

Writing for Computer Science & Engineering

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Writing a Paper



Introduction

❖ Principle for writing

- Begin early
- If it is possible to start writing, then writing should start
- Shaping the research and write-up is an effective way of giving structure to a project

❖ Three main phases

- Organizing material so that the work tells a story
- Giving this story the structure of a thesis or academic paper
- Writing

❖ It is much more than a record of the work

- A few pages to represent months or more of activities by several people
- A paper may be only a small window into the work that was done



The Scope of a Paper

❖ The first task

- Describe your aim – write down everything that motivated you to start your research; What did you want to achieve? What problem did you expect to address? What makes the problem interesting
- Define the scope of the work – make choice about what to include, identify what might be included, your research has become focused on investigation of small number of specific question
- Preliminary experimental or theoretical results that suggest what the core contribution of the work is going to be



Asking Question

- ❖ Which results are the most surprising
- ❖ What is the one result that other researchers might adopt in their work
- ❖ Are the other outcomes independent enough to be published separately later on? Are they interesting enough to justify their being included?
- ❖ Does it make sense to explain the new algorithms first, followed by description of the previous algorithms in terms of how they differ from the new work? Or is the contribution of the new work more obvious if the old approaches are described first, to set the context
- ❖ What assumptions or definitions need to be formalized before the main theorem can be presented
- ❖ What is the key background work that has to be discussed?
- ❖ Who is the readership? For example, are you writing for specialists in your area, your examiner, or general computer science audiences?



Valuable Exercise

❖ **Speculate on the format and scope of the results**

❖ **Example : network congestion**

- ❖ How is the network congestion to be measured?
- ❖ As a function of data volume, number of machines, network bandwidth, or something else?
- ❖ Answering this question suggests a form of presentation into which the experimental results can be inserted: a graph
- ❖ The form of this graph can be sketched even before any coding has begun, and doing so identified the kind of output that the code is required to produce



The Scope of a Paper

❖ The reporting way is determined by the characteristics of the audience

- Machine learning for computer vision
- Material is explained to the two readership must be based on your judgement of what is common knowledge and what is unfamiliar
- The nature of the audience may even determine what can be reported.

❖ Choice about content of a paper

- Material to be excluded
- String sorting might well have implications for integer sorting
- Stop undertaking new work and write up what has been achieved so far
- If newer work can be published independently, then write it up separately



The Scope of a Paper

❖ Where The work Might Be Published

- Relevant to your topic
- How your work measures against the standard for that forum (is there a page limit, are the other papers in that venue primarily theoretical or experimental? What prior knowledge or background is a reader likely to have?)

❖ Once the material for a paper has been collected, it has to be organized into a coherent self-contained narrative, which ultimately will form the body of the write up

❖ Turning this narrative into a write-up involves putting it in the form of an academic paper: including an introduction, a bibliography and so on



Telling a Story

❖ Good writing

- Identify what the reader needs to learn
- A thesis or paper has a story-like flow with a sequence of concepts building from a foundation of knowledge assumed to be common to all readers up to new ideas and results
- The body of a good paper should have a logical flow that has the feel of a narrative

❖ Story told by a paper

- Walk through the ideas and outcomes that explains the material in a structured way
- First parts of the paper teach the readers the things they need to understand for the later parts
- A way to think about the starting point is to consider the “you” as you were the day that you began your research
- Think about what you know, what you have learnt

**Your paper or thesis is a chance to teach the past “you”
all the knowledge that is needed to become the current “you”
-> guided tour through a gallery**



Telling a Story

❖ Structuring the body of a paper

- Chain, specificity, example, complexity

❖ Chain

- Results and the background on which they build dictate a logical order for presentation of the material
- Problem statement, then a review of previous solution and their drawbacks, then the new solution, and finally a demonstration that the solution improves on its predecessors

❖ Example : “Compression for fast external sorting”

