Research Methods Technical Writing

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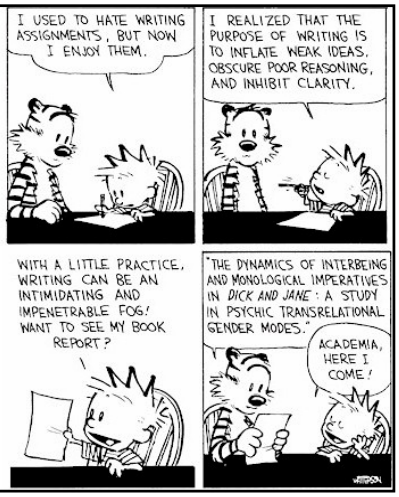
Outline

Approaching Writing
Getting Published
Some Key Elements of Technical Style
Your Report (1 slide)
A Conference Paper



Why Learn to Write Well?

It takes lots of practice, so why bother?
- Because it is one of the most valuable life-long skills

Most CS careers require writing:
- Research - proposals, research notes, literature surveys, paper reviews, conference and journal papers, theses
- Industry - code comments, documentation, reports, memos

The purpose is communication not obfuscation

How to begin?

Bottom-up
- Describe details and link them together
- Leads to unstructured mess

Top-down
- Start with structure and flesh out
- Leads to shifting structure as you progress

Bi-directional
- Write notes as you do research (bottom-up)
- Then structure your thesis/paper around a message (top-down)
- Then fill in the structure with details (bottom-up)

High-level Issues

Your writing should have a message
- An argument (hypothesis) for which your research provides evidence
- Message must be reflected in the title, abstract, introduction, conclusion and body of your writing

Aiming to be understood is not sufficient:
- Write so that you cannot be misunderstood
- Assume your audience is intelligent but (a) ignorant and (b) given to willful misunderstanding
- State key ideas transparently, prominently and often

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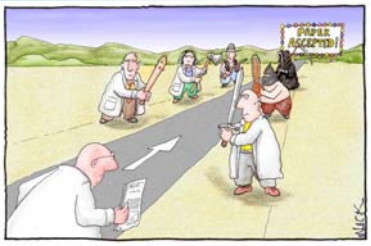
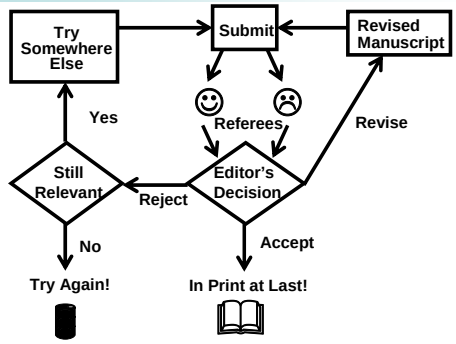
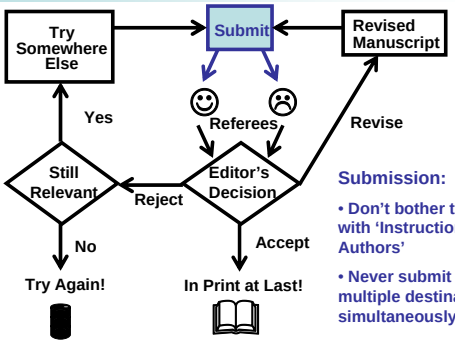


Most scientists regarded the new streamlined peer-review process as 'quite an improvement.'

Getting Published — The FlowChart



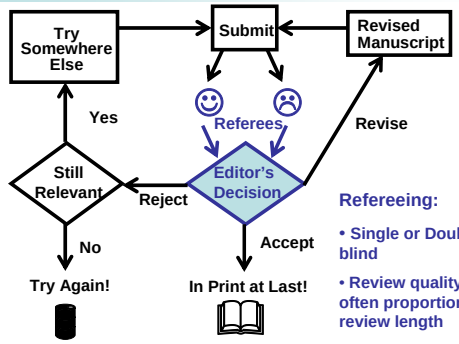
Submission



Submission:

- Don't bother too much with 'Instructions to Authors'
- Never submit to multiple destinations simultaneously

