Introduction
The Writing Process
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Writing a Research Paper

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Research Seminar

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Outline

1. Introduction

2. The Writing Process

3. The Audience

4. Concept Development

5. First Draft

6. Details and the Final Product

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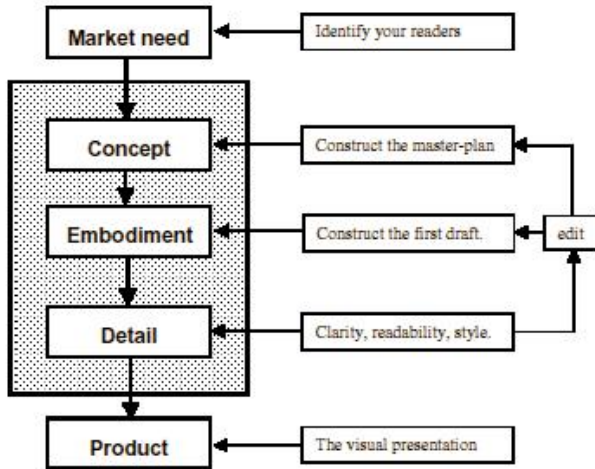Details and the Final Product

A Good Research Paper:

- clearly states the problem addressed by the paper;
- exposes, with enough details, the proposed solution;
- presents the evaluation methodology, if it applies, and the obtained results;
- and discusses the relevant state of the art and the contribution, novelty and/or advantages of the proposed solution.

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Goal of an Engineering Research Paper

The main goal of a engineering research paper is to present a novel technical/scientific result:

- an algorithm;
- a system: a hardware design, a software system, a protocol, etc;
- a performance evaluation: analysis, simulation and/or measurement;
- a theory: definitions, theorems, etc.

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Research Paper Development Process

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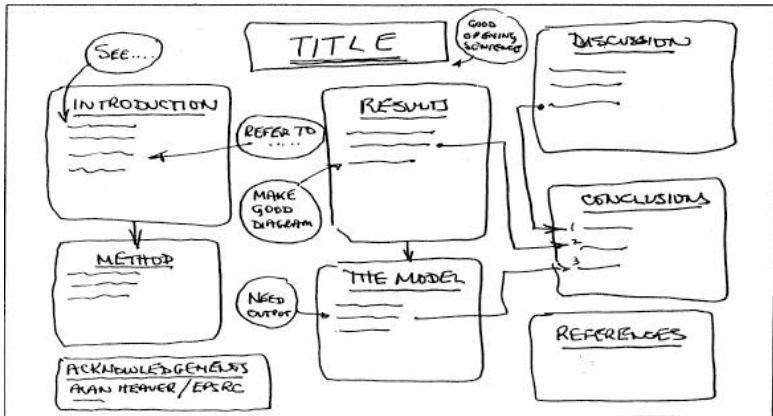Details and the Final Product

Determining the Audience

- Who are going to be the readers of the paper (report, proposal, thesis, etc.)?
- Which information would they like to find in it?
- Type of papers:
    - Magazine paper
    - State of the art paper
    - Conference paper
    - Journal paper

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Concept Development

- General outline of the paper
- Usually, unstructured or loosely structured
- Alternatives:
    - Topic list
    - Synoptic table
    - Semantic network or conceptual map
    - Sketch

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Concept Development Example

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First Draft Organization

- Title
- Attribution
- Abstract
- Introduction
- Proposed solution
- Experimental evaluation
- Discussion
- Conclusions
- References
- Appendices

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Title

- Concrete and precise title
- Avoid abbreviations and acronyms
- Use adjectives that clearly describe the characteristics of your work

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Abstract

- Goal: to tell to a potential reader, in the shortest possible space, what he/she will find in the paper.

- It must include:
    - Clear presentation of the paper objective
    - Brief description of the approach
    - Main results and their interpretation

- It must not include:
    - Bibliographic references
    - Motivation or justification
    - Irrelevant details

- Usually, it is the final part to be written

- Between 100 and 150 words

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Introduction

- What the problem is and why it is interesting
- Review of the state of the art (it may have its own section)
- What the main contribution of the paper is
- A brief description of the remaining sections

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Proposed Solution

- Depends on the type of paper:
  - presentation of an algorithm
  - presentation of an architecture (hardware, software),
  - presentation of a methodology, etc.
- Clearly state what is novel on the proposed solution and/or why it is better
- Give enough details, so that it is possible to reproduce the algorithm, method, system, etc.
- Do not mix the experimental evaluation with the presentation of the proposed solution (next section)

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Experimental Evaluation and/or results

- Clearly describe the experimental design (if it applies)
- Present the results of the experiments, implementation of the architecture or application of the methodology
- Use tables and figures, explaining them clearly in the main text

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Discussion

- Extract principles, relationships and generalizations
- Present analysis, models or theories
- Show the relationships between the results and analysis, models or theories
- Evaluate the results:
  - does the proposed technique satisfactorily solves the problem?

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Conclusions

- Summarize the main results and their consequences
- Describe the limitations and restrictions (it they apply)
- Discuss open problems and possible ways to extend the work

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References

- Cite significant previous works
- Cite the sources of theories, data, techniques and any other thing that has been taken from somewhere else
- References must be complete and follow a specific standard (ACM, IEEE, LNCS, etc.)

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Appendices

- Essential material that may interrupt the normal flow of the main text
- Examples:
  - Long mathematical derivations
  - Long data tables
  - Detailed description of procedures
  - Long algorithms

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Taking Care of Details

- After finishing the first draft, allow it to 'rest' for at least one day
- After that you can reread it taking care of:
  - Grammar
  - Spelling
  - Right use of punctuation marks
  - Writing style

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Some Tips

- Use the dictionary, the spell checker and the grammar checker
- Read the paper at least 2 or 3 times (it may be useful to make it aloud):
    - Does it say what you wanted to say?
    - Do you need to change the order of ideas, experiments, results, interpretations in order to improve the flow of the text?
    - Can you make some phrases shorter to make them clearer?
- Give the paper to somebody else to read and comment it

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Style

- Be clear and concrete
- Be simple and direct
- Use the right words
- You may use first person but limit its use
- Do not use colloquial language
- Define every symbol and acronym

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The Final Product

- The visual appearance is important:
    - Good organization
    - Clear headings
    - Well designed figures
    - Clear tables

- Verify that the paper adapts to the required format: fonts, section numbering, number of columns, reference style, placing of figures and tables, etc.

- Consider using a text editor that makes it easier to follow the format

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References

- Mike Ashby, How to Write a Paper,
  http://www-mech.eng.cam.ac.uk/mmd/ashby-paper.pdf
- Marc E. Tischler, Scientific Writing Booklet, University of Arizona,
  http://www.biochem.arizona.edu/marc/Sci-Writing.pdf
- W.C. Booth, G.G. Colomb, and J.M. Williams. The Craft of Research. University of Chicago Press, Chicago, 1995.
- V. Booth, Communicating in Science: Writing and Speaking, 2ed, Cambridge Univ. Press, 1993.