- Problem statement : an explanation of external sorting and argument that disk access cost are a crucial bottleneck
- Review : standard compression methods and why they cannot be integrated into external sorting
- New solution : compression method developed in the research
- Demonstration : series of graphs and table based on experiments that compare the costs of sorting with and without compression



Telling a Story

❖ Specificity

- Approach that is particularly appropriate for results that can be divided into several stages
- Material is first outlined in general terms then the details are progressively filled in
- Most technical papers have this organization at the high level but it can also be used within sections

❖ Example : Retrieval System with several component

- Text retrieval : a parser, procedure for building an index, queries must likewise be parsed into a format that is consistent with that of the stored text, query evaluator
- The explanation might begin with a review of this overall structure, then proceed to the detail of the element



Telling a Story

❖ Example

- Idea or result is initially explained by applying it to some typical problem
- The idea can be explained more formally, in a framework that example has made concrete and familiar

❖ Example : “Compression for fast external sorting”

- The explanation could begin by considering, hypothetically, the likely impact of compression on sorting
- To make the discussion more concrete, a couple of specific instances – a small table and a large table – could be used to illustrate the expected behavior in different circumstances
- Given a clear explanation of hypothetical scenarios, you can then proceed to fill in details of the method that was tested in the research



Telling a Story

❖ Complexity

- Simple case can be given first, then a more complex case can be explained as an extension, thus avoiding the difficulty of explaining foundational concepts in a complex framework

❖ Example : “a kind of tutorial”

- Reader is brought by small steps to the full result
- A mathematical result for an object-oriented programming language might initially be applied to some simple case such as programs in which all objects are the same class
- Result could be extended by considering programs with inheritance

In appropriate for a write-up :

- 1) chronological list of experiments and results**
- 2) List all proofs or results, then analyze them later -> analyze proofs or experimental results as they are presented**



Organization

❖ Scientific paper

- Allow readers to quickly discover the main results
- If interested, to examine the supporting evidence

❖ Importance behavior

- Many readers accept or reject conclusions based on a quick scan, not having time to read all the papers they see

❖ A well-structured write-up

- Important statements as near the beginning as possible
- Describes the work in the context of accepted scientific knowledge
- State the idea that is being investigated, often as a theory or hypothesis
- Explain what is new about the idea, what is being evaluated, or what contribution the paper is making
- Justify the theory, by methods such as proof or experiment



Title and Author

❖ Papers

- Begin with their title and information about authors including name, affiliation, and address

❖ Name

- Personal decision for name; A.B. Cee, Ae Cee, Ae B. Cee
- Use the same style for your name on all your papers – index
- Include a durable email address or web address if possible

❖ Collection search terms, keyword

- Use words that concern the paper's principal themes



Abstract

- ❖ **Typically a single paragraph of about 50–200 words**
 - **Allow readers to judge whether or not the paper is of relevant to them**
 - **Concise summary of the paper' s aim, scope, and conclusion – no space for unnecessary text**
 - **Kept to as few words as possible while remaining clear and informative**
 - **Acronyms, mathematics, abbreviations or citation is inappropriate**



Abstract

❖ Five-element organization

- A general statement introducing the broad research area of the particular topic being investigated
- An explanation of the specific problem (difficulty, obstacle, challenges) to be solved
- A review of existing or standard solution to the problem and their limitations
- An outline of the proposed new solution
- A summary of how the solution was evaluated and what the outcomes of the evaluation were



Abstract

❖ A draft with five sentences

- Introduction should be structured in much the same way, but with a paragraph or two, not a sentence for each component
- Valuable exercise is to read other papers, analyze their abstract and introductions to see if they have this form, and then decide whether they are effective

❖ The more specific an abstract is, the more interesting it is likely to be

- Space requirements can be significantly reduced → space requirements can be reduced by 60%
- We have a new inversion algorithm → we have a new inversion algorithm, based on move-to-front list



