.txt`:

```
Terminal> ipynb2doconce mydoc2.ipynb
```

Title, author, and other information in DocOnce that does not have a corresponding syntax in the notebook are stored as special comments in the generated `.ipynb` file so that DocOnce can retrieve this information when running the `doconce ipynb2doconce` conversion command.

# 17 Matlab Notebooks

The Matlab *publish* format is aimed at notebooks, but the markup is quite primitive, so only a small subset of DocOnce markup can translate successfully to the Matlab publish format. However, if you write within that subset, it is easy to create notebooks in DocOnce that can translate both to Python and Matlab (use preprocessor directives or Mako functions to include Matlab or Python code, depending on the output format).

The Matlab publish format is called `matlabnb`:

```
Terminal> doconce format matlabnb mydoc
```

The `--replace_ref_by_latex_auxno=` option for referring to equations and sections in a textbook, as explained at the end of the section on Jupyter/IPython notebooks, also works with Matlab notebooks (and for any other output format):

```
Terminal> doconce format matlabnb mydoc \
          --replace_ref_by_latex_auxno=book.aux
```

# 18 Plain ASCII Text

We can go from DocOnce "back to" plain untagged text suitable for viewing in terminal windows, inclusion in email text, or for insertion in computer source code:

```
Terminal> doconce format plain mydoc.do.txt  # results in mydoc.txt
```

# 19 reStructuredText

Going from DocOnce to reStructuredText gives a lot of possibilities to go to other formats. First we filter the DocOnce text to a reStructuredText file `mydoc.rst`:

```
Terminal> doconce format rst mydoc.do.txt
```

We may now produce various other formats:

```
Terminal> rst2html.py  mydoc.rst > mydoc.html # html
Terminal> rst2latex.py mydoc.rst > mydoc.tex  # latex
Terminal> rst2xml.py   mydoc.rst > mydoc.xml  # XML
Terminal> rst2odt.py   mydoc.rst > mydoc.odt  # OpenOffice
```

The OpenOffice file `mydoc.odt` can be loaded into OpenOffice and saved in, among other things, the RTF format or the Microsoft Word format. However, it is more convenient to use the program `unoconv` to convert between the many formats OpenOffice supports *on the command line*. Run

```
Terminal> unoconv --show
```

to see all the formats that are supported. For example, the following commands take `mydoc.odt` to Microsoft Office Open XML format, classic MS Word format, and PDF:

```
Terminal> unoconv -f ooxml mydoc.odt
Terminal> unoconv -f doc mydoc.odt
Terminal> unoconv -f pdf mydoc.odt
```

**Remark about Mathematical Typesetting.** At the time of this writing, there is no easy way to go from DocOnce and LaTeX mathematics to reST and further to OpenOffice and the "MS Word world". Mathematics is only fully supported by `latex` as output and to a wide extent also supported by the `sphinx` output format. Some links for going from LaTeX to Word are listed below.

- http://ubuntuforums.org/showthread.php?t=1033441
- http://tug.org/utilities/texconv/textopc.html
- http://nileshbansal.blogspot.com/2007/12/latex-to-openofficeword.html

# 20 Sphinx

## 20.1 The Basic Steps

Sphinx documents demand quite some steps in their creation. We have automated most of the steps through the `doconce sphinx_dir` command:

```
Terminal> doconce sphinx_dir version=1.0 dirname=sphinxdir \
          theme=sometheme mydoc short_title="short title" mydoc
```

The author, title, and copyright information needed by Sphinx is taken from the DocOnce file `mydoc.do.txt`. By default, `version` is 1.0 and `dirname` is `sphinx-rootdir`. The `theme` keyword is used to set the theme for design of HTML output from Sphinx (the default theme is `classic`).

There are more options for the `sphinx_dir` command: `-runestone` for Runestone Interactive books, `toc_depth=` for setting the depth of the table of contents, `intersphinx` for allowing the document to link automatically to other Sphinx documents, `conf.py=` for specifying a tailored `conf.py` file, `logo=` and `favicon=` for specifying logo and favicon files.

