Research 101
Paper Writing with LaTeX

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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.
Writing Papers
=
Conveying Your Ideas
Writing Good Papers = Conveying Your Ideas Effectively
Learning to Review a paper
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.
Characteristics of a “Good” paper
This talk

• Several useful guidelines for typesetting your paper with LaTeX

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

• Crowdsourse more tricks and best practices
Why LaTeX?

• Great typesetting tool (Word is terrible at this)

• Style and content separation
  • Easier to resubmit your paper to somewhere else if your paper is rejected (?)

• No need to worry about the numbers of sections, figures, tables

• Reference management

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

• Math related
  • \texttt{\textbackslash DeclareMathOperator\{*\{argmin\}\{\arg\!\\min\}}
  • \texttt{\textbackslash DeclareMathOperator\{*\{argmax\}\{\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!
Define commonly used notations

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

Let \( \mathbf{p}_x^k \), \( \mathbf{p}_y^k \), \( \mathbf{p}_z^k \) be the ...

\begin{equation}
\mathbf{p}_z^k = \mathbf{p}_x^k + \mathbf{p}_y^k
\end{equation}

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

\( \def{px}{\mathbf{p}_x^k} \)
\( \def{py}{\mathbf{p}_y^k} \)
\( \def{pz}{\mathbf{p}_z^k} \)

... Let \( \px, \py, \pz \) be the ...

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

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

To-Do items
• \newcommand{\todo}{{\textbf{\color{red}[TO-DO]\_} }}

Added new texts
• \def\newtext#1{\textcolor{blue}{#1}}

Modified texts
• \def\modtext#1{\textcolor{red}{#1}}
Sections

\section{Introduction}

\section{Related Work}

\section{Overview}

\section{Method}

\section{Experimental Results}

\section{Conclusions}

- \textbf{DO} add labels to all sections

\section{Overview}
\label{sec:overview}

- \textbf{DO} use informative section names to replace “Method/Algorithm”

\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}

\begin{itemize}
\item \textbf{DO} add labels to all subsections
\section{Experimental Results}
\label{sec:experimental}

\item For sections, I cap the \textbf{first letter for every word}
\subsection{Implementation details}
\label{sec:implementation}

\item For subsections, I cap \textbf{ONLY the first letter of the first word}
\end{itemize}
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

• DO NOT use subsubsections
  • Too confusing

• DO use \paragraph

\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]

[Huang et al 2016]

[Darabi et al. 2012]

[Zhang et al 2016]
Figure – Motivation

• Examples that highlight the key idea of the paper

[Parikh and Grauman 2011]

[Huang et al. 2015]

[Torralba and Efros 2011]
Figure – Overview

• Summarize the overall process
• Provide forward references to Equations and sections

[Huang et al. 2016]

[Wadhwa et al. 2013]

[Xue et al. 2015]

[Girshick 2015]
Figures

• File format
  • DO NOT use JPEG images (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 \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.
Multiple Images

• Use subfigure or minipage. DO NOT use tabular.

• Never manually define the physical size of the image
  
  • \includegraphics[width=5cm]{IMAGE.png} \rightarrow \text{Bad}

  • \includegraphics[width=0.5\linewidth]{IMAGE.png} \rightarrow \text{Good}

  • \setlength{\figwidth}{0.5\linewidth}
    \begin{minipage}{\figwidth}
      \includegraphics[width=\linewidth]{IMAGE.png}
    \end{minipage}
    \rightarrow \text{Best}
Multiple Images

- Put captions directly under images, 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
• Use $\textsc{Name}$ to separate images, videos, dataset names from the main texts.

[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 $= \frac{H}{W} = c$
  • What’s $x$?

\[
\begin{align*}
  cx &= 2(1 - x) \\
  (2 + c)x &= 2 \\
  x &= \frac{2}{(2 + c)}
\end{align*}
\]


\begin{table}[t]
\caption{Table caption} % Table captions are ABOVE the table
\label{tab:table_name} % Always label the table

\begin{tabular}{clr}
  XX & XX & XX \\
  YY & YY & YY
\end{tabular}

\end{table}

\begin{tabular}{clr}
% c: center, l: left, r: right
XX & XX & XX \\
YY & YY & YY
\end{tabular}

\end{table}
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 Blur Model</td>
<td>Synthetic Uniform</td>
<td>Synthetic Uniform</td>
<td>Real Non-uniform</td>
<td>Real Unknown</td>
<td>Synthetic Both</td>
</tr>
<tr>
<td>Latent Images</td>
<td>4</td>
<td>80</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</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
• Separate methods that use different training sets or different level of supervision
• Always cite papers for each method

• If you have a big table, use

\resizebox{\textwidth}{!}{
\begin{tabular}
...
\end{tabular}
}
Algorithms

• 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.

<table>
<thead>
<tr>
<th>Input</th>
<th>Video $I$, user-specified mask $\Omega$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output</td>
<td>Completed video $I$</td>
</tr>
</tbody>
</table>

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

[Huang et al. 2016]
Equations

- Use \( \begin{equation} \ldots \end{equation} \) environment.

- Use \( \begin{align} \ldots \end{align} \) if you have multiple lines of equations.

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

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

- Define every notation

- For texts that are not part of the equation, use \texttt{\textbackslash mathrm}, e.g. \( x_{\texttt{\textbackslash mathrm{color}}} \)
Equations

• Number all equations
  • Easy to refer to

• Equations are grammatically 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 braskets
  • Use \langle and \rangle, instead of the comparison operators < and >

• Big parentheses
  • Use \left and \right for automatic resizing
    round (), square [], and angled \langle\rangle brackets as well as vertical
    bars \vert and \Vert

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

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

• Paper title:
  • Use correct capital letter, e.g., ImageNet -> Image{N}et
  • The first letter after ``:" should be capital, e.g., DeepPose: Human pose estimation ... -> Deep{P}ose: {H}uman 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 Transcations on Pattern Analysis and Machine Intelligence'',
    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

• 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}

Credit: https://www.cs.dartmouth.edu/~wjarosz/writing.html
Thank You!

• Please let me know if you would like to share your best practices

• Additional resources
  • Awesome Computer Vision – Writing
  • A quick guide to LaTeX