Paper Writing with \LaTeX
What's the most resilient parasite?

An idea.

A single idea from the human mind can build cities. An idea can transform the world and rewrite all the rules.

Source: https://uk.pinterest.com/explore/inception-quotes/
Writing Papers = Conveying Your Ideas
Writing Good Papers = Conveying Your Ideas Effectively
Learning to Review a Paper

Source: Paper Gestalt
Characteristics of a “Good” paper

**Math:** Sophisticated mathematical expressions make a paper look technical and make the authors appear knowledgeable and “smart.”

**Plots:** ROC, PR, and other performance plots convey a sense of thoroughness. Standard deviation bars are particularly pleasing to a scientific eye.

**Figures/Screenshots:** Illustrative figures that express complex algorithms in terms of 3rd grade visuals are always a must. Screenshots of anecdotal results are also very effective.

Source: [Paper Gestalt](https://www.papergestalt.com)
Characteristics of “Bad” papers

- Large confusing tables.
- Missing pages.
- Lack of colorful figures.

Source: Paper Gestalt
This talk

• Share several useful guidelines for typesetting your paper with LaTeX

• Master the tool so you can maximize the clarity of your paper

• Crowdsource more tricks and best practices
Why LaTeX?

- Great typesetting tool (MS Word is terrible at this)
- Style and content separation
  - Easier to re-submit the rejected paper to somewhere else (?)
- No need to worry about the numbers of sections, figures, tables
- Beautiful math equations
- Reference management
Use the Correct Style File (.sty)

Which one do you want?

• Manually format the paper, e.g.,

All text must be in a two-column format. The total allowable width of the text area is 6 7/8 inches (17.5 cm) wide by 8 7/8 inches (22.54 cm) high. Columns are to be 3 1/4 inches (8.25 cm) wide, with a 5/16 inch (0.8 cm) space between them. The main title (on the first page) should begin 1.0 inch (2.54 cm) from the top edge of the page. The second and following pages should begin 1.0 inch (2.54 cm) from the top edge. On all pages, the bottom margin should be 1-1/8 inches (2.86 cm) from the bottom edge of the page for 8.5 × 11-inch paper; for A4 paper, approximately 1-5/8 inches (4.13 cm) from the bottom edge of the page. All printed material, including text, illustrations, and charts, must be kept within a print area 6-7/8 inches (17.5 cm) wide by 8-7/8 inches (22.54 cm) high.

• Or, just make sure that you use the correct style file

Recommended by Tiffany Yu-Han Chen
Version Control

- Version control platform
  - Git
  - SVN

- Online collaborative editors
  - Overleaf
  - ShareLaTeX

- Pros:
  - What-You-See-Is-What-You-Get platform
  - Real-time collaborative writing

- Cons: version control is not free
Example LaTeX Document

\documentclass[10pt,twocolumn,letterpaper]{article}
\include{macros} % Pre-defined instructions
\usepackage{cvpr} % CVPR style file (paper margin, font size, type)
\def\cvprPaperID{****} % *** Enter the CVPR Paper ID here

\begin{document}

\title{My Awesome Paper Title}
\author{****}

% Paper content

\end{document}
Macros – Packages, Latin, and Math

• Commonly used packages
  • Figures, algorithms, tables, list, math, fonts, comments, hyperlinks
  • See an example here

• Latin abbreviations
  • \(\text{\texttt{\textbackslash def\textbackslash etal\{et~al.\}_}}\) % and others, and co-workers
  • \(\text{\texttt{\textbackslash def\textbackslash eg\{e.g.,\}~}}\) % for example
  • \(\text{\texttt{\textbackslash def\textbackslash ie\{i.e.,\}~}}\) % that is, in other words
  • \(\text{\texttt{\textbackslash def\textbackslash etc\{etc\}}}\) % and other things, and so forth
  • \(\text{\texttt{\textbackslash def\textbackslash cf\{cf.\}~}}\) % compare
  • \(\text{\texttt{\textbackslash def\textbackslash viz\{viz.\}~}}\) % namely, precisely
  • \(\text{\texttt{\textbackslash def\textbackslash vs\{vs.\}~}}\) % against