One often just runs the simple command

```
Terminal> doconce sphinx_dir mydoc
```

which creates the Sphinx directory `sphinx-rootdir` with relevant files.

The `doconce sphinx_dir` command generates a script `automake_sphinx.py` for compiling the Sphinx document into an HTML document. Run

```
Terminal> python automake_sphinx.py
```

As the output also tells, you can see the Sphinx HTML version of the document by running

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

or loading the `index.html` file manually into your favorite web browser.

If you cycle through editing the DocOnce file and watching the HTML output, you should observe that `automake_sphinx.py` does not recompile the DocOnce file if the Sphinx `.rst` version already exists. In each edit-and-watch cycle do

```
Terminal> rm mydoc.rst; python automake_sphinx.py
```

**Tip.**

If you are new to Sphinx and end up producing quite some Sphinx documents, you are encouraged to read the Sphinx documentation and study the `automake_sphinx.py` file. Maybe you want to do things differently.

The following paragraphs describes the many possibilities for steering the Sphinx output.

## 20.2 Links

The `automake_sphinx.py` script copies directories named `fig*` over to the Sphinx directory so that figures are accessible in the Sphinx compilation. It also examines `MOVIE:` and `FIGURE:` commands in the DocOnce file to find other image files and copies these too. I strongly recommend to put files to which there are local links (not `http:` or `file:` URLs) in a directory named `_static`. The `automake_sphinx.py` copies `_static*` to the Sphinx directory, which guarantees that the links to the local files will work in the Sphinx document.

There is a utility `doconce sphinxfix_localURLs` for checking links to local files and moving the files to `_static` and changing the links accordingly. For example, a link to `dir1/dir2/myfile.txt` is changed to `_static/myfile.txt` and `myfile.txt` is copied to `_static`. However, I recommend instead that you manually copy files to `_static` when you want to link to them, or let your script which compiles the DocOnce document do it automatically.

One can get all links to open in a new window by adding the option `--html_links_in_new_window` to the `doconce format` command.

## 20.3 Themes

DocOnce comes with a rich collection of HTML themes for Sphinx documents, much larger than what is found in the standard Sphinx distribution. Additional themes include `agni`, `alabaster`, `basic`, `basicstrap`, `bootstrap`, `cloud`, `epub`, `fenics`, `fenics_minimal`, `flask`, `haiku`, `jal`, `pylons`, `pyramid`, `redcloud`, `scipy_lectures`, `scrolls`, `slim-agogo`, `sphinx_rtd_theme`, and `vlinux-theme`. Some of the themes come with basic Sphinx, while others must be installed separately, see the `bundled/README_sphinx_themes.do.txt` file in the DocOnce source code tree for installation instructions.

The `doconce sphinx_dir` insert lots of extra code in the `conf.py` file to enable easy specification of information and, in particular,customization of themes. For example, modules are loaded for the additional themes that come with DocOnce, code is inserted to allow customization of the look and feel of themes, etc.

**Using a Your Own Configuration File.** The `conf.py` file is a good starting point for fine-tuning your favorite theme, and your own `myconf.py` file can later be supplied and used when running `doconce sphinx_dir`: simply add the command-line option `conf.py=myconf.py`. If you leave the `project` and `copyright` variables as empty strings in your own `myconf.py` file, DocOnce will automatically edit a copy (`conf.py`) of `myconf.py` in the sphinx root directory so that `project` becomes the title of the DocOnce source file, and `copyright` is based on the author or copyright information in the source file. Other variables in `myconf.py` depending on title, author, and copyright information will also be edited. In this way, you can have your tailored `conf.py` file, and be sure that it is always compatible with title, author, and copyright information in the underlying DocOnce source.

If a short title is desired, use the `short_title=` option as part of the `doconce sphinx_dir` command. This will propagate the short title to your tailored `conf.py` file regardless of what the short title in that file is.

It is recommended to leave the variables `latex_documents`, `man_pages`, and `texinfo_documents` as empty lists: `[]` in a tailored `conf.py` file.

