Tools of the Trade:
resources to help prepare papers and conduct research

Trung V. Dang, Shlomi Hod, Luowen Qian
Tool use shapes thinking
Few General Principles for Building your Toolbox

Goal: Effectiveness (ability) & Efficiency (productivity)

Define your system, design your process

Simplicity (proxy measure: numbers of clicks for an action)

Experiment with tools before committing to them

Sometimes you want use more than one tool for a task (e.g., offline and online writing in LaTeX)
Be aware...

<table>
<thead>
<tr>
<th>HOW MUCH TIME YOU SHAVE OFF</th>
<th>50/DAY</th>
<th>5/DAY</th>
<th>DAILY</th>
<th>WEEKLY</th>
<th>MONTHLY</th>
<th>YEARLY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 SECOND</td>
<td>1 DAY</td>
<td>2 HOURS</td>
<td>30 MINUTES</td>
<td>4 MINUTES</td>
<td>1 MINUTE</td>
<td>5 SECONDS</td>
</tr>
<tr>
<td>5 SECONDS</td>
<td>5 DAYS</td>
<td>12 HOURS</td>
<td>2 HOURS</td>
<td>21 MINUTES</td>
<td>5 MINUTES</td>
<td>25 SECONDS</td>
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<tr>
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<td>2 HOURS</td>
<td>30 MINUTES</td>
<td>2 MINUTES</td>
</tr>
<tr>
<td>1 MINUTE</td>
<td>8 WEEKS</td>
<td>6 DAYS</td>
<td>1 DAY</td>
<td>4 HOURS</td>
<td>1 HOUR</td>
<td>5 MINUTES</td>
</tr>
<tr>
<td>5 MINUTES</td>
<td>9 MONTHS</td>
<td>4 WEEKS</td>
<td>6 DAYS</td>
<td>21 HOURS</td>
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</tr>
<tr>
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<td>6 MONTHS</td>
<td>5 WEEKS</td>
<td>5 DAYS</td>
<td>1 DAY</td>
<td>2 HOURS</td>
<td>25 MINUTES</td>
</tr>
<tr>
<td>1 HOUR</td>
<td>10 MONTHS</td>
<td>2 MONTHS</td>
<td>10 DAYS</td>
<td>2 DAYS</td>
<td>5 HOURS</td>
<td>1 DAY</td>
</tr>
<tr>
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<td>2 MONTHS</td>
<td>10 DAYS</td>
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<td>2 WEEKS</td>
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</tr>
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</tr>
</tbody>
</table>
Keyboard Shortcuts

Why?

- Spending more time on the things that matter
- Reducing cognitive load
- Good for preventing RSI (repetitive strain injury)

Sometimes steep learning curve

Tip: flip your mouse, disable your touchpad

Good starting point: lifehacker - Back to Basics: Learn to Use Keyboard Shortcuts Like a Ninja
Tools for What?

1. Writing
2. Coding
3. Organizing
4. Collaborating
5. Presenting

.... and now an opinionated survey!
Task I: Tools for Writing Papers - LaTeX

- Pros: ...
- Cons: ...

You don’t have a choice so you don’t need to care
LaTeX editors

Emacs + AUCTeX, Vim + LaTeX-suite, Sublime Text + LaTeXTools…

Pros:

● Efficient given you know the editor very well
● Easy to use if you spend time configuring it

Cons:

● You spend time finding plugins/extensions for it
● You spend time configuring it
● You need to be ready to debug editors if things are not working or are slow
LaTeX IDEs
a.k.a. LaTeX editors that work out of the box

Ordered by community preference: [https://tex.stackexchange.com/q/339/97178](https://tex.stackexchange.com/q/339/97178)

- TeXstudio (formerly TexMakerX)
- Texmaker
- TeXworks
- Kile
- TexShop for Mac
- TeXnicCenter for Windows
- … (you don’t need to know the rest)

Overleaf (formerly ShareLaTeX)

Better than IDEs:

- Works in your browser
- Built-in collaboration tools (more on this later)

Worse than IDEs: (caveats)

- “Lost Connection” “Please refresh the page to continue.”
- “Planned Maintenance”
- Has maximum compilation size (suggested by Andrew Wood)
Example: Forward/Inverse Search

TeXstudio: right click, choose “Go to PDF” or “Go to Source”

Overleaf: double click or

Emacs + AUCTeX, instructions: https://tex.stackexchange.com/q/161797/97178

Punchline: use an IDE (unless you have already invested in an editor + plugins)
LaTeX Packages

- LaTeX is Turing complete
- TeX is a macro language
- Macro packages are macros written by other people
- Use macros & packages!
LaTeX Packages for Making Figures

- **Use `graphicx` for inserting:**
  - Bitmaps (jpg/png) you make elsewhere (hopefully not Microsoft Paint)
  - Graphics (ps/eps) you export from mathematical or scientific graphics software
  - PowerPoint figures can be converted into ps/eps: [http://www.cs.bu.edu/~reyzin/pictips.html](http://www.cs.bu.edu/~reyzin/pictips.html)

