# Writing (Computer Vision & Machine Learning) Papers from the Reviewer's Perspective

#### DFKI Brown Bag Talk

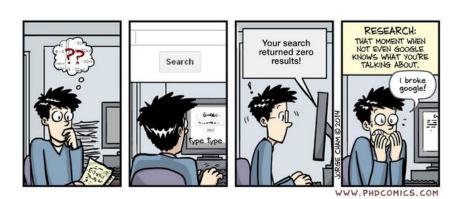
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#### What is this talk about?

- Overall we write lots of papers, but there is not much training for people to write good papers from the start. Many learn writing as a trade over time.
- Reviewing papers is also valuable for the community but reviewers get little formal training.
- In this talk I will give tips on how to write good papers, and how it connects to how papers are reviewed.
- Part of this talk was given at the LatinX in Al Workshop at the International Conference on Computer Vision.
- I would like to leave some knowledge or know-how before moving to the University of Groningen (As Asst. Prof in ML).
- We will also discuss a bit about doing a Doctoral research, and this
  is not criticism of any person in particular.

#### What is Research?



## My Experience Reviewing

LXAI @ ICCV.

- 2022 Reviewer for CVPR.
  2021 Reviewer for NeurIPS.
  2021 Paper writing tutorial at
  2020 Reviewer for ICML and ICLR
  2019 Reviewer and Visa Chair at LXAI @ NeurIPS
- 2021 PC co-chair at LXAI @ CVPR and General co-chair at LXAI @ ICCV.

  2018 Reviewer for AISTATS,
  Black in AI @ NeurIPS and
  Women in Machine
  Learning @ NeurIPS.
- 2020 Top 33% Reviewer Award at ICML 2020. 2017 Reviewer for ICRA and IROS.

Since 2017, reviewer for IEEE Access, IET Image/Signal Processing, IJCAI, and various workshops and journals.

In total I have reviewed over 130 papers. For comparison I have written over 40 publications in my career.

## Why do we review papers?

- Peer review is a system of quality control for scientific research. Not only papers are reviewed, but also conference/workshop proposals, research project proposals, Master/PhD Thesis, etc.
- "the goals of peer review are crystal clear: to ensure the accuracy and improve the quality of published literature through constructive criticism" [Nicholas and Gordon. 2011]
- Peers are generally defined as researchers publishing in the same or similar topics as the paper under review. This means that in order to be a reviewer, one needs to be familiar with the related literature (and publishing papers is a proxy for this).

#### **Peer Review**

- Peer Review is the process where your peers review the draft publication, making comments, suggesting corrections, evaluating its novelty and scientific relevance, and making a recommendation to the editor.
- Reviewers are generally experts in the field, such as Professors, established Researchers in Academia and Industry, and PhD students. Usually the minimum qualification is to have a completed PhD or be working towards one.
- Reviews are similar between journals and conferences, but conferences generally do not have (but can have) multiple review cycles.
- The review process is sometimes a bit random, with contradictory reviews. The PC co-chairs aimto reduce the randomness.

#### The Job of the Reviewer

- Advice the PC co-chairs on which papers to accept.
  - Using your experience and scientific skills.
  - It is important to have some background on the topics the paper under review is about.
- Make sure that authors understand your opinion and its fundamentals.
  - Always justify your recommendation and support it with evidence.
  - Help the authors to improve their paper with justified recommendations.
- Treat everyone fairly and uniformly.
  - Write reviews that you would like to receive.
  - Apply the reviewing standards and guidelines uniformly.
- Behave ethically and expect others to do the same.
  - Prevent conflicts of interest.

## What is in a good/accepted paper?

- Topic is of interest for the community (specific to a conference/journal).
  - Not just topic but also the core contribution of the paper.
  - Paper contribution should be crystal clear.
  - All papers should be well motivated.
- Meets community standards of correctness and significance.
  - Significance does not mean beat a particular state of the art.
  - Evaluation should be using multiple criteria, not just based on target metrics.
- Paper is scientifically sound.
  - Paper has no mistakes in evaluation.
  - Paper is understandable to the reader.
  - Logical arguments in the paper body are sound (proofs, motivations, etc).

## **Typical Reviewing Process**

- Read the paper completely, annotating issues in the paper's body.
   Printing the paper for manual anotation or using a tablet helps in this regard.
- Re-read the paper but now focus in key areas, like contributions, description of the technique, experimental setup and results, and conclusions.
- 3. Refer to the literature in case the paper requires it.
- Review the claims made by the authors and check if they are supported by their evidence (like results).
- 5. If the paper includes it, also review supplementary material, particularly at points where the paper refers to it.
- 6. Write your review.

