3.7.3 The Use of English

Given the importance of English as a basis for technical communication accepted worldwide I recommend to write all technical papers in English. As a matter of fact, papers written in other languages only get a small fraction of the international attention English papers obtain. Authors of non-English papers mostly become very frustrated when they learn that their results are not known and have been re-invented by others without any reference to their non-English paper.

Some people find this dominance of English quite unacceptable. They desperately try to ignore it and sacrifice the success of their papers for the idea that all scientists in the world should know many (natural) languages. Personally, I also would welcome if scientists learned more languages. However, I think one must accept facts and there is no question about the fact that — by simple laws of economy — it is by far more economic to translate from many languages into one "intermediate language" (English) than to translate from each language into every other.

3.7.4 Style of English Text

There are some questions of style that are specific for technical papers and, hence, can be discussed in this book without going into subtle discussions about aesthetics.

3.7.4.1 The Use of "I", "We", "One", Passive

In technical papers there are two different situations that must be distinguished by appropriate style:

1. passages in which *known results* from the literature are reported and
2. passages in which the author reports his own *original results*.

In passages about known results one should use "one", passive voice, neutral subjects or the polite "we" that gives the reader the impression that one composes the material in a joint effort. In passages about original results one can use "we" or, in exceptional situations, "I".

Example: A typical text containing both situations: "In ... a method for reducing this problem to solving an algebraic system is described. This method proceeds as follows: .... The proof is divided into two parts: .... In the following sections we present a new method that avoids .... Personally, I am not convinced that ...." □

It is embarassing if *known results* are presented in a style that leads the uninformed reader to the conclusion that the author of the paper has invented the results. Some authors are very careless in this respect and it is surely not acceptable if the style of a paper leads to wrong conclusions about the origin of the results. The use of "I" or "we" at the wrong places comes close to plagiarism.

It is also embarassing if one tries *to make things seemingly easy* or "pedagogically presented" by using "we" and "our" or "mine" for creating a feeling of intimacy when speaking about mathematical object, steps of a proof etc. For example, some people are tempted to speak about "our set S" when they have managed to introduce an arbitrary but fixed S or they speak about "our lemma ..." when they decomposed the correctness proof for Euclid's algorithm into two easy lemmas etc.

I also strongly *recommend against using "you"* except in some situations (for example, in programming manuals) where you (!) really want to express the feeling that the reader should be guided by easy instructions. In my opinion it is unpolite if one addresses readers (or the audience) by "you" in situations where, by doing so, one forces the reader to take a position in a controversy. For example, one often will hear or read sentences of the kind: "If you attempt to solve this problem by a straight-forward application of ... you will be surprised by .... You rather should ...." The reader might never have had the desire to solve the problem by a straight-forward application of .... In fact, the reader might be much more sophisticated than the author. By using "you" in such situations the author puts the reader into the position of a person who must be educated or, even worse, just is about to commit a mistake.

"I" should be used only where one really wants to stress the personal contribution or, alternatively, one wants to take complete responsibility for an opinion, proposal etc. For exmample, in the paragraph above I said "I also strongly recommend againgst ..." because I know that other people have a very different opinion about this and I do not want to create the impression that my personal opinion should be taken as a rule.

In most cases, using "one", passive voice, neutral subjects (e.g. "the proof proceeds by ...") and "we" according to a natural feeling for style is a save basis for formulating technical papers. *Since "we" is ambiguous* with respect to the distinction between known and new results one has to be careful not to use it in situations where the reader might get the impression that an already known result is due to the author. In such situations it is particularly important to explicitly explain the status of results, whether they are known or new (see the "claim of originality" explained earlier).

3.7.4.2 Parallelism and Variation

For writing prose, it is generally accepted that one should try to vary the choice of words. This is, of course, also true for the passages of a paper that are real prose. However, in technical papers. passages in natural languages very often are quite technical too. In such situations it is much better if one stays with certain patterns if one wants to express similar facts ("*parallelism*") because the objective is that the reader easily gets the common pattern rather than to be entertained with a variety of possible ways to express the same pattern.

Example: "The first case divides into the following subcases: .... The second case divides into the following subcases: ...." This is better than to say: "The

first case divides into the following subcases: .... We now consider the subcases of the second case. ...."

3.7.4.3 The Use of Particular English Words and Phrases

We compile some English words and phrases whose usage is specific for technical papers.

Which and That as Relative Pronouns As a relative pronoun, when should one use "which" and when "that"? In fact, for mathematicians it is quite easy to decide this question.

1. A "that" clause (without comma!) is used for defining a *subset* of a given set.
2. A ", which" clause (with comma!) is used for defining *another (non-restrictive) property* of a given set.

Example: "The words that can be derived by application of these rules ...." (Set: the set of words. Subset: those that can be derived by the rules.) " "These are the rules one should follow, which are also accepted by other committees." (Set: the set of rules. New property: they are also followed by other committees.) □

In fact, situations where "that" is appropriate are much more frequent than the ", which" situations and one should be very cautious with the use of ", which" as a relative pronoun. Also, ", which" may be replaced by ", that" (with comma!). Another easy test for identifying situations in which one should use "that" is to see whether one can reformulate the sentence by saying "those x that satisfy ...".

Don't, Aren't, Won't Don't (!) use the colloquial versions "don't, aren't, won't" etc. in technical papers. Always use "do not, are not, will not" etc. An exception are manuals etc. where one wants to convey a certain feeling of personal assistance. In manuals, the written text replaces a human guide.

