Continuous Integration and TEX with Org-mode

TEX in the cloud

by

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Introduction

- Find me here: `https://rgoswami.me`
- Who?
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Big Picture

- TeX is the lingua franca of academic communities
- Collaborations with TeX revolve around proprietary systems
  - Overleaf
- Or collaborators require some expertise with TeX

Mitigation Mechanisms

Everyone wants TeX *output without writing* TeX

- **pandoc**, **orgmode** promise TeX without the pain
- Cloud build machines are cheap to deploy now

Goals

- A nonexpert TeX workflow which requires no proprietary tools
  - Transparent **git** and CI setup
- Expert friendly in terms of templating

Writing TEX

```
1 \documentclass{article}
2 \author{John Doe}
3 \title{Astounding Discoveries}
4 \begin{document}
5 \maketitle
6 \section{TeX}
7 Hello World
8 \end{document}
```

- Not bad
  - Fairly comprehensive
- Quickly gets out of hand

Trivial for all examples which fit on slides

Splitting Code

`.cls` files Loaded with `\documentclass` and `\usepackage`

`.sty` files Style files or packages (including beamer themes)

`.rc` files Control files for build systems (`.latexmkrc` or `Makefile`)

- What CTAN handles typically
  - Popularly managed by `texlive` distributions
- Abstracts TeX and LaTeX (styling) away from document writing
  - Great for collaboration

Straying Away

Orgmode

```
#+author: John Doe
#+title: Astounding Discoveries
 * TeX
Hello World
```

```
(org-BACKEND-export-to-FRONT)
(org-latex-export-to-latex)
```

Pandoc Markdown

```
# TeX
Hello World
```

```
pandoc -s thing.md -o thing.tex
  --metadata title="Astounding
  Discoveries" author="John
  Doe"
```

Appears more readable and easier to write however…

Polluted Outputs

```
1 wc -l {base,orgOne,pandocOne}.tex
```

```
 8 base.tex
15 orgOne.tex
63 pandocOne.tex
86 total
```

- Generated files involve template substitution

Pandoc Substitution

- Top down approach
- Fixed locations in a template (e.g. zenYoda)
  - Variables expanded into TeX
- YAML metadata

```
$for(header-includes)$
$header-includes$
$endfor$
```

```
header-includes:
    - \numberwithin{figure}{section}
    - \numberwithin{equation}{section}
```

Orgmode Substitution

- Bottom up approach
- `tangle` to an output
  - Structure defined per-file

```
#+TITLE: Continuous Integration and TeX with Org-mode
#+SUBTITLE:  TeX in the cloud
#+LATEX_COMPILER: xelatex
#+LaTeX_CLASS: beamer
#+LaTeX_CLASS_OPTIONS: [unknownkeysallowed,aspectratio=169]
#+LATEX_HEADER: \usepackage{biblatex}
#+ATTR_LaTeX: :width 0.4\linewidth
```

Not strictly true (preset variables)

Conceptual Differences

- `org` exporter options assume only one output
  - Allows arbitrary `emacs-lisp` evaluations
  - Sharing configurations can be clunky
- `pandoc` shares configuration system for multiple outputs
  - Sane defaults, good templating options
  - Easy to share templates

Continuous Integration

- No one likes switching computers to test
  - MacOS, Windows (WSL often), Many Linux distributions
- There are far too many options nowadays
  - Wercker, ~~Travis CI~~, Shippable, GitLab CI, Github Actions
- Mostly transient `docker` or `nix` based systems
  - Setup can be annoying without `nix`

TEX Gains

- Single reproducible source of truth for TeX
  - The CI machine configuration

Teaching CI about TEX

- Relying on build machine OS `texlive` is fragile
  - `texliveonfly` can get packages “on the fly”

Basic TeXLive Profile

```
selected_scheme scheme-basic
TEXDIR /tmp/texlive
TEXMFCONFIG ~/.texlive/texmf-config
TEXMFHOME ~/texmf
TEXMFLOCAL /tmp/texlive/texmf-local
TEXMFSYSCONFIG /tmp/texlive/texmf-config
TEXMFSYSVAR /tmp/texlive/texmf-var
TEXMFVAR ~/.texlive/texmf-var
option_doc 0
option_src 0
```

TexLive CI Script

```
export PATH=/tmp/texlive/bin/x86_64-linux:$PATH
if ! command -v texlua > /dev/null; then
  wget http://mirror.ctan.org/systems/texlive/tlnet/install-tl-unx.tar.gz
  tar -xzf install-tl-unx.tar.gz
  cd install-tl-20*
  ./install-tl --profile=$1
  cd ..
fi
tlmgr install luatex scheme-small \
  biber         \
  beamer        \
  xetex         \
  pdflatex      \
  latexmk       \
  etoolbox      \
  minted        \
  texliveonfly
tlmgr option -- autobackup 0
tlmgr update --self --all --no-auto-install
```

