A load of stylistic advice for technical writing

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Agenda

Basics

Good writing and good ideas

- good writing is essential in a dissertation, but it cannot compensate for paucity of ideas or concepts
- a clear presentation actually exposes weaknesses

Basics

Clarity

- each sentence in a dissertation must be complete and correct in a grammatical sense
- writing must be crystal clear

Basics

Clarity

- shades of meaning matter: terminology and prose must make fine distinctions
- the words must convey *exactly* the meaning intended

Basics

Pitfalls

a dissertation must satisfy the stringent rules of formal grammar, and avoid:

- contractions, such as "not" for "-n't", "have" for "-'ve"
- colloquialisms, such as "old as the hills", "raining cats and dogs", "dead as a doornail", etc.
- slang, "cool" and "hot"
- undefined technical jargon,
- hidden jokes

Basics

Technical terms

- each technical term used in a dissertation must be defined:
  - a reference for standard terms
  - a precise, unambiguous definition that appears before the term
- each term should be used in one and only one way throughout the dissertation
- the introduction can give the intuition of terms, provided a precise definition is given later

Grammar and style

Style

- avoid adverbs: "mostly, they are very often overly used"
- use strong words: "writers abuse adverbs"

Grammar and style

Style

- use the active voice: "the operating system starts the device", not "the device is started by the operating system"
- avoid future tense: "the system writes a page to the disk and then uses the frame ..." instead of "the system will use the frame after it wrote the page to disk ..."

Grammar and style

Sentence structure

- negation early: "no data block waits on the output queue" instead of "a data block awaiting output is not on the queue"
- be careful that the subject really does what the verb says: "RPC requires programs to transmit large packets" is not the same as "RPC requires a mechanism that allows programs to transmit large packets"

Grammar and style

First person

- the author is invisible, and talks from the perspective of the done work: "we were surprised to learn" is never said
- no first person: "I will describe" should be "Section 7 describes"

Moral judgements

Amoral assessment

- no moral judgements such as "true, pure, bad, good, nice, terrible, stupid"; things are "correct/incorrect"
- quality assessments are done precisely: "method A requires less computation time than method B"

Moral judgements

No qualitative judgements

- avoid qualitative judgements such as "better/worse"
- "obvious, clear, simple" is vague and often slightly insulting
- nothing is "perfect", or "an ideal solution"

Moral judgements

Minor mistakes

- "a famous researchers" is never relevant; also, do not prejudice the reader
- "commercial success" is never relevant; also, do not prejudice the reader
- "hopefully": hope has no place in science
- "should": who says so?

Precision

Minor mistakes

Precision is of paramount importance in science:

- "few, most, all, any, every" are not precise enough
- "all, any, every" are almost always false

Precision

Minor mistakes

Precision is of paramount importance in science:

- "most computer systems contain X": are you sure you really know the facts? How many computers were built and sold yesterday?
- For example, did you know that books sell more than films or music *combined*?

Precision

Minor mistakes

- "today, modern times" are tomorrow's yesterday
- "soon" means nothing: it is true now, or it is irrelevant

Precision

Minor mistakes

- "seems, seemingly, would seem to show": appearances do not matter; facts and substance do
- ...unless you are making a point to ensure the reader does not fall into an intuitive trap

Precision

Minor mistakes

- "in terms of, based on" is usually too vague
- "in light of" is too colloquial

Precision

Minor mistakes

- "lots of, kind of, type of, just about, something like, number of, due to, probably" are too vague and colloquial

Precision

Risky constructs

- "actually, really" often imply imprecision; restructure so as to avoid the need for clarification

Precision

Risky constructs

- "this, that" can refer to too many things: "X does Y. This means ..." Y? does?
- "proof, prove, show" would a mathematician agree? (show = prove)
- "can/may"; "the algorithm can compute the F of X up to ten thousand elements ..."; "a user may choose option A or option B"

Principles to adhere to

Core principles of correct scientific writing

- **Correctness.** Write correct English, but know that you have more latitude than your high-school English teachers may have given you.
- **Consistent names.** Refer to each significant character (algorithm, concept, language) using the same word everywhere. Give a significant new character a proper name.
- **Singular.** To distinguish `one-to-one` relationships from `n-to-m` relationships, refer to each item in the singular, not the plural.

