How to Write a Good Paper?

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Outline

- Introduction: The form and the contents
- Contents of a paper
    - The core content: What is research?
    - Structuring the core content for accessibility
- Detailed structure of a paper
- Elements of writing
- Conclusions

Focus of This Talk

- Significant distinction between
  - How to write a good paper?
  - How does a good paper look like?

- Process of writing Vs. Product of writing

Focus of This Talk

- Significant distinction between
  - ▶ How to write a good paper?
  - ▶ How does a good paper look like?
- Process of writing Vs. Product of writing
- We focus on the product rather than focus
- Assumptions:
  - ▶ Process is goal oriented. Once goals are clear, process is clear
  - ▶ Repeat: Write, read, review, refine, revise . . .

Core Contents of a Research Paper

What is a Research Paper?

Does a research paper describe

- A software?
- Design of a software?
- A piece of hardware?
- A theorem?
- A proof?
- Empirical measurements?
- . . .

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- . . .

A research paper describes an idea!

What is a Research Paper?

- Cannot be a complete description of work
  (process/product/modelling/reasoning/postulate/evidence)
  Must omit many details

- Should describe a logically complete idea
  Or a collection of logically complete related ideas

- Must embody a running theme that forms the essence of an idea

- This theme must be explicated in the paper

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  Right choice of form and content is important

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$\Delta < 0$	Why do you want to write a paper?

Ingredients of Good Research

- Innovation

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- Aesthetics

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- Other important aspects :

  ▶ Completeness

  ▶ Rigour

  ▶ Empirical demonstration

  ▶ Effective communication

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- Have you illustrated key ideas?

  ▶ New examples

  ▶ New pictures

  ▶ New applications

  ▶ Better explanations

Aesthetics

- Total is greater than the sum of the parts

  "Scientists study science not because it is useful, but because it is beautiful. Here I do not talk about the beauty of appearance or beauty of qualities ... Here I talk about that **profound beauty which comes from a harmonious order of parts** ..."

  – Henry Poincare.

- Example : Painting.

  Proportion of colours Vs. their arrangements

Part 2

Structuring the Core Contents for Accessibility

Intuition and Rigour in a Paper

- Ideas should be presented at two levels:
    - ▶ Intuition
        - – Distilling the idea to its essence
        - – Emphasizing the most important aspects (ignoring some details)
        - – Using representative examples (even if all aspects are not illustrated)

    - ▶ Rigour
        - – Plugging all the holes through formalism or reasoning
        - – Presenting convincing empirical evidence

- Description of ideas at these two levels should be interleaved

Presenting Evolution of Ideas

- Evolution in discovery is different from evolution in presentation
- Evolution in presentation
  - ▶ Perspective
  - ▶ Problem Definition
  - ▶ Key Ideas
  - ▶ Key contributions
  - ▶ Development of the key ideas
  - ▶ Conclusions

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  - ▶ Conclusions
    Honest analysis of work done, The Moral of the story

Part 3

The Structure of a Paper

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- Title
- Abstract
- Introduction, Motivation
- Background, Related work
- Main Contents
- Results, Conclusions
- Future Work
- References

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  - ▶ Wireless networks
  - ▶ Partial redundancy elimination in presence of critical edges for practical imperative programs with recursion and large number of functions and calls through function pointers

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- Possible good titles
    - A software based control system for . . .
    - On XYZ theorem
    - Reducing congestion in wireless networks
    - Partial redundancy elimination in extreme situations

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- Common mistakes
  - ▶ Too verbose
  - ▶ Too long
  - ▶ Too short
  - ▶ Omitting essential details

How About this Abstract?

"We worked in Computer Science. We proved some theorems. Some were big, some were small. Big theorems had big proof, small theorems had small proofs. We tried to connect the proofs to the theorems. Sometimes we succeeded, sometimes we didn't. By then, the time for submission had arrived, so we submitted the paper ..."

M. Leunen and R. Lipton. "*How to Have Your Abstract Rejected*".

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- Outline of the paper

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Why is a good introduction important?

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  Writing style, overall quality, analytical skills, confidence in ideas
- Last chance of making the reader want to read your paper in details

How to Describe Background and Related Work?

- Not just what? but also why?, why not?, how?, how else? etc.
  - ▶ Not just a list of summaries
  - ▶ Analysis, comparison, strengths, limitations
- Organized by ideas rather than by references

Main Contents

Important questions are answered

- Questions: Problem, Theorem, . . .
- Answers: Algorithm/Protocol/Formulation, Proof, Counter example
  . . .
- Type of contribution:
  Beauty, utility, or both
- Use formalism but don't hide ideas behind notation
  Introduce notation, terminologies only where required

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  - ▶ What the readers should remember after they have forgotten the details

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  - ▶ What the readers should remember after they have forgotten the details
- Brings back the general level
  - ▶ Abstract → Introduction → Details: Journey from general to specific
  - ▶ Details → Conclusions: Return journey from specific to general

How to Write References?

- Reference or Bibliography?
  - ▶ References: List of sources that you actually cite in your paper
  - ▶ Bibliography: List of all related publications
- Each item in the list must have at least the following fields:
  Title, Author(s), Journal/Proceedings, Publisher, Year
- URLs don't have a publication date, hence say when accessed it last
- Follow the style specified by the publisher

Part 4

Elements of Writing

Elements of Writing

- Be careful about the language: Grammar, sentence formations, spellings, punctuation etc.
- Each paragraph should represent a specific idea
- Smooth transition from
  - One paragraph to the next
  - One sentence to the next

Plenty of help available on Internet ☺

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- Avoid unnecessary words in a sentence

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- Convert nouns to verbs
  - ▶ "His verticality changed to horizontality"
    "He fell down"
  - ▶ "This paragraph provides a conclusion of the description"
    "This paragraph concludes the description"

Part 5

Conclusions

Conclusions

Writing good papers is important for your research

- For your own understanding
- For communicating your ideas to others
- For getting feedback from others

Conclusions

On good writing

- Writing helps you understand your ideas better
- Write, read, revise. Repeat as long as you can
- Writing is a creative process and a big source of satisfaction
- Writing is an art
  - ▶ Rules are not absolute
  - ▶ Break rules if you must, but understand why it is necessary
- How to be a good writer? Read a lot
  - ▶ Best resource: "Elements of Style" by Strunk and White

  - ▶ Plenty of help available on Internet ☺

Acknowledgements

- Anonymous referees of our own papers
- Discussions with colleague
- Numerous tips available on Internet
- Talk by Abhiram Ranade

Last But Not the Least

Thank You!

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