• Math related
  • \texttt{\texttt{\textbackslash DeclareMathOperator*{\argmin}{\arg\,!\,\min}}} \(\arg\,!\,\min\)
  • \texttt{\texttt{\textbackslash DeclareMathOperator*{\argmax}{\arg\,!\,\max}}} \(\arg\,!\,\max\)
Macros - References for figures, tables, equations, and sections

```
\newcommand{\secref}[1]{Section~\ref{sec:#1}}
\newcommand{\figref}[1]{Figure~\ref{fig:#1}}
\newcommand{\tabref}[1]{Table~\ref{tab:#1}}
\newcommand{\eqnref}[1]{\eqref{eq:#1}}
\newcommand{\thmref}[1]{Theorem~\ref{#1}}
\newcommand{\prgref}[1]{Program~\ref{#1}}
\newcommand{\algref}[1]{Algorithm~\ref{#1}}
\newcommand{\clmref}[1]{Claim~\ref{#1}}
\newcommand{\lemref}[1]{Lemma~\ref{#1}}
\newcommand{\ptyref}[1]{Property~\ref{#1}}
```

\section{Overview}

\label{sec:overview}

...  

Section~\secref{overview} describes XXX

...

**DO NOT** manually set the section, figure, table numbers!
Macros – Short-hand notations

Define commonly used notations

- \textbf{newcommand}{\texttt{tb}}[1]{\texttt{#1}}
- \textbf{newcommand}{\texttt{mb}}[1]{\texttt{#1}}
- \textbf{newcommand}{\texttt{Paragraph}}[1]{\texttt{noindent \texttt{#1}}}
- \textbf{def}{\texttt{ith}}{\texttt{i^{\texttt{textit{th}}}}}

\texttt{Let } \textbf{mathbf{p}}_{x^k}, \textbf{mathbf{p}}_{y^k}, \textbf{mathbf{p}}_{z^k} \texttt{ be the } \ldots

\texttt{begin{equation}}
\textbf{mathbf{p}}_{z^k} = \textbf{mathbf{p}}_{x^k} + \textbf{mathbf{p}}_{y^k}
\texttt{end{equation}}

\textbf{DO NOT} type the same symbol more than twice

\texttt{-> Poor readability, error-prone, difficult to revise}

\texttt{Let } \textbf{px}, \textbf{py}, \textbf{pz} \texttt{ be the } \ldots

\texttt{begin{equation}}
\textbf{pz} = \textbf{px} + \textbf{py}
\texttt{end{equation}}
Macros – Comments, To-Do, Revision

In-text comments

- \newcommand{\jiabin}[1]{\color{blue}\textbf{Jia-Bin:} #1}\normalfont

To-Do items

- \newcommand{\todo}{\color{red}[TO-DO] _}

Added new texts

- \def\newtext#1\textcolor{blue}{#1}

Modified texts

- \def\modtext#1\textcolor{red}{#1}

Ignore texts

- \def\ignorethis#1{}
Macros – Quickly remove comments

Three easy steps for removing all in-text comments

• Step 1: Include required package `\usepackage{ifthen}`
• Step 2: Put `\newcommand{\final}{1}` right below `\documentclass`
• Step 3: Renew commands if the draft is final
  `\ifthenelse{\equal{\final}{1}}{\renewcommand{\todo}[1]{}\renewcommand{\jiabin}[1]{}{}}{}`

Source: Li-Yi Wei and Chia-Kai Liang
Sections

\section{Introduction}
\section{Related Work}
\section{Overview}
\section{Method}
\section{Experimental Results}
\section{Conclusions}

- DO add labels to all sections
- DO use informative section names to replace “Method/Algorithm”
  - \section{Method}
    ->
  \section{Completion as Optimization}
Subsections

\section{Algorithm XXX}
\label{sec:algorithm}

\subsection{Problem formulation}
\label{sec:problem}

\subsection{Objective function}
\label{sec:objective}

\subsection{Optimization}
\label{sec:optimization}

• \textbf{DO} add labels to all subsections
\subsection{Objective function}
\label{sec:objective}