Frequent Misspellings and Wrong Usage

correct	*wrong*
proceeding	proceding
preceding	preceeding
occurrence	occurence
its size	it's size

to be continued

3.7.4.4 British Versus American English

There are certain small differences in American and British spelling and usage of words. It is a matter of taste whether one chooses the American or the

British variant. However, one should stay with one variant in a given paper. (For German writers the following is a booklet that summarizes the differences between American and British English: Bernd Rink, *Amerikanisch compact"*, Max Hueber Verlag, München, 1977.)

3.7.5 Correctness and Style of Formal Notation

3.7.5.1 Correctness of Notation

Mathematical and computer science notation must follow strict rules that derive from the underlying logic (which most frequently is some variant of predicate logic). A complete mastery of logic is indispensable for choosing a good notation on which proofs can be based. For details see the chapter on proving.

3.7.5.2 Choice and Style of Notation

It pays off if one spends significant time on choosing good notation. An appropriate notation

1. is sometimes a key step in mathematical invention,
2. can save a lot of time when writing, and
3. may save considerable time for understanding.

A careless choice of notation at the beginning may result in endless rewritings later.

A good notation should combine two objectives:

1. it should be totally *in accordance with the laws of logic*,
2. it should be *as pictorial as possible* or, at least carry as much semantics as possible.

Ideally,*symbols* (for the function and predicate constants in the sense of logic) should be chosen in such a way that they reflect the corresponding operations or relations by *simplified drawings*. This will greatly facilitate inventing and understanding. Not always will it be possible to characterize the underlying operations and relations by simplified drawings. Then, at least, the identifiers used as function and predicate constants should convey as much of the semantics as possible. It becomes more and more common (in software technology but also in mathematics) to use quite long words as function and predicate symbols.

Example: Here is a piece of mathematical text that introduces some notions and corresponding pictorial notation for speaking about reduction relations:

"For reduction relations $\rightarrow$, the following additional notation is used: $\leftarrow$ is the inverse relation to $\rightarrow$. $\leftrightarrow$, $\rightarrow^+$, $\rightarrow^*$, $\leftrightarrow^*$ are the symmetric, transitive, reflexive-transitive and reflexive-symmetric-transitive closure of $\rightarrow$, respectively. Furthermore:

$$a \rightarrow \quad \text{iff} \quad a \rightarrow b \text{ for some } b$$

(read: "a is reducible (w.r.t. $\rightarrow$)").

$\underline{a}$ iff $a \to b$ for no b (i.e. not $a \to$)
(read: "a is irreducible" or "a is in normal form").

$a \leftrightarrow^* (\prec d) b$ iff for some $e_0 \leftrightarrow e_1 \leftrightarrow e_2 \leftrightarrow, \ldots, \leftrightarrow e_{n-1} \leftrightarrow e_n = b$
and $e_0, e_1, \ldots, e_n \prec d$
(read: "a and b can be connected below d").

The notation is used quite flexibly: for example, "$a \to^* d \leftarrow^* b$" is an abbreviation for "$a \to^* d$ and $d \leftarrow^* b$". ..." □

One should try to be very systematic in introducing variable identifiers etc. Always think about how the reader can save most time, is least distracted, has to keep as little as possible in his memory, etc.

Example:

Good:	*Bad:*
$f_i < f_j$ if $i < j$	$f_i < f_j$ if $j > i$
$s_1.x_1 + s_2.x_2$	$s.x_1 + t.x_2$
the mth and nth element	the nth and mth element

...

3.7.5.3 Drawings

One should take any opportunity to train one's skill in presenting complicated problems, theorems, methods, proofs in simple drawings. "A picture is more than thousand words". This is particularly true for mathematical and computer science papers.

Important principles for making good mathematical drawings are:

1. *Emphasize the important* features,
2. *Omit inessential* details.
3. A drawing should describe an instance of the problem that is *simple enough* not to be confusing by complexity,
4. A drawing should describe an instance of the problem that is *complicated enough* not to be misleading by special properties that may hold only in simple cases.

3.8 Technicalities

3.8.1 Typing

It is recommendable to train oneself in using ten fingers for typing. The following page shows the system. I found that the quickest way of learning to type with ten fingers is to choose a text one is obliged to type (not some toy text!)

and to use ten fingers systematically according to the system shown. At the beginning one will be much slower that with the "two finger system". Soon, i.e. after 5 - 6 pages, one will detect that one becomes faster than with the "two finger system". From then on one has an advantage for the rest of one's life.

3.8.2 Word Processors

As a tendency, all technical papers are written on text processing systems. For details about such systems one must consult the respective manuals. Basically, there are two design philosophies for such systems:

1. WYSIWYG (What You See Is What You Get) systems,
2. Markup systems.

In WYSIWIG systems one composes the text on the screen exactly in the form it will appear when printed. In Markup systems one types the text in any format on the screen and has to include some extra information about the logical structure of the text and some printing parameters. WYSIWIG systems have the obvious advantage that one immediately sees whether one is satisfied with the appearance of the printed text. Markup systems (like TEX) have the advantage that one can concentrate on the logical structure of the text and the system will take care of all technicalities of composing the actual printed version.

A particularly helpful effect of using such systems is that they support a structured approach towards writing. With these systems one is guided to structure one's ideas systematically, to make rough sketches of the overall structure, to refine the structure, to sketch the text, to revise it several times until it finally meets one's expectations.

Some people prefer to compose the text while using a word processing system. Others like to write a first draft by and on paper. I think that, normally, formulae will be sketched before written into the text processor whereas natural language text might preferably be composed directly while using the word processor. However, basically, all this will depend on personal taste and preferences.