GitHub Actions TeXLive

```yaml
jobs:
  deploy:
    runs-on: ubuntu-latest
    steps:
      - uses: actions/checkout@v2.3.4
      - name: Install package
        run: |
          sudo apt-get install -y python-pygments emacs
      - name: Setup LaTeX
        run: |
          export PATH=/tmp/texlive/bin/x86_64-linux:$PATH
          export PATH=$HOME/texmf/bin:$PATH
          scripts/getTexLive.sh $(pwd)/scripts/texlive.profile
```

Minimal Lisp for TEX

- Running functions
- Setting variables

```
1  (require 'ox-extra) ;; :ignoreheading:ignore:
2  (ox-extras-activate '(ignore-headlines))
3  (org-babel-tangle)
4  (setq org-latex-pdf-process (list "latexmk -shell-escape -f -pdfxe %f"))
5  (setq org-latex-listings 'minted)
6  (setq org-latex-minted-options
7        '(("bgcolor" "white") ("breaklines" "true") ("linenos" "true") ("style"
         ↪  "tango")))
8  (add-hook 'after-save-hook '(lambda () (org-beamer-export-to-latex) t)) ;; Export
```

Org Syntax for TeX

Source blocks `#+begin_src <lang> :exports <code/none/results> :eval <never> +#end_src`

Direct TeX export `#+begin_export <lang> #+end_export`

```
* Org Syntax for TeX
  - Source blocks :: ~#+begin_src <lang> :exports
  - Direct ~TeX~ export :: ~#+begin_export <lang>
  #+begin_src cpp
  #include <stdio.h>
  int main(){
      return 1;
  }
  #+end_src
```

Org and Packages

- Effectively generates `.cls` and `.sty` files

```
Beamer Theme :ignoreheading:ignore:
:PROPERTIES:
:BEAMER_env: ignoreheading
:VISIBILITY: folded
:END:
#+begin_src latex :exports none :results none :tangle beamerthemeExecushares.sty :eval always
\usepackage{tikz}
\usetikzlibrary{calc}
\usepackage[none]{hyphenat}
\usepackage{fontspec}
\defaultfontfeatures{Ligatures=TeX}

\newif\ifbeamer@pixelitem
\beamer@pixelitemtrue
\DeclareOptionBeamer{nopixelitem}{\beamer@pixelitemfalse}
\ProcessOptionsBeamer

% define colours
% taken from pickton on Adobe Kuler:
% https://kuler.adobe.com/Some-Kind-Of-Execushares-color-theme-3837185/
\definecolor{ExecusharesRed}{RGB}{230,37,52}
\definecolor{ExecusharesBlack}{RGB}{43,40,40}
\definecolor{ExecusharesBlue}{RGB}{22,190,207}
\definecolor{ExecusharesWhite}{RGB}{255,255,243}
\definecolor{ExecusharesGrey}{RGB}{107,110,108}
```

Org and Headers

- In body TeX can be directly written in `export` blocks
  - `#+LATEX_HEADER:` can be used to add to document headers

```
#+LATEX_COMPILER: xelatex
#+LATEX_HEADER: \PassOptionsToPackage{unicode=true}{hyperref}
#+LATEX_HEADER: \PassOptionsToPackage{hyphens}{url}
#+LATEX_HEADER: \PassOptionsToPackage{dvipsnames,svgnames*,x11names*,table}{xcolor}
#+LATEX_HEADER: \usepackage{amssymb,amsmath}
#+LATEX_HEADER: \usepackage{mathtools}
#+LATEX_HEADER: \usepackage{physics}
#+LATEX_HEADER: \usepackage{hyperref}
#+LATEX_HEADER: % Make use of float-package and set default placement for figures to H
#+LATEX_HEADER: \usepackage{float}
#+LATEX_HEADER: \floatplacement{figure}{H}
```

Generating Classes

- `#+LATEX_CLASS: myclass` is populated from `org-latex-classes`
  - So we need to add to it before use
- Or use it as part of the `single file setup`

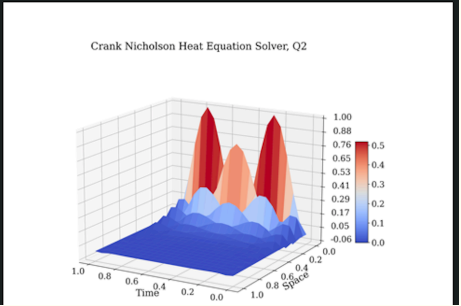
```
(append-to-list
 'org-latex-classes
 '(("tufte-book"
    "\\documentclass[a4paper, sfsidenotes, openany, justified]{tufte-book}"
    ("\\part{%s}" . "\\part*{%s}")
    ("\\chapter{%s}" . "\\chapter*{%s}")
    ("\\section{%s}" . "\\section*{%s}")
    ("utf8" . "utf8x")
    ("\\subsection{%s}" . "\\subsection*{%s}"))))
```