• For sections, I cap the \textbf{first letter for every word}
\section{Experimental Results}

• For subsections, I cap \textbf{ONLY the first letter of the first word}
\subsection{Implementation details}
Subsubsections

\subsubsection[XXX]{

- 4.1.3 Dataset A
- 4.2.5 Dataset B
- 4.3.1 Metrics
- 4.3.4 Run-time
- 4.5.2 Results on dataset A
- 4.5.3 Results on dataset B

\begin{itemize}
  \item \textbf{DO NOT} use subsubsections
    \begin{itemize}
      \item Too confusing
    \end{itemize}
  \item \textbf{DO} use \paragraph
\end{itemize}

\subsection{Datasets}
\paragraph{Dataset A}
\paragraph{Dataset B}
\paragraph{Metrics}

\subsection{Implementation details}
\paragraph{Run-time}

\subsection{Results}
\paragraph{Results on dataset A}
\paragraph{Results on dataset B}
Organize your files

- Move figures to separate folders

- Use one tex file for each figure, table, and algorithm
  - Leave the main.tex with only main texts
  - Help focus on finetuning each figure
  - Avoid copying and pasting an entire block of tables/figures

- Use \input{FILE_NAME} to include the file to the main paper
  - \input{figures/teaser}
  - \input{figures/overview}

- (Optional) Use one tex file for each major section
  - Avoid merge/commit conflicts
Figures – Teaser

- Show off the strongest results (Input and Output)

[Isola et al 2017]

[Darabi et al. 2012]

[Huang et al 2016]

[Zhang et al 2016]
Figures – Motivation

- Examples that highlight the **Key Idea** of the paper

[Huang et al. 2015]

[Natural, Not Natural]

[Parikh and Grauman 2011]

[Smiling, Not Smiling]

[Torralba and Efros 2011]
Figures – Overview

• Visualize the **algorithm**

• Provide forward references to equations and sections
Figures

• File format
  • DO NOT use JPEG images (to avoid compression artifacts). Use PNG or PDF

• Resolution
  • DO NOT use low-resolution images

• Position
  • Put the figures to the top of each page \begin{figure}[t]

• Caption
  • The image caption should be self-contained
  • Highlight the topic of the figure with bold font \textbf

![Figure 1: A unified approach to fg/bg video segmentation in unconstrained videos. Our algorithm can handle in a single framework video sequences which contain highly non-rigid foreground and background motions, complex 3D parallax and simple 2D motions, and severe motion blur.][Faktor and Irani 2014]
Multiple Images

- Use `subfigure` or `minipage`. DO NOT use `tabular`.

- Never manually define the physical size of the image
  - `{\includegraphics[width=5cm]{IMAGE.png}}` -> Bad
  - `{\includegraphics[width=0.5\linewidth]{IMAGE.png}}` -> Good
  - `{\setlength{\figwidth}{0.5\linewidth}
    \begin{minipage}{\figwidth}
    \includegraphics[width=\linewidth]{IMAGE.png}
    \end{minipage}}` -> Best
Multiple Images

- Put sub-captions directly under subfigures, do not put them in the caption

- All the legends, axis, labels must be clearly visible

- Make use of color and textures to code information

[Huang et al. 2016]
Spacing between Images

\begin{figure}[t]
% Maximum length
\includegraphics[width=0.3\linewidth]{A.png} \hfill \includegraphics[width=0.3\linewidth]{A.png}

% Equal length
\hspace*{\fill} \includegraphics[width=0.3\linewidth]{B.png} \hfill \includegraphics[width=0.3\linewidth]{B.png} \hspace*{\fill}

% Fixed length
\centering \includegraphics[width=0.3\linewidth]{C.png} \hspace{1em} \includegraphics[width=0.3\linewidth]{C.png}
\end{figure}
TikZ package

\usepackage{tikz}
\begin{tikzpicture}
code
\end{tikzpicture}

Tutorial: A very minimal introduction to TikZ by Jacques Crémer (TSE)

Tools for converting your figures to TikZ figures

- MATLAB
- Python

Recommended by Oliver Wang and Yanjun Li
Image, video, and dataset names

- Use \textsc{Name} to separate images, videos, dataset names from the main texts.

