

# 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

=

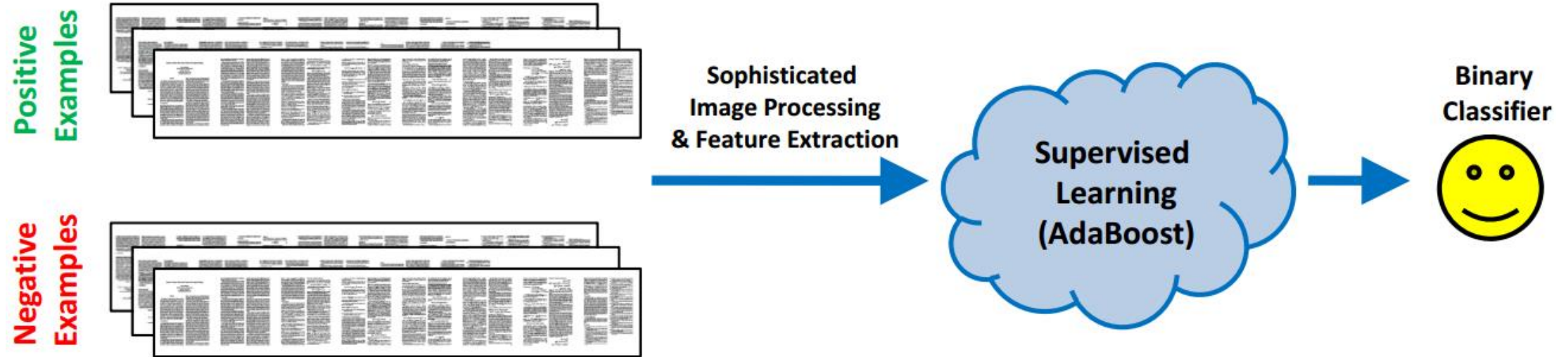
Conveying Your Ideas

Writing **Good** Papers

=

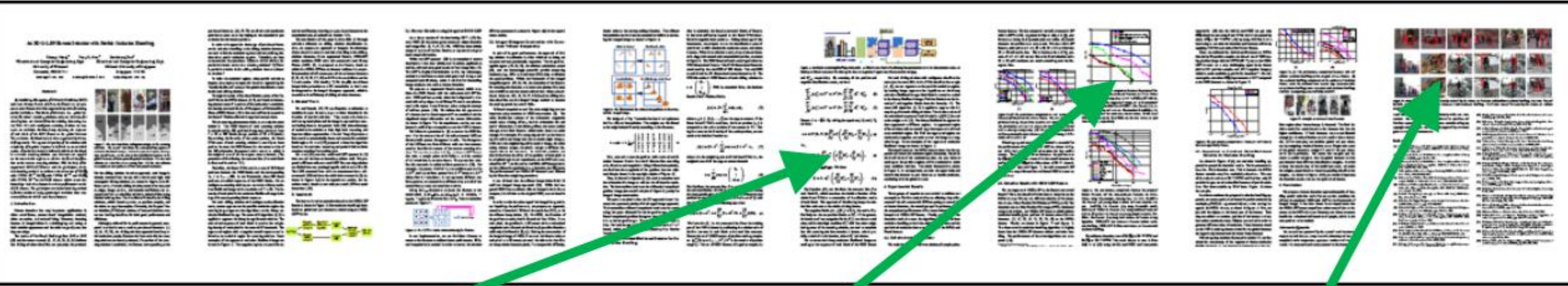
Conveying Your Ideas  
**Effectively**

# 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”.

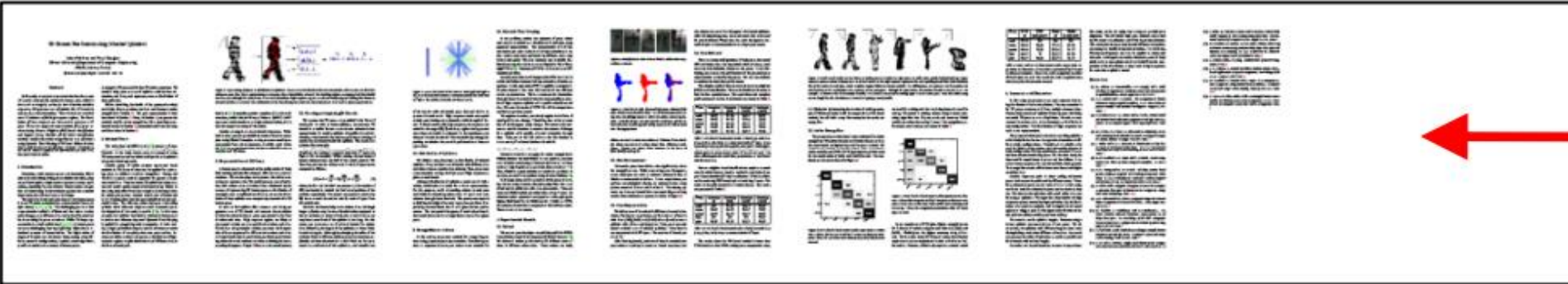
**Plots:** ROC, PR, and other performance plots convey a sense of thoroughness. Standard deviation bars are particularly pleasing to a scientific eye.

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

# Characteristics of a “Good” paper



Large confusing tables.



Missing pages.



Lack of colorful figures.



# This talk

- 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 (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

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

- Math related

- `\DeclareMathOperator*{\argmin}{\arg\!\min}`
- `\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!