Principles to adhere to

Core principles of correct scientific writing

- **Subjects and verbs.** Important characters in subjects; join each subject to a verb that expresses a significant action.
- **Information flow.** In each sentence, move from familiar information to new information.
- **Emphasis.** For material you want to carry weight or be remembered, use the end of a sentence.
- **Coherence.** In a coherent passage, choose subjects that refer to a consistent set of related concepts.
- **Parallel structure.** Order your text so your reader can easily see similar/different concepts.

Practices to follow

Behaviours that lead to better texts

- Write in brief daily sessions. Ignore the common myth that successful writing requires large, uninterrupted blocks of time.
- Focus on the process, not the product. Do not worry about the size or quality of your output; instead, reward yourself for the consistency and regularity of your input.

Practices to follow

Behaviours that lead to better texts

- Prewrite. Do not be afraid to think before you write, or even jot down notes, diagrams, and so on.
- Use index cards. Use them to plan a draft or to organize or reorganize a large unit like a section or chapter.
- Write a *Shitty First Draft* ^{TM}. Value a first draft not because it is great but because it is there.
- Do not worry about page limits. Write the paper you want, then cut it down to size.

Guidelines

Supplementary useful guidelines

When explaining new concepts in science and engineering:

- enumerate all the properties of the thing
- say whether the thing is completely characterized by those properties
- give a name or symbol to each property
- give the type/kind of each property
- explain relationships that hold among the properties, and what forces them to hold

Guidelines

Supplementary useful guidelines/2

Examples help a lot when explaining complex concepts.

- Do you have examples? They are helpful, and they should
  - Be plentiful
  - Use parallel structure
  - Be connected to each other when possible

  Ideally a single running example appears in each section of the manuscript (supplemented by additional examples.)
- Every general, abstract declaration is illustrated by an example

Guidelines

Supplementary useful guidelines/3

When presenting complicated technical abstractions:

- You may well have a nest of interrelated concepts
- Sometimes there is no obvious order of presentation
- Make simplifications for pedagogical purposes (and announce them)
- Mention a concept without defining it ("Let's assume that `l` is a location on the stack, without going into the details, which are in Section *12*.")

Guidelines

Supplementary useful guidelines/4

When presenting complicated technical abstractions:

- Types help. Give the type of every operation
- Explain the name of each variable or Greek letter; for example, explain that Γ stands for a parsing environment

Problem statement

Finding the problem

- a thesis identifies a *worthwhile* problem or question
- a (thorough) review of the existing literature on the subject shows your question to be original and valuable

Problem statement

Highlighting the problem statement

- the research question should be stated *as clearly as possible*

Thesis goals

Central concerns

- a thesis is a hypothesis or conjecture
- two important adjectives are "original" and "substantial"

Scientific methodology

Methodology

- describe your scientific methodology, and why you have chosen it

Scientific methodology

Process

- start with a hypothesis, and then collect evidence to support or deny it
- the most difficult part of a dissertation is the organization of the evidence and associated discussions into a coherent form

Scientific methodology

Methodology

- the facts that result from an experiment are called "data", the useful information condensed from the data is the resulting "knowledge"
- the aim of a thesis is always knowledge

Scientific methodology

Goal

- a dissertation concentrates on principles: it states the lessons learned, and not merely the facts behind them
- this requires an effort in generalization; *what useful bit of understanding comes from the results?*

Scientific methodology

Methodology

- the essence of a dissertation is *critical thinking*, not experimental data
- analysis and concepts form the heart of the work

Dangers

Challenges to proper science

- separate cause-effect relationships from statistical correlation
- "pirates absorb C02"
- `http://www.forbes.com/sites/erikaandersen/2012/03/23/true-fact-the-lack-of-pirates-is-causing-global-warmin`

Dangers

Challenges to proper science

- only draw warranted conclusions: "the same game on an XBox One is faster than on a PS4, therefore the PS4 is worse than the XBox One"
- may depend on implementation, language, runtime, OS, etc.

