Chapter 4:

Presentation Technique

4.1 Structure of the Lecture

4.1.1 Theoretical Part

We will present some basic information on

- how to write mathematical papers (written presentations) and on
- how to give mathematical talks (oral presentations).

4.1.2 Practical Part

Each student will choose a subject of interest and

- write a mathematical paper on this subject and
- give a (short) mathematical talk on this subject.

4.2 Structure of the Lecture Notes

The lecture notes will contain ‘‘theoretical material’’ on

- how to write mathematical papers (written presentations) and on
- how to give mathematical talks (oral presentations).

Much of the material contained in this ‘‘theoretical part’’ is taken from material available from the course ‘‘Thinking Speaking Writing’’ taught by Bruno Buchberger at RISC between 1990 and 1992.

Moreover, it will contain ‘‘practical material’’ such as

- papers written by students and
- written material accompanying talks given by students.

4.3 Importance of Written and Oral Presentations

It is of utmost importance for mathematicians (as for scientists in other fields) to document and present their work in written (papers) and oral (talks) form. Otherwise, the results of hard work may become useless because it is more efficient (i.e. cheaper) to *reinvent the results* than to *use available results* from the literature. Moreover, every scientist must try to embed oneself into the scientific community of one’s own field of interest. The only way to do this is by publishing one’s own results in the literature and by giving talks at scientific conferences.

4.4 Types of Mathematical Documents

The main types of written mathematical documents are:

- monographs, i.e. books,
- articles in journals,
- articles in collections of articles,
- articles in conference proceedings, and
- technical reports of research institutions.

These categories differ at least with respect to authorship, contents, scientific originality, production, and quality control.

4.4.1 Monographs

- Authorship: Every researcher may be author of a book.
- Contents: Large area treated in uniform style.

- Scientific Originality: Usually no new results.
- Production: Author writes a book and then searches for a book company to publish the book or a book company asks an author to write a book. Usually, there is some agreement between author and company before the author starts to actually write the book.
- Quality Control: Editors both for scientific quality as well as for language.

4.4.2 Articles in Journals

- Authorship: Every researcher may be author of a journal article.
- Contents: New results in the expert area of the author and the ‘‘scope’’ of the journal (new theorems, new algorithms, etc.).
- Scientific Originality: See contents.
- Production: Author sends article to the editor of the journal. After successfully passing the refereeing procedure the article is published in an issue of the journal.
- Quality Control: Anonymous refereeing.

4.4.3 Articles in Collections of Articles

The only difference between an article in a collection of articles and journal article is that collections of articles are a single event in contrast to journals, which appear regularly.

4.4.4 Articles in Conference Proceedings

- Authorship: See journal articles.
- Contents: Results that fit into the ‘‘scope’’ of the conference.
- Scientific Originality: See journal articles.
- Production: Call for papers, deadline for submission, notification of acceptance/rejection, proceedings available already at the conference (not always).
- Quality Control: Depends on the conference (anonymous refereeing). Due to deadlines, the quality control can never be as thorough as for journal papers.

4.4.5 Technical Reports of Research Institutions

- Authorship: Member of the institution or visiting researchers.
- Contents: New results, preliminary versions of articles submitted to journals, lecture notes, etc.
- Scientific Originality: See contents.
- Production: Depends on the institution.
- Quality Control: Depends on the institution.

4.4.6 Papers vs. Publications

Ususally, the word ‘‘publication’’ is used for written documents that undergo a rigorous quality control, i.e. books, journal articles, articles in collections and refereed conference papers. The word ‘‘paper’’ is much less official, it stands for any written document except for a book. In particular, a technical report is a paper that does not count as publication.

4.4.7 Quality Control: Anonymous Refereeing

4.4.7.1 An Algorithm for Fast Refereeing of Conference/Journal Papers (due to Bruno Buchberger)

The following ‘‘algorithm’’ is intended to be used together with the ‘‘Referee report form’’ below.

1.) Read the abstract, introduction, and conclusion ($\leq$ 10 minutes).

2.) If the paper is *in the scope of the conference/journal*

then assign 1 to 5 points for the respective category in the report form and goto 3

else report **Reject** and stop.