- **Use `tikz` for drawing images in TeX** (remember to use macros or `\tikzset`!)
  - Interactive tools that can export tikz: Asymptote, Inkscape, GeoGebra

- **Other packages:** PStricks, Xy-pic, Metapost...
LaTeX Packages for Code

- Packages \texttt{algorithmic}, \texttt{algorithm2e}, \texttt{algorithmicx}, \texttt{program} \\
  Looks nice but more or less equally hard to use
- \textbf{Just use \texttt{enumerate} for pseudocode}
- \textbf{Use \texttt{listings} or \texttt{minted} to typeset real code}
LaTeX Tools for Bibliography

- Use `biblatex` **unless you are submitting to a journal**  (it is more easily configurable and has better Unicode support)
- Use `bibliography/bibtex` for simplicity
- Use `thebibliography` if you like complete control  (i.e. do not use this under normal circumstances)

Finding BibTeX citations:

- General search engines -- `dblp`, `MathSciNet`, `Google Scholar`
- Publisher website
Comparison of BibTeX entries

@inproceedings{DBLP:conf/crypto/GargOS18,
  author    = {Sanjam Garg and Rafail Ostrovsky and Akshayaram Srinivasan},
  editor    = {Hovav Shacham and Alexandra Boldyreva},
  title     = {Adaptive {G}arbled {RAM} from Laconic Oblivious Transfer},
  series    = {Lecture Notes in Computer Science},
  volume    = {10993},
  pages     = {515--544},
  publisher = {Springer},
  year      = {2018},
  url       = {https://doi.org/10.1007/978-3-319-96878-0_18},
  doi       = {10.1007/978-3-319-96878-0_18},
  timestamp = {Tue, 14 May 2019 10:00:48 +0200},
  biburl    = {https://dblp.org/rec/conf/crypto/GargOS18.bib},
  bibsource = {dblp computer science bibliography, https://dblp.org}
}

@incollection{MR3847907,
  author = {Garg, Sanjam and Ostrovsky, Rafail and Srinivasan, Akshayaram},
  title = {Adaptive garbled {RAM} from laconic oblivious transfer},
  booktitle = {Advances in cryptology --- {CRYPTO} 2018},
  series = {Lecture Notes in Comput. Sci.},
  volume = {10993},
  pages = {515--544},
  publisher = {Springer, Cham},
  year = {2018},
  mrclass = {94A60},
  mrnumber = {3847907},
  doi = {10.1007/978-3-319-96878-0_18},
  url = {https://doi.org/10.1007/978-3-319-96878-0_18},
}

@inproceedings{garg2018adaptive,
  title={Adaptive garbled RAM from laconic oblivious transfer},
  author={Garg, Sanjam and Ostrovsky, Rafail and Srinivasan, Akshayaram},
  booktitle={Annual International Cryptology Conference},
  pages={515--544},
  year={2018},
  organization={Springer}
}

@InProceedings{10.1007/978-3-319-96878-0_18,
  author="Garg, Sanjam and Ostrovsky, Rafail and Srinivasan, Akshayaram",
  editor="Shacham, Hovav and Boldyreva, Alexandra",
  title="Adaptive Garbled RAM from Laconic Oblivious Transfer",
  booktitle="Advances in Cryptology -- CRYPTO 2018",
  year="2018",
  publisher="Springer International Publishing",
  address="Cham",
  pages="515--544",
  abstract="We give a construction of an adaptive garbled RAM scheme. In the adaptive setting, a client first garbles a "large" persistent database which is stored on a server. Next, the client can provide garbling of multiple adaptively and adversarially chosen RAM programs that execute and modify the stored database arbitrarily. The garbled database and the garbled program should reveal nothing more than the running time and the output of the computation. Furthermore, the sizes of the garbled database and the garbled program grow only linearly in the

 Springer (publisher)

 dblp
 MathSciNet
 Google Scholar
LaTeX compilers

- arXiv only supports ((PDF)La)TeX
  (yes, you are required to submit your source files there)
- XeLaTeX/LuaLaTeX is more modern and more friendly for Unicode

Use \texttt{iftex} to get best of both worlds...

\usepackage{iftex}
\ifpdf\texttt{pdf}\else\texttt{non-pdf}\fi
\begin{itemize}
  \item \texttt{usepackage[noTeX]{mmap}}
  \item \texttt{usepackage[T1]{fontenc}}
  \item \texttt{usepackage[unicode-math]}
\end{itemize}
### Task II: Coding

<table>
<thead>
<tr>
<th>If you want to...</th>
<th>IDE</th>
<th>GUI E</th>
<th>TER E</th>
</tr>
</thead>
<tbody>
<tr>
<td>get off the ground fast?</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>work with a specific language only supported by an IDE (matlab, verilog, etc.)</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>remain on a same tool for decades?</td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>code on many languages</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>do the work remotely</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>auto complete, code lint, code hint, etc.</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>get rid of the mouse</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>advanced tools (database, git integration, deployment, etc.)</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>customize your environment</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
2019 Survey

