582519 Scientific Writing for MSc in Computer Science:
Writing process

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Last week's task:
How did it go?

Introduction to the Use of Computers? Who?

Small group meetings? Who?


-- fill comments here --

What is scientific writing?

- Describing new scientific ideas and results for other scientists and the science community

  - New ideas or combining old ideas in a new way

- Evaluation of the presented ideas/results

  - Correctness

  - Relationship to former ideas and results

- Scientific writing is an important part of the process of science, i.e., the process of accumulating reliable knowledge

What is scientific writing? (2)

- New results (new contribution) build on existing knowledge

- Scientific results are accepted when they have been independently reviewed and published

- Different types of scientific publications with their own characteristics

- Scientific writing itself is also a process
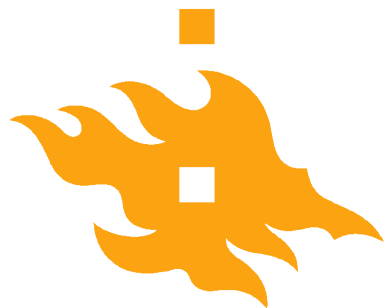
Levels of thinking/ writing/ learning by Boehm (see also Bloom's taxonomy)

	LEVEL	FOCUS	GOAL	VERBS
1	INFORM-ATION	Identification and repeating - able to repeat accurately	Know that you know	List, repeat, describe, define, identify, create titles
2	UNDER-STANDING	Reach the impact and meaning of information	Show that you understand	Explain, condense, interpret, enhance, modify, measure
3	APPLIC-ATION	Use information -apply knowledge to new situations	Show: use the information	Apply, use, find solutions or examples, solve, choose methods
4	ANALYSIS	Make conclusions f.e. show relationships between elements and the whole	Show: find the essential elements in the information	Analyse, debate, brake into elements, generalise, create outlines, deduce
5	SYNTESIS	Be creative and original - compose elements and ideas in new ways	Show: create and formulate large wholes	Create, invent, design, produce, implement, combine, compose, merge
6	EVALUATION	Create criteria in order to evaluate the information. Use the criteria.	Show: evaluate ideas, information, methods and solutions	Compare, choose, evaluate, contrast, create criteria, valuate

The process of science

- Idea or research question

- Hypothesis or model for the solution

- Testing the hypothesis/model

- Representing and evaluation of the results

- Publishing the results after independent reviewing

- Good writing is a crucial part of this process!

Contents of a scientific article

- The position of the new idea with respect to the former scientific knowledge

- Clear and formal statement of the new idea

  - Often as a hypothesis or a model

- Description of the novelty of the idea, or the contribution of the article

- Justification of the theory by proof or experiments

- Note: details of the research process leading to the article do not usually belong to the article!

Structure of a scientific article

- Title and author
- Abstract
- Introduction
- Body of the article (including related research/work)
- Summary/conclusions
- (Acknowledgements)
- Bibliography
- Appendices

Types of publications

- Course books

- Other kinds of text books

- Standards

- Journal articles

- Conference articles

- Theses

- Technical reports

- Manuscript

- Web documents/publications

Nature of publications

- Primary sources

  - Original, reliable information

  - Articles in scientific journals, conference and workshop books, research reports, theses

  - Patents, laws and directives, standards

- Secondary sources

  - Useful material for restructuring and analysis of existing information, not original and new results

  - Course books, article collections, surveys, newsletters, dictionaries, etc.

Process of writing scientific text

- Idea or interesting topic

- Finding and evaluating relevant source material

- Reading material

- Identifying essential issues

- Restructuring them logically

- Writing them down using proper presentation techniques

- **Iterative process**: text must be re-written several times!

Characteristics of scientific text

- Content usually technical
- Should be based on facts
  - Writer's interests and opinions can be seen in the choice of the topic, not in the text as such
- Based on former theories and research results
- Motivating on why the problem considered is important
  - Not marketing of the ideas
- Arguments and conclusions
- Verifiability, reliability, and repeatability of the results

Characteristics of scientific text (2)

- Clear and logical structure

- Not a direct copy from anybody else's text

- Source material is analysed and restructured

- Based on peer-reviewed research material

  - Journal, conference and workshop articles in computer science are typically peer-reviewed

  - Peer-reviewers are researchers that are experts in the topic in question

  - Writers do not know who the reviewers are

Characteristics of scientific text (3)

- Text is suitable for its target group
  - How are the readers?
  - How are they going to use the text and the information given in it?

- Clearness of the text
  - The reader must understand the text in a same way as the writer

- Reflects writer's deep understanding of the topic!

Target groups of scientific text

- Readers that have scientific background

- Other researchers in the same area

- Whole scientific community

- General public

- Some basic knowledge of the topic is usually required

- In this course and in the seminars: other MSc degree students

How do you learn scientific writing?

- Following the topic area and reading relevant articles

- Writing yourself

- Searching for feedback from others

  - Peer students

  - Teachers

  - ...

- Iterative process!

