

Writing for the Mathematical and Physical Sciences

Lecture 1: Writing

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There are three rules for writing a novel. Unfortunately, no one knows what they are.

W. Somerset Maugham

Word-smithing is a much greater percentage of what I am supposed to be doing in my life than I would have ever thought.

Donald Knuth [KLR89, p.54]

Why write?

Communication (obviously)

We write

- to tell people about our work
 - ▶ journals, conferences, ...
 - ▶ wiki, arXiv, tech reports, ...
 - ▶ press
- to get jobs, grants, ...
- to collaborate
 - ▶ talking is good, but often imprecise
 - ▶ writing things makes them concrete, and exact
- to teach (notes, tutes, assignments, exams, ...)
- to participate in our profession (reviews, references, manuals, ...)

But there is another aspect to writing: it helps you think!

In writing, you clarify your own thoughts, and strengthen your conviction. Indeed you probably grasp your thoughts for the first time. Writing is a way of thinking. Writing actually creates thought, and generates your ability to think: you discover thoughts you hardly knew you had, and come to know what you know. You learn as you write.

Sheridan Baker, 1985

Writing brings out gaps in your understanding, by forcing you to focus on steps in your thinking that you might otherwise skip.

Nicholas Higham, 1995 [Hig95, p.2]

How can I tell what I think till I see what I say?

E. M. Forster

Philosophy of this course

- This is not a conventional course on how to write
 - ▶ I'm not going to try to teach you grammar
 - ★ I'm not that good at it anyway
 - ★ there are a million on-line resources to help
 - ▶ I'm not going to teach you style
 - ★ it varies in different contexts anyway
- I want to concentrate on how writing improves our thinking
 - ▶ I have meta-rules that help the process
 - ▶ if we get this right, good communications is natural
 - ★ but you do still need to learn grammar and style
 - ▶ I will try to highlight how this works

Meta-rules

- Do it!
- What's your story?
- Be precise
- KISS
- Rules are for lawyers
- Write, rewrite and rewrite again
- Avoid verbal ticks

Do it!

When do you plan to start writing your ?

- When do you plan to start writing your thesis?

When do you plan to start writing your ?

- When do you plan to start writing your thesis?
- NOW!!!
 - ▶ Writing helps you think!
 - ▶ The best way to learn to write is
 - ★ write a lot
 - ★ when you aren't writing, read a lot [KLR89, p.74] and remember what you liked, and didn't like
 - ★ get feedback, from **anyone** who will read your stuff

Getting started

- Get rid of the blank page
 - ▶ bullet points
 - ▶ cartoons or story-boards
 - ▶ if you can't write something good, write something crap
- Start small
 - ▶ write something easy 1st, and build up to harder things
 - ▶ snack write (little but often)
- Have milestones
 - ▶ X words per day
 - ▶ start easy, and build up
- **Templates**
 - ▶ get an example of the document you are working on
 - ▶ cut out the text, and start with the section headings
- 6 Ws (Who, Why, How, When, Where, What)
 - ▶ just answer these questions

Showing people

When is it good enough to show people?

- never
 - ▶ scientists are often perfectionists
 - ▶ hence don't want to show it until it's perfect
 - ▶ but it won't be perfect without feedback
- so just do it
- you need feedback, particularly when you are starting out
 - ▶ its too hard to write from the point of view of your audience
 - ▶ we forget what they don't know
 - ▶ sometimes we forget what we don't know
 - ▶ **having another reader shows you where your ideas have loose ends**
 - the feedback may be negative: get over it

Writing productively

Writing is purely a matter of inspiration. Writing is my profession, so I ensure that I am inspired from 9:00 to 5:00, Mondays to Fridays.

W. Somerset Maugham

- Procrastinate tomorrow
 - ▶ avoid distractions (non-work and work)
 - ▶ don't wait until you're "ready" or in the "mood"
 - ★ action inspires motivation as much as the other way around
 - ▶ **Constructive procrastination**
- Time and place
 - ▶ set times to write
 - ★ stop reading, thinking, experimenting (for a little while)
 - ★ write what you have now
 - ▶ have a place to write (quiet, undisturbed, ...)

Lots of this advice comes from [GK10]

Sometimes its fun to write badly

The Bulwer-Lytton Fiction Contest

Worst starting sentence ...