# Macros – Short-hand notations

## Define commonly used notations

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

**DO NOT** type the same symbol more than twice  
-> Poor readability, error-prone, difficult to revise

```
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}
```



```
\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}
```

- **DO** add labels to all sections

```
\section{Overview}
```

```
\label{sec:overview}
```

- **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}
```

- **DO** add labels to all subsections

```
\subsection{Objective function}
```

```
\label{sec:objective}
```

- For sections, I cap the first letter for every word

```
\section{Experimental Results}
```

- For subsections, I cap 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

- **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}
```

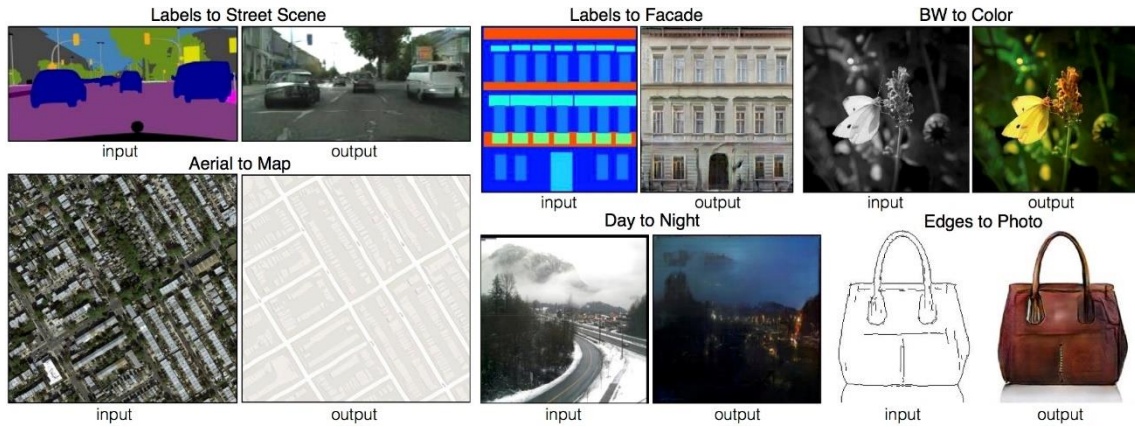
```
\paragraph{Results on dataset B}
```

