Scientific Writing
in Computer Science

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December 13, 2019

joint work with Alan Arroyo

Before we start

- There is no absolute truth here

- There is always a counterexample to the statements here

- Other people (e.g., your supervisor) may disagree in part

- This presentation is mostly a collection of advice by other people that we agree with

- Some of the advice here, marked in red, is for writing a *bad* paper, which you do *not* want to follow

Writing a good paper is not easy at all

- Many published papers you read are well written

- You may think that you are the only person with problems

- Wait until you review papers

- Most papers get *rejected* (often for good reasons)

- You cannot learn writing in theory, so write (and read) often

# Overview

[Setting](#)

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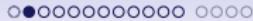
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The setting

Before we talk about writing papers,
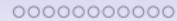
we need to clarify some facts about them
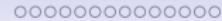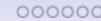
What is your goal?

You want to get a paper because

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You want to get a paper because you want to

- make your results available to others,

- satisfy your Ph.D. requirements,

- increase your impact ($=$ get citations)

- . . .
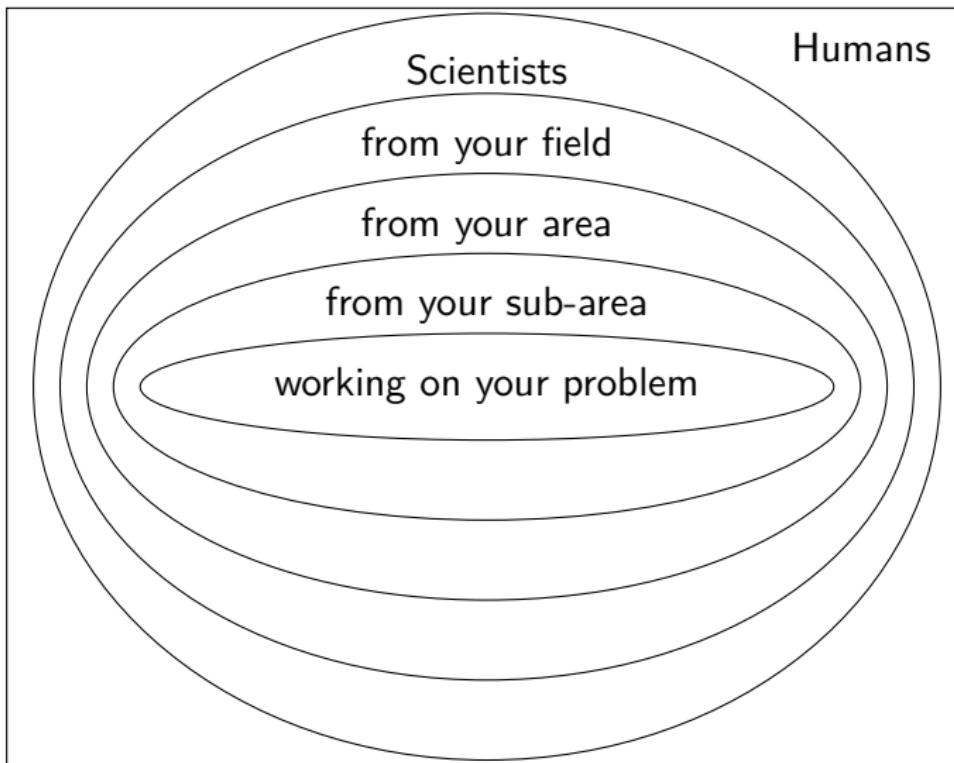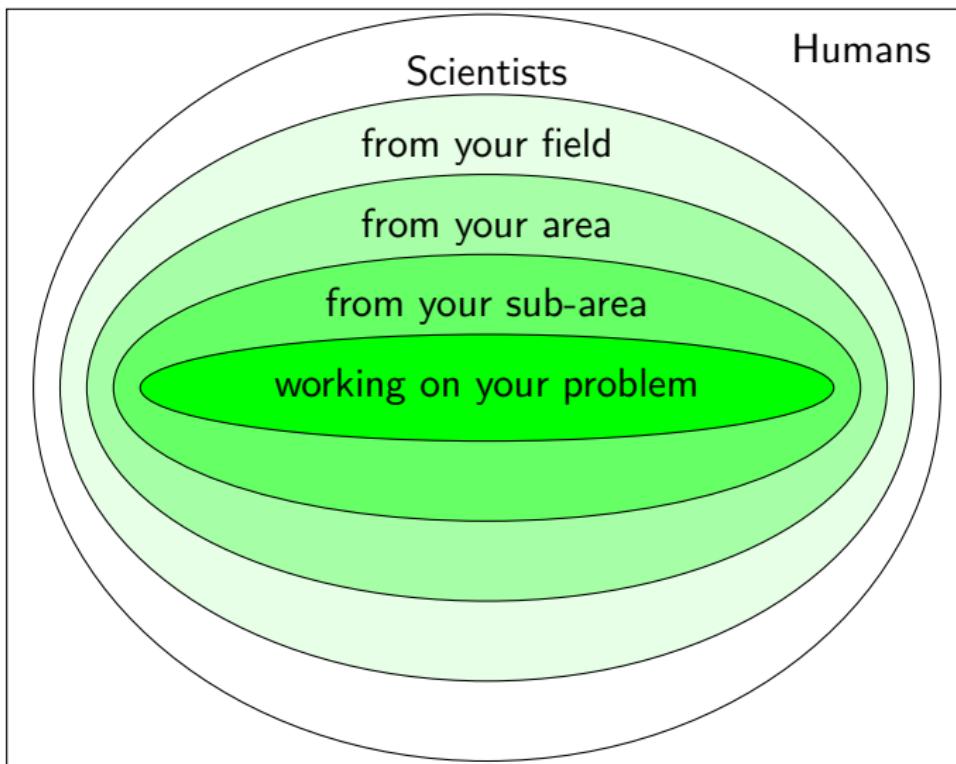
Who is your audience?