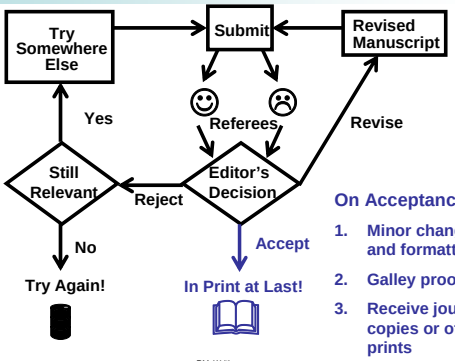
Refereeing



Refereeing:

- Single or Double blind
- Review quality is often proportional to review length

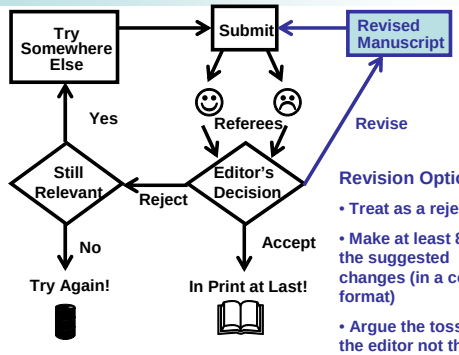
Acceptance



On Acceptance:

1. Minor changes and formatting
2. Galley proofs
3. Receive journal copies or off-prints

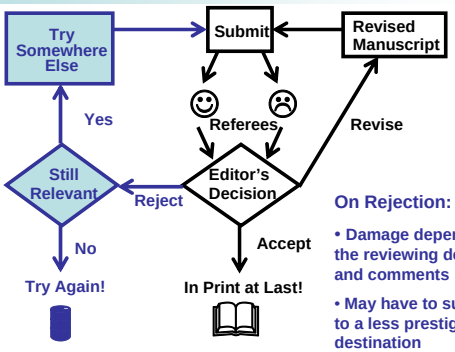
Revision



Revision Options:

- Treat as a rejection
- Make at least 80% of the suggested changes (in a collage format)
- Argue the toss (with the editor not the reviewers)

Rejection



On Rejection:

- Damage depends on the reviewing delay and comments
- May have to submit to a less prestigious destination

Outline

Approaching Writing
Getting Published
Some Key Elements of Technical Style
- **Citations**
- **Third Person**
- **Tense**
- **Conciseness**
- **Flow of Ideas**

Your Report (1 slide)
A Conference Paper

Source: W. Hopkins, "Guidelines on Style for Scientific Writing", Sports Science, 3(1), 1999

Basic stuff

Submit by the deadline
Keep to the length restrictions
- Do not narrow the margins
- Do not use 6pt font
- On occasion, supply supporting evidence (e.g. experimental data, or a written-out proof) in an appendix

Always use a spell checker

Visual structure

Give strong visual structure to your paper using
- sections and sub-sections
- bullets
- italics
- laid-out code

Find out how to draw pictures, and use them

Citations

Serve to:
- Acknowledge the work of others
- Direct the reader to additional sources of information
- Acknowledge conflicts with other results
- Provide support for the views expressed in the paper
- Broadly, place a paper within its scientific context, relating it to the present state of the art

An unsupported statement
- Sure sign that either a reference is needed or a supporting argument

Citation Styles

There are many styles. Choose one and apply it consistently.
Example: ACM Style
- Journal — Anderson, R.E. Social impacts of computing: Codes of professional ethics. Social Science Computing Review 10, 2 (Winter 1992), 453-469.
- Conference — Mackay, W.E. Ethics, lies and videotape, in Proceedings of CHI '95 (Denver CO, May 1995), ACM Press, 138-145.
- Book — Schwartz, M. Guidelines for Bias-Free Writing. Indiana University Press, Bloomington IN, 1995.
- Citing in the text - [1] [3, 15]

Other styles include Harvard, IEEE

Exercise: Citations

- Place ACM-style citation labels in the following text where required:
  - "The field is well researched and Bechmann and Milliron et al. provide useful surveys. Typically, deformations are specified by manipulators, including parametric hyperpatches, points, curves, twisting frames and 2-1/2 D surfaces."
- Solution:
  - "The field is well researched and Bechmann [1] and Milliron et al. [2] provide useful surveys. Typically, deformations are specified by manipulators, including parametric hyperpatches [3, 4], points [5], curves [6, 7], twisting frames [8] and 2-1/2 D surfaces [9]."