## Typical Reviewing Process [Nicholas and Gordon. 2011]

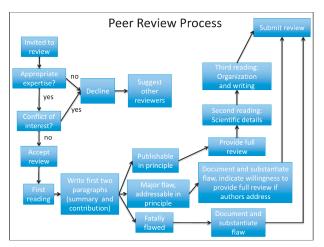


Fig. 1.A flowchart depicting the major steps and decisions facing a peer reviewer throughout the review process.

## **Reviewing - We Must be Better**



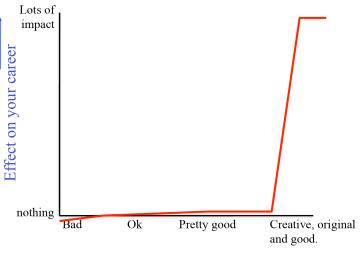
## Why do we write papers?

- To advance personal careers (Grad school, PhD, etc)?
- To make an impact in the field?
- To communicate ideas and advance the state of the art?

The main idea writing of scientific papers is to communicate ideas to an audience, or review other people's work.

This means that a paper is written not for the author to read, but for other scientists to understand.

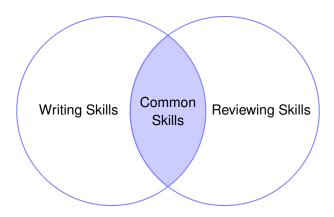
## **Impact of Papers**



Paper quality ———

From "How to write a good CVPR submission" by Bill Freeman, 2014.

## Writing and/or Reviewing Papers?



There is a large intersection between both skill sets.

Writing papers requires the reviewer's perspective and reviewing papers requires the author's perspective.

#### The Seven W's

#### What is the problem?

Define the problem and its context.

#### Why is it important?

Describe why the problem is important and to who it is important.

#### What have other people done about the problem?

Survey the literature for the problem, describing the state of the art in detail. People generally write a conceptual framework to categorize previous research.

#### The Seven W's

#### Why is it not sufficient?

Usually part of the introduction or related work, describes why the problem is still not solved, either from a theoretical or practical standpoint. There could be many deficits and people only describe the ones relevant to their paper.

#### What do you propose to do differently?

This is the main content of the paper, describing the proposed technique, theoretical framework, or research idea and concepts.

#### Why is it better?

Corresponds to the evaluation section of the paper (experimental or theoretical), and contains the main body of results that argue why the proposed technique is better.

#### The Seven W's

#### What is left to be done?

Corresponds to the analysis of results and conclusions/future work sections.

- All these steps/questions should be present in a paper in clear writing.
- It is a good reference for both writing and reviewing a paper.
- After reading the paper, the reviewer should be able to answer these
  questions to a degree, anything missing might point to an issue in
  the paper.

#### The Reviewer's Job

- Check that the paper is correctly evaluated, written, sound methodology, and it is understandable.
- Evaluate and check the claims made in the paper.
- Overall, provide constructive feedback that improves the paper.
- Sometimes, evaluate novelty of the proposed approach or gap in the state of the art.
- If there is a rebuttal process, ask questions, interact with the authors, and re-evaluate their review, if needed.

## Author(s) vs Reviewer(s)

Author	Reviewer
Drafts, designs, and writes the paper	Provides feedback about the paper.
Knows their own work quite well, worked on it for a long time	"One-shot" look and opinion about the work.
Knows the idea in their head, and tries to put it in words/figures/tables in their paper	Tries to understand the idea behind the paper, just by reading the paper.
Can anticipate the reviewer's requests/thinking	No way to deal with uncertainty in the paper.

Author and reviewer should not be enemies, but friends!

#### **Core Advice**

When writing a paper, experienced authors (that usually also act as reviewers), can predict issues the reviewers will point out. This is why writing a paper alone (specially as beginner) can be difficult.

Always have other (more experienced) researchers read your paper and make comments. This very important to get an outsiders perspective.

The very important point is that **other people should understand the paper**, not just the authors. This is the most common issue pointed by reviewers. Audience research/selection is very important.

## **Methodological Choices**

- **Baselines** Selecting appropriate baselines is difficult, and it is a common source of reviewer complaints.
  - **Datasets** Use the standard datasets for the task, if deviating, justify appropriately. This can be problematic in new tasks with no available datasets.
- **Ablations** Perform the correct variations of hyper-parameters or algorithmic choices to evaluate your technique/system and find how performance changes and justify your choices.