# Organize your files

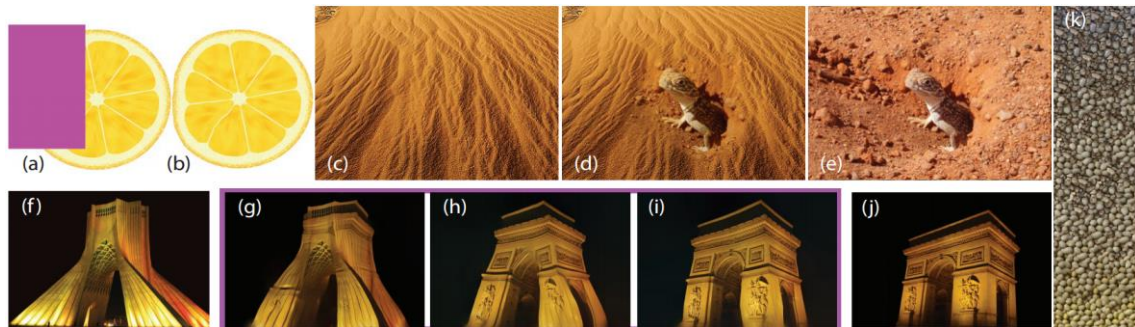
- Move figures to separate folders
- Use one tex file for each figure, table, and algorithm
  - Leave the `main.tex` with only main texts
  - Help focus on finetuning each figure
  - Avoid copying and pasting an entire block of tables/figures
- Use `\input{FILE_NAME}` to include the file to the main 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**)



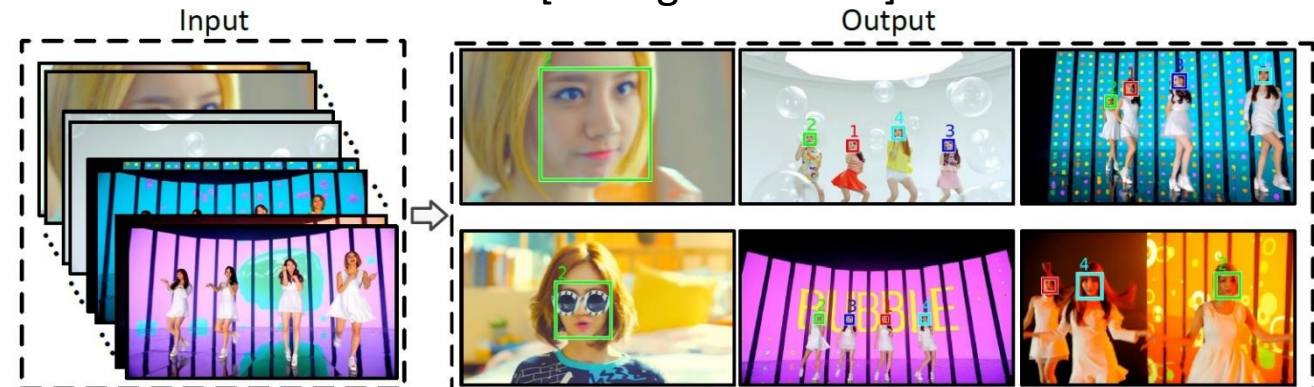
[Isola et al 2017]



[Darabi et al. 2012]



[Huang et al 2016]



[Zhang et al 2016]



# Figure – Motivation

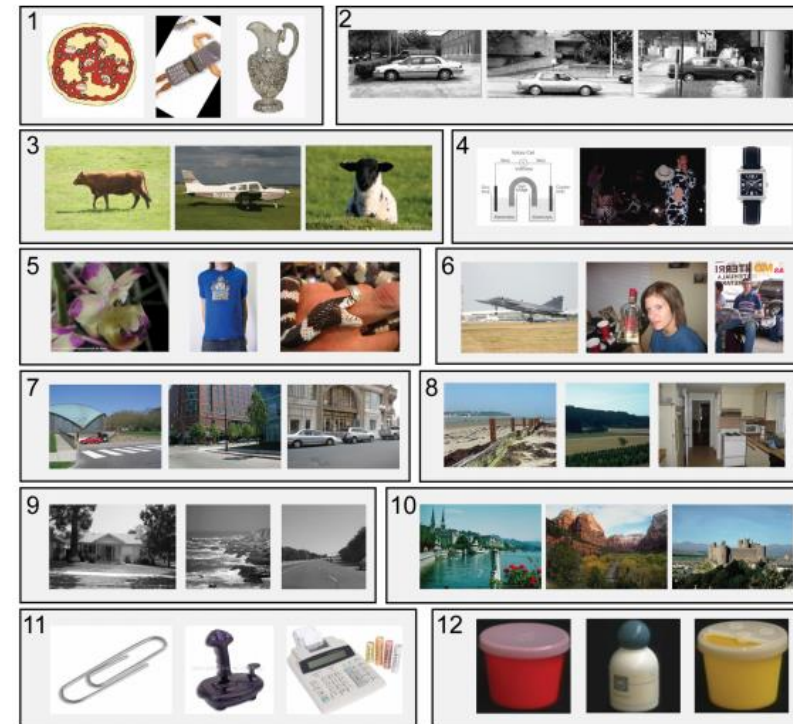
- Examples that highlight the **key idea** of the paper