[Image: Various images of Downhill Skiing, Mountain Biking, Kayaking, Santiago Market Walk, Cable Car, City Biking, Pike Market Walk, Toddler]

[Kopf 2016]
Multiple Images

• How do I align images with different sizes?
  • Solve a simple algebra problem

• Suppose we know the image on the left has aspect ratio = H/W = c
  • What’s x ?

\[
\begin{align*}
\text{cx} & = 2(1-x) \\
(2+c)x & = 2 \\
x & = 2/(2+c)
\end{align*}
\]
Tables – Basics

\begin{table}[t]
\caption{Table caption} % Table captions are ABOVE the table
\label{tab:table_name} % Always label the table
\begin{tabular}{|c|c|c|}
\hline
XX & XX & XX \\
\hline
YY & YY & YY \\
\hline
\end{tabular} % c: center, l: left, r: right
\end{table}

User-friendly LaTeX table generator (recommended by Ting-Hao Kenneth Huang)
Tables – Comparison to related work

- Provide conceptual differences to related work

<table>
<thead>
<tr>
<th>Method</th>
<th>No bottleneck required</th>
<th>Uses input dropout</th>
<th>No domain gap</th>
<th>No input handicap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autoencoder [15]</td>
<td>×</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Denoising autoencoder [36]</td>
<td>✓</td>
<td>✓</td>
<td>×</td>
<td>✓</td>
</tr>
<tr>
<td>Context Encoder [28]</td>
<td>✓</td>
<td>✓</td>
<td>×</td>
<td>✓</td>
</tr>
<tr>
<td>Cross-Channel Encoder [42]</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>×</td>
</tr>
<tr>
<td>Split-Brain Autoencoder</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

[Zhang et al 2017]

<table>
<thead>
<tr>
<th>Dataset</th>
<th>Levin et al. [17]</th>
<th>Sun et al. [38]</th>
<th>Köhler et al. [13]</th>
<th>Ours (real)</th>
<th>Ours (synthetic)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Synthetic/Real</td>
<td>Synthetic</td>
<td>Synthetic</td>
<td>Real</td>
<td>Real</td>
<td>Synthetic</td>
</tr>
<tr>
<td>Blur Model</td>
<td>Uniform</td>
<td>Uniform</td>
<td>Non-uniform</td>
<td>Unknown</td>
<td>Both</td>
</tr>
<tr>
<td>Latent Images</td>
<td>4</td>
<td>8</td>
<td>4</td>
<td>100</td>
<td>25</td>
</tr>
<tr>
<td>Kernels / Trajectories</td>
<td>8</td>
<td>8</td>
<td>12</td>
<td>100</td>
<td>8</td>
</tr>
<tr>
<td>Blurred Images</td>
<td>32</td>
<td>640</td>
<td>48</td>
<td>100</td>
<td>200</td>
</tr>
<tr>
<td>Depth variation Evaluation</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Evaluation</td>
<td>PSNR/SSIM</td>
<td>PSNR/SSIM</td>
<td>PSNR</td>
<td>User study</td>
<td>User study</td>
</tr>
</tbody>
</table>

[Lai et al 2016]
Tables – Results

- Highlight the best and the second best results
- Group methods that use different training sets or different levels of supervision
- Always provide citation for each method

If you have a big table, use

\resizebox{\textwidth}{!}{
\begin{tabular}{...}
\end{tabular}
Tables – Making nice tables

- Which one looks better?