Introduction

❖ Expanded version of the abstract

- Describe the paper' s topic, the problem being studied, references to key papers, the approach to the solution, the scope and limitations of the solution, and the outcomes
- Include motivation – why the problem is interesting, what the relevant scientific issues are, why the approach taken is a good one, and why the outcomes are significant
- Only a brief summary of the supporting evidence, which the interested reader can find in the body of the paper
- Relevant literature can be cited in the introduction
- What in the paper is new and what the outcomes are



Body

❖ Present the results

- Provide Necessary background and terminology
- Explain the chain of reasoning that leads to the conclusion
- Provide the details of central proofs
- Summarize any experimental outcomes

❖ Headings

- Background, previous work, proposals, experimental design, analysis, results, and discussion

❖ Background vs. discussion

- Background : knowledge the reader need to understand
- Discussion : alternative approaches that are superseded by your work
- Discussion of background and previous work also introduce the state of the art and its failings, the importance and circumstances of the research question, and benchmarks or baseline that the new work should be compared to

❖ Results

- Assembly of evidence on which the key arguments are based
- Presentations of experimental outcomes, theorems, proofs, analysis of



Body

❖ Experiments

- Yield far more data than can be presented in a paper of reasonable length
- Summarized in a graph and a table

❖ No need to include the details of proofs lemmas or min theorems

❖ Thesis

- Each chapter has structure, including an introduction and a summary or conclusions
- This structure varies with the chapter' s purpose
- Background chapter : variety of topics necessary to understanding of the contribution of the thesis
- New algorithm chapter : simple linear organization in which the parts of the algorithm are presented in turn



Literature Review

- ❖ Few results or experiments are entirely new
- ❖ They are extensions of or corrections to previous research – incremental addition to existing knowledge
- ❖ Literature review
 - Compare the new results to similar previously published results
 - Describe existing knowledge
 - Explain how it is extended by the new results
 - How existing methods differ from one another and what their respective strengths and weakness are
 - Creates a specific expectation of what the contribution of the paper should be
 - Shapes what the readers expect of your work and how they will respond your ideas



Literature Review

❖ Positions

- Can be early in a paper to describe the context of the work
- Might in that case be part of the introduction
- Less commonly, the literature review can follow or be part of the main body at which point a detailed comparison between two old and the new can be made
- Not gathered into a single section, but is discussed where it is used—background material in the introduction,



Conclusions

❖ Conclusions or summary

- Draw together the topics discussed in the paper
- Include a concise statement of the paper's important result and explanation of their significant
- Appropriate place to state any limitation of the work: shortcomings in the experiments, problem that the theory does not address
- Appropriate place to look beyond the current context to other problems that were not addressed, to questions that were not answered, to variations that could be explored

❖ Conclusions vs. conclusion

- Conclusions are the inferences drawn from a collection of information
- Conclusion is that which concludes or the end



Bibliography

❖ Bibliography

- Bibliography or its set of references is complete list of theses, papers, books, and reports cited in the text
- No other items should be included



Appendices

❖ Appendices

- Giving detail of proofs or experimental results and where appropriate, material such as listing of computer programs
- Hold bulky material that would otherwise interfere with the narrative flow of the paper or material that even interested readers do not need to refer to
- Occasionally necessary for a paper, in cases where there is material such as proof whose length would interrupt the flow



The First Draft

❖ First draft

- Write freely – without particular regard to style, layout, punctuation
- Concentrate on presenting a smooth flow of ideas in a logical structure
- If you tend to get stuck, just write anything, no matter how awful; be sure to delete ravings later

In-memory sorting algorithms require random access to records. For Large files stored on disk, random access is impractically slow. These files Must be sorted in blocks. Each block is loaded into memory and sorted in turn. Sorted blocks are written to temporary files. These temporary files are then merged. There may be many files but in practice the merge can be completed in one pass. Thus each record is read twice and written twice. Temporary space is required for a complete copy of the original file

- ❖ Should be thoroughly edited before the paper is submitted
- ❖ Edit and revise carefully
- ❖ Best writing is the result of frequent, thorough revision



