



# 582519 Scientific Writing for MSc in Computer Science: Writing process

Lecture 2, 10.9.2014

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# Last week's task: How did it go?

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Computing Tools for CS studies? Who?

(Latex –week 4?)

Small group meetings?

-- fill comments here --



# What is scientific writing?

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- 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)

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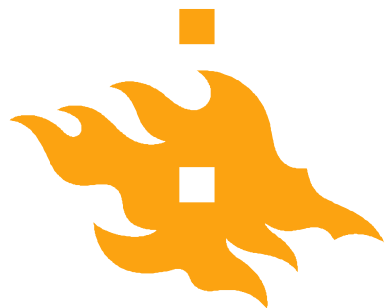
- New results (new contribution) build on existing knowledge
- Scientific results are accepted when they have been independently reviewed and published
- Different types of scientific publications with their own characteristics
- Scientific writing itself is also a process



# The process of science

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- 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
Comprehension	Demonstrate an understanding of the facts	Classify, <b>paraphrase</b> , explain, extend, select
Application	Apply knowledge to actual situations	Change, employ, use, modify, <b>relate</b> , discover
Analysis	Break down objects or ideas into simpler parts and find evidence to support general.	Appraise, criticize, model, examine, <b>diagram</b>
Synthesis	Complete component ideas into a new whole or propose alternative solutions	Arrange, create, plan, collect, develop, <b>write</b>
Evaluation	Make and defend judgments based on internal evidence or external criteria	<b>Argue</b> , assess, choose, compare, evaluate



# 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



# Contents of a scientific article

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- 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

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



# Types of publications

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- Course books
- Other kinds of text books
- Standards
- Journal articles
- Conference articles
- Theses
- Technical reports
- Manuscript
- Web documents/publications



# Nature of publications

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- 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

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- 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

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- 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)

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- 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)

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- 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

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- 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?

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- Following the topic area and reading relevant articles
- Writing yourself
- Searching for feedback from others
  - Peer students
  - Teachers
  - ...
- Iterative process!



# Important things to remember

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- It is important that the reader understands what you have written
  - The audience you should write to are the other students in this course, not only in your group!
- 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

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



# How to start: Collecting joint ideas

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- -- to be added in the class --



# Writing process

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- (Scientific) writing is a process
- Different phases
  - Thinking and planning
  - Outlining
  - Writing
  - Revising
  - Finalising
- Iteration between phases sometimes necessary



# Thinking and planning

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- 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

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- 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

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- 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

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- **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)

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- 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)

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- 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)

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- 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)

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- 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

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- 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)

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- 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

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- 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)

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- 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

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- 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)

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- 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)

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- 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

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- 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

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- 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

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- 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

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- 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

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- 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)

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- 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)

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- 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)

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- 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

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- 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

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



# Abstract

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- 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

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- 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)

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- 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)

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- 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

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- 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

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- 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

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- 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

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- 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

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- All the authors have some kind of contribution to the contents of the article
- Brainstorming and developing ideas
- Even writing together
  - Each author writes a certain part of the text (different styles, non-coherent style)
  - One or two authors write the draft, and others revise it in turns