<table>
<thead>
<tr>
<th>signal processing concept</th>
<th>algebraic concept (coordinate free)</th>
<th>in coordinates</th>
</tr>
</thead>
<tbody>
<tr>
<td>filter</td>
<td>$h \in \mathcal{A}$ (algebra)</td>
<td>$\phi(h) \in \mathbb{C}^I \times \mathbb{C}^I$</td>
</tr>
<tr>
<td>signal</td>
<td>$s = \sum s_i b_i \in \mathcal{M}$ (A-module)</td>
<td>$s = (s_i)_{i \in I} \in \mathbb{C}^I$</td>
</tr>
<tr>
<td>filtering</td>
<td>$\cdot s$</td>
<td>$\phi(h) \cdot s$</td>
</tr>
<tr>
<td>impulse</td>
<td>base vector $b_i \in \mathcal{M}$</td>
<td>$b_i = (\ldots, 0, 1, 0, \ldots)^T \in \mathbb{C}^I$</td>
</tr>
<tr>
<td>impulse response of $h \in \mathcal{A}$</td>
<td>$h \cdot b_i \in \mathcal{M}$</td>
<td>$\phi(h) \cdot b_i = (\ldots, h_{i-1}, h_0, h_1, \ldots)^T \in \mathbb{C}^I$</td>
</tr>
<tr>
<td>Fourier transform</td>
<td>$\Delta : \mathcal{M} \to \bigoplus_{\omega \in \mathbb{R}} \mathcal{M}_\omega$</td>
<td>$\mathcal{F} : \mathbb{C}^I \to \bigoplus_{\omega \in \mathbb{R}} \mathbb{C}_\omega$</td>
</tr>
<tr>
<td>spectrum of signal</td>
<td>$\Delta(s) = (s_\omega)<em>{\omega \in \mathbb{R}} = \omega \mapsto s</em>\omega$</td>
<td>$\mathcal{F}(s) = (s_\omega)<em>{\omega \in \mathbb{R}} = \omega \mapsto s</em>\omega$</td>
</tr>
<tr>
<td>frequency response of $h \in \mathcal{A}$</td>
<td>n.a.</td>
<td>$(\phi_\omega(h))<em>{\omega \in \mathbb{R}} = \omega \mapsto \phi</em>\omega(h)$</td>
</tr>
</tbody>
</table>

Source: Small Guide to Making Nice Tables by Markus Püschel (ETH Zürich)
Recommended by David J. Crandall
Algorithms

• See the documentation of algorithm2e

• Provide the main steps of the algorithm

• Use consistent annotations

• Use references to sections and equations to connect the main texts with the algorithm

Algorithm 1: Proposed video completion algorithm.

\begin{algorithm}[H]
\SetAlgoLined
\KwResult{Completed video $I$}
\textbf{Input}: Video $I$, user-specified mask $\Omega$

1. Compute forward/backward flow fields $U, V$ in $\Omega$
2. Initialization: filling hole $\bar{\Omega}$ in $I, U, V$ at coarsest scale (Sec. 4.4)
3. for scale $s$ from 1 to $n_s$ do
4. \hspace{1em} for iteration $k$ from 1 to $K_s$ do
5. \hspace{2em} (a) NNF estimation: Minimize Eq. 2 w.r.t. $\{s_i, \theta_i\}$, with $I, U, V$ fixed.
6. \hspace{2em} (b) Color update: Minimize Eq. 5 w.r.t. $I$, with $U, V$, $\{s_i, \theta_i\}$ fixed.
7. \hspace{2em} (c) Flow update: Minimize Eqs. 3 and 4 w.r.t. $U, V$, with $I$, $\{s_i, \theta_i\}$ fixed.
8. \hspace{1em} end
9. \hspace{1em} Upsample $U, V$ using bicubic interpolation.
10. \hspace{1em} Upsample $\{s_i, \theta\}$ using nearest-neighbor interpolation.
\end{algorithm}

[Huang et al. 2016]
Equations

• Use \begin{equation}...\end{equation} environment.

• Use \begin{align}...\end{align} if you have multiple lines of equations

• Label every equation \label{eqn:Eqn-Name}

• For in-text math symbols, use $\$, e.g. Let $x$ be ...