## **Making Comparisons**

A big source of conflict with reviewers is how comparisons are made, this can be because:

- **Baselines** Incorrect (not SOTA) or improperly tuned baselines can create reviewer uncertainty.
- Train/Test Splits Leakage between train/test sets must be prevented, if creating new datasets, then this part is very important.

  Leakage can happen due to individuals being in both sets, data augmentation, incorrect methodology, etc.
  - **Metrics** Each metric being evaluated must be carefully selected and justified, it should produce some knowledge by evaluating it. Using the incorrect metric for a task will be noticed by reviewers.

## **Aesthetics and Visual Appeal**

The visual look and aesthetics of the paper does matter. It will play a role on how the reviewer looks at the paper. Some tips:

- Place figures/tables at the top of the page/column.
- Ensure that figures/images are high resolution and are understandable.
- Format tables without vertical lines, with proper spacing, and explainable rows/columns
- Use colors to guide the reader, for example, by highlighting best performing combinations in **bold**.

## **Deep Paper Gestalt (Bad Papers)**

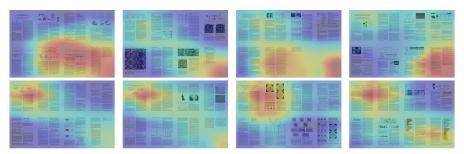


Figure 5. Class-specific discriminative regions for *bad* papers. (*Top*) Failing to fill the paper into a full eight-page paper is a discriminative visual cue for bad paper. (*Bottom*) The generated heatmaps focus on the top-right corner of the first page. This suggests that the *absence* of illustrative figures in the first two pages may cause the paper more difficult to understand.

Figure from "Deep Paper Gestalt" by Jia-Bin Huang, arXiv:1812.08775.

## **Deep Paper Gestalt (Good Papers)**

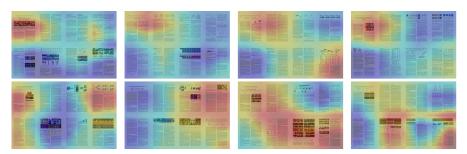


Figure 6. Class-specific discriminative regions for good papers. The heatmap generated by class activation mapping [24] highlights regions specific to good papers, e.g., teaser figures in the first page for illustrating the main ideas, tables/plots showing a sense of thoroughness in experimental validation, impressive math equations, and arrays of colorful images for qualitative results from benchmark datasets.

Figure from "Deep Paper Gestalt" by Jia-Bin Huang, arXiv:1812.08775.

## "Teaser" Figure One on Page One/Two

Many people put a specially crafted figure/diagram that teases or explains the proposed technique. It helps explain in simple words/diagrams what the paper is about and how it is different from the state of the art. I believe this is a good practice.

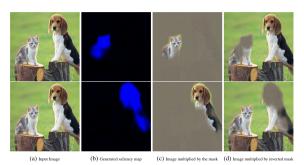


Figure 1: An example of explanations produced by our model. The top row shows the explanation for the "Egyptian cat" while the bottom row shows the explanation for the "Beagle". Note that produced explanations can precisely both highlight and remove the selected object from the image.

#### **Toy Examples**

Many papers include examples on small or toy datasets, in order to showcase the basics of the idea/concept. This connects back with the teaser figure, and it gives the reader a small idea of the basic concepts in the paper. Later examples can be more complex.

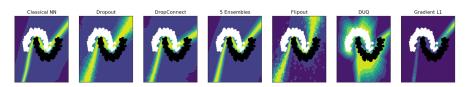


Figure made by myself to show different uncertainty methods on the two moons dataset. Differences are quite clear.

Make appropriate captions that guide the reader about what to "see" in this figure/table.



Please refer to the texts for detail.







Fig. 2. Example of multi-view wire sculpture art. The anamorphose sculpture created by the French sculptor Matthies Robert-Ort is a six example of multi-view wire art. When viewing from one specific angle, two we perceive a drawing of an elephant. When viewing from another wire point, the interpretation changes into two giraffer. The 2D projection in the intermediate view does not produce an interpretable image.

Always include citations in the text to guide the reader to which technique/dataset is being compared.



We compare our method against X-Net, Y-Net, Z-Net on the dataset W.



We compare our method against X-Net [1], Y-Net [2], Z-Net [3] on the dataset W [4].