Important things to remember

- It is important that the reader understands what you have written

  - The audience you should write to are the other students in this course!

- All the texts must be written by you

  - Not a copy of a text written by someone else

  - Not a direct copy from the reference material

- Remember always to check the correctness of the language!

Important things in your paper

- Department's layout for thesis and reports
- Structure of our text
- List of references

How to start: Collecting joint ideas

- -- to be added in the class --

Writing process

- (Scientific) writing is a process

- Different phases
    - Thinking and planning
    - Outlining
    - Writing
    - Revising
    - Finalising

- Iteration between phases sometimes necessary

Thinking and planning

- Getting started

    - Defining purpose and scope

    - Identifying target group

- Gathering ideas

    - Finding relevant background information

    - Identifying things to be included

- Taking the requirements of the intended publication forum into account

Getting started

- Define the purpose and scope of your text
  - What are the problems considered? Why are they interesting?
  - What perspective is taken?
  - What are the objectives of the text?
  - Which purpose the text is written to?

- Who are the readers? (target group)
  - What the readers want to know?
  - What information should be given to them?
  - In this course: your fellow students

Gathering ideas

- Finding background information
  - Information retrieval of scientific text
  - Reading the relevant material
  - Defining the main references to be used
  - What kind of related work should be considered?

- Identifying things (topics) to be included and finding their relationships
  - Key words, key phrases
  - Relevant concepts and definitions
  - The most important results to be presented

Outlining

- **Starting point**: What text's scope and purpose?

- What does the reader need to learn or know about the topic?

- Starting from the common knowledge and proceeding to the new ideas and results

- **Logical structure and order** of the text is essential!

Outlining (2)

- Helps authors to
    - organise their thoughts
    - evaluate relevance of different topics and their representation
    - remember the relationships between topics
- Should support reading and reader's understanding
    - Describes
        - structure of the text
        - logical presentation and reading order
    - Should still support several types of reading
        - browsing, specific information searches, learning, ...

Outlining (3)

- Should lead to a logical, clear story
  - In a concise form in the list of contents
  - Clarified in the introduction, especially if there is something special in it

- Questions to answer:
  - What topics are considered?
  - In which order they are told?
  - What is the importance and length of each topic?

Outlining (4)

- What kind of parts are needed?
  - Which chapters?
    - Only in longer texts; seldom in scientific articles
  - Which sections?
  - Which subsections?
  - Some other parts?

- Finding
  - a good title for the whole text
  - headings for chapters, sections and subsections

Outlining (5)

- Some publication forums may have strict rules on the outline
  - For example: Introduction, Methods, Results, Discussion

- Can cause problems in explaining complex topics in phases
  - For example a comparison of two methods => Introduction, Background, Methods, Results, Discussion, Methods, Results, Discussion

- Not typical in computer science

Different types of outlines

- Chaining outline

    - Presentation of the problem

    - Related work, earlier solutions and their flaws

    - New solution

    - Results and their evaluation

- Specificity-based outline

    - First general explanation/description, then more specific ones

    - For example for describing a system consisting of several components

Different types of outlines (2)

- Example-based outline

  - Idea or results explained first with help of a typical case or situation

  - Generalisation of ideas/results and describing them more formally

- Complexity-based outline

  - First presentation of a simple case

  - Then description of a more complicated case (generalisation, extension)

Titles

- A title of an article/thesis/report must be informative and concise
  - Too general terms and titles should be avoided
  - Every term should be necessary

- Must be attractive

- Not too complicated and filled with words

- Not too short either

- Preciseness is more important than conciseness and attractiveness!

Titles (2)

- Examples:

  - Too complicated:

    - An Investigation of the Effectiveness of Extensions to Standard Ranking Techniques for Large Text Collections

  - Better:

    - Extensions to Ranking Techniques for Large Text Collections

  - Too general:

    - Huffman Coding for Databases

  - Better:

    - Limited-Memory Huffman Coding for Databases of Textual and Numeric Data

Chapter and section headings

- Should reflect the structure of the work
  - For example
      4. List and trees
        4.1. Lists
        4.2. Trees

- Not complete sentences
  - Example:
    - Not: Replication of Data Leads to Reduction in Network Traffic
    - But: Replicating Data to Reduce Network Traffic

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Chapter and section headings (2)

- Not too lively

- Avoid questions or abbreviations

- Headings at the same level should
    - be comparable in their contents and structure
    - have a clear connection to the balanced outline

- Third-level headings, i.e. subsubsections, seldom needed
    - Usually the need of them indicates problems in the outline

Chapter and section headings (3)

- Paragraph titles should be avoided

  - If needed, should be part of the paragraph

- Numbering of headings depends on the publication forum

  - Unnumbered headings must be distinguished by a specific font, style or font size

  - At our department numbering of headings is required

Paragraphs

- Building blocks of chapter, sections and subsections

- Should not be too long
  - Logical flow of the text becomes difficult to follow

- Short paragraphs easier to read and they make communication more efficient
  - No paragraphs consisting of just one sentence!