**Tip: Error messages from `conf.py`.**

When you have edited a `conf.py` file and supplied it as part of a `doconce sphinx_dir` command through the `conf.py=myconf.py` option, it is a danger that `python automake_sphinx.py` will abort with an error message because of a problem with your configuration file. Note that the error message refers to a line in the `conf.py` in the Sphinx root directory (`sphinx-rootdir` by default) and *not* the configuration file `myconf.py` you created yourself (so make sure you search in `sphinx-rootdir/conf.py` for the error). If the error comes from some wrong manual editing, make sure you correct the error in `myconf.py`.

**Compiling Multiple Themes.** A script `make-themes.sh` can make HTML documents with one or more themes. For example, to realize the themes `fenics`, `pyramid`, and `pylon` one writes

```
Terminal> ./make-themes.sh fenics pyramid pylon
```

The resulting directories with HTML documents are `_build/html_fenics` and `_build/html_pyramid`, respectively. Without arguments, `make-themes.sh` makes all available themes (!). With `make-themes.sh` it is easy to check out various themes to find the one that is most attractive for your document.

You may supply your own theme and avoid copying all the themes that come with DocOnce into the Sphinx directory. Just specify `theme_dir=path` on the command line, where `path` is the relative path to the directory containing the Sphinx theme. You must also specify a configure file by `conf.py=path`, where `path` is the relative path to your `conf.py` file.

**Example.** Say you like the `scipy_lectures` theme, but you want a table of contents to appear *to the right*, much in the same style as in the `default` or `classic` themes (where the table of contents is to the left). You can then run `doconce sphinx_dir`, invoke a text editor with the `conf.py` file, find the line `html_theme == 'scipy_lectures'`, edit the following `nosidebar` to `false` and `rightsidebar` to `true`. Alternatively, you may write a little script using `doconce replace` to replace a portion of text in `conf.py` by a new one:

```
doconce replace "elif html_theme == 'scipy_lectures':
    html_theme_options = {
        'nosidebar': 'true',
        'rightsidebar': 'false',
        'sidebarbgcolor': '#f2f2f2',
        'sidebartextcolor': '#20435c',
        'sidebarlinkcolor': '#20435c',
        'footerbgcolor': '#000000',
        'relbarbgcolor': '#000000',
    }" "elif html_theme == 'scipy_lectures':
    html_theme_options = {
        'nosidebar': 'false',
        'rightsidebar': 'true',
        'sidebarbgcolor': '#f2f2f2',
        'sidebartextcolor': '#20435c',
        'sidebarlinkcolor': '#20435c',
        'footerbgcolor': '#000000',
        'relbarbgcolor': '#000000',
    }" conf.py
```

Obviously, we could also have changed colors in the edit above. The final alternative is to save the edited `conf.py` file somewhere and reuse it the next time `doconce sphinx_dir` is run

```
doconce sphinx_dir theme=scipy_lectures \
                   conf.py=../some/path/conf.py mydoc
```

## 20.4 RunestoneInteractive books

The `doconce format sphinx` command accepts an option `-runestone` for generating RunestoneInteractive books (which build on Sphinx). You must run the generated `automake_sphinx.py` also with a `-runestone` option to generate these type of documents.

## 20.5 The manual Sphinx procedure

If it is not desirable to use the autogenerated scripts explained above, here is the complete manual procedure of generating a Sphinx document from a file `mydoc.do.txt`.

**Step 1.** Translate DocOnce into the Sphinx format:

```
Terminal> doconce format sphinx mydoc
```

**Step 2.** Create a Sphinx root directory either manually or by using the interactive `sphinx-quickstart` program. Here is a scripted version of the steps with the latter:

```
mkdir sphinx-rootdir
sphinx-quickstart <<EOF
sphinx-rootdir
n

_
Name of My Sphinx Document
Author
version
version
.rst
index
n
y
n
n
n
n
y
n
n
y
y
y
EOF
```

The autogenerated `conf.py` file may need some edits if you want to specific layout (Sphinx themes) of HTML pages. The `doconce sphinx_dir` generator makes an extended `conv.py` file where, among other things, several useful Sphinx extensions are included.