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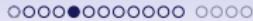
The reviewer

- Reviewers are often the first readers of your paper

- The reviewers' goals are different from yours

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- The reviewers' goals are different from yours

    - Safe time,
    - Defend the quality of the community,
    - Defend their own work,
    - Community service / improve their CV,
   - ...
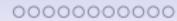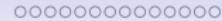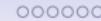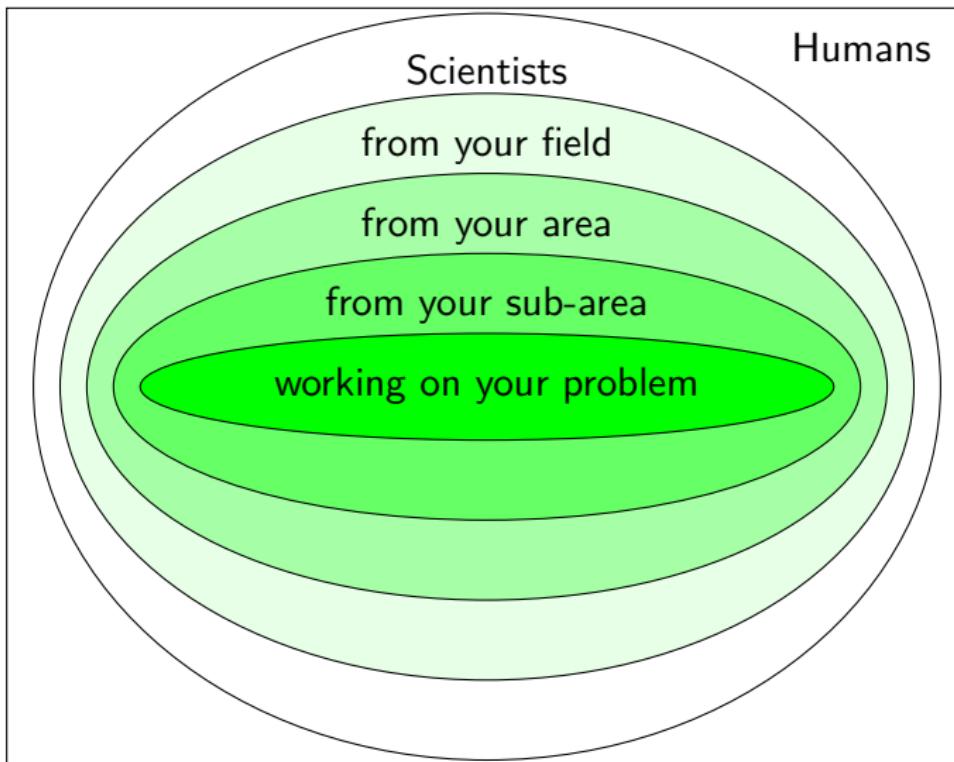
The reviewers

Who are the reviewers?