#### Figures taken from

https://twitter.com/jbhuang0604/status/1279992087497314305.

Use a consistent notation and use it in your figures/tables.

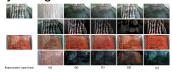






Make it easier for the reader to interpret your figures.









Use human-readable notations for equations.



$$L = \lambda_1 L_1 + \lambda_2 L_2 \\ \vdots$$

$$\lambda_1 = 0.1, \lambda_2 = 2.5$$



$$L_{total} = \lambda_{rec} L_{rec} + \lambda_{smooth} L_{smooth}$$

$$\lambda_{rec} = 0.1, \lambda_{smooth} = 2.5$$

Group captions in sub-figures and tables for easier interpretation.



























Augment math notation in text with human interpretations.



The  $F_{\theta}$  takes  $I_i$ ,  $I_j$  as inputs and produce  $W_{i \rightarrow j}$ .



The flow estimation network  $F_{\theta}$  takes a pair of frames  $I_i$ ,  $I_j$  as inputs and produces a dense flow field  $W_{i \rightarrow j}$ .

Use image/shape attributes to describe ideas/results.













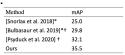






Provide details between differences in the SOTA and your proposed method.







Method	External data?	Finetuned?	mAP
[Snorlax et al. 2018]	<b>√</b>	-	25.0
[Bulbasaur et al. 2019]	✓	✓	29.8
[Psyduck et al. 2020]	-	✓	32.1
Ours	-	-	35.5

One message/ablation per table.



Method	Acc (%)
Variant A1	75
Variant A2	65
w/o B	77
w/o C	73
Full model	80



Method	Acc (%)	Method	Acc (%)	Method	Acc (%)
Full model	80	Full model	80	Full model	80
Variant A1	75	Without B	77	Without C	73
Variant A2	65				

Format and group table columns in a human understandable way, specially when using related metrics/datasets.



Method	Abs Rel	Sq Rel	RMSE	log RMSE	$\delta < 1.25$	$\delta < 1.25^2$	$\delta < 1.25^3$	Method	ATE (m)	RPE Trans (m)	RPE Rot (deg)
DeepV2D [56]	0.526	3.629	6.493	0.683	0.487	0.671	0.761	DeepV2D [56]	0.9526	0.3819	0.1869
Ours - Single-scale pose (aligned MiDaS)	0.380	2.617	5.773	0.533	0.562	0.736	0.832	Ours - Single-scale pose (aligned MiDaS)	0.1883	0.0806	0.0262
Ours - Single-scale pose + depth fine-tuning	0.472	3.444	6.340	0.635	0.534	0.694	0.790	Ours - Single-scale pose + depth fine-tuning	0.1686	0.0724	0.0139
Ours - Single-scale pose + depth filter	0.375	2.546	5.763	0.530	0.569	0.738	0.835	Ours - Single-scale pose + depth filter	0.1882	0.0806	0.0262
Ours - Flexible pose	0.379	2.702	5.795	0.533	0.565	0.744	0.836	Ours - Flexible pose	0.1843	0.0723	0.0095
Ours - Flexible pose + depth fine-tuning	0.439	3.100	6.213	0.614	0.524	0.698	0.796	Ours - Flexible pose + depth fine-tuning	0.1656	0.0651	0.0070
Ours - Flexible pose + depth filter	0.377	2.657	5.786	0.531	0.568	0.745	0.837	Ours - Flexible pose + depth filter	0.1843	0.0723	0.0095



	Depth - Error metric↓			Depth - Accuracy metric†			Pose - Error metric			
Method	Abs Rel	Sq Rel	RMSE	log RMSE	$\delta < 1.25$	$\delta < 1.25^2$	$\delta < 1.25^3$	ATE (m)↓	RPE Trans (m)↓	RPE Rot (deg)
DeepV2D [56]	0.526	3.629	6.493	0.683	0.487	0.671	0.761	0.9526	0.3819	0.1869
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Ours - Flexible pose + depth filter	0.377	2.657	5.786	0.531	0.568	0.745	0.837	0.1843	0.0723	0.0095

#### Ross Girshick's Advice

Ross Girshick gave very good advice at ICCV 2019, South Korea, mostly about Object Detection:

- A paper should be about a single focused idea/question.
- "Idea" usually means method, what should I learn?
  - Under what conditions does it work?
  - When does it **not** work?
  - If the idea has multiple components, which are the most important?
  - Which implementation details are important?
- I seldom care if "your idea + unrelated ideas/tricks"  $\rightarrow$  SOTA results.
  - My first priority is to learn some interesting things about your idea.