- “It was a dark and stormy night; the rain fell in torrents – except at occasional intervals, when it was checked by a violent gust of wind which swept up the streets (for it is in London that our scene lies), rattling along the housetops, and fiercely agitating the scanty flame of the lamps that struggled against the darkness.”
Edward George Bulwer-Lytton, Paul Clifford (1830)
- “As he told her that he loved her she gazed into his eyes, wondering, as she noted the infestation of eyelash mites, the tiny deodicids burrowing into his follicles to eat the greasy sebum therein, each female laying up to 25 eggs in a single follicle, causing inflammation, whether the eyes are truly the windows of the soul; and, if so, his soul needed regrouting.”
Cathy Bryant, Manchester, England, 2012 Winner.

What's your story?

What's your story?

- Writing needs structure

- ▶ beginning
- ▶ middle
- ▶ end

and this applies to at every level

- ▶ thesis/book/article
- ▶ section
- ▶ paragraph

- More than this, we need a narrative

- ▶ what is the story you are telling
- ▶ how do you get from A to B to C ...
- ▶ sections need to connect
- ▶ new ideas can't appear from the blue

- Motivate me

- ▶ keep me reading
- ▶ if you don't know your motivation, then what the hell are we all wasting our time on?

Logic isn't just for maths

- You need to develop ideas logically
 - ▶ new ideas don't just appear from the blue
 - ▶ stay one step ahead of the reader
- Support your statements
 - ▶ provide references (we'll talk more about these later)
 - ▶ provide data
 - ▶ provide logical arguments
- One idea builds on another towards your results
 - ▶ writing your argument down helps you see what's still missing

Don't waste my time

I would have written a shorter letter, but I did not have the time.

Blaise Pascal

- Avoid writing that doesn't add to the story
 - ▶ it wastes the reader's time
 - ▶ it dilutes your message
 - ▶ it risks losing the reader completely
- It's really hard
 - ▶ we love our own words
 - ▶ think about what's important and what isn't?
- Thoughts:
 - ▶ write for your audience
 - ★ common assumptions don't need to be repeated
 - ★ but make sure
 - ▶ edit (see later)

Don't waste my time

100 Great Books in Haiku, David Bader

Sing, Goddess, of how
brooding Achilles' mood swings
caused him to act out.

Illiad, Homer

Chorus: Poor bastard.
Oedipus: This is awful!
Blind Seer: Told you so.

Oedipus Rex, Sophocles

Be precise!

A writer needs three qualities: creativity, originality, clarity and a good short term memory.

Desmond J. Higham, More Commandments of Good Writing, 1992

Precision

- 6 Ws (Who, Why, How, When, Where, What)
- Concrete nouns preferred to abstract
- Repeatability
- Repetition is good

Concrete nouns preferred over abstract

Abstract nouns are by definition ambiguous, and the more often they crop up, the less informative the writing.

Johnson [Joh82]

Common examples: stuff, thing, type, case, class, ...

Think about what you really want to talk about. Be precise!

Pronouns are another common source of ambiguity.

Repeatability

Think about repeatability

- Give me enough detail to repeat your experiment, ...
- Be quantitative, not qualitative (where possible)
- Describe data exactly: dates, amount, problems, ...
- Reference tools and methods
- Answer the easy questions
 - ▶ <http://www.icir.org/mallman/plea.txt>
 - ▶ units
 - ▶ define notation
- Tell me your assumptions

Try this

Count the “f”s

Five thousand famous artists from France, were of the opinion that if they framed paintings in frames of fine wood, then if anyone found their art full of fancy, at least they couldn't find fault in the frame.

Try this

Count the “f”s

Five thousand famous artists from France, were of the opinion that if they framed paintings in frames of fine wood, then if anyone found their art full of fancy, at least they couldn't find fault in the frame.

The answer is 18

Repetition is good

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Your readers are busy, and reading quickly [KLR89, p.59]. They don't read your text the way you think they do. They miss things.

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Your readers are busy, and reading quickly [KLR89, p.59]. They don't read your text the way you think they do. They miss things.
- Repetition is good (but you don't have to be dumb about it)
- Say the same thing more than once, but differently

Repetition is good

- Restating your main ideas consistently
 - ▶ forces you to be really clear about what those ideas are
- The danger is it gets boring, or seems patronising
 - ▶ you need to use repetition only when it matters
 - ▶ forces you to think about what your main ideas are

More on the literature review

Why do we cite?