The reviewers

Who are the reviewers?

- Experts working on the same topic

- People from your community aware of the state of the art

- People from your community unaware of the state of the art

- Senior people having worked on the topic for 20 years

- Ph.D. students working on a related topic since two months

Recall: Who is your audience?

Your audience: the reviewers

Bad news

- You *need* to write the paper for the reviewers

Good news

- You *want* to write the paper for the reviewers
  (because they perfectly represent your target audience)

How to *not* target the reviewers

Who are the reviewers?

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  Be shallow; cite them incorrectly or not at all

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- Ph.D. students working on a related topic since two months
  Do not provide the necessary background

How does the communication to a reviewer work?

author   paper   reviewer   review

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author   paper   reviewer   review

- You need to say *everything* in the paper

- You have *exactly one* attempt

How does a reviewer work?

Reading your paper

- They start in a neutral state

- While reading, they establish their opinion about the outcome (acceptance/rejection) and collect arguments

- After reaching a threshold, they lock in their opinion and only quickly go through the rest (or even stop reading)

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Writing their review

- Summary, in particular your contributions

- Arguments for their judgment
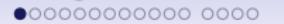
What you should aim for

- Never leave the reviewer in any doubt

- Help the reviewer as much as possible in defending your paper

- Make attacking your paper as hard as possible for the reviewer

Use your guinea pigs

- Let other people read your paper before you submit

- You need to have the paper ready in advance for that

- They like you and will be nice, so instruct them to be critical

- Most important information: When did they get lost?

- The closer to your area the better, but general feedback about the introduction can be given by anybody from your field

- You can use them *only once* per paper

- Offer yourself to others (you also learn from that)
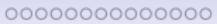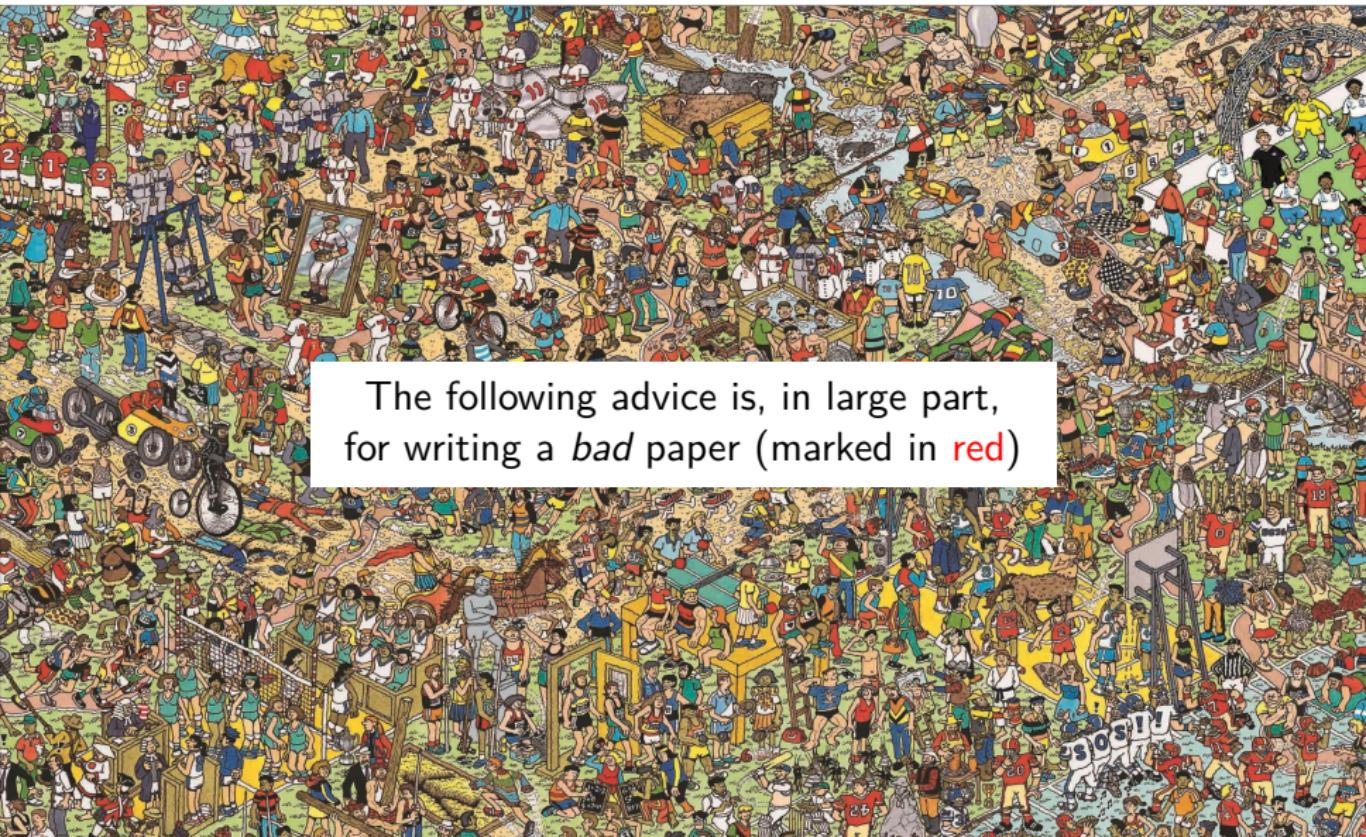
The don'ts