Most popular development environment (Stack Overflow Developer Survey)

- Don’t be a jake of all trades
- Don’t be too loyal to a tool
### 2017

<table>
<thead>
<tr>
<th>Editor</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual Studio</td>
<td>38.8%</td>
</tr>
<tr>
<td>Notepad++</td>
<td>34.3%</td>
</tr>
<tr>
<td>Sublime Text</td>
<td>31.4%</td>
</tr>
<tr>
<td>Vim</td>
<td>27.1%</td>
</tr>
<tr>
<td>Visual Studio Code</td>
<td>24.0%</td>
</tr>
<tr>
<td>IntelliJ</td>
<td>23.0%</td>
</tr>
<tr>
<td>Atom</td>
<td>20.0%</td>
</tr>
<tr>
<td>Eclipse</td>
<td>20.0%</td>
</tr>
<tr>
<td>Android Studio</td>
<td>14.0%</td>
</tr>
<tr>
<td>PHPStorm</td>
<td>11.7%</td>
</tr>
<tr>
<td>Xcode</td>
<td>9.2%</td>
</tr>
<tr>
<td>NetBeans</td>
<td>7.8%</td>
</tr>
<tr>
<td>PyCharm</td>
<td>7.7%</td>
</tr>
<tr>
<td>Emacs</td>
<td>4.2%</td>
</tr>
<tr>
<td>IPython / Jupyter</td>
<td>3.4%</td>
</tr>
<tr>
<td>RubyMine</td>
<td>2.2%</td>
</tr>
<tr>
<td>RStudio</td>
<td>1.3%</td>
</tr>
<tr>
<td>TextMate</td>
<td>1.2%</td>
</tr>
<tr>
<td>Coda</td>
<td>0.7%</td>
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<tr>
<td>Komodo</td>
<td>0.6%</td>
</tr>
<tr>
<td>Zend</td>
<td>0.5%</td>
</tr>
<tr>
<td>Light Table</td>
<td>0.2%</td>
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### 2019

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</table>
Don’t forget to...

Keep track of your work

- Make yourself comfortable with git
- Your BU’s home directory is taken snapshot hourly, nightly and weekly!
- Make sure your results are reproducible (save experiment details, use random seed, etc.)
Don’t forget to...

Keep track of environment and dependencies

- Use package manager: pip, anaconda, npm
- Use virtual machine or virtual environment
Task III: Organization

Organization of what….? Everything!

Build your “life operation system”

Notes, Docs
Knowledge Base
Tasks, Projects
Databases

https://www.notion.so/product

Free Personal plan with @bu.edu
Task III: Organization - con’t

Organization of what….? Research, Knowledge.

Mind Mapping!  (Wikipedia list)

My (current) favorite: Coggle

example 1
example 2

“Research Tree”
Task IV: Tools for Collaboration - Remote Meetings

- Best way to communicate is to talk offline
- Zoom has comprehensive features but expensive
  - University sponsored license
  - Virtual whiteboard support with annotations (more on this later)
- Skype is free and widely used (so are your favorite video calling apps)
- **Whereby** works in-browser
Task IV: Tools for Collaboration - Virtual Whiteboards

The only usable one: [Google Jamboard (jamboard.google.com)](https://jamboard.google.com)

Honorable mention: Microsoft Whiteboard

Also consider Google docs if your collaborators do not have a stylus
Task IV: Tools for Collaboration - Coding

Use git, with your code hosted on GitHub/GitLab/BitBucket…

- Branching and merging
- Bisecting
- Submodules

Unpopular alternatives: Apache Subversion, Mercurial SCM…
Task IV: Tools for Collaboration - Writing in LaTeX

**Overleaf:**
- Real-time source code updates
- Almost no learning curve: your co-authors might not know git

**git:**
- Resolving conflicts using branching and merging
- Use it with your favorite LaTeX editor/IDE
- Works offline!

Use both if possible to get best of both worlds
Task V: Presentation

Popular:

- Good for general use: PowerPoint
- Good for collaboration: Google Slides

For researcher & developer

- Good for fast prototyping: Markdown
- Good for scientific presentation: Latex Beamer
Create your academic personal website

How to...

● create a static & minimal homepage? Jenkyll
● start a blog? Wordpress, Medium, etc.
● register a domain? github, google domains (?)
Remote Working

Best practice for working from home

https://coronavirustechhandbook.com/remote
Summary

1. Introduction - Tool use shapes thinking, Building your Toolbox, Shortcuts
2. Writing - IDE, Overleaf, BibTeX, LaTeX packages
3. Coding
4. Organizing - Notion, Coggle
5. Collaborating
6. Presenting
Discussion

What makes a good tool?

Do you have a story about a tool that really changed the way they work?

How do you find tools?
References

https://academia.stackexchange.com/a/56513/86377
https://github.com/overleaf/translations/blob/50a9bc3d03961f6604bed335c0635b0a7dea5407/locales/en.json#L885
https://web.iit.edu/sites/web/files/departments/academic-affairs/graduate-academic-affairs/pdfs/figure-help1.pdf
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