3.) Read the main parts of the paper superficially ($\approx$15 minutes) and write a short summary ($\leq$ 5 minutes) in your own words. Concentrate on the problem addressed in the paper and the results achieved. Put this summary into the ‘‘Comments for the authors’’-section of the report form.

4.) If the presentation is *clear enough* in order to make a fair evaluation of the paper in reasonable time

then assign 1 to 5 points for the respective category in the report form and goto 5

else report **Reject** and stop.

5.) If the main results in the paper seem to be *important*

then assign 1 to 5 points for the respective category in the report form and goto 6

else report **Reject** and stop.

6.) If the main results in the paper are *non-trivial, difficult to prove or discover*, etc.

then assign 1 to 5 points for the respective category in the report form and goto 7

else report **Reject** and stop.

7.) If the main results in the paper seem to be *original*

then assign 1 to 5 points for the respective category in the report form and goto 8

else report **Reject** and stop.

8.) If there are *sufficiently many details* in the paper for checking the correctness of the results

then goto 10

else goto 9.

9.) If, by intuition, the results seem to have a *high chance for being correct*

then assign 1 to 3 points for the respective category in the report form and goto 12

else report **Reject** and stop.

10.) Read the paper in detail and check the correctness.

11.) If the paper is *logically and formally correct*

then assign 4 to 5 points for the respective category in the report form and goto 12

else if the paper contains non-severe errors that can be corrected without influencing the main message of the paper then assign 2 to 3 points in the respective category in the report form and goto 12

else report **Reject** and stop.

12.) If *presentation, structure, language, format, and style* of the paper is of high standard

then assign 4 to 5 points for the respective category in the report form

else assign 1 to 3 points for the respective category in the report form.

13.) If in one ore more categories you assigned $\leq$ 3 points

then report **Revise**

else report **Accept**.

14.) Collect suggestions for the author (typos, minor errors, suggestions for improvement, relevant literature, etc.) in the respective field in the report form. Write confidential comments for the editor in the respective field in the report form. The latter is used in particular for explaining a rejection to the editor.

4.4.8 (Typical) Referee Report Form

Paper Number:
Referee's Name:
−−
Judgement by Categories:
(assign points to each category: 0=very bad, 5=excellent)

Relevance to the field (scope od the conference/journal): _ pts
Clarity of presentation: _ pts
Importance of the results: _ pts
Difficulty: _ pts
Originality of the results: _ pts
Logical and formal correctness: _ pts
−−
Structure and style of presentation: _ pts
Is language correction necessary?
−−
Report:
( ) Accept
( ) Revise
( ) Reject
−−
Confidential comments to the editor (will not be forwarded to the authors):

−−
Comments for the authors (will be forwarded to the authors):

4.5 Writing Mathematical Papers

Given a certain *topic* for a paper, the following steps are necessary when actually producing the paper. In each phase of writing a paper, bear in mind the most important principle for the author to follow:

Save the time of the reader !!!

4.5.1 Analysis of Readership

Ask yourself for whom you want to write the paper! What is the scientific/professional background of the readers? What knowledge do I presuppose on the side of the readers? Are the readers already motivated to read the paper? All what follows will heavily depend on the answers to these questions.

4.5.2 Specification of Goals

Analysis of the readership ✓

Now, clear goals have to be specified and structured. A topic for a paper is not yet a goal! It is helpful to always specify goals in the form of *operational goals*, i.e. by describing the operations (actions) the reader should be able to perform after having read the paper. Operational goals offer an easy way to check the quality of one's own paper: If readers from the intended group of readers are not capable of performing the operations specified as the operational goals then the paper does not meet the goals.

Clear operational goals give the reader a clear motivation to read the paper, namely the desire to acquire the skills that are described by the goals of the paper.

After the goals have been specified they need to be structured. It may be that one goal is a subgoal of another, one goal can be a prerequisite of another, or two goals may be independent. A hierarchical structure of goals, subgoals, subsubgoals, etc. often structures the actual paper naturally into chapters, sections, subsections, etc.

4.5.3 Collecting Material

Analysis of the readership ✓
Specification of Goals ✓

The necessary material needs to be collected. In this phase, the literature needs to be studied, i.e. one has to look for relevant books, articles, reports, etc. that contain relevant information for writing the paper. The use of available literature consists of basically four steps:

- *Finding* relevant literature items.
- *Retrieving* the relevant literature items.
- *Processing* the retrieved literature items.