[Huang et al. 2015]



[Parikh and Grauman 2011]



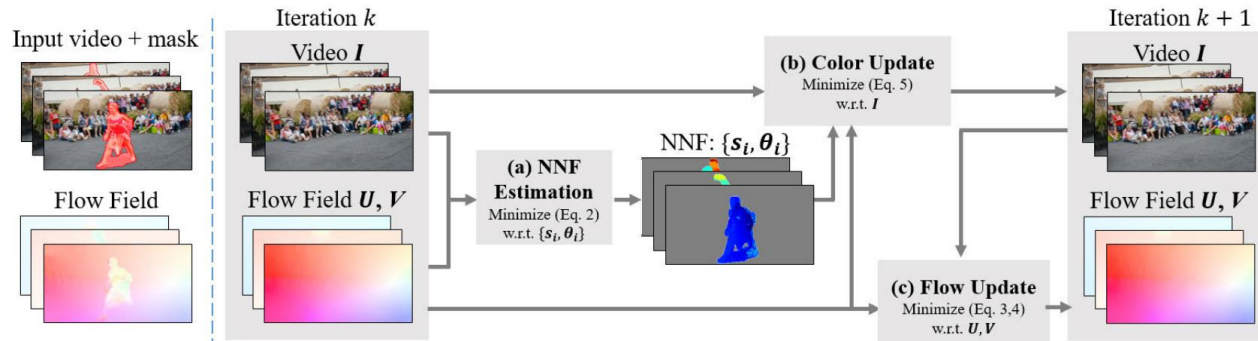
Caltech101  Tiny  LabelMe  15 Scenes   
MSRC  Corel  COIL-100  Caltech256   
UIUC  PASCAL 07  ImageNet  SUN09

[Torralba and Efros 2011]