**Step 3.** Copy the `mydoc.rst` file to the Sphinx root directory:

```
Terminal> cp mydoc.rst sphinx-rootdir
```

If you have figures in your document, the relative paths to those will be invalid when you work with `mydoc.rst` in the `sphinx-rootdir` directory. Either edit `mydoc.rst` so that figure file paths are correct, or simply copy your figure directories to `sphinx-rootdir`. Links to local files in `mydoc.rst` must be modified to links to files in the `_static` directory, see comment above.

**Step 4.** Edit the generated `index.rst` file so that `mydoc.rst` is included, i.e., add `mydoc` to the `toctree` section so that it becomes

```
.. toctree::
   :maxdepth: 2

   mydoc
```

(The spaces before `mydoc` are important!)

**Step 5.** Generate, for instance, an HTML version of the Sphinx source:

```
make clean   # remove old versions
make html
```

Sphinx can generate a range of different formats: standalone HTML, HTML in separate directories with `index.html` files, a large single HTML file, JSON files, various help files (the qthelp, HTML, and Devhelp projects), epub, LaTeX, PDF (via LaTeX), pure text, man pages, and Texinfo files.

**Step 6.** View the result:

```
Terminal> firefox _build/html/index.html
```

Note that verbatim code blocks can be typeset in a variety of ways depending the argument that follows `!bc`: `cod` gives Python (`code-block:: python` in Sphinx syntax) and `cppcod` gives C++, but all such arguments can be customized both for Sphinx and LaTeX output.

# 21 Wiki Formats

There are many different wiki formats, but DocOnce only supports three: Google-code wiki, MediaWiki, and Creole Wiki. These formats are called `gwiki`, `mwiki`, and `cwiki`, respectively. Transformation from DocOnce to these formats is done by

```
Terminal> doconce format gwiki mydoc.do.txt
Terminal> doconce format mwiki mydoc.do.txt
Terminal> doconce format cwiki mydoc.do.txt
```

The produced MediaWiki can be tested in the sandbox of wikibooks.org. The format works well with Wikipedia, Wikibooks, and ShoutWiki, but not always well elsewhere (see this example).

Large MediaWiki documents can be made with the Book creator. From the MediaWiki format one can go to other formats with aid of mwlib. This means that one can easily use DocOnce to write Wikibooks and publish these in PDF and MediaWiki format, while at the same time, the book can also be published as a standard LaTeX book, a Sphinx web document, or a collection of HTML files.

The Googlecode wiki document, `mydoc.gwiki`, is most conveniently stored in a directory which is a clone of the wiki part of the Googlecode project. This is far easier than copying and pasting the entire text into the wiki editor in a web browser. Note that Google decided to close down its Googlecode service in 2015.

When the DocOnce file contains figures, each figure filename must in the `.gwiki` file be replaced by a URL where the figure is available. There are instructions in the file for doing this. Usually, one performs this substitution automatically (see next section).

# 22 Google Docs

Google Docs are normally made online in the interactive editor. However, you may upload a DocOnce document to Google Docs. This requires transforming the DocOnce document to one of the accepted formats for Google Docs:

- OpenOffice: `doconce format rst` and then run `rst2odt` (or `rst2odt.py`). Upload the `.odt` file, click *Open...* in Google Drive and choose *Google Docs* as viewer.
- MS Word: `doconce format pandoc` and then run `pandoc` to produce a `.docx` file that can be uploaded to Google Drive and opened in Google Docs.
- RTF: `doconce format pandoc` and then run `pandoc` to produce a `.rtf` file that can be uploaded to Google Drive and opened. Another possibility is to run `doconce format latex` and then latex2rtf (the support of mathematics has gotten worse).
- Plain text: `doconce format plain`. Upload the `.txt` file to Google Drive and open in Google Docs.
- HTML: `doconce format html`. Upload the `.html` file and open in Google Docs. Complicated HTML files can be misinterpreted by Google Docs.