- *Documenting* the used literature items.

4.5.3.1 An Algorithm for Finding Relevant Literature Items

Iterate the following steps as long as necessary:

- *Ask* friends and colleagues.
- *Search* the internet. Libraries offer electronic search facilities for literature.
- Once you have found one item, consult the *list of references* of this paper (“backward search”).
- Once you have found one item, consult the *citation index* and start a “forward search” starting from available literature. The citation index allows to find literature items, which cite a given item. Nowadays, several citation services are available also over the internet.
- Consult the *subject index* and the *table of contents* of relevant books.
- Consult the *keyword indices* of libraries.
- Consult *review journals*: review journals contain abstracts of reviewed papers!
- *Write to authors* of available relevant papers.

4.5.3.2 Retrieving Relevant Literature Items

Much of the available literature, in particular recent items, can be found on the internet and can be downloaded for printout. Search the author’s homepage!

For books, use the author index in the library. For journal articles, don’t use the author index since journals are ordered by their name usually. For articles in collections and conference proceedings, search for the editor in the author index, don’t search for the author! For technical reports, contact a representative of the institution or contact the author. Anyway, contacting the author directly is often very efficient.

4.5.3.3 Processing Literature Items

Once you have all the desired literature items in your hands you have a lot of work still, because

- mathematics is often presented in different (and incompatible) notation,

- details are often left out, auxiliary notations are needed,
- solution methods are presented in a general form where the special case that is actually needed is often hard to recover,
- solution methods are presented in a special form that is not applicable to the problem at hand,
- the actual problem is different from the problem treated in the literature,
- parts in the literature are incomplete or even wrong,
- etc.

4.5.3.4 Documenting Used Literature

The documentation of used literature consists of

- *citations* of literature items within the text and
- a *list of references* containing all relevant data of the cited literature items.

Some general rules for citation:

- Every paper used must be cited at an appropriate place, an entry in the list of references must occur. Every entry in the reference list must be cited somewhere in the paper.
- Each entry in the reference list must contain the data necessary to actually find and retrieve the item in question.
- State clearly, which part of the work is new and which parts have already been available in the literature.
- Try to cite the original inventor, not some later text book. If, in fact, you used the textbook, but the textbook again cites the original inventor, then try to cite both with some appropriate text, e.g. "… this result goes back to [original], see also [textbook] …".
- Use labels (abbreviations) for the citations when you cite an item in your paper. From this label, it should be possible to uniquely determine the item in the list of references. Different styles for labels are used by different authors, such as e.g. numbering, combinations of author's initials and year of publication, combinations of author's full name and year of publication, etc. In the running text, labels for citations are usually enclosed in parentheses or brackets. Examples for citations according to the above styles are: (1), [1], (WW99), [WW 99], (Wind99), [Wind 1999],

(Windsteiger99), [Windsteiger, 1999]. Whatever style you use, use it *uniformly*!

Try to find out whether the word processing software that you use supports citations in some way. Maybe auxiliary tools for producing citations are available for the word processor you use. The most wide-spread word processing system for scientific publications—at least in mathematics—is still LaTeX. Not only is it wide-spread, it is currently the standard format for most publishers in the scientific area. Among the advantages of LaTeX is its capability of accessing the bibliography database BibTeX, which is a text-based format for storing literature information. A sample BibTeX entry looks as follows:

```
@ARTICLE {Paue92,
  AUTHOR={Pauer,G.},
  TITLE={{On Lucky Ideals for Gröbner Basis Computations}},
  JOURNAL={JSC},
  YEAR={1992},
  VOLUME={14},
  NUMBER={5},
  PAGES={471−−482}}
```

The string "Paue92" is the *key* of this entry. For citing this article you simply write "\cite{Paue92}" in the running text at every place where you want to cite the article. Depending on the so-called bibliography-style a label for this citation, e.g. [Pauer, 1992], and an entry for the list of references, e.g.

> [Pauer, 1992] G. Pauer: On Lucky Ideals for Gröbner Basis Computations. *JSC* **14**(5), p.471-482, (1992).

is generated automatically.