Viewpoint Usage

Rule (made to be broken):
- Never use the 1st person singular ('I')

Third person is preferred
- Not - "I found out when I ran pilot experiments that the initial design suffered from my personal bias."
- Rather - "On running pilot experiments it was found that the initial design suffered from experimenter bias."
- This often necessitates passive voice (subject last)

Use of 1st person plural ('We')
- Use (sparingly) where the sentence would otherwise become too contorted
- Even if you are the only author

Exercise: 3rd Person

- Convert to a technical viewpoint:
  - "As I approached the road that cut through the New River Mesa, I noticed that there were seven layers. Looking at the lowermost layer it seemed to me to be an arkosic sandstone."
- Solution:
  - "Where the road cut through the New River Mesa, seven layers were noticeable. The lowermost of these layers seemed to be an arkosic sandstone."

Use the active voice

- The passive voice is "respectable" but it DEADENS your paper. Avoid it at all costs.

NO	YES
It can be seen that...	We can see that...
34 tests were run	We ran 34 tests
These properties were thought desirable	We wanted to retain these properties
It might be thought that this would be a type error	This might seem like a type error

"We" = you and the reader

"We" = the authors

Use simple, direct language

NO	YES
The object under study was displaced horizontally	The ball moved sideways
On an annual basis	Yearly
Endeavour to ascertain	Find out
It could be considered that the speed of storage reclamation left something to be desired	The garbage collector was really slow

Reminder: Tense

Tense shows position in time (past, present, future)

Types:
- Simple (most basic)
- Continuous (ongoing)
- Perfect (completed)
- Perfect continuous (ongoing actions that will be completed at some definite future time)

	Simple	Continuous	Perfect
Past	explored	was exploring	had explored
Present	explore/s	is exploring	has explored
Future	will/shall explore	will be exploring	will have explored

Tense Usage

Present Simple and Perfect predominate in scientific writing:
- The work exists now and is timely but may have started in the past
- Example - "From-point visibility algorithms are less costly computationally than from-region approaches"

Except:
- Use past tense to report results. E.g., "in our experiments we found that …"
- But use present tense to discuss them. E.g., "a simple explanation of these findings is that …"

Exercise: Conciseness

- Reword the paragraph to make it concise:
  - "Virtually all experienced writers agree that any written expression that deserves to be called vigorous writing, whether it is a short story, an article for a professional journal, or a complete book, is characterized by the attribute of being succinct, concise, and to the point. A sentence--no matter where in the writing it occurs--should contain no unnecessary or superfluous words, words that stand in the way of the writer's direct expression of his or her meaning and purpose. In a very similar fashion, a paragraph--the basic unit of organization in English prose--should contain no unnecessary or superfluous sentences, sentences that introduce peripheral content into the writing or stray from its basic narrative line. It is in this sense that a writer is like an artist executing a drawing, and it is in this sense that a writer is like an engineer designing a machine. Good writing should be economical for the same reason that a drawing should have no unnecessary lines, and good writing should be streamlined in the same way that a machine is designed to have no unnecessary parts, parts that contribute little or nothing to its intended function."

Solution: Conciseness

"Vigorous writing is concise. A sentence should contain no unnecessary words, a paragraph no unnecessary sentences, for the same reason that a drawing should have no unnecessary lines and a machine no unnecessary parts."

- 34 words

Be careful not to overdo it. Some concepts need to be explained in detail.

Flow of Ideas (Cohesion)

At a sentence level
- One sentence linked to the next

At a paragraph level
- First sentence sets the topic
- No unlinked ideas in the paragraph

At a section level
- Outline first
- Don't repeat or contradict other sections

At a document level
- Create a logical and cohesive outline supporting the message
- Set the draft aside for a while, get other to read it

Outline

Approaching Writing

Getting Published

Some Key Elements of Technical Style

Your Report (1 slide)

A Conference Paper

Project Write-up: This is what determines your mark!

