# What makes a good research paper?

## Mechanical aspects

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# Motivation

- Appearance, clarity and organizational structure of a paper is as important as its technical content

    ▸ Technical content must be there beforehand

- Presentation alone can make the difference between mediocre and great publication

    ▸ Not in terms of technical content but likely in impact of publication venue

- Mechanical in that it can always be applied and optimized independently of the technical part

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# Paper Structure
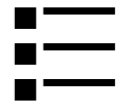
- A clear organization typically encloses the inner technical part

  ‣ Introduction and related work at the beginning

  ‣ Discussion and/or conclusion section at the end

- Inner part must include the precise problem statement, detailed description of technical solution, implementation details if applicable, and experimental results

  ‣ Scientific treatment and analysis of the problem statement and its technical realization

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# Typical organization
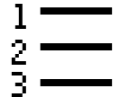
- Abstract

- Introduction

- Related work

- Solution

- Analysis

- Results

- Conclusion

# Abstract

- "Abstract" is important for strategizing or steering the review process

  ‣ Advertise the content, it should be giving an interesting overview that entices the reader to dive into your text

- Briefly state the problem and contributions of the paper

- "Keywords" may dictate the kind of reviewers the paper will be assigned to

  ‣ "GPU computation of Voronoi Diagram": Should it go to a "computational geometry" reviewer or a "Graphics architecture/industry" reviewer?

# Introduction

- The introduction sets the stage and it motivates why the work presented is of any interest

  ‣ It introduces the problem and emphasizes its importance

- It makes the reviewer interested and strategizes the presentation – list of arguments that leads to the conclusion that the problem under consideration is important to solve

  ‣ Shows a gap in the known literature or

  ‣ Motivates using a practical problem

# Introduction

- Clearly states the contributions of this work and their impact

    ‣ Make contributions a clear subsection within the introduction

- At the end, it may include a short summary of the structure of the rest of the paper

# Literature Survey

- Know your literature well in order to…

  ▸ …find the missing link, or the most important unsolved problem

  ▸ … understand your contribution to the field

  ▸ …place your contributions in the midst of other works, and to sell your work

- Select references carefully and organize into related groups

  ▸ From old (first seminal) paper to newest achievements

  ▸ Restrict to last few most important works

# Related Work

- Try to classify the related works in the literature, including the presented work

  ‣ Then establish the position of your work with respect to only those within your work's class

- State the core contribution of each of the important work within your work class

  ‣ If it is different from yours, clearly indicate the limitations that your solution improves upon

  ‣ If it is similar to yours state its advantage over other methods and thus indirectly justify your method

- At the end, it should be clear why a new solution is required to solve the same problem and how your method is substantially different

# Related Work

- Sometimes methods similar to yours may have been presented in other fields. Do you mention it?

  ‣ You can state in a way that will not lead to the impression that you have copied or just borrowed the method from other places

    – "In AREA_X, variants of the presented methods have been used to solve PROBLEM_Y"

  ‣ Or it should be so elaborate with references from other fields that it should be trivial to argue for the use of this method in your problem
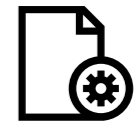
# Technical Sections

- The technical sections introduce and motivate the proposed solution in the light of the problem

  ‣ Precise problem statement, assumptions and requirements

- Detailed description of the proposed technical solution should allow the resourceful and interested reader to reproduce and verify your work

  ‣ Organize into coherent subsections

  ‣ Introduce formalisms, provide overview

- Implementation section specifically targeted to explain programming details

# Technical Sections
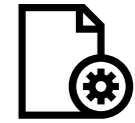
- To begin with…

  ‣ It may describe the problem and state the observations that the presented work would exploit

  ‣ It may give a sequence of arguments to finally lead to the presented solution

  ‣ It introduces the theory and concepts required to understand the technical part of the paper

  ‣ This introduction should be good enough for a technical researcher in a slightly different area to understand the contribution of the paper

# Technical Sections

- This is the most important section of the paper that would answer every little technical question that arises in the reviewer's mind

- Your algorithm might be a puzzle with many pieces which are described in a linear order – many such orders may be possible

  ▸ The best order is the one that would keep the reader interested, (pleasantly) surprise him (like a thriller), and encourage him/her to predict what comes next

  ▸ One measure of goodness may be the order that minimizes forward references to the text, but this is not enough

# Technical Sections
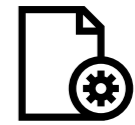
- One common feature of all good papers is that you get the overall idea of the algorithm fairly quickly

  ‣ One approach is to give the overview of the entire algorithm in the beginning and describe each step elaborately in each subsection

    – This will usually cover all parts of the method

    – WARNING: Since it reveals all the secret right in the beginning, it may become a boring reading – Watch out!