#### Reference:

https://twitter.com/prajjwal\_1/status/1188653550810697728

## Ross Girshick's Advice - Simplicity

- Start from a solid baseline.
- Apply your idea to it.
- Perform ablations under simple settings.

This should be the most basic evaluation method for any paper that proposes new methods/techniques.

#### Mask R-CNN's Ablations and Tables

net-depth-features	AP	$AP_{50}$	$AP_{75}$
ResNet-50-C4	30.3	51.2	31.5
ResNet-101-C4	32.7	54.2	34.3
ResNet-50-FPN	33.6	55.2	35.3
ResNet-101-FPN	35.4	57.3	37.5
ResNeXt-101-FPN	36.7	59.5	38.9

	AP	$AP_{50}$	$AP_{75}$
softmax	24.8	44.1	25.1
sigmoid	30.3	51.2	31.5
	+5.5	+7.1	+6.4

	align?	bilinear?	agg.	AP	$AP_{50}$	$AP_{75}$
RoIPool [9]			max	26.9	48.8	26.4
RolWarp [7]		<b>√</b>	max	27.2	49.2	27.1
Korwarp [7]		✓	ave	27.1	48.9	27.1
RoIAlign	<b>√</b>	<b>√</b>	max	30.2	51.0	31.8
KolAtign	✓	✓	ave	30.3	51.2	31.5

(a) Backbone Architecture: Better backbones bring expected gains: deeper networks do better, FPN outperforms C4 features, and ResNeXt improves on ResNet. (b) Multinomial vs. Independent Masks (ResNet-50-C4): Decoupling via perclass binary masks (sigmoid) gives large gains over multinomial masks (softmax). (c) **RoIAlign** (ResNet-50-C4): Mask results with various RoI layers. Our RoIAlign layer improves AP by  $\sim$ 3 points and AP<sub>75</sub> by  $\sim$ 5 points. Using proper alignment is the only factor that contributes to the large gap between RoI layers.

	AP	$AP_{50}$	$AP_{75}$	AP <sup>bb</sup>	$AP_{50}^{bb}$	$\mathrm{AP^{bb}_{75}}$
RoIPool	23.6	46.5	21.6	28.2	52.7	26.9
RoIAlign	30.9	51.8	32.1	34.0	55.3	36.4
	+7.3	+ 5.3	+10.5	+5.8	+2.6	+9.5

	mask branch	AP	$AP_{50}$	$AP_{75}$
MLP	fc: 1024→1024→80·28 <sup>2</sup>	31.5	53.7	32.8
MLP	fc: $1024 \rightarrow 1024 \rightarrow 1024 \rightarrow 80 \cdot 28^2$	31.5	54.0	32.6
FCN	conv: $256 \rightarrow 256 \rightarrow 256 \rightarrow 256 \rightarrow 256 \rightarrow 80$	33.6	55.2	35.3

(d) **RoIAlign** (ResNet-50-**C5**, *stride* 32): Mask-level and box-level AP using *large-stride* features. Misalignments are more severe than with stride-16 features (Table 2c), resulting in massive accuracy gaps.

(e) Mask Branch (ResNet-50-FPN): Fully convolutional networks (FCN) vs. multi-layer perceptrons (MLP, fully-connected) for mask prediction. FCNs improve results as they take advantage of explicitly encoding spatial layout.

Table 2. Ablations for Mask R-CNN. We train on trainval35k, test on minival, and report mask AP unless otherwise noted.

Start from a solid baseline. Apply your idea to it. Perform ablations (variations of hyper-parameter or technical choices) under simple settings.

These ablations justify the different choices made in this detector.

#### Ross Girshick's Advice - Claims

#### Support all your claims!

- All claims should be supported.
  - By citation, or.
  - By experiments (carefully designed).
- Otherwise, qualify the statement:
  - "Intuitively, increasing X is important for Y..."
  - "Increasing X may lead to improved Y..."

## **Reviewer Variability/Uncertainty**

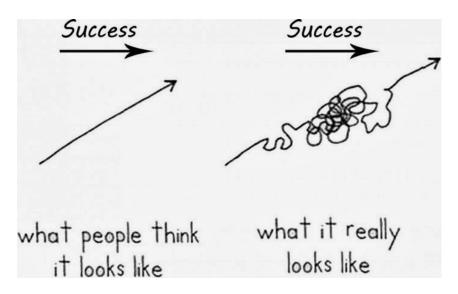
In most top conferences, there is significant variability in reviewer opinion, experience, and attention.