(Very Last) Abstract

1. *(Last)* Introduction: Aims, importance, outline
2. *(First & ongoing)* Background
3. *(Second)* Theory/Algorithms
4. *(Third)* Application of Theory/Algorithm Implementation
5. *(Fourth)* Experiment: Design + Results + Discussion of Results
6. *(Last)* Conclusion — Tie up with aims:

   "we said we would and we did", except (oops) some didn't work, and (wow) we found an amazing unexpected thing, but now we would do this … (future work)

Tell a story

Writing a Paper

The purpose of writing a research paper is to communicate your ideas to your peers
- This is more limited than the project research report or dissertation or thesis

Each paper must have a central idea
- With evidence to support it

How to write a great research paper
Simon Peyton Jones
Microsoft Research, Cambridge

The Idea:
A re-usable insight, useful to the reader

Figure out what your idea is

Make certain that the reader is in no doubt what the idea is. Be 100% explicit:

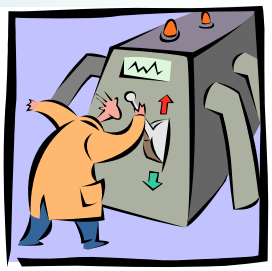
- "The main idea of this paper is...."
- "In this section we present the main contributions of the paper."

Many papers contain good ideas, but do not distil what they are.

The purpose of your paper is not...

To describe the WizWoz system

- Your reader does not have a WizWoz
- She is primarily interested in re-usable brain-stuff, not executable artefacts



Your narrative flow

Here is a problem

It's an interesting problem

It's an unsolved problem

Here is my idea

My idea works (details, data)

Here's how my idea compares to other people's approaches

Structure (conference paper)

- **Title** (1000 readers)
- **Abstract** (4 sentences, 100 readers)
- **Introduction** (1 page, 100 readers)
- The problem (1 page, 10 readers)
- My idea (2 pages, 10 readers)
- The details (5 pages, 3 readers)
- Related work (1-2 pages, 10 readers)
- Conclusions and further work (0.5 pages)

The abstract

Write the abstract last

Used by program committee members to decide which papers to read

Four sentences [Kent Beck]

1. State the problem
2. Say why it's an interesting problem
3. Say what your solution achieves
4. Say what follows from your solution

Abstract MadLibs!!

This paper presents a _____ (synonym for *new*) method for _____ (sciencey verb) the _____ (noun few people have heard of). Using _____ (something you didn't invent), the _____ (property) was measured to be _____ (number) +/- _____ (number) _____ (units). Results show _____ (sexy adjective) agreement with theoretical predictions and significant improvement over previous efforts by _____ (Loser), et al. The work presented here has profound implications for future studies of _____ (buzzword) and may one day help solve the problem of _____ (supreme sociological concern).

Keywords: _____ (buzzword), _____ (buzzword), _____ (buzzword)

Example

Many papers are badly written and hard to understand

This is a pity, because their good ideas may go unappreciated

Following simple guidelines can dramatically improve the quality of your papers

Your work will be used more, and the feedback you get from others will in turn improve your research

Structure

Abstract	(4 sentences)
Introduction	(1 page)
The problem	(1 page)
My idea	(2 pages)
The details	(5 pages)
Related work	(1-2 pages)

Conclusions and further work (0.5 pages)

State your contributions

Write the list of contributions first

The list of contributions drives the entire paper: the paper substantiates the claims you have made

Reader thinks:

- "wow, if they can deliver on this … I'd better read on"

Do not leave the reader to guess what your contributions are!

- "In this paper we …"
- "We explain precisely what … surprisingly this has not been done before"
- "… articulating this is one of our main contributions"

The introduction (1 page)

- Describe the problem
- State your contributions
- ...and that is all
- ONE PAGE!

Use an example to introduce the problem

Bulleted list of contributions

Contributions should be refutable

NO!	YES!
We describe the WizWoz system. It is really cool.	We give the syntax and semantics of a language that supports concurrent processes (Section 3). Its innovative features are...
We study its properties	We prove that the type system is sound, and that type checking is decidable (Section 4)
We have used WizWoz in practice	We have built a GUI toolkit in WizWoz, and used it to implement a text editor (Section 5). The result is half the length of the Java version.

No "rest of this paper is..."

