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?

C programming?

Other courses?

Small group meetings?

What did you do last week for your paper?

Course material

Read one book about scientific (or academic writing):

- Zobel: Writing for computer science
- Murray: How to write a thesis

Read general style guides:

- Strunk: The elements of style (1st ed 1918, 5th ed 2009)

Any general books about writing in English:

- Grammar, punctuation,

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

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!

Bloom's Taxonomy Action Verbs
by Clemson university

Level	Bloom's definition	Verbs
Knowledge	Remember previously learned information	Memorize, **list**, define, identify, repeat, order
Compre-hension	Demonstrate an understanding of the facts	Classify, **paraphrase**, explain, extend, select
Application	Apply knowledge to actual situations	Change, employ, use, modify, **relate**, discover
Analysis	Break down objects or ideas into simpler parts and find evidence to support gener.	Appraise, criticize, model, examine, **diagram**
Synthesis	Compile component ideas into a new whole or propose alternative solutions	Arrange, create, plan, collect, develop, **write**
Evaluation	Make and defend judgments based on internal evidence or external criteria	**Argue**, assess,choose, compare, evaluate

http://www.clemson.edu/assessment/assessmentpractices/referencematerials/

Levels of thinking/writing/learning by Boehm (based on the orginal 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

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 (student paper’s normally contain justified opinions also)
- 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 your text
- List of references

How to start: Collecting joint ideas

- -- to be added in the class --

Writing process

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 is 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

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 paper

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