- To provide attribution of ideas
 - ▶ **avoid plagiarism**
- To support our arguments
 - ▶ every statement you make should be supported by logic, data or citations
- To provide a link
 - ▶ e.g., standard technique, definition, data or software
 - ▶ so someone else can find a resource
 - ▶ further reading
 - ▶ so we don't have to explain every single thing in our paper
 - ▶ so our paper can be more readable
- To show you understand the context of your work
 - ▶ **you know your work is novel, and why**
 - ▶ if you are repeating/validating work then you know it

Citations get used as a measure of impact: e.g. h-index, so people really care

The role of references

<http://www.rogerclarke.com/SOS/SCSP-09.html>

KISS!

KISS

Most (of my) writing is too verbose. A major and tedious task of an editor is to remove unnecessary or unimportant words (often qualifiers that Engineers and Mathematicians may feel were important for precision, but which are really just ways to weasel out of saying something definite) that might otherwise clutter up and extend sentences beyond the bounds of a reader's limited tolerance, leading the reader to feel that it is just too much work to go on, and at some point you stopped reading this so I can say pretty much anything I like from now on, not to mention the fact that you probably forgot what I was saying at the start of the sentence.

- Short sentences are good.
- Avoid jargon for jargon's' sake.
- Edit your work.

An Example (from [Gow86, p.46])

This appeared in the Lancet

Experiments are described which demonstrate that in normal individuals the lowest concentration in which sucrose can be detected by means of gustation differs from the lowest concentration in which sucrose (in the amount employed) has to be ingested in order to produce a demonstrable decrease in olfactory acuity and a noteworthy conversion of sensations interpreted as a desire for food into sensations interpreted as a satiety associated with ingestion of food.

An Example (from [Gow86, p.46])

Wouldn't you prefer

Experiments are described which demonstrate that a normal person can taste sugar in water in quantities not strong enough to interfere with his sense of smell or take away his appetite.

Simplicity is hard

For every complex problem there is an answer that is simple, elegant, and wrong.

H. L. Mencken

- Simplicity is hard
- It requires editing out the unimportant from the important
- If it were easy, you wouldn't have a job
- Simplifying concepts requires clear understanding

KISS, part II

Everything should be as simple as it can be, but not simpler.

Albert Einstein

- Often, you will be given the advice “Avoid fancy words” [SW99]
 - ▶ Perhaps, prefer [Gow86, p.47]
 - ★ familiar to far-fetched
 - ★ concrete to abstract
 - ★ single word to circumlocution
 - ★ short to long
 - ★ Saxon to Romance
 - ▶ But English has a delightful level of subtlety: we can say
 - ★ “dance” or “caper”
 - ★ “have intercourse” or “fuck”
 - ★ “teach” or “enlighten”and half the fun and beauty of writing is choosing the exact right words
- Jargon has its place: would you rather say
 - ▶ a “relatively small carnivorous mammal with fur, retractile claws and a distinctive sonic output”, or

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- Jargon has its place: would you rather say
 - ▶ a “relatively small carnivorous mammal with fur, retractile claws and a distinctive sonic output”, or
 - ▶ a cat (paraphrased from Ralph P. Boas, “Can we Make Mathematics Intelligible?”, 1981)

Rules are for lawyers

Rules

You need to know the rules, but ...

Rules may obviate faults, but can never confer beauties.

Samuel Johnson

Good English

- Almost all scientific writing is currently in English
- A necessary condition for a good paper is that it be well written
 - ▶ this is not a sufficient condition, but almost!
- Writing for a scientific paper isn't really any different to writing anything else [Rub]
 - ▶ maybe it needs to be more precise
 - ▶ maybe a little less lyrical or whimsical
- There are many tools to help you write well
 - ▶ style/readability guides [Gov90, Str99, SW99, DuB04]
 - ★ The Chicago Manual of Style
 - ★ Guide to Grammar and Style by Jack Lynch
 - ▶ academic writing guides [Hig95, GK10]
 - ▶ books and essays on general writing [Gol12, Gow86]
 - ★ Politics and the English Language, George Orwell
 - ▶ Apps
 - ★ e.g., <http://www.hemingwayapp.com/>

Good English, part II

Beware: “good English” is terribly hard to nail down

- The rules are complex
 - ▶ [Bry90] quotes many mistakes in English in English grammar manuals.
- Exceptions are rife, even if only because violating the rule draws attention (hopefully in a way that was intended)
- English changes:

King Charles described it [St Paul's Cathedral] as “awful, pompous, and artificial” — and he was intending it to be complimentary.