This is not yet much tested. It remains to see how code becomes in Google Docs. Support for mathematics is probably impossible until Google Docs can import LaTeX files, but LaTeX mathematics can be embedded in Google Docs and the googledoc2latex script can convert a Google document to LaTeX.

# 23 Options for the `doconce` commands

## 23.1 `doconce format` command-line options

The transformation of a DocOnce source to various format is done with the `doconce format` command, which has *a lot* of command-line options. These are printed out by `doconce format -help`. The output is listed here for convenience.

```
Terminal> doconce format --help
b'\n        doconce format X doconcefile\n\n        where X can be any of the formats: html, latex, pd
```

# 24 Installation of DocOnce and its Dependencies

Below, we explain the manual installation of all software that may be needed when working with DocOnce documents. The impatient way to install everything that is needed is to use Anaconda Python and the `conda` program:

DocOnce is available from the `conda-forge` channel. To add the `conda-forge` channel and subsequently install DocOnce, run the following commands.

```
Terminal> conda config --add channels conda-forge
Terminal> conda install doconce
```

If you do not want to use Anaconda and are on a Debian-based Linux computer (running, e.g., Ubuntu), you can instead run the Bash script `install_doconce.sh` or the equivalent Python script `install_doconce.py`. These scripts give a comprehensive installation. Some users will prefer to install just what is needed for them, and this is explained below.

**Version control systems are needed!**

The coming installation instructions require that the version control systems Subversion, Mercurial, and Git are installed on your computer.

**What about Mac and Windows?**

DocOnce is primarily tested on GNU/Debian Linux systems, but also to a minor extent on Mac OS X. Experience with Windows is limited. Since most packages are Python-based and can be installed via `pip install` no problems should arise on Mac and Windows. However, some of the image processing tools and spell checking apply Unix-specific software.

You can omit reading the next sections if you rely on `conda` or `apt-get install` commands in the Bash script for installing DocOnce.

## 24.1 DocOnce

DocOnce itself is pure Python code hosted at https://github.com/hplgit/doconce. Installation can be done via

```
sudo pip install git+https://github.com/hplgit/doconce
# or if doconce is already installed
sudo pip install git+https://github.com/hplgit/doconce --upgrade
```

However, the recommended approach is to have a copy of the source on the local computer and run `pip install` in that directory:

```
git clone git@github.com:hplgit/doconce.git
cd doconce
sudo pip install .
cd ..
```

Since DocOnce is frequently updated, it becomes necessary to ensure that you work with the most recent version:

```
cd doconce
git pull origin master
sudo pip install --upgrade .
```

## 24.2 Dependencies

Producing HTML documents, plain text, pandoc-extended Markdown, and wikis can be done without installing any other software. However, if you want other formats as output (LaTeX, Sphinx, reStructuredText) and assisting utilities such as preprocesors, spellcheck, file differences, bibliographies, and so on, a lot of extra software must be installed.

**Python v2.7.** First you need Python version 2.7 and the `pip` installation program. Unless you already have these, we recommend to install a comprehensive Python bundle like Anaconda.

You do not need more software if you avoid using preprocessors, there is no bibliography, and you stick to the output formats LaTeX and HTML (you need of course LaTeX installed to process `.tex` files).

**Preprocessors.** If you make use of the Preprocess preprocessor, this program must be installed:

```
pip install -e \
   git+https://github.com/doconce/preprocess#egg=preprocess --upgrade
```

A much more advanced alternative to Preprocess is Mako. Its installation is done by

```
pip install Mako
```

It is recommended to install both Preprocess and Mako.

Note that neither Preprocess nor Mako is run if you do not have preprocessor directives in your DocOnce source. That is, you only need this extra software if you make active use of preprocessors.