4.5.4 Structuring Papers

Analysis of the readership ✓
Specification of goals ✓
Collecting material ✓

The typical structure of a scientific (mathematical) paper consists of

- a title block,
- an abstract,
- the main part with

- introduction,
- exact presentation of the results,
- details on the results, and
- a conclusion, and

- appendices.

The core ideas contained in a paper should be presented as early as possible. The key ideas should be addressed in *each of the above parts* of a paper and they should be repeated several times *in increasing detail*.

4.5.4.1 The Title Block

The title block of a paper consists of the actual title of the paper, the name(s) of the author(s), the contact address of the author(s), and the complete bibliographic information on the paper. If the paper is published in a journal or a report series, then part of the bibliographic information is already contained on the cover page. In any case, the title block *together with* the cover page must contain sufficient bibliographic data necessary to actually find and retrieve the paper.

When choosing a title for a paper it is often a good idea to address "the three coordinates of mathematical space", namely the *problem*, the *data domain*, and the *method* (the *algorithm*, the *theorem*). This will help the user to quickly decide about the relevance of the paper. If a coordinate is missing in the title then the reader should expect the paper to give an overview over several or all instances on that axis or that this aspect is maybe not addressed at all in the paper. Examples of titles in this style:

A Symbolic Computation-Based (Method) Expert System (Data domain) for Alzheimer's Disease Diagnosis (Problem).

Using Symbolic Computation (Method) in an Automated Sequent Derivation (Problem) System for Multi-valued Logic (Data domain).

Conflict Management (Problem) in an Intelligent Multiagent Robotics System (Data domain) based on FSM Approach (Method).

Assertion-Based Analysis (Problem) of Hybrid Systems (Data domain) with PVS (Method).

Examples of titles not following the above scheme:

> The Wright ω-Function.
>
> Multicontext Logic for Semigroups of Contexts.
>
> A Novel Face Recognition Method.
>
> Making Conjectures about Maple Functions.

The above considerations are to be thought as *guidelines*, not as a must!

The title block often also contains "sponsoring information" about projects, in whose frame the work has been carried out. This is very important because at the end of a project one often needs to report on publications that have been supported by the project. In most cases, the reference to the sponsor is required for a publication to count for thast project. Moreover, it is a matter of fairness against the sponsoring institution. Typically, this information is put as a footnote to the title or even better to the author.

4.5.4.2 Abstract

The abstract is a short summary of the main contents of the paper. Typically, an abstract is not longer than half an A4 page maximum. The reader of the abstract should be able to decide about the relevance of the paper without having access to the entire paper. As a consequence, no reference to later sections of the paper, in particular the list of referenced literature, may occur in the abstract. No special mathematical notation should be used in the abstract, except for commonly known expressions, e.g. $\mathbb{R}$ for "the real numbers" or $a \in A$ for expressing that "a is contained in A". However, in the abstract it may be considered to even write those standard notions in their long prosaic form avoiding any mathematical notation.

4.5.4.3 Introduction

The introduction of the paper is again a summarizing presentation of the contents of the paper. However, it differs from the abstract in at least the following aspects:

- The introduction may be much longer.
- The introduction may refer to later sections of the paper.

The introduction should be written in an easy to understand language, no technical details should distract the reader from the important information. However, the introduction should contain

- a clear *informal description of the problem* treated in the paper,
- a *description of the solution*,
- a *claim of originality*, and
- possibly reading instructions and other helpful information.

It is the challenge of this part to give a clear and understandable description of the problem and the solution without going into the details of a *formal description* containing all technical details. The description of the problem typically contains an assessment on the history of the problem and its solutions as available in the literature. The results of the phase ‘‘Collecting Material’’ should be collected here. In addition to that, it should be clearly mentioned here, which parts of the paper are *new* and which parts can already be found somewhere in the literature, how the results in the paper compare to existing similar results, etc. (‘‘claim of originality’’). A clear presentation of the importance and the relevance of the paper will result in a strong motivation of the reader to really read and understand the content of the paper.

Finally, spend some words on how the remainder of the paper is structured (‘‘reading instructions’’) so that readers can maybe skip certain parts of the paper. For long papers, a table of contents may be included in the introduction.