The following advice is, in large part,
for writing a *bad* paper (marked in red)
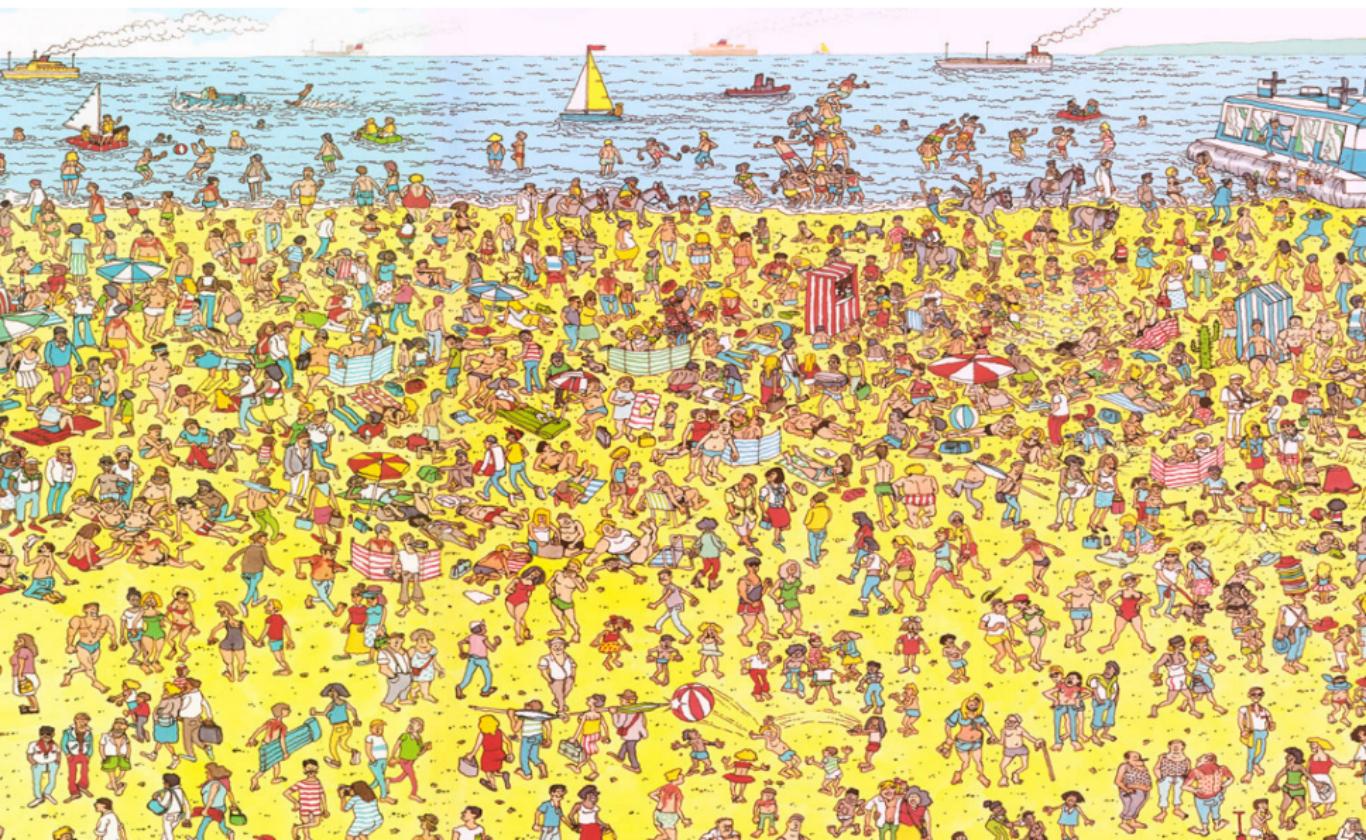
Process