**Bibliography.** The Python package Publish is needed if you use a bibliography in your document (`cite` commands and a `BIBFILE:` specification). The installation is done by

```
pip install -e hg+https://bitbucket.org/logg/publish#egg=publish
```

**Image file handling.** Different output formats require different formats of image files. For example, PDF or PNG is used for `pdflatex`, PostScript for `latex`, while HTML needs JPEG, GIF, or PNG formats. DocOnce calls up programs from the ImageMagick suite for converting image files to a proper format if needed. The ImageMagick suite can be installed on all major platforms. On Debian Linux (including Ubuntu) systems one can simply write

```
sudo apt-get install imagemagick
```

The convenience program `doconce combine_images`, for combining several images into one, will use `montage` and `convert` from ImageMagick and the `pdftk`, `pdfnup`, and `pdfcrop` programs from the `texlive-extra-utils` Debian package. The latter gets installed by

```
sudo apt-get install texlive-extra-utils
```

Automatic image conversion from EPS to PDF calls up `epstopdf`, which can be installed by

```
sudo apt-get install texlive-font-utils
```

**Spellcheck.** The utility `doconce spellcheck` applies by default the `ispell` program for spellcheck. On Debian (including Ubuntu) it is installed by

```
sudo apt-get install ispell
```

Alternatively, `doconce spellcheck` can use the `aspell` program, which can be installed by

```
sudo apt-get install aspell
```

**Ptex2tex for LaTeX Output.** Originally, DocOnce relied on the ptex2tex program for very flexible choice of typesetting of verbatim code blocks. A simplified version, `doconce ptex2tex`, is bundled with DocOnce. However, even greater flexibility is now offered by the `--latex_code_style=` option to `doconce format` so unless you already are a `ptex2tex` user, it is recommended to forget about `ptex2tex` and just use the `--latex_code_style=` option.

The stand-alone `ptex2tex` program is installed by

```
svn checkout http://ptex2tex.googlecode.com/svn/trunk/ ptex2tex
cd ptex2tex
sudo python setup.py install
```

It may happen that you need additional style files, you can run a script, `cp2texmf.sh`:

```
cd latex
sh cp2texmf.sh  # copy stylefiles to ~/texmf directory
cd ../..
```

This script copies some special stylefiles that that `ptex2tex` potentially makes use of. Some more standard stylefiles are also needed. These are installed by

```
sudo apt-get install texlive
```

on Debian Linux (including Ubuntu) systems. TeXShop on Mac comes with the necessary stylefiles (if not, they can be found by googling and installed manually in the `/texmf/tex/latex/misc` directory).

Note that the `doconce ptex2tex` command, which needs no installation beyond DocOnce itself, can be used as a simpler alternative to the `ptex2tex` program.

**Pygments and the Minted Code Style.** The *minted* LaTeX style is popular for typesetting code. This style requires the package Pygments to be installed. On Debian Linux, the simplest approach is to install `sphinx`:

```
pip install sphinx
```

All use of the minted style requires the `-shell-escape` command-line argument when running LaTeX, i.e., `pdflatex -shell-escape`.

Inline comments apply the `todonotes` LaTeX package if the option `--latex_todonotes` is given. The `todonotes` package requires several other packages: `xcolor`, `ifthen`, `xkeyval`, `tikz`, `calc`, `graphicx`, and `setspace`. The relevant Debian packages for installing all this are listed below.

**LaTeX packages.** Many LaTeX packages are potentially needed, depending on various constructions in the text and command-line options used when compling DocOnce to LaTeX. The standard packages always required are `relsize`, `makeidx`, `setspace`, `color`, `amsmath`, `amsfonts`, `xcolor`, `bm`, `microtype`, `inputenc`, and `hyperref`. Optional packages that might be included in the `.tex` output are `minted`, `listings`, `fancyvrb`, `xunicode`, `inputenc`, `helvet`, `mathpazo`, `wrapfig`, `calc`, `ifthen`, `xkeyval`, `tikz`, `graphicx`, `setspace`, `shadow`, `disable`, `todonotes`, `lineno`, `xr`, `framed`, `mdframe`, `movie15`, `a4paper`, and `a6paper`.

Relevant Debian packages that gives you all of these LaTeX packages are

```
texlive
texlive-extra-utils
texlive-latex-extra
texlive-font-utils
```

Alternatively, one may pull in `texlive-full` to get all available style files.