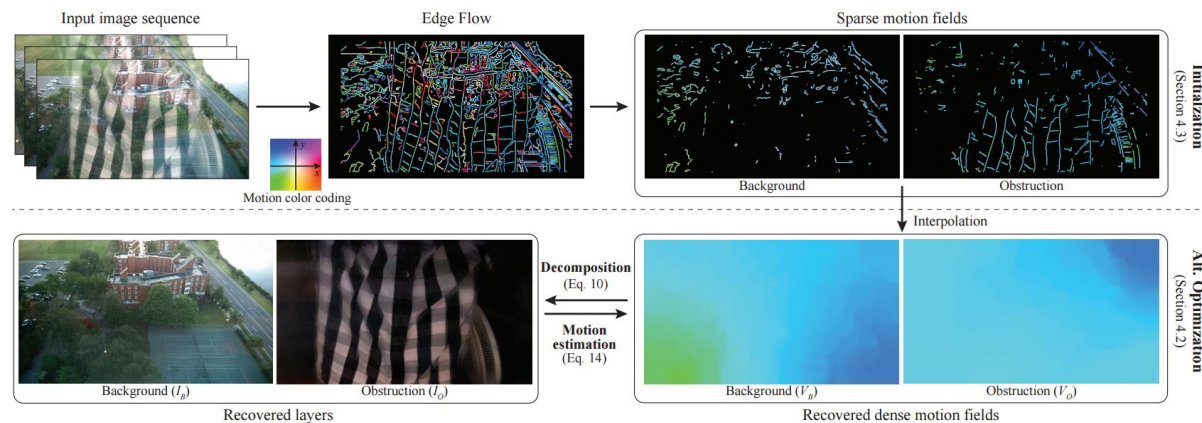


# Figure – Overview

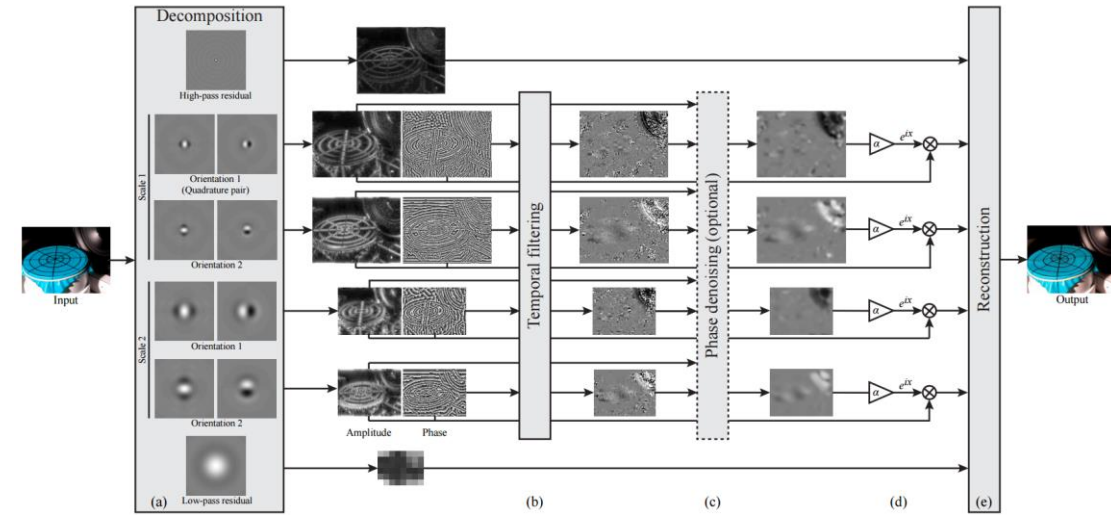
- Summarize the overall process
- Provide forward references to Equations and sections



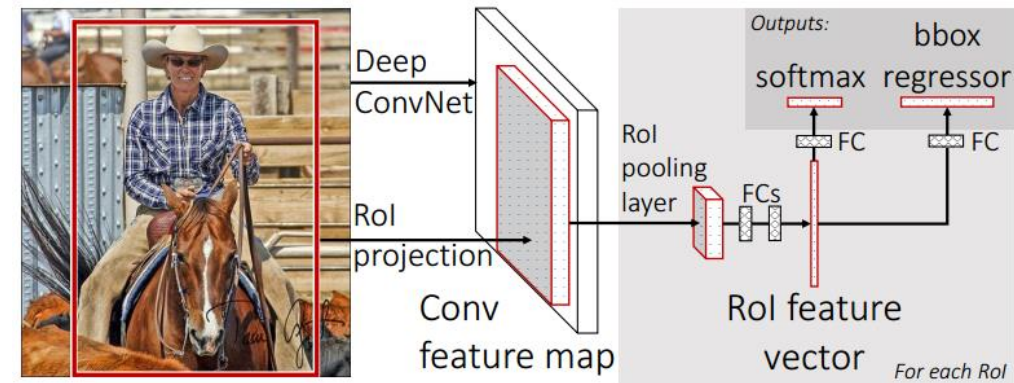
[Huang et al. 2016]



[Xue et al. 2015]



[Wadhwa et al. 2013]

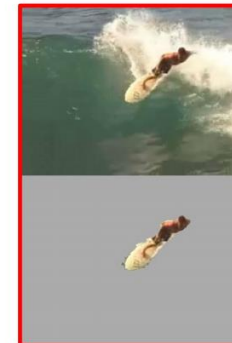


[Girshick 2015]

# 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 **bold font**  
`\textbf`

Non-rigid motions  
(both fg & bg)