4.5.4.4 Exact Presentation for the Users

This part is intended for the ‘‘user’’, who wants to use the results contained in the paper. She does neither want to go into all details, nor need she be an expert in the field. As a consequence, this part of the paper must be written in an exact mathematical language and no gaps or ambiguities may be left for the reader. The exact problem specification, all definitions and concepts, theorems and algorithms, and some examples should be given in this part using a formal mathematical language.

It is often advisable to give an easy example for the problem at the beginning of this part. If the problem given in the example cannot be solved using existing techniques or the existing solutions show severe disadvantages, then this is usually a strong motivation for the reader to study the paper. Do not forget to come back to the solution of this introductory example later at the end of this part, where further (even more difficult) examples may be presented.

The choice of *good examples* is very important for the success of a paper. Try to consider the following guidelines:

- The example should be *simple enough* such that the problem and its solution can be described with reasonable effort.
- The example should be *difficult enough* such that it becomes clear that the problem is non-trivial.

The exact presentation for users is what for software is typically called ‘‘user manual’’.

4.5.4.5 Detailed Presentation for the Insiders

This part of the paper is intended for ‘‘insiders’’, who want to completely understand the contents of the paper and who maybe want to contribute to the topics presented in the paper. It must therefore contain *all details* and it must be formally correct. This part must contain enough detail so that the reader can check the correctness of the paper. In addition, also an informal explanation of the key ideas may go into this part. When appropriate, this part may contain details on the implementation of an algorithm, complexity of the method, etc.

The exact presentation for insiders is what for software is typically called ‘‘reference manual’’.

4.5.4.6 Conclusion

The final part of a paper is typically a section called the ‘‘conclusion’’, which contains a summary of the most important achievements contained in the paper. In contrast to the abstract, the conclusion is meant for a reader who has already read the paper, whereas the abstract is meant for potential readers who want to decide whether they should read the paper. Typical issues addressed in the conclusion are the review of important points, plans for future research, open/related problems, or an assessment of strengths and weaknesses of the content described in the paper.

4.5.4.7 Appendices

The most important appendix is the list of referenced literature, see also the section on ‘‘Documenting Used Literature’’ above. If source code of some computer-implementation of an algorithm should be part of the paper, then it is usually put as an appendix, not as part of the main part of the paper.

4.5.5 Structuring Text

Analysis of the readership ✓
Specification of goals ✓
Collecting material ✓
Structuring the paper ✓

4.5.5.1 Chapters, Sections, and Subsections

The logical structure should be reflected in the textual structure of the paper in the form of chapters, sections, and subsections. Try to choose telling chapter/section/subsection headings. The reader should recognize from the size/face of the heading whether it is a chapter/section/subsection heading. A decimal numbering scheme for chapters/sections/subsections may often be helpful for clarifying the structure.

4.5.5.2 Paragraphs, Sentences, and other Means for Structuring Text

Paragraphs are the next finer level for structuring text. They are used for marking the flow of ideas. Usually, one paragraph does not contain more than one idea. Paragraphs should be easily recognizable, one either uses indentation of the first line in a paragraph, or one adds additional spacing between paragraphs.

As a general rule, try to use *short sentences*. It is often advantageous to use indentation within sentences in order to reflect the structure. The indented textblocks are often accompanied by certain symbols (e.g. •, ○, □, etc.) or numbers at the beginning in order to indicate some enumeration-like structure. Consider the following example: ‘‘The operation of substitution has three arguments: an expression e in which the substitution takes place, a (free) variable x for which a term should be substituted, and a term t which is substituted for the variable.’’. Using indentation, this sentence could be written in one of the following styles:

‘‘The operation of substitution has three arguments:

an expression e in which the substitution takes place,

a (free) variable x for which a term should be substituted, and

a term t which is substituted for the variable.’’

‘‘The operation of substitution has three arguments:

- an expression e in which the substitution takes place,

- a (free) variable x for which a term should be substituted, and
- a term t which is substituted for the variable.''

''The operation of substitution has three arguments:

1. an expression e in which the substitution takes place,
2. a (free) variable x for which a term should be substituted, and
3. a term t which is substituted for the variable.''