The First Draft

❖ Mathematical content, definitions and the problem statement should be made precise as early as possible

- Your understanding is lacking or the ideas are insufficiently developed

❖ The writing

- Begin as soon as the research is started
- The later the writing is begun, the harder it will be
- Delay increases the time between having ideas and having to write about them, increases the pressure to read papers to be discussed, and reduces the number of experiments that can be thoroughly described

❖ Thesis vs. paper

- Guidance on writing is the same
- The task of writing a thesis can be broken into manageable stages
- Ph.D., each chapter can be as rich as a paper



From Draft to Submission

❖ Process of assembling a technical paper

- Brainstorm – writing down in point form what has been learnt, what has been achieved, and what the results are
- Prepare a skeleton – choosing results to emphasize and discarding material that on reflection seems irrelevant
- Work out a logical sequence of sections – leads the reader naturally to the results

❖ Useful discipline

- Choose the section title before writing any text (if material to be included doesn't seem to belong in any section then the paper's structure is probably faulty)

❖ Introduction

- An outline of the order and content of the section
- Each section can be sketched 20–200 words



From Draft to Submission

❖ Body and closing summary

- Introduction usually needs substantial revision because the arguments presented in the paper are likely to mature and evolve as the writing proceeds

❖ Final version of abstract is the last part to be written

❖ With a reasonable thorough draft completed, it is time to review the write-up' s content and contribution

❖ Completion of a paper tends to focus on writing of the whole document, while a thesis is typically completed chapter by chapter

- When planning a schedule for completion of a thesis, you need to allow time for multiple revisions of each chapter
- Reason why it is so important to write early

❖ During drafting and revision



From Draft to Submission

❖ Novice writer

- A good starting point is imitation
- Choose a paper or thesis whose results are of similar flavor to your own, analyze its organization, and sketch an organization for your results based on the same pattern
- Habit of using similar patterns for papers – their standardization – helps to make them easier to read

❖ Student should keep a file of notes as they proceed

- Meeting
- Decisions
- Ideas
- Expectations of outcomes
- Papers you have read
- Sketches of algorithm
- Code versions
- Theorems
- Source of data
- Experiments and outcomes
- Sketches of proof



Co-authoring

❖ Authoring

- All authors contributed in some significant way to the intellectual content of the paper
- Task of writing was shared

❖ Strategy

- Brainstorm the content of the paper, then for each author to write a designated section
- Take turns – One person write a draft, the next revises and extends, and so on with each person holding an exclusive lock on the paper while amending it.
- Tends to lead to papers in which the authorial voice makes dramatic shifts, the table and figures are inconsistent, and there is great deal of repetition and omission

❖ Form of research training

- It is opportunity for advisor to lean in detail where their students are weak, while a paper that has been revised by an advisor is an opportunity for students to contract their attempts at research writing with that of people with more experience



Getting It Wrong

❖ Defects of paper

- Problems that make it certain that the paper will be rejected, and which in some cases are obvious to the referee in the first few moments of reading
- Irrelevance
- Inconsistency, Inadaequacy, and Incompleteness
- Incomprehensibility
- Ugliness
- Ignorance



Irrelevance

❖ Impression form in a minute or two, influenced by layout, readability

- “I cannot figure out what the paper is about” , “Something elementary is utterly missing”
- Lack of connection to the literature on any particular topic – what the author is trying to achieve
- Elegant solution – what the problem is, unrealistic problem
- Example
 - Starting point was the challenge faced by teachers who wish to ensure that Web searches only return pages that are appropriate for children – contribution concerned mechanism for selectively highlighting passages that were relevant to the query

❖ Submission to an inappropriate venue

- File compression submitted to a conference on database modeling

❖ No obvious research question, no statement of aims or goals, no claimed contribution, experimental results are unrelated to the conclusion

- A paper that gave results for the efficiency of a string search method but drew the conclusion that the method enhanced data privacy