Complex  
3D parallax



Severe  
motion blur

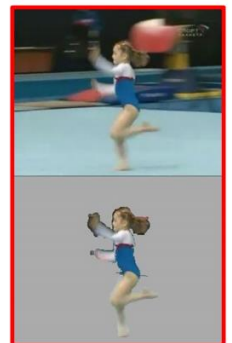


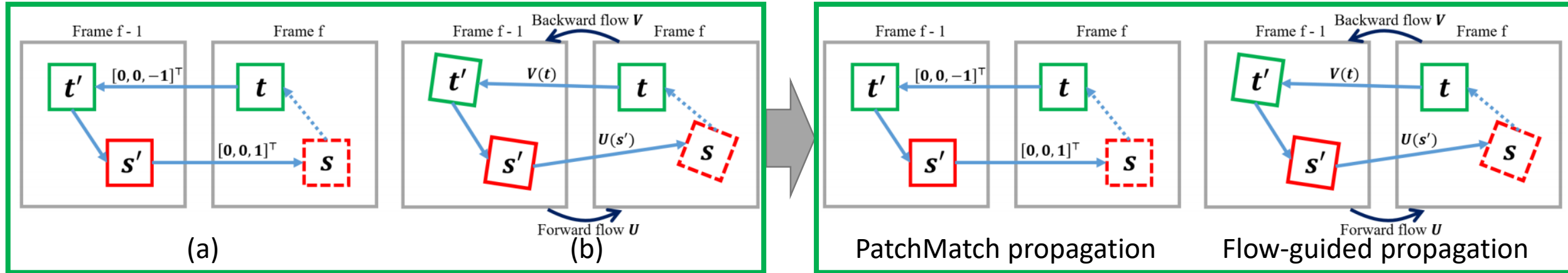
Figure 1: **A unified approach to fg/bg video segmentation in *unconstrained* videos.** Our algorithm can handle in a single framework video sequences which contain highly non-rigid foreground and background motions, complex 3D parallax and simple 2D motions, and severe motion blur.

# Multiple Images

- Use `subfigure` or `minipage`. DO NOT use `tabular`.
- Never manually define the physical size of the image
  - `\includegraphics[width=5cm]{IMAGE.png}` → **Bad**
  - `\includegraphics[width=0.5\linewidth]{IMAGE.png}` → **Good**
  - `\setlength{\figwidth}{0.5\linewidth}` → **Best**  
`\begin{minipage}{\figwidth}`  
`\includegraphics[width=\linewidth]{IMAGE.png}`  
`\end{minipage}`

# 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



# Image, video, dataset name

- 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

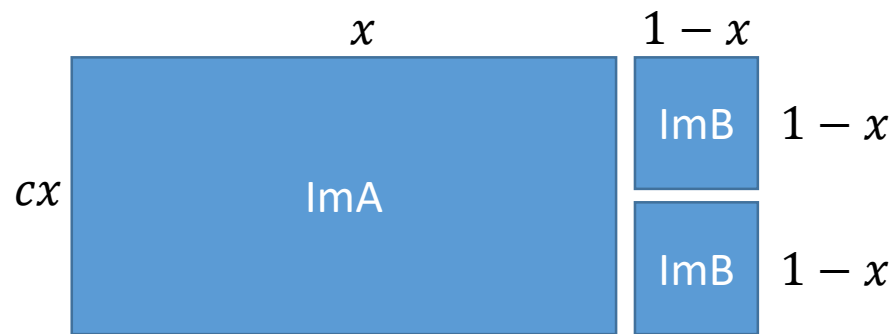


TODDLER

[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 =  $H/W = c$ 
  - What's  $x$  ?



$$cx = 2(1 - x)$$

$$(2 + c)x = 2$$

$$x = 2/(2 + c)$$

```
\setlength{\figa}{0.612\textwidth}  
\setlength{\figb}{0.388\textwidth}
```

```
\begin{minipage}{\figa}  
\includegraphics[width=\linewidth]{ImA.png}  
\end{minipage}  
\begin{minipage}{\figb}  
\includegraphics[width=\linewidth]{ImB.png}  
\includegraphics[width=\linewidth]{ImB.png}  
\end{minipage}
```