      ▪ Especially if it is a SIGGRAPH submission 🙂

    – Many good conferences like this kind of writing

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# Technical Sections
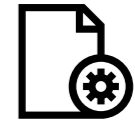
- Here is another approach for SIGGRAPH submissions

  ▸ Give the macro level algorithm with the most important steps, in a detailed manner such that it is implementable

  ▸ Just when the reader is happy that it is so simple, surprise him with a problem in this "macro" method, give a solution for it, and introduce this step into the algorithm

  ▸ Repeat the above step to introduce additional intermediate steps, and eventually get the complete algorithm

- This usually keeps the paper interesting

  ▸ Encourages readers to ask questions when he/she reads the paper and provides opportunities to the author to answer them immediately

# Results

- The evaluation discusses the proposed and competing solutions in the light of the requirements

  ‣ Typically involves some experimental evaluation which leads to some type of statistical test or, even better, a formal proof

  ‣ Meaningful and informative numerical results must be complete and unambiguous

- Essentially, the goal of this section is to convince the reader by some sort of proof why the proposed solution is good

- Explain in detail how the evaluation is designed, as well as the experimental setup and test cases

# Discussion/Conclusion

- Put the results in perspective, discussing it in relationship to other related work

  ‣ Indicate possible (side-)effects and eventual limitations due to the evaluation

  ‣ Take home message of the paper

- Provide outlook on future work

- If you do not have anything interesting to conclude call it a "Summary"

  ‣ Give a brief description (that is different from the Abstract) of the proposed solution

- In other words, "Conclusion" is not "Summary" and "Summary" is not "Abstract"

# Bibliography

- Use a citation management system

  ‣ e.g. BibDesk for BibTEX files and use with LaTEX

- Quick search for references  with Google(-scholar)

  ‣ More specific and accurate citations from ACM portal (portal.acm.org),
    IEEE Xplore (ieeexplore.ieee.org), EG Digital Library (www.eg.org/EG/
    DL/), graphbib (www.siggraph.org/publications/bibliography/)

- Clean, accurate and consistent reference section

  ‣ Complete names (first and last), venue, pages and year

  ‣ Consistent venues (name the conference, journal in the same way)

  ‣ Concise entries (avoid unnecessary or duplicate information such as
    conference location or duplicated association/organization etc.)

```
@ inproceedings{as78439729asf,
    Title = {Tile-based LOD for the Parallel Age},
    Author = {Niski, Krzysztof and Cohen, J.~D.},
    Booktitle = {Proceedings IEEE Visualization Conference (IEEE Vis'10)},
    Volume = {13},
    Pages = {1352},
    Organization = {IEEE},
    Series = {IEEE TVCG journal},
    Publisher = {Computer Society Press},
}
```

[NC] Krzysztof Niski and J. D. Cohen. Tile-based lod for the parallel age. In *Proceedings IEEE Visualization Conference (IEEE Vis'10)*, volume 13 of *IEEE TVCG journal*, page 1352. IEEE, Computer Society Press.

```
@article{NC:07,
    Title = {Tile-based {LOD} for the Parallel Age},
    Author = {Niski, Krzysztof and Cohen, Jonathan~D.},
    Journal = {IEEE Transactions on Visualization and Computer Graphics},
    Month = {November/December},
    Volume = {13},
    Number = {6},
    Pages = {1352--1359},
    Year = {2007}
}
```

[NC07] Krzysztof Niski and Jonathan D. Cohen. Tile-based level of detail for the parallel age. *IEEE Transactions on Visualization and Computer Graphics*, 13(6):1352–1359, November/December 2007.