Consider writing a duty

- Start late
  Writing takes time, so do not waste it until the very end

- Never get feedback
  You are the expert, other people would not understand

- If anything, get feedback very late
  You do not want to waste your colleagues' time, so only show
  the final version to them

Never reflect

- Never revise or throw away what you have written
  That would not be productive
  You cannot identify your own mistakes anyway
  Why would you do better the next time?

- Never read the paper as a whole
  You know the paper, so there is no gain
  It takes *so much* time

- Do not stick to the style of other papers in the area
  It is *your* paper
  Those people are scientists, not professional writers

Write without a plan

- Do not start from a skeleton

TODO title

UNDISCLOSED AUTHOR(S)

Abstract. TODO what. TODO why. TODO how.

1 INTRODUCTION

TODO

    This paper makes the following contributions:

- TODO

1.1 Related work

2 PRELIMINARIES

TODO

3 TODO MAIN SECTION TITLE

TODO

    THEOREM 3.1. *TODO main theorem*

    TODO

4 EXPERIMENTAL EVALUATION

TODO

5 CONCLUSION

TODO

Setting
ooooooooooooo
Process
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Content
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Structure
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Language
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Continuation
ooo

Write without a plan

- Write from the beginning to the end
  This is how you read papers, after all

- Get lost in details
  - Prepare figures, tables, examples etc. immediately
  - Make every sentence perfect
  - Tweak the layout

  Now is as good as ever, and it has to be done anyway

Content

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Be unclear about the contribution

- Never explicitly say what your contributions are
  Everybody *loves* mystery stories
  The readers are scientists – they will figure it out
  Signposting is so primitive

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Do not focus

- Results: the more the merrier

  We present three algorithms to solve problem A. We realized that the second algorithm can also be used to solve problem B, so we also present an optimization for problem B. We also found a subclass of A to make the algorithm from [17] run in linear time

- Put in everything you have

  Below is another example [. . .] Alternatively, we could have defined [. . .] Remark 34 [. . .]

- Tell *your* whole story

  First we tried A. But that did not work. Next we tried B. That solved A's problems but now we had new problems. Eventually, C worked

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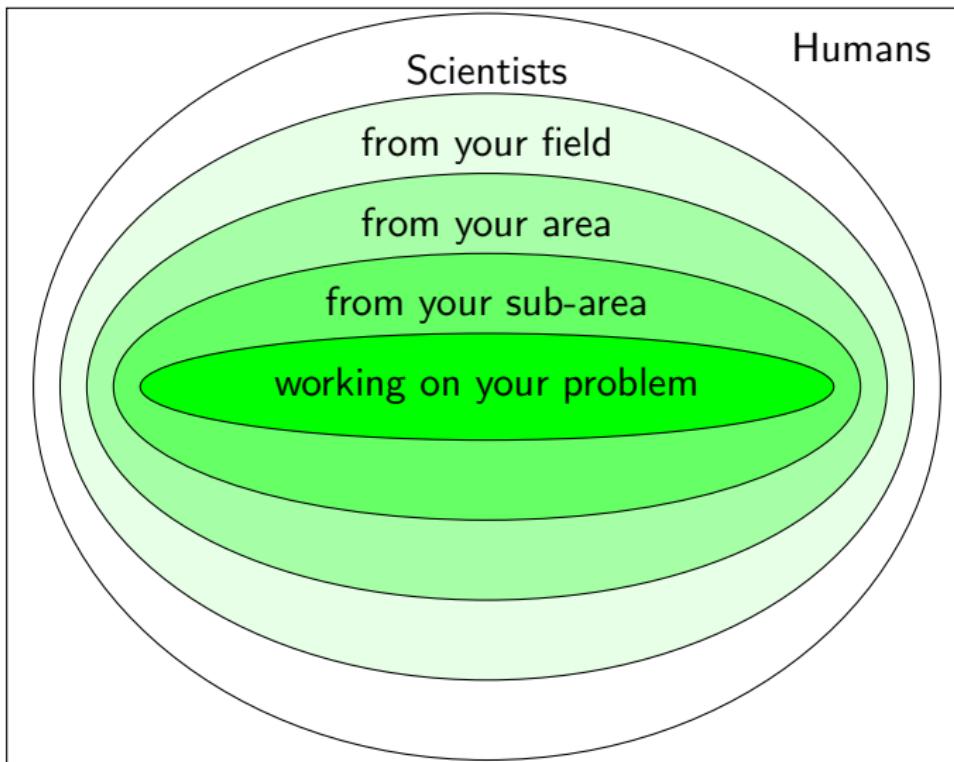
Avoid motivation