Dangers

Challenges to proper science

- even if the cause of some phenomenon seems obvious, one cannot draw a conclusion without solid, supporting evidence
- do not hide reliability problems with your testing methodology; your resources are constrained, so random samples or extensive tests may not be feasible
- reasonable choices and honesty are always appreciated

Results, results, results!

Strict exposition of results

- focus on results, not people or circumstances
- "after eight hours of tests, Jim and I discovered the results now in Table 3"
- "if that cat had not crawled through the hole in the floor, we might not have discovered the power supply error indicator"

Results, results, results!

Strict exposition of results

- avoid self-assessment, such as "we present a major breakthrough in the design of distributed systems", or "although the technique in the next section is not earthshaking, ..."

Results, results, results!

Each statement works well

- each statement in a dissertation must satisfy the most stringent rules of logic applied to mathematics and science

Results, results, results!

Principles of knowledge

- have a basis for all statements; either original work, or a reference to scientific literature
- references should only be interested in others' results, not their methodology or analysis

Results, results, results!

Sociality and science

- never draw conclusions about economic viability or commercial success; "over four hundred vendors make products using technique Y" is irrelevant in a dissertation
- it does not matter whether government bodies, political parties, religious groups, or other organizations endorse an idea
- it does not matter who discovered something: a first year graduate student or a Nobel-prize winner

Comparisons

On the shoulders of giants

- a thesis should contain a chapter about what other people have done in the same or similar areas

Comparisons

On the shoulders of giants

- some web pages and wikipedia articles contain very scientifically sound information. Refer to them, possibly through *WebCite*

Comparisons

On the shoulders of giants

- all references *must* be referred to in the main body of the thesis
- do not use footnotes for references

Comparisons

Problem statement references

- you should *demonstrate* that the question has not been answered already and that it is worth answering
- interestingly, it is easier to answer the question than to discuss it, as you will become familiar with the details of the solution by working on it
- the question is harder to reason about since it stems from your intuition

Comparisons

No plagiarism

- avoid plagiarism at all costs; clearly specify every text you have quoted from someone else, and never use other people's text without indicating the source
- it is *exactly* a form of stealing; you are stealing someone else's hard work and using it to achieve your own personal results

Funnel

Funnel structure

- introduction (broadest, intuition)
- problem (still broad, precise)
- solution (narrow, specific to the problem, precise)
- assessment (narrowest, specific to the solution, very precise, analytic/synthetic)

Writing strategy

From the intuition to the details

- prepare an extended outline, one or two sentences for each chapter/section

Writing strategy

From the intuition to the details

- write the problem statement and assessment methodology first, then go to your supervisor
- without these, he cannot determine if your thesis will work or not!

Broader issues

Not all theses are very good

Many theses are accepted even though they are not very good because:

- they are too long
- there is too much well-known information on the field, such as tutorials or user guides
- they are too short
- they contain detailed transcripts of data
- they leave you wondering "so what?"

Remember your audience

Your thesis is read by people

Answer the following supervisor questions with your thesis:

- what is the student's *research question*?
- is it a good (*open*, *novel*, *relevant*) question?
- did the student convince me that the question was *adequately answered*?

Clarity and knowledge

Just remember

- it is impossible to be too clear, so spell things out carefully
- tools such as computer programs are fine and useful products, but the most important item of all is the ideas embodied by the tool, not the tool itself
- remember that the purpose of your thesis is *knowledge*

This is it

Thank you!