# Writing Discipline ✎

- Writing is difficult work and usually takes more time than expected
  - ‣ Good to formalize and write down your progress
  - ‣ Write as early as possible and get feedback
- Usually, you cannot really be sure that you know something until you are able to explain it in writing
- Conveying ideas exactly but in a concise and compact manner is important
  - ‣ Key to leave enough room to describe the huge amount of work and results you have 😊

# Stylistic Issues

- "I" versus "we"
  - ‣ For a personal opinion you can use the first person
  - ‣ For everything else a neutral form should be used, passive voice or third person
  - ‣ But be careful to avoid the interpretation of "passive voice" as "someone else did it, and it is not our contribution"
    - – "This mindboggling observation was made." vs. "We made this mindboggling observation."
- Tell them what you are going to tell them – tell them – and tell them what you told them
  - ‣ It is important to get it exactly clear to the reader and to avoid the impression that something has been left out or that the contribution is not that significant
  - ‣ Do not over-claim, and more importantly do not under-claim

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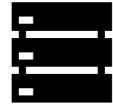
# Sections

- Every section must introduce what the reader should expect

- Then tell the details

- Summarize, and lead over to the next section
  - This approach is, by the way, a good approach to fill the space between the section heading and the first sub heading

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# Paragraphs

- Each paragraph should have a clear message
  - ▸ Consistent topic what the paragraph is about

- First paragraph of a section must clearly lead into the main topic of that section

- First line of paragraph should state or at least clearly lead to the message of that paragraph

- Every sentence has to be understandable exactly with what is known up to that time from the paper

# Writing Style

- Do not jump topics/issues

- Do not assume that user still remembers what was mentioned only as a passing comment three pages back

- Use "parallelism" whenever possible

  ‣ Introduce a set of topics to elaborate on subsequently in sections and paragraphs

  ‣ Keep order of topics

# Structuring

- If the topics of text parts change is too much, then divide them into subsections

- If paragraphs switch topics, try inline paragraph headings for easy navigation of paragraphs

  ‣ One way to integrate such paragraphs is to write an introductory paragraph in the beginning of the section and use parallelism

# Postprocessing

- Read through the text, spell check, and (if possible) grammar check the text

- Obvious errors are unacceptable

- Try to take the role of a reviewer…

  ‣ Reading your paper costs him time, so question everything

  ‣ The reviewer will not be forgiving

  ‣ Be the devil's advocate

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# Formatting

- Follow rules of conference or journal publisher

    ‣ Compact double-column (ACM, IEEE) styles

    ‣ Avoid extensive spacing

- Use font modifications carefully

    ‣ Bold, italic, sans-serif or different fonts

- Use proper math and symbol styles

    ‣ Use (our math.tex) style file for consistency

    ‣ Use same scalar, vector, matrix styles throughout text

# Figures
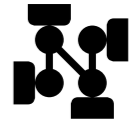
- Every figure must support a key idea or concept

- Meaningful self-explanatory captions

- Consistent style and appearance
  - ‣ Clean lines and diagrams
  - ‣ Careful color usage
    - Not too bright or disturbing colors
    - Watch out for grayscale
  - ‣ Sans-serif fonts unless for math symbols and variables
  - ‣ Consistent upper-lower case usage

- Use only high-quality vector figures (PDFs)
  - ‣ White or transparent background

# Screenshots 📷

- Must demonstrate a clear visual effect, major point of your work or problem of a standard (prior) approach

  ‣ Some images may be visual teasers…

- All details such as statistics and experimental settings must be given

  ‣ In caption or accompanying text

- Use only high-quality resolution images (**not** PDFs)

  ‣ Consistent background (white)

# Graphs

- Must clearly demonstrate numerical test results

  ‣ Strictly avoid clutter within one graph

- Relate parameters and results of experiments

  ‣ Just listing basic values can be done in tables

  ‣ Expressive and clearly labelled axis

    – Understandable without reading text

- Use only high-quality vector graphs (PDFs)

  ‣ White or transparent background with clearly readable text

# Floats

- Figures, screenshots and graphs along with their self-explanatory captions should express the overall idea of the paper

- Place after first paragraph referencing it, never after a heading

- Put large double-column floats at the top of following page

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