Replacing Jupyter

```
#+PROPERTY: header-args:python :python
/home/haozeke/.pyenv/shims/python :session OnePy
:results output :exports both :tangle pyCode.py3
```

```
#+BEGIN_SRC python :results output file :exports both
xs = np.linspace(0,1,myN+1)
ts = xs
X, Y = np.meshgrid(xs,ts)
fig = plt.figure(figsize=(12,10))
ax = fig.gca(projection='3d')
surf=ax.plot_surface(X, Y, t.T, cmap=cm.coolwarm)
ax.zaxis.set_major_locator(LinearLocator(10))
ax.zaxis.set_major_formatter(FormatStrFormatter('%.02f'))
fig.colorbar(surf, shrink=0.35, aspect=8)
ax.view_init(elev=15,azim=120)
plt.xlabel('Time')
plt.ylabel('Space')
plt.title("Crank Nicholson Heat Equation Solver, Q2")
plt.savefig('images/plotp2.png', dpi = 300)
plt.close()
print('images/plotp2.png')
#+END_SRC
```

#+RESULTS:



PDF Output

- Much nicer (and more native) than Jupyter

Part a

Given the IBCs:

$$\begin{cases} u(x,0) = 2\cosh x & \text{for } 0 \le x \le 1 \\ u(0,t) = 2e^{2t} & \text{for } 0 \le t \le 1 \\ u(1,t) = (e^2+1)e^{2t-1} & \text{for } 0 \le t \le 1 \end{cases}$$

Recall that the exact solution for $u_t = 2u_{xx}$for $0 \le x \le 1, 0 \le t \le 1$; is $u(x,t) = e^{2t+x} + e^{2t-x}$. We can use the same generic function defined earlier, and simply need to write in the appropriate conditions.

```
def drichp2a(x):
    return (2*np.cosh(x))
def lef2a(t):
    return (2*np.e**(2*t))
def righ2a(t):
    return (np.e**2+1)*(np.e**(2*t-1))
```

Teaching CI Org-TEX

```
(require 'package)
(setq package-check-signature nil)
(add-to-list 'package-archives '("melpa" . "https://melpa.org/packages/") t)
(package-initialize)
(unless package-archive-contents   (package-refresh-contents))
(package-install 'use-package)
(package-install 'org)
(dolist (package '(use-package))
   (unless (package-installed-p package)
       (package-install package)))
(use-package org-ref
   :ensure t)
(require 'ox-latex)
;; Define an interactive function for easy testing
(defun org-beamer-export-to-pdf-directory (files)
  "Export all FILES to latex."
  (interactive "Export org files to tex")
;; Export all org files given on the command line
(org-beamer-export-to-pdf-directory argv)
```

GH Actions and Org-TEX

- More completely, see this script
  - With this action

```
- name: Generate TeX
  run: emacs -q -nl --script scripts/org2tex.el src/filename.org
- name: Build pdf
  run: |
```

```
export PATH=/tmp/texlive/bin/x86_64-linux:$PATH
export PATH=$HOME/texmf/bin:$PATH
cd src/
texliveonfly -c latexmk -a "-pdfxe -shell-escape -f" wgtqc.tex
```

Omitted Topics

Caching CI rebuilds can be sped up with caching mechanisms

Emacs-Lisp Too much and too irrelevant for TeX in general

Advanced Concepts CI configurations and custom `emacs` setups; a lot more detail here

Jupyter and Org Orgmode can be used as a fully fledged multi-language plain text Jupyter replacement for data science

Advanced Concepts

- Going beyond single files with `:noweb yes`
  - Uses named blocks for clarity `#+NAME: orgConf`
    - Named blocks are not tangled

```
(eval-after-load 'ox '(require 'ox-koma-letter))
(with-eval-after-load 'ox-latex
 <<tex_process>>
 <<common_pkgs>>
 <<tufte_book>>
 <<koma_art>>
)
```

Conclusions

- `orgmode` provides a viable alternative syntax for writing TeX
  - Can be used on public clouds without knowing `emacs`
- TeX is here to stay
- Abstracting complexity away from users is good
  - Public cloud usage spares installation issues
    - Enables `git` workflows
- Alternative syntaxes provide more natural usage for novices
  - `orgmode` facilitates native execution

End

Thank you