

# How to Write

## Graduate Boot Camp

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- Technical writing is often drivel (synonyms: nonsense, twaddle, claptrap, balderdash, gibberish, rubbish, garbage):
  - Missing or incomprehensible main point
  - Impossible to follow organization and narrative
  - Paragraph and sentence structure that obfuscates meaning
  - Mystifying grammar and punctuation

 You can do better!

# Effective writing takes organization and effort

- *The writing aspect of scientific research is exhausting. . . I have rewritten many parts of papers four to six times, restructuring the entire organization, before I finally became satisfied.*
  - Hermann Helmholtz, as quoted in Alley (1996)
- *I'm done with the research. All I have left to do is write it up.*
  - the average graduate student

## **The Big Picture**

## General principles:

- Consider the big picture before dealing with details:
  - What are the key ideas?
  - What is the best way to make the argument?
- Review and revision are essential parts of the process:
  - For well written papers, much more time is often spent revising early drafts than in writing the early drafts in the first place.

**Before writing any text or starting to prepare a presentation, think about:**

- The *audience* of the document or presentation
- The *take-home message* of the document or presentation

**Most people never do this!!!**

- Write-before-think is similar to code-before-think.

## Who is going to read the document or listen to the talk?

- What is their *general level of expertise* about the topic area?
- What is their *specific level of expertise* about the topic area?
- It is particularly challenging to communicate effectively when there is wide variation in audience expertise.

## What are the audience expectations?

- About the topic
- About the *breadth* and *depth* of coverage
- About the style

## What is the *single* most important point you want to make?

- Decide on this *before* you start writing a document or preparing a presentation
- ... but note that take-home message may end up changing as you write!



## The effectiveness of technical communications depends in part on telling a compelling story

- *Narrative structure:*
  - Content (the “story”)
    - The key points to be made
  - Logical argument (the “plot”)
    - The order in which the arguments are made
- Engineers and scientists rarely think explicitly about the narrative structure of their writing

## One good way to start is by writing a *focus statement*:

- One paragraph briefly describing:
  - The problem being solved and its significance
  - The key principles associated with your solution to the problem
- It is best to write the first version of the focus statement *before* starting the research.
  - At this point, the key principles will be speculative.
  - The focus statement helps structure the work to be done.
  - Writing down an idea will make it better.
  - Attempting to write down a truly bad idea will often make it go away.
- Write new versions of the focus statement as needed.
  - Often multiple full rewrites are required as the work progresses.

## Write early and often.

- Outline
  - Most useful if:
    - It helps you to have a checklist of what needs to be written.
    - There are hard choices to be made in narrative structure.
- Background
  - Typically the part of the paper least affected by the results.
  - Helps focus research on original contributions
- Introduction
  - Helps focus research on principles, not just code and results.
  - Typically evolves during the conduct of the research.

## Budget time for writing

- Different schedules work best for different people.
  - You will need *lots* of time.
  - Try to focus on one section of the document at a time.

## Revise early and often

- Force yourself to write first drafts, even if they are not very good.
- Get used to the idea that your writing will need to be revised.
  - Some times, revisions involve relatively simple editing.
  - Often, good writing requires complete rewrites.

## **Use presentations as a way to try out ideas and narrative structure.**

- Frequent informal presentations to your research group are extremely useful.
  - Get feedback when it is most useful.
  - Attempting to explain an idea will (usually) make it better.
- Don't just describe incremental progress.
  - At least some presentations should be made as if no one in the audience is familiar with what you are working on.
  - This helps refine description of key points and narrative structure.

## **Make sure following questions have been answered:**

- *What problem was addressed in the work being described?*
- *Why is the problem significant?*
- *What existing work relates to this problem?*
- *What strategy was used to address the problem?*
- *How were potential solutions to the problem explored?*
- *How well did your solutions work?*
- *What lessons should be learned from this work?*

## What problem was addressed in the work being described?

- Emphasize the key aspects of the problem.
  - Details can hide the key points and so should come later.
- Don't conflate the problem and the solution.
  - Be particularly careful to avoid describing a solution in search of a problem!
  - ✗ "This paper describes a system that does XYZ."
  - ✓ "This paper describes a method that solves problem ABC."

## Why is the problem significant?

- The importance of your results depends in part on the importance of the problem that you are addressing.
- Significance can be practical or theoretical in nature.

## What existing work relates to this problem?

- A description of related work serves three very different purposes:
  - Provides background to the reader to help make sense of the rest of the paper.
  - Provides motivation for the approach taken to solving the problem.
  - Documents that the work described is original
    - Originality is a requirement in most research publications.
    - Exception: papers that are explicitly review articles.



## What strategy was used to address the problem?

- What is the *key idea* that allows a solution to the problem?
  - This is different from describing the system-building activities of the research.
  - What contribution is made by the research, beyond the artifacts that were created?
- A clear articulation of the key idea is the single most important part of the paper.
  - Don't force the reader to figure this out on his or her own!

## How were potential solutions to the problem explored?

- What was done to conduct the research?
  - System building.
  - Theoretical analysis.
  - Empirical experiment.
  -
- This is different from the strategy used to address the problem, which is a statement of principles.
  - Many papers contain only a description of what was done, without providing generalizable principles.
  - These papers rarely have significant impact!