Inconsistency, Inadequacy, and Incompleteness

❖ Commonest problem for rejection

- Inadequate experiments (experiments are trivial or uninformative, and fall far short of supporting the claims)
- The data set used is too artificial to allow any interesting conclusion to be drawn.
- Data set may not be relevant to the problem at all

❖ Inadequacy

- Parts of the paper are missing, or dealt with a few brief lines rather than page
- No literature review or are based on a single out-of-date textbook as if previous or recent work was of no relevance
- If the author can be troubled to properly place the work in context of what is already known, a reader cannot learn what the contribution is
- The reader cannot identify what the data is (there may be 200 documents, but where from, what contents? What size, and so on) or who ran the experiment, or what techniques were tried



Incomprehensibility

❖ No hope for a paper

- “Internet supports all type of the forms of information that are digital, such as the pages of the Web everywhere and also libraries and email, so it is a language of all our information sources in the world repository that is our knowledge”
- Wide gap between what the writer want to say and the actual words on the pages
- Want to pour all of their thoughts into a few sentence



Ugliness

❖ The look of a document is another respect in which problems can be immediately obvious

- If something looks terrible, the author doesn't care about the content

❖ Several forms of this ugliness

- Illustration and table: graph that are badly designed or badly rendered, table that are irregular or chaotic, diagram in which the parts are unrelated
- Layout: absurdly sized headings or columns that overlap
- Presence of dramatic formatting glitches: font and font size changing from paragraph to paragraph
- Inappropriate steeples of presentation: comic sans font has been widely mocked for its use in slides
- Paper is dense with errors: spelling error, garble citations, incomplete sentence, or any of a range of such things



Ignorance

❖ Nothing is more certain than a display of ignorance

- Paper is spent explaining an elementary concept that will be familiar to any likely reader and maybe even to undergraduates (why spend six pages of an algorithm paper explaining the difference between random-access memory and hard-disks? Use 1980s literature on memory technology in a 2000s paper)
- Discuss at great length a statement is either blindingly obvious or worse, clearly false
- Relation to past literatures (when the background and literature review are crushed into a few paragraphs, it is almost certain that the author has nothing to contribute)



A Checklist

❖ Scope of the work

- In what forum, or kind of forum, do you plan to publish?
- Is the scope of the work well defined?
- Is there a single, clearly articulated research question or goal? Have you identified
- which aspect of the work is of greatest impact, or of greatest interest?
- What would success in the project look like? What would failure look like? Can you anticipate the form of the outcomes in either case?
- Who is the readership? How deep or thorough will the background need to be to ensure that the readers fully appreciate the work?
- Do you and your co-authors have an agreed methodology for sharing the work of completing the write-up?
- Are the roles of the participants clear? What are your responsibilities? What activities will the others undertake?



A Checklist

❖ How write-up is organized and presented

- What form will your write-up take? What other paper or thesis should your writeup resemble?
- Are you writing to a well-defined structure and organization? What are the sections, and how do they relate to each other?
- Do the title, abstract, and introduction appropriately set the context for the work?
- Have you identified a structure for the argument? A format for the results?
- Have you established a connection between the question, background, methods, and results? That is, have you identified the shape that the narrative will take?
- Is there anything unusual about the organization of the write-up, and, if so, is there a reason for this organization and how will it be explained to the reader?
- If you are writing a paper, are you working to defined length limits or a specified format?
- If you are writing a thesis, are there formatting requirements?



A Checklist

❖ Your approach to the work

- Are you maintaining a log and notebook?
- Do you work to an explicit schedule with dates and targets?
- Do the deadlines leave enough time for your advisor to provide feedback on your drafts, or for your colleagues to contribute to the material?
- Do you have an effective approach to writing that lets you quickly generate text?
- How are results being selected for presentation? How do these results relate to your original aims? How do the selected results relate to the complete body of evidence you are gathering?
- Have the results been critically analyzed?
- In a thesis with multiple contributions, are they explicitly linked by an overarching goal?
- For a thesis, do you know how it will be examined? How is that knowledge shaping your writing?