# Tables - Basics

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

| <b>Method</b>              | <b>No bottleneck required</b> | <b>Uses input dropout</b> | <b>No domain gap</b> | <b>No input handicap</b> |
|----------------------------|-------------------------------|---------------------------|----------------------|--------------------------|
| Autoencoder [15]           | ×                             | ×                         | ✓                    | ✓                        |
| Denoising autoencoder [36] | ✓                             | ✓                         | ×                    | ✓                        |
| Context Encoder [28]       | ✓                             | ✓                         | ×                    | ✓                        |
| Cross-Channel Encoder [42] | ✓                             | ✓                         | ✓                    | ×                        |
| Split-Brain Autoencoder    | ✓                             | ✓                         | ✓                    | ✓                        |

[Zhang et al 2017]

| Dataset                | Levin et al. [17] | Sun et al. [38] | Köhler et al. [13] | Ours (real) | Ours (synthetic) |
|------------------------|-------------------|-----------------|--------------------|-------------|------------------|
| Synthetic/Real         | Synthetic         | Synthetic       | Real               | Real        | Synthetic        |
| Blur Model             | Uniform           | Uniform         | Non-uniform        | Unknown     | Both             |
| Latent Images          | 4                 | 80              | 4                  | 100         | 25               |
| Kernels / Trajectories | 8                 | 8               | 12                 | 100         | 8                |
| Blurred Images         | 32                | 640             | 48                 | 100         | 200              |
| Depth variation        | No                | No              | No                 | Yes         | No               |
| Evaluation             | PSNR/SSIM         | PSNR/SSIM       | PSNR               | User study  | User study       |