If you want to use the *anslistings* code environment with `ptex2tex` (`.ptex2tex.cfg` styles `Python_ANS`, `Python_ANSt`, `Cpp_ANS`, etc.) or `doconce ptex2tex` (`envir=ans` or `envir=ans:nt`), you need the `anslistings.sty` file. It can be obtained from the ptex2tex source. The same code style is in "modern DocOnce" just implemented by the command-line option

```
"--latex_code_style=default:lst[style=yellow2_fb]"
```

**Sphinx or reStructuredText Output.** Output to `sphinx` or `rst` requires the Sphinx software, installed by

```
pip install sphinx --upgrade
```

DocOnce comes with many Sphinx themes that are not part of the standard Sphinx source distribution:

- cloud and redcloud: https://bitbucket.org/ecollins/cloud_sptheme
- bootstrap: https://github.com/ryan-roemer/sphinx-bootstrap-theme
- solarized: https://bitbucket.org/miiton/sphinxjp.themes.solarized
- impressjs: https://github.com/shkumagai/sphinxjp.themes.impressjs
- sagecellserver: https://github.com/kriskda/sphinx-sagecell

Appropriate installation commands for these themes are

```
pip install -e hg+https://bitbucket.org/ecollins/cloud_sptheme#egg=cloud_sptheme
pip install -e git+https://github.com/ryan-roemer/sphinx-bootstrap-theme#egg=sphinx-bootstrap-theme
pip install -e hg+https://bitbucket.org/miiton/sphinxjp.themes.solarized#egg=sphinxjp.themes.solarized
pip install -e git+https://github.com/shkumagai/sphinxjp.themes.impressjs#egg=sphinxjp.themes.impressj
pip install -e git+https://github.com/kriskda/sphinx-sagecell#egg=sphinx-sagecell
```

It can also be handy to have special typesetting of IPython sessions:

```
pip install -e git+https://bitbucket.org/hplbit/pygments-ipython-console#egg=pygments-ipython-console
```

To make OpenOffice or LibreOffice documents from `rst` output, you will need more software, typically the following on a Debian system:

```
sudo apt-get install unoconv libreoffice libreoffice-dmaths
```

**Markdown and Pandoc Output.** The DocOnce format `pandoc` outputs the document in various Markdown versions: the Pandoc extended Markdown format (which via the `pandoc` program can be translated to a range of other formats), strict Markdown, and GitHub-flavored Markdown. Installation of Pandoc, written in Haskell, is most easily done by

```
sudo apt-get install pandoc
```

on Debian (Ubuntu) systems.

**Epydoc Output.** When the output format is `epydoc` one needs that program too, installed by

```
svn co https://epydoc.svn.sourceforge.net/svnroot/epydoc/trunk/epydoc epydoc
cd epydoc
sudo make install
cd ..
```

**Remark.** Several of the packages above installed from source code are also available in Debian-based system through the `apt-get install` command. However, we recommend installation directly from the version control system repository as there might be important updates and bug fixes. For `svn` directories, go to the directory, run `svn update`, and then `sudo python setup.py install`. For Mercurial (`hg`) directories, go to the directory, run `hg pull; hg update`, and then `sudo python setup.py install`.

**Analyzing file differences.** The `doconce diff file1 file prog` command for illustrating differences between two files `file1` and `file2` using the program `prog` requires `prog` to be installed. By default, `prog` is `difflib` which comes with Python and is always present if you have DocOnce installed. Another choice, `diff`, should be available on all Unix/Linux systems. Other choices, their URL, and their `sudo apt-get install` command on Debian (Ubuntu) systems appear in the table below.

| Program | URL | Debian/Ubuntu install |
|---|---|---|
| `pdiff` | a2ps wdiff | `sudo apt-get install a2ps wdiff texlive-latex-extra texlive-lat` |
| `latexdiff` | latexdiff | `sudo apt-get install latexdiff` |
| `kdiff3` | kdiff3 | `sudo apt-get install kdiff3` |
| `diffuse` | diffuse | `sudo apt-get install diffuse` |
| `xxdiff` | xxdiff | `sudo apt-get install xxdiff` |
| `meld` | meld | `sudo apt-get install meld` |
| `tkdiff.tcl` | tkdiff | not in Debian |

# 25 Basic Parsing Ideas

The (parts of) files with computer code to be directly included in the document are first copied into verbatim blocks.