- Do not explain why your work is relevant and difficult
  Everybody knows that
  There is no reason required to do basic research
  Implies citing other work, which reduces your own credit
  You did the theory; let other people think about applications

- Do not explain the structure
  There is only one natural structure

- Do not provide any intuition
  Informal, not scientific
  Scientists do not like prose – we like formulas

Seven sins about proofs

- Do not explain definitions and theorems before the formal statement

- Prove trivial results, especially if the proofs are long and require additional theory

- Skip over complicated steps, maybe calling them "trivial"

- Nobody likes reading long proofs, so keep them short

- Be sure to have a typo in a theorem or definition

- Have a free variable in your theorem that was defined in a subclause two pages before

- Do not double-check dependencies after editing

Recall: Who is your audience?

Background information

- Do not provide any background information
  Context is a waste of space
  The readers are supposed to be experts
  If not, they are still researchers, so they will look things up

Be bold

- Make unsubstantiated claims

  We present the best algorithm
  No approach can solve this problem

- Never add a reference to claims

  This is a well-known and open problem. We [. . .]

- The reader will immediately be on guard
  A single superlative can destroy the reader's trust
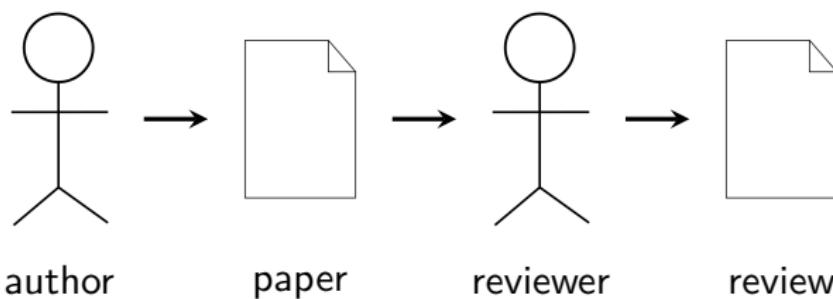
Mountain vs. molehill

Mountain vs. molehill

Computer programs often have bugs. It is very important to eliminate these bugs [1, 2]. Many researchers have tried [3, 4, 5, 6]. It really is very important

Consider this program, which has an interesting bug. [. . .] We show an automatic technique for identifying and removing such bugs

Recall: Communication to a reviewer

author   paper   reviewer   review

Weaknesses in your contribution

- Hide your weaknesses
  Will result in the following statement in the review:

  The authors seem unaware of the shortcoming [. . .]

- Draw attention to your weaknesses

  Our approach does not work in setting A at all, is weaker than approach X in setting B, and weaker than approach Y in setting C

- Make other approaches inferior so your approach shines
  Only discuss scenarios/experiments in favor of your approach
  Remove experiments where your approach does not win
 Show no comparison/discussion at all

Structure

OCAR narrative structure (storytelling)

- **O**pening
  Introduce your characters = objects of study, conjecture

- **C**hallenge
  What is the question that drives your research?
  What are the difficulties?
  What has been tried before?