[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}
}
```

| Algorithm     | Scale | SET5                                       | SET14                                      | BSDS100                                    | URBAN100                                   | MANGA109                                   |
|---------------|-------|--------------------------------------------|--------------------------------------------|--------------------------------------------|--------------------------------------------|--------------------------------------------|
|               |       | PSNR / SSIM / IFC                          | PSNR / SSIM / IFC                          | PSNR / SSIM / IFC                          | PSNR / SSIM / IFC                          | PSNR / SSIM / IFC                          |
| Bicubic       | 2     | 33.65 / 0.930 / 6.166                      | 30.34 / 0.870 / 6.126                      | 29.56 / 0.844 / 5.695                      | 26.88 / 0.841 / 6.319                      | 30.84 / 0.935 / 6.214                      |
| A+ [28]       | 2     | 36.54 / 0.954 / <u>8.715</u>               | 32.40 / 0.906 / <u>8.201</u>               | 31.22 / 0.887 / <u>7.464</u>               | 29.23 / 0.894 / 8.440                      | 35.33 / 0.967 / 8.906                      |
| SRCNN [7]     | 2     | 36.65 / 0.954 / 8.165                      | 32.29 / 0.903 / 7.829                      | 31.36 / 0.888 / 7.242                      | 29.52 / 0.895 / 8.092                      | 35.72 / 0.968 / 8.471                      |
| FSRCNN [8]    | 2     | 36.99 / 0.955 / 8.200                      | 32.73 / 0.909 / 7.843                      | 31.51 / 0.891 / 7.180                      | 29.87 / 0.901 / 8.131                      | 36.62 / 0.971 / 8.587                      |
| SelfExSR [15] | 2     | 36.49 / 0.954 / 8.391                      | 32.44 / 0.906 / 8.014                      | 31.18 / 0.886 / 7.239                      | 29.54 / 0.897 / 8.414                      | 35.78 / 0.968 / 8.721                      |
| RFL [24]      | 2     | 36.55 / 0.954 / 8.006                      | 32.36 / 0.905 / 7.684                      | 31.16 / 0.885 / 6.930                      | 29.13 / 0.891 / 7.840                      | 35.08 / 0.966 / 8.921                      |
| SCN [31]      | 2     | 36.52 / 0.953 / 7.358                      | 32.42 / 0.904 / 7.085                      | 31.24 / 0.884 / 6.500                      | 29.50 / 0.896 / 7.324                      | 35.47 / 0.966 / 7.601                      |
| VDSR [16]     | 2     | <u>37.53</u> / <u>0.958</u> / 8.190        | 32.97 / <b>0.913</b> / 7.878               | <b>31.90</b> / <b>0.896</b> / 7.169        | <b>30.77</b> / <b>0.914</b> / 8.270        | 37.16 / <b>0.974</b> / 9.120               |
| DRCN [17]     | 2     | <b>37.63</b> / <b>0.959</b> / 8.326        | <u>32.98</u> / <u>0.913</u> / 8.025        | <u>31.85</u> / <u>0.894</u> / 7.220        | <u>30.76</u> / <u>0.913</u> / <u>8.527</u> | <b>37.57</b> / 0.973 / <b>9.541</b>        |
| LapSRN (ours) | 2     | 37.43 / 0.958 / <b>8.999</b>               | <b>33.05</b> / 0.912 / <b>8.497</b>        | 31.77 / 0.894 / <b>7.716</b>               | 30.36 / 0.909 / <b>8.898</b>               | <u>37.23</u> / <u>0.973</u> / <u>9.482</u> |
| Bicubic       | 4     | 28.42 / 0.810 / 2.337                      | 26.10 / 0.704 / 2.246                      | 25.96 / 0.669 / 1.993                      | 23.15 / 0.659 / 2.386                      | 24.92 / 0.789 / 2.289                      |
| A+ [28]       | 4     | 30.30 / 0.859 / 3.260                      | 27.43 / 0.752 / 2.961                      | 26.82 / 0.710 / 2.564                      | 24.34 / 0.720 / 3.218                      | 27.02 / 0.850 / 3.177                      |
| SRCNN [7]     | 4     | 30.49 / 0.862 / 2.997                      | 27.61 / 0.754 / 2.767                      | 26.91 / 0.712 / 2.412                      | 24.53 / 0.724 / 2.992                      | 27.66 / 0.858 / 3.045                      |
| FSRCNN [8]    | 4     | 30.71 / 0.865 / 2.994                      | 27.70 / 0.756 / 2.723                      | 26.97 / 0.714 / 2.370                      | 24.61 / 0.727 / 2.916                      | 27.89 / 0.859 / 2.950                      |
| SelfExSR [15] | 4     | 30.33 / 0.861 / 3.249                      | 27.54 / 0.756 / 2.952                      | 26.84 / 0.712 / 2.512                      | 24.82 / 0.740 / 3.381                      | 27.82 / 0.865 / 3.358                      |
| RFL [24]      | 4     | 30.15 / 0.853 / 3.135                      | 27.33 / 0.748 / 2.853                      | 26.75 / 0.707 / 2.455                      | 24.20 / 0.711 / 3.000                      | 26.80 / 0.840 / 3.055                      |
| SCN [31]      | 4     | 30.39 / 0.862 / 2.911                      | 27.48 / 0.751 / 2.651                      | 26.87 / 0.710 / 2.309                      | 24.52 / 0.725 / 2.861                      | 27.39 / 0.856 / 2.889                      |
| VDSR [16]     | 4     | 31.35 / 0.882 / 3.496                      | 28.03 / <u>0.770</u> / <u>3.071</u>        | <u>27.29</u> / <u>0.726</u> / <u>2.627</u> | <u>25.18</u> / <u>0.753</u> / 3.405        | 28.82 / 0.886 / 3.664                      |
| DRCN [17]     | 4     | <b>31.53</b> / <u>0.884</u> / <u>3.502</u> | <u>28.04</u> / 0.770 / 3.066               | 27.24 / 0.724 / 2.587                      | 25.14 / 0.752 / <u>3.412</u>               | <u>28.97</u> / <u>0.886</u> / <u>3.674</u> |
| LapSRN (ours) | 4     | <u>31.52</u> / <b>0.884</b> / <b>3.559</b> | <b>28.18</b> / <b>0.771</b> / <b>3.147</b> | <b>27.31</b> / <b>0.727</b> / <b>2.677</b> | <b>25.21</b> / <b>0.755</b> / <b>3.530</b> | <b>29.08</b> / <b>0.889</b> / <b>3.729</b> |

# 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.

---

**Input** : Video  $I$ , user-specified mask  $\bar{\Omega}$

**Output:** Completed video  $I$

```
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   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.
11  end
12  Upsample  $U, V$  using bicubic interpolation.
13  Upsample  $\{s_i, \theta\}$  using nearest-neighbor interpolation.
14 end
```

# 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. `$x_ \mathrm{color}$`

# 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 brackets
  - 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`



# 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

# 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 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
- 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}`

# 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](#)