Important short parts within sentences can be emphasized using *italics* or **bold face**. Another possibility to structure text is the use of footnotes. However, footnotes tend to destroy the flow of reading, therfore it is often better to restructure the sentences such that footnotes are not anymore necessary.

4.5.5.3 Text and Formulae

A mathematical paper usually consists of *formal parts* (definitions, theorems, proofs, etc.) intermixed with *informal parts* (explaining text, comments, etc.). The beginning of a formal part is usually marked by some keyword such as ''Definition'', ''Theorem'', or ''Proof'' accompanied by an optional label or a numbering (usually this is omitted in case of ''Proof''). In case of short papers one usually uses simple ascending numbering, for long papers or books one often uses composite numbers composed of chapter and/or section number and an ascending numbering within the chapter or section. Some others prefer to have seperate numbering for definitions, theorems, etc. (Definition 1, Theorem 1, Lemma 1, Lemma 2, Definition 2, Theorem 2, Lemma 3, …), whereas others prefer to use only one numbering for all formal entities (Definition 1, Theorem 2, Lemma 3, Lemma 4, …). Both have their advantages.

Numbers and labels are used for refering to the respective formal part, i.e. one may later refer to a certain theorem by ''… by Theorem 1 …''. One might consider to use ''semantic labels'' such as ''Theorem (Limit of Continuous Function)''. One may then refer to this theorem by ''… by the theorem on the limit of continuous functions …''. Often a combination of decimal numbering with semantic labels such as ''Theorem 5.28 (Limit of Continuous Function)'' may be the most helpful for the reader. One would refer to this theorem then typically by ''… by Theorem 5.28 on the limit of continuous functions …''.

If it seems unclear where a formal part ends, then use some marker to clearly separate formal from informal parts. The end of a proof is usually marked by ''□'' or ''q.e.d'', but also for long definitions it might often be useful the explicitely mark where they end.

Both within formal and informal text there might occur mathematical formulae. Usually, important formulae are written on a line for themselves (displayed formulae), whereas less important formulae are written within the running text

(inline formulae). Within a formula, mathematical symbols denoting constants or variables are written italics, e.g. $f[x] > a$, except for known function constants such as "sin", "exp", "log", etc. In most of the cases formulae do not stand on their own but they are embedded in natural language text. In such situations, be careful that the formula acts as a correct part of the sentence! In particular, punctuation (".'' and ",") must be used appropriately, even if it is a displayed formula, e.g. "in this case, we have

$$f[x] < \log[a] \text{ ."}$$

(Note that one leaves some additional space before the punctuation in a displayed formula!) Try to avoid inline formulae as the beginning of a sentence, in particular if the formulae consists of only one letter, e.g. "some text. A stands for the area …" would be easier to read if written as "some text. Let now A stand for the area …".

Formal parts should not be embedded into running text. Don't write "We will later need

Theorem 2 …"

Instead, write some thing like "We will later need the following important result.

Theorem 2 …"

Different inline formulae within one sentence should be separated by words in order to avoid ambiguities, e.g. " for all i and for all $j \in A$" is better than "for all $i, j \in A$". Use mathematical symbols only inside formulae, don't use them for abbreviating natural language text, e.g. don't write "… from Lemma 2.1 we know that $\exists$ an $\epsilon > 0$ such that …". The abuse of "$\Rightarrow$" as abbreviation for the expression "from … we can infer …" on the meta-level (see Lecture "Predicate Logic as a Working Language") falls into the same category.

After reading several mathematical texts you will get some feeling on what the habits in the community are. Much is, of course, personal taste but much of the commonly used styles has developed over the years and there are good reasons why certain things are written in a certain style. Try to *develop your personal style*! Try to *copy the good things* that you see from other authors! Try to *avoid the bad things* that you detect in other authors' writing!

4.5.6 Technical Matters

Whatever tool you want to use for preparing a mathematical paper, try to concentrate on the logical structure of the paper, not on the optical appearance! A clear logical structure will *automatically* result in a well-structured appearance.

4.6 Giving Mathematical Talks

This section is still to be written …

4.6.1 Analysis of Audience

4.6.2 Specification of Goals

4.6.3 Preparation of the Talk

4.6.4 The Presentation

4.6.5 Analysis of Success