- **A**ction
  Prove your claims, emphasize

- **R**esolution
  How your contribution has changed the state of the art

The title

- Gives a good idea about the content

- Contains keywords
  Think about how you search for related work

- Catchy
  Fancy titles can have a subtitle to satisfy the above constraints
  Examples:
    - *Gaussian elimination is not optimal*
    - *ALGOL 68 with fewer tears*
    - *Nineteen dubious ways to compute the exponential of a matrix*
    - *Fingers or fists? (The choice of decimal or binary representation)*
    - *Pole dancing: 3D morphs for tree drawings*

The abstract

- Three sentences: What, why, and how

- The reader should understand what you do

- The reader should want to read the paper

- Avoid technical language and symbols

- Only promise what you can deliver

- Is not part of the paper
  Hence literal overlap with the paper is fine
  Do not forget to introduce abbreviations later again

The abstract

Example from Donald Knuth: *Mathematical typography*. Bulletin
Amer. Math. Soc. (New Series), I(2):337-372, 197:

> *Mathematics books and journals do not look as beautiful
> as they used to. It is not that their mathematical content
> is unsatisfactory, rather that the old and well-developed
> traditions of typesetting have become too expensive. For-
> tunately, it now appears that mathematics itself can be
> used to solve this problem.*

Introduction

- Most important section

- Contains *everything* but on a higher level
    - The problem, including a motivation
    - Your solution
    - Your contributions
    - That's it!

- Forward references (not necessarily an "Outline" paragraph)

- Often an example/picture helps conveying the idea

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The contributions

List of claims that you substantiate with evidence in the remainder

This paper makes the following contributions:

- *We describe the WizWoz system.*

- *We study its properties.*

- *We have used WizWoz in practice.*

- *We give the syntax and semantics of WizWoz that supports concurrent processes (Section 3). Its innovative features are [...]*

- *We prove that the type system is sound, and that type checking is decidable (Section 4).*

- *We have built a GUI toolkit in WizWoz and used it to implement a text editor (Section 5).*

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The related work

- Two valid locations:

  - A subsection of the introduction (shallower discussion)
  - Right before the conclusion (deeper discussion)

- Purpose:

  - Make other works bad
  - List all papers you know
  - Give context
  - Show evidence that the problem is relevant
  - Elaborate on the novelty

The preliminaries

- Optional

- Alternative: concepts used only once can be introduced later

- Only contains *known* things (e.g., notation)

- Simple structure, keywords (readers will come back here later)

The main part

- This is the section you should start writing with

- There can be follow-up sections for discussions or extensions

The evaluation or case study

- Necessary if there is (almost) no theory

- Necessary if you describe an algorithm

The conclusion

- Optional but very common

- Remind the reader of the main results

- Careful: some readers skip the main part
  So write this section on the level of the introduction

- Open problems, Future work

Audience breakdown per section

- Title (1,000 readers)

- Abstract (100 readers)

- Introduction (10 readers)

- Main part (1 reader)

- Related work & conclusion (5 readers)

Signposting

- The first section explains the other sections

- The first sentence of a section explains the section

- The first sentence of a paragraph explains the paragraph

Examples

- Use examples

- Use figures for illustration

- Ideally have a running example (typically hard)