- A paragraph for each aspect of the topic

Writing

- Scientific text should be impartial, accurate and objective

  - Arguments must be based on evidence

  - Statements should be supported by examples

  - Sources of information and ideas must be indicated

  - Use enough words to make your meaning clear

- Started by writing a draft of the text

  - Flow of ideas

  - A short text can be drafted completely

First draft

- Freely written

  - Concentrate on presenting ideas in a logical way

- Raw text

  - Style, layout and punctuation can be corrected later

  - Exception: mathematical and formal issues as precisely as possible from the very beginning

- Must be edited and revised carefully and thoroughly

  - Several times

  - Difficult things more times than easier

How to proceed with writing

- Different approaches
  - Write the introduction first
  - Start from the body of the text

  => use the method that is **the best for you**

- Write something even if it is hard
- Start with easier things
- If everything else is difficult, fix the technical details (list of references, etc.)

Revising

- After the first draft is ready/complete

- **Aim:** ensure that thoughts created in the mind of the reader(s) are the same as the thoughts of the writer(s)

- Checking

  - the order of presented ideas

  - the use of words and terminology

  - style, layout and punctuation

Revising (2)

- No statement should be introduced abruptly and without warning

- Relationships between parts at a same level should be clear
  - Each section should be related to the preceding and the next one
  - Similarly with paragraphs in a section and sentences in a paragraph

Revising (3)

- Paragraphs and sentences should be in a logical and effective order

- Balance is important
  - Parts must be balanced in themselves, and in the relation to one another
  - Holds for sections, subsections, paragraph, and even sentences
  - For example, no sections with just one subsection!

Revising (4)

- Important and difficult parts typically re-written several times

- After a revision, put the text a side for a moment
  - Avoid blindness to your own text!

- Ask someone to read your text and give comments!
  - Experts versus non-experts
  - The function of criticism and feedback is to improve your writing

Finalising

- When all the parts of the text are written at least once

- Check that objectives, motivation and restrictions are in line

- Evaluate issues that the readers or reviewers might criticise or argue against

- Check technical details

- If published, the critics of the reviewers should be taken into account

- Changing publication forum may require bigger changes

Structure of a thesis, report or seminar work

- Title page
- Abstract
- Table of contents
- Introduction
- Body of the work
- Conclusions
- List of references
- (Appendices)

Abstract

- Helps the reader to decide whether to read the whole text or not

- Should be short, but clear, informative and concise

- Details or description of the outline not part of the abstract

- Final version is written after all the other parts of the text are ready

- Aimed to large audience

  - Readers are not necessarily experts on the topic

- No references to other articles

Introduction

- Introduction should be the easiest part of the text to read and not too long

- Must tell what are the new ideas and the main results presented in the article/report/thesis

- Must show that that the whole text is worth reading

- Can be written first, but then typically must be revised

Introduction (2)

- Not too technical, but specific and informative enough
    - Not technical terminology
    - Not very detailed definitions of terms/concepts
    - Not too much mathematics and formulas

- Must contain motivation

- No deep literature analysis

- Importance of the results, not conclusions

- (References to relevant work)

Introduction (3)

- Typical contents and structure
  - Description of the topic and its context
  - (Related work)
  - Description of the problem considered
  - Summary of the proposed solution
  - Evaluation of the solution
    - Application areas
    - Consequences
  - Brief description of the outline of the work
- In surveys: why the certain approaches were chosen

Literature overview

- Related work, survey

- Connections to earlier research on relevant topics

- As important as the description of the contribution of the text

- Location in the text

  - In the beginning of the article (description of the context, a part of introduction)

  - If large, a separate section is required

    - As a part of the body of the text

    - After the body, where a comparison of old and new solutions is possible

  - In different sections when it is appropriate

Definitions

- Terminology, variables, abbreviations and acronyms must be defined or explained **the first time** they appear in the text

- Consistent emphasising

  - Different style of letters: italics, boldfacing, …

  - Only the first occurrence

- Sometimes several explanations can be good

- Definitions are given when needed

  - Usually a separate section "Definitions" is not needed/good

  - Every defined term should be necessary

Results and their analysis

- Traditional order of presentation:
    - Description of all results
    - Analysis of the results

- Drawback: the reader might not be able to follow what happens

- More reasonable order of presentation:
    - Analysis is combined with the description of results and how they are obtained

- Description of a particular result should usually start with a brief summary on the main observations

Conclusions

- Brief repetition of the main ideas, results and conclusions as well as their meaning

- Restrictions of the work can be repeated

- No new ideas or conclusions that are not presented in the body

- Can be stated

  - Unsolved problems

  - Which points or perspectives were omitted

  - Which variations should be considered/researched further

Divided authorships

- All the authors have some kind of contribution to the contents of the article

- Brainstorming and developing ideas

- Even writing together
    - Each author write a certain part of the text (different styles, non-coherent style)
    - One or two authors write the draft, and other revise it in turns