All verbatim and TeX blocks are removed and stored elsewhere to ensure that no formatting rules are not applied to these blocks.

The text is examined line by line for typesetting of lists, as well as handling of blank lines and comment lines. List parsing needs some awareness of the context. Each line is interpreted by a regular expression

```
(?P<indent> *(?P<listtype>[*o-] )? *)(?P<keyword>[^:]+?:)?(?P<text>.*)\s?
```

That is, a possible indent (which we measure), an optional list item identifier, optional space, optional words ended by colon, and optional text. All lines are of this form. However, some ordinary (non-list) lines may contain a colon, and then the keyword and text group must be added to get the line contents. Otherwise, the text group will be the line.

When lists are typeset, the text is examined for sections, paragraphs, title, author, date, plus all the inline tags for emphasized, boldface, and verbatim text. Plain substitutions based on regular expressions are used for this purpose.

The final step is to insert the code and TeX blocks again (these should be untouched and are therefore left out of the previous parsing).

It is important to keep the DocOnce format and parsing simple. When a new format is needed and this format is not obtained by a simple edit of the definition of existing formats, it might be better to convert the document to reST and then to XML, parse the XML and write out in the new format. When the DocOnce format is not sufficient to getting the layout you want, it is suggested to filter the document to another, more complex format, say reST or LaTeX, and work further on the document in this format.

## 25.1 Typesetting of Function Arguments, Return Values, and Variables

**Note.**

This text is somewhat outdated. Now DocOnce supports NumPy-style docstrings. DocOnce can also do automatic references to Python documentation, say the 'math' module, but the link only works in case of Sphinx output. Typical syntax is

```
With :mod:‘numpy‘ and the :func:‘scipy.io.loadmat‘ function in
the :mod:‘scipy.io‘ module, we can ...
```

In case of ambiguous names, say a local `math` module, one can use `python`, `numpy`, `scipy`, and `mpl` (matplotlib) as prefix (as defined in `conf.py`, generated by the `doconce sphinx_dir`):

```
With :func:‘python:math.sin‘ instead of :func:‘math.sin‘ ...
```

(More info in the Sphinx API doc by the author - under development.)

A Mako function can provide greater flexibility such that other formats than Sphinx can take advantage of such references (full URL can be built into the function, depending on the format).

As part of comments (or doc strings) in computer code one often wishes to explain what a function takes of arguments and what the return values are. Similarly, it is desired to document class, instance, and module variables. Such arguments/variables can be typeset as description lists of the form listed below and *placed at the end of the doc string*. Note that `argument`, `keyword argument`, `return`, `instance variable`, `class variable`, and `module variable` are the only legal keywords (descriptions) for the description list in this context. If the output format is Epytext (Epydoc) or Sphinx, such lists of arguments and variables are nicely formatted.

```
- argument x: x value (float),
  which must be a positive number.
```

```
- keyword argument tolerance: tolerance (float) for stopping
  the iterations.
- return: the root of the equation (float), if found, otherwise None.
- instance variable eta: surface elevation (array).
- class variable items: the total number of MyClass objects (int).
- module variable debug: True: debug mode is on; False: no debugging
  (bool variable).
```

The result depends on the output format: all formats except Epytext and Sphinx just typeset the list as a list with keywords.

**module variable x:** x value (float), which must be a positive number.

**module variable tolerance:** tolerance (float) for stopping the iterations.

# 26 References

**Note.**

The references below are just for illustrating and testing citation syntax and not references for explaining parts of the text.

# References


[1] D. E. Knuth. Theory and practice. *EATCS Bulletin*, 27:14–21, 1985.

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[5] H. P. Langtangen, K.-A. Mardal, and R. Winther. Numerical methods for incompressible viscous flow. *Advances in Water Resources*, 25:1125–1146, 2002.

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