• Define every notation

• For texts that are not part of the equation, use mathrm, e.g. $x_{\text{mathrm{color}}}$
Equations

• Number all equations
  • Easy to refer to them

• Equations are grammatical parts of the sentences
  • Never forget a period after an equation
  • Never create a dangling displayed equation

• Negative numbers
  • “-” indicate the dash. Use $-1$ to represent minus one

• Angle brackets
  • Use $\langle \text{ } \rangle$ and $\langle \text{ } \rangle$, instead of the comparison operators $<$ and $>$

• Big parentheses
  • Use $\langle \text{ } \rangle$ and $\langle \text{ } \rangle$ for automatic resizing round ( ), square [ ], and angled $\langle \text{ } \rangle\rangle$ brackets as well as vertical bars $\langle \text{ } \rangle$ and $\langle \text{ } \rangle$
Dashes

• hyphen (−, produced with one dash –)
  • interword dashes
  • E.g., non-negligible

• en-dash (－, produced with two dashes --)
  • indicate an opposition or relationship
    • e.g., mass--energy equivalence → “mass–energy equivalence”
  • Pages
    • e.g., as seen on pages 17--30 → “as seen in on pages 17–30”

• em-dash (―, produced with three dashes ---)
  • denote a break in a sentence or to set off parenthetical statements
  • e.g., A flock of sparrows – some of them juveniles – flew overhead

Source: https://www.cs.dartmouth.edu/~wjarosz/writing.html
References

• Paper title:
  • Use correct capital letter, e.g., ImageNet -> ImageNet
  • The first letter after ":" should be capital, e.g., DeepPose: Human pose estimation ...
    -> DeepPose: Human pose estimation ...

• Authors:
  • Make sure that you use "{}" for special letters, e.g., Durand, Fr\'e\'do.

• Journal papers
  • Fill in authors, title, journal, volume, number, pages, year.

Conference papers
  • Only fill in authors, title, booktitle, and year.
  • Do not fill in volume, number, page, and publisher.
References

• Journal/conference venue:
  • Use the pre-defined string
    @string { ICCV = "International Conference on Computer Vision" }
    booktitle = ICCV

• Be consistent
  • Do not use "IEEE Transactions on Pattern Analysis and Machine Intelligence",
    "Pattern Analysis and Machine Intelligence, IEEE Transactions on",
    "IEEE Trans. PAMI",
    "TPAMI" at the same time. Using the pre-defined strings can help avoid this issue.

• Label:
  • Recommended naming convention: Last name of the first author-Publication-Year, e.g., Huang-CVPR-2015.
References

• Avoid multiple entries of the same paper

• Find the correct venue where the paper was published
  • Do not use arXiv for every paper

• Manage the references
  • Group the papers into different categories
Citations

• Do not use citations as nouns
  • If you remove all parenthetical citations from the paper, you should still have complete, grammatically correct sentences
  • “As shown in [1]” -> “As shown by XXX et al. [1]”
  • No “[1] present XXX…”

• Spacing
  • Use a non-breaking space “~” between a citation and the preceding word in the sentence: “Path tracing~\cite{Kajiya:86} is...”.

• Multiple citations
  • Use \cite{key1, key2}
  • Do not use \cite{key1}\cite{key2}

Source: https://www.cs.dartmouth.edu/~wjarosz/writing.html
Fit your paper into the page limit

Step 1. Use consistent lengths for reducing margins
\newlength\secmargin
\newlength\paramargin
\newlength\figmargin
\setlength{\secmargin}{-1.0\textwidth}
\setlength{\paramargin}{-2.0\textwidth}
\setlength{\figmargin}{-3.0\textwidth}

Step 2. Apply the \vspace to the corresponding positions
\vspace{\secmargin} \vspace{\paramargin} \vspace{\figmargin}

Step 3. Adjust baseline
\renewcommand{\baselinestretch}{0.998}
Better tool than LaTeX?

- https://www.authorea.com/

Recommended by Tzu-Mao Li
Resources on Writing

- Awesome computer vision – writing by Jia-Bin Huang (Virginia Tech)
- A quick guide to LaTeX by Dave Richeson (Dickinson College)
- Common mistakes in technical writing by Wojciech Jarosz (Dartmouth College)
- SIGGRAPH paper template by Li-Yi Wei (University of Hong Kong)
- Notes on writing by Fredo Durand (MIT)
- How to write a good CVPR submission by Bill Freeman (MIT)
- How to write a great research paper by Simon Peyton Jones (MSR)
- How to write papers so people can read them by Derek Dreyer (MPI)
Thank You!