## How well did your solution work?

- The results.
  - ... but to what purpose?
- Evidence that the strategy used to address the problem was in fact a good one.
  - Should be clearly separated from descriptions of system building.
  - Evidence can be empirical or theoretical.
    - Most computer science research includes at least some empirical evidence.
    - Empirical evidence needs to be methodologically sound.
    - Empirical evidence needs to be placed within the context of existing work.
- Which of the results are most likely to be useful to others?
- Were any of the results surprising?

## **What lessons should be learned from this work?**

- Ties together problem statement, existing work, approach, and results.
- Generalizes results to the degree possible.
- Points to possible future work.

## Reverse outline

- Bottom-up analysis of what you have written.
  - What does each sentence mean in isolation?
    - If you don't know, fix it!
  - What does each paragraph mean? What role does it serve in the story?
    - Write this down in the margin.
    - If a paragraph plays either no role or multiple roles, make a note.
  - Summarize in a sentence what each section actually says.
    - Do the paragraphs in the section tell a consistent story?
- 🗉 The reverse outline summarizes the paper as written, not as you *thought* you wrote it!

## Independent review

- Someone other than the primary author(s) should carefully read the manuscript.
- This needs to be done early enough to allow time for major revisions, if needed.

## **Building Blocks**

`http://www.indiana.edu/~wts/pamphlets/paragraphs.shtml`

## Content:

- A paragraph should express a single *controlling idea*.
  - Often described in a *topic sentence* that starts the paragraph.
- Each paragraph needs to be *coherent*.
  - All parts of the paragraph need to relate to the controlling idea.
    - ... and serve to further arguments supporting the controlling idea!
  - Coherence also requires that the paragraph tie in with preceding text and lead naturally to following text.
  - Coherence requires paragraphs of an appropriate length.



`http://www.indiana.edu/~wts/pamphlets/paragraphs.shtml`

## Structure:

- Introduction
  - Topic sentence
  - Necessary transition or background
- Body
  - Discussion of the key idea
- Conclusion
  - Summarize connections between key idea and discussion in body of paragraph

- “A reader will feel that a paragraph is coherent if she can read a sentence that specifically articulates its point.”

Joseph M. Williams, *Style: Lessons in Clarity and Grace* (10th edition), Longman, 2010.

- This *point sentence* should usually come in the introduction or the conclusion of the paragraph.
  - Burying the point sentence in the middle of a paragraph is a common error.
  - An even more common error is a paragraph with no point sentence!

## sen·tence [sen-tns]

- “A grammatical unit of one or more words that expresses an independent statement, question, request, command, exclamation, etc., and that typically has a subject as well as a predicate, as in *John is here.* or *Is John here?*”

<http://dictionary.reference.com>

- “A word, clause, or phrase or a group of clauses or phrases forming a syntactic unit which expresses an assertion, a question, a command, a wish, an exclamation, or the performance of an action. . . .”

<http://www.merriam-webster.com>

- A sentence is definitely bad if:
  - It doesn't have both a subject and a verb.
    - But: "This sentence no verb."
  - It doesn't make a single point.
  - It doesn't make sense when you read it out loud.
- A sentence is probably bad if:
  - It doesn't have an object to go along with the subject and verb.
  - It goes longer than two lines of text.
  - It contains repeated words.
  - It doesn't make sense when you read it out loud.

## Common types of errors

- Sentences with either no main point, a muddled point, or too many main points.
- Style
  - Stylistic errors both impact comprehension and annoy the reader.
  - Beyond the scope of this talk.
- Grammar
  - Incorrect grammar can make it difficult or impossible to understand a sentence.
  - Beyond the scope of this talk.
  - There are books that can help:
    - Claire Kehrwald Cook, *Line by Line: How to Edit Your Own Writing*, Houghton Mifflin, 1985.
    - Lynne Truss, *Eats, Shoots & Leaves: The Zero Tolerance Approach to Punctuation*, Gotham, 2004.

# Sentences: keep it simple and clear!

From Justin Zobel, *Writing for Computer Science* (2nd edition), Springer, 2004:

- ✗ The status of the system is such that a number of components are now able to be operated.
- ✓ Several of the system's components are working.
  
- ✗ In respect to the relative costs, the features of memory meant that with regard to systems today disk has greater associated expense for the elapsed time requirements of tasks involving access to stored data.
- ✓ Memory can be accessed more quickly than disk.

# Sentences: keep it simple and clear!

From Justin Zobel, *Writing for Computer Science* (2nd edition), Springer, 2004:

- ✗ When the kernel process takes over, that is when in the default state, the time that is required for the kernel to deliver a message from a sending application process to another application process and to recompute the importance levels of these two application processes to determine which one has the higher priority is assumed to be randomly distributed with a constant service rate  $R$ .

## **The take-home message of the talk**



- 👉 **The take-home message of this talk is that there should always be a take-home message!**
- Consider the take-home message at *all* levels:
  - Full document/presentation
  - Paragraphs/slides
  - Sentences/bullets