- Examples do not make a paper informal

- Examples do not relieve you from being precise

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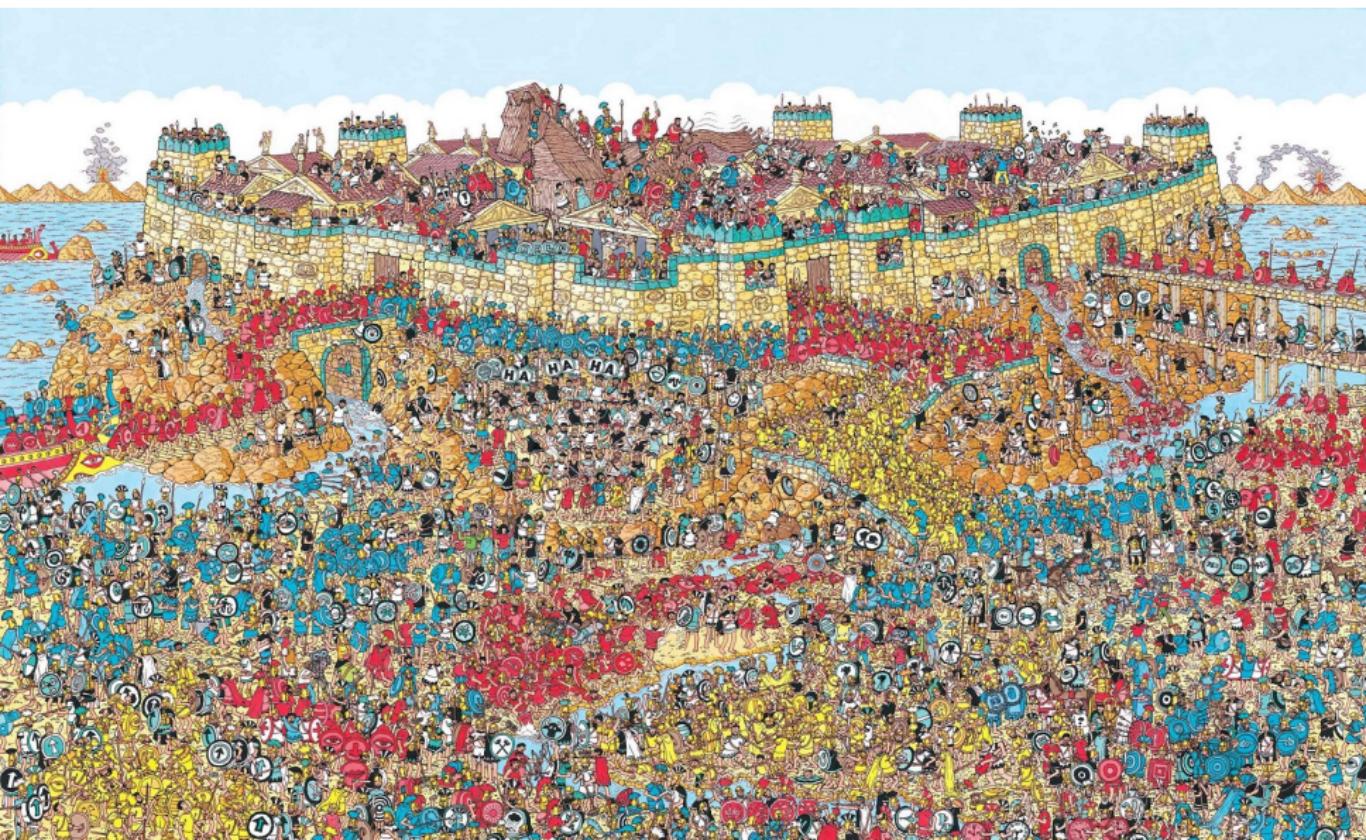
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Language

Be fancy

- Impress the reader with your English skills
  The paper is your novel, your poem

- Use long sentences with many subclauses
  Deep thinking reflects best in deep sentences

- Use fancy words
  If you need a dictionary, others will do as well

- Use qualifiers and fillers

  We should all try to do a little better, we should all be very watchful of this rule, for it is a rather important one and we are quite sure to violate it now and then

Be fuzzy

- Prefer the general to the specific, the vague to the definite, the abstract to the concrete

  A period of unfavorable weather set in.

  It rained every day for a week.

- Never commit

  We try to [. . .]

- Mix facts and opinions

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Be confusing

- Use ambiguities wherever you can

  A quadratic polynomial has a linear derivative with exactly one root. It can be easily computed.

- Use a great variety of words and form to refer to the same concept ("variatio delectat" – variety is delighting)

  Formerly, science was taught by the textbook method, while now the laboratory method is employed

  Formerly, science was taught by the textbook method; now it is taught by the laboratory method

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Abbreviations and symbols

- Do not use abbreviations and symbols
  Rather spell out everything dozens of times

- Introduce lots of notation

- Use obscure abbreviations, symbols, and font packages

- Do not introduce all abbreviations and symbols

- Start sentences with symbols or digits

  Start with 3.1. 3.2 *comes next.* π *is in between.*

- Do not stick to notational and intuitive conventions
  Greek letters, capital/small letters, other symbols, . . .
  Graph G, function f, natural number n, iterators i, j, k, . . .

- LaTeX macros simplify a change in notation later

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Further language crimes

- The active voice should be avoided

  The results were obtained

  We obtained the results

- Put things in the negative form, ideally with double negation

  He was not very often on time

  He usually came late

 *It is not impossible*

- Mix tenses, and do it often

Setting
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Continuation

What to do after a rejection

- Do not listen to your reviewers' comments
  Obviously they hate you and are ignorant

- Just resubmit the same manuscript again
  There is no chance that you get the same reviewers

  You should understand that once you have a soundly accept-proof manuscript you should resubmit it every year. You will become part of the mythology of your field. As program committee succeeds program committee, the question will be asked, 'Did you get Old Whosit's paper again? What's he calling it this year?'