Tom Burton [Bur95, p.5]

- Most of the rules were just made up at some point
 - ▶ Shakespeare signed his own name with 6 different spellings, none of them “Shakespeare”
- Madly following the rules leads to dry colourless prose of value only to dry colourless people

Good English, part III

- You need to learn good grammar and style
 - ▶ at least in order to abuse it well
- The ear you get from reading is better than reading style guides, but you need to read a lot
- Be consistent (except when you don't want to be)
- Learn the rules that people care about in your domain
 - ▶ some people are sticklers for some particular set of English grammar
 - ▶ just deal with it
- Break rules to achieve an affect, not by accident

Read stuff

not all of it has to be science

...

*He was my North, my South, my East and West,
My working week and my Sunday rest,
My noon, my midnight, my talk, my song;
I thought that love would last for ever: I was wrong.*

*The stars are not wanted now: put out every one;
Pack up the moon and dismantle the sun;
Pour away the ocean and sweep up the wood.
For nothing now can ever come to any good.*

W.H.Auden, "Stop all the clocks, cut off the telephone"

Write, rewrite, and rewrite again

Write, rewrite, rewrite, rewrite, ... [KLR89, p.73]

Easy writing makes hard reading

Ernest Hemingway

What is written without effort is in general read without pleasure.

Samuel Johnson

I love deadlines. I like the whooshing sound they make as they fly by.

Douglas Adams

But know when to stop – you also have to be efficient.

A work of art is never completed, only abandoned

Leonardo da Vinci

Editing

My basic principle in editing

- Assume you have a (tight) page or word limit
 - ▶ force yourself to rewrite until it fits
- Make sure every word, sentence and paragraph carries its weight
 - ▶ avoid weasel words and phrase
 - ▶ avoid padding, e.g., “in order to” \Rightarrow “to”
 - ▶ avoid motherhood statements, e.g., “Motherhood is good”
- If its shorter, most likely it is also clearer

Avoid verbal ticks

Pitfalls

- Scientists and Mathematicians seem to have some verbal ticks

- Examples:

- ▶ over qualification

- ★ it's more precise, right?

- ▶ passive verbs

- ★ often used so the writer avoids responsibility

Cigarette ads were designed to appeal to children

vs

We designed the cigarette ads to appeal to children

<http://grammar.ccc.commnet.edu/grammar/passive.htm>

- ★ in science, we seek truth – it shouldn't depend on us, right?

- ▶ gap words: obviously, clearly, ...

- ★ we subconsciously know there is a gap

Avoid excessive prepositional qualifications

Johnson calls the difference catalogical vs analytical writing [Joh82].

Catalogical: *The need in the company for great increases in space, caused by a steady growth in research work, has necessitated the addition of a new wing to the laboratory.*

Analytical: *Because its research work has been growing steadily, the company is adding a new wing that will greatly increase its laboratory space.*

Catalogical lumps all details in together without order. Analytic gives the logic.

P.S. Johnston is actually making another classic mistake – which one?

Active verbs preferred to passive

Passive verbs sound unnatural and weak, but technical people seem to like using them [Joh82].

Passive: *Correction of production errors was obtained through laboratory tests.*

Active: *The laboratory tests corrected production errors.*

Look for places where the subject of the verb receives the action of the verb, instead of just being done.

Gap words

When we have a gap in our understanding we often try to bridge it:

- clearly, obviously

Even if it isn't a gap, don't use these words

- what if it isn't obvious to your reader?

Avoid verbal ticks

- This section hasn't really been about clear thinking
- Its about cleaning up afterwards
- But I didn't think I could walk away without saying anything about style

Conclusion

- Writing helps you think
 - ▶ if you approach it this way, then it will help you communicate
- What to remember
 - ▶ Do it!
 - ▶ What's your story?
 - ▶ Be precise
 - ▶ KISS
 - ▶ Rules are for lawyers
 - ▶ Write, rewrite and rewrite again
 - ▶ Avoid verbal ticks

Further reading I



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<http://public.lanl.gov/kmh/pc-25-5-johnson.pdf>.

Further reading II



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