- This is due to expert reviewer shortage, good reviewers become area chairs, and finding good reviewers is difficult.
- Also due to the deluge of new papers being submitted to each conference, and increasing every year.
- Very annoying from the author's perspective, as the purpose of the review process is not only to make accept/reject decisions, but also help the author improve their research and paper.
- Only solution possible is for the community to invest more resources (time) into the review process, and to train reviewers.

#### Research Ideas in CV/ML/AI

- Work/research on interesting topics, find your own niche.
- Consider societal and research field impact when selecting problems.
  - If the problem is not important, when solved, only a few people will care.
  - If its a very important problem, even if progress is small, it will have a large importance and impact.
- Consider the impact of AI developments on minorities and disadvantaged groups.
- Think deeply on who gets power by an algorithm. Always think and prevent misuses.
- Just improving on the state of the art (a % on a benchmark) is not always the best. New problems, tasks, and datasets, are very important too!

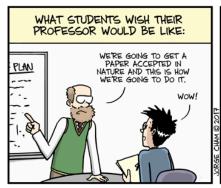
## Doing a PhD in AI/ML/CV



## What to look for in a Doctoral Supervisor?

- Experience supervising Doctoral students (pass success kind of predicts future success).
- Experience and expertise in the research topic of your thesis. Does not have to be a perfect match.
- Connection with communities/conferences/workshops in the topic of interest.
- For international students, it could be important to consider if the supervisor has had other successful international students. Same for Female candidates.
- Remember that you can (and should) have more than one Doctoral supervisor, which can bring conflict, but it is also a "backup" in case of issues with the 1st supervisor. Also very useful for multidisciplinary topics and to bring new expertise.

## **Supervisor Expectations vs Reality**





WWW. PHDCOMICS. COM

## Success in your Doctorate?

Sucess in a Doctoral program depends on the following factors (in order of importance):

- 1. Motivation for Science and Research.
- Motivation for the Research and/or Thesis topic. Very important to remember that the thesis topic is completely chosen by the Doctoral candidate.
- The supervisor, Supervision style (Absent, micromanager, Good mentor, etc), and their support during PhD research and thesis writing. Not all Supervision styles match every person needs.
- 4. Match between research interests of the candidate and the supervisor. Does not have to be a perfect match.
- Maturity and research experience of the candidate. If the candidate does not consider the suggestions and experience of the supervisor, failure is possible.

#### Be Successful in your Doctorate

- Doctoral research an be a lonely experience (due to being individual), you should always try to prevent loneliness (PhD Cafe).
- There is always a fear of being an "impostor", that our research is exposed as low quality or fraudulent. It is a constant fight against impostor syndrome.
- Many people do not like to share or discuss their research, for fear
  of criticism or finding big mistakes. But discussion is fundamental for
  scientific progress. If there are issues in your research, it is better to
  find them in early stages.
- Always try to attend conferences, workshops, scientific events, publish papers, get reviewer and community feedback.
- Always try to network with your community, connect with people working in similar topics. Research collaborations are very important. Science is an international effort.

#### **Take Home Messages**

- Writing papers is an art, and does require a bit of artistic skills to clearly present ideas.
- We write papers so other people can understand them, they have a clear audience, and to advance the state of the art.
- Writing, presenting ideas/data/figures, is not as easy as one might think. Clarity is paramount.
- It takes time/experience to polish the paper. It is not just about evaluation results, but how they are presented. This is very important.
- I usually look at highly cited papers to see how they present results, tables, formatting, figures, etc. This has been time well spent.

## Writing/Reviewing Resources

- CVPR 2021 reviewing guidelines. http://luthuli.cs.uiuc.edu/~daf/ CVPR21TrainingMaterials/RefSlides.pdf
- CVPR 2018 Workshop "Good Citizen of CVPR".
   https://www.cc.gatech.edu/~parikh/citizenofcvpr/
- CVPR 2020 Tutorial on How to Write a Good Review.
   https:
   //sites.google.com/view/making-reviews-great-again/
- How to write a good CVPR submission by Bill Freeman.
   https://billf.mit.edu/sites/default/files/documents/cvprPapers.pdf
- Nicholas, K. A. and Gordon, W. S. (2011), A Quick Guide to Writing a Solid Peer Review, Eos Trans. AGU, 92(28), 233.

Thank you!

Questions?