Not:

"The rest of this paper is structured as follows. Section 2 introduces the problem. Section 3 ... Finally, Section 8 concludes".

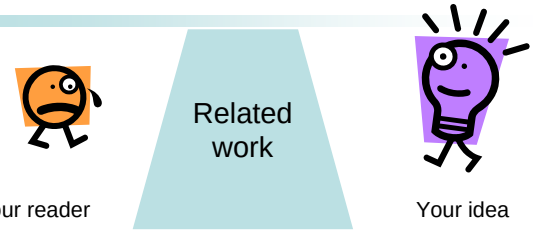
Instead, **use forward references from the narrative in the introduction**.

- The introduction (including the contributions) should survey the whole paper, and therefore forward reference every important part.

Structure

- Abstract (4 sentences)
- Introduction (1 page)
- ~~Related work~~
- The problem (1 page)
- My idea (2 pages)
- The details (5 pages)
- Related work (1-2 pages)
- Conclusions and further work (0.5 pages)

No related work yet!



We adopt the notion of transaction from Brown [1], as modified for distributed systems by White [2], using the four-phase interpolation algorithm of Green [3]. Our work differs from White in our advanced revocation protocol, which deals with the case of priority inversion as described by Yellow [4].

No related work yet

Problem 1: the reader knows nothing about the problem yet; so your (carefully trimmed) description of various technical tradeoffs is absolutely incomprehensible

Problem 2: describing alternative approaches gets between the reader and your idea

- BUT: Delaying the related work is unconventional
  - The *important* thing is to *design* your paper with your readers in mind.

Structure: The Body

Abstract	(4 sentences)
Introduction	(1 page)
The problem	(1 page)
My idea	(2 pages)
The details	(5 pages)
Related work	(1-2 pages)
Conclusions and further work	(0.5 pages)

Presenting the idea

3. The idea

Consider a bifurcated semi-lattice D, over a hyper-modulated signature S. Suppose pi is an element of D. Then we know for every such pi there is an epi-modulus j, such that pj < pi.

- Sounds impressive...but
- Sends readers to sleep
- In a paper you MUST provide the details, but FIRST convey the idea

Idea first — Details Second

Explain it as if you were speaking to someone using a whiteboard

Conveying the intuition is primary, not secondary

Once your reader has the intuition, she can follow the details (but not vice versa)

Even if she skips the details, she still takes away something valuable

Putting the reader first

Do not recapitulate your personal journey of discovery. This route may be soaked with your blood, but that is not interesting to the reader.

Instead, choose the most direct route to the idea.

The payload of your paper

Introduce the problem, and your idea, using

EXAMPLES

and only then present the general case

The details: evidence

Your introduction makes claims

The body of the paper provides **evidence to support each claim**

Check each claim in the introduction, identify the evidence, and forward-reference it from the claim

Evidence can be: analysis and comparison, theorems, measurements, case studies

Structure

Abstract	(4 sentences)
Introduction	(1 page)
The problem	(1 page)
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Related work

Fallacy To make my work look good, I have to make other people's work look bad

The truth: credit is not like money

Giving credit to others does not diminish the credit you get from your paper

- Warmly acknowledge people who have helped you
- Be generous to the competition. "In his inspiring paper [Foo98] Foogle shows.... We develop his foundation in the following ways..."
- Acknowledge weaknesses in your approach

Credit is not like money

- Failing to give credit to others can kill your paper
  - If you imply that an idea is yours, and the referee knows it is not, then either
    - You don't know that it's an old idea (bad)
    - You do know, but are pretending it's yours (very bad)

Structure

Abstract	(4 sentences)
Introduction	(1 page)
The problem	(1 page)
My idea	(2 pages)
The details	(5 pages)
Related work	(1-2 pages)
Conclusions and further work	(0.5 pages)

- (and add your references!)

Conclusions and further work

- Be brief.

(Our) Conclusion

- Technical writing is a skill: you must practice
  - Different from other forms of writing
- Deliver a coherent message
  - Identify your key idea
  - Use examples
- Make *your* contributions explicit

More advice:

- www-2.cs.cmu.edu/afs/cs.cmu.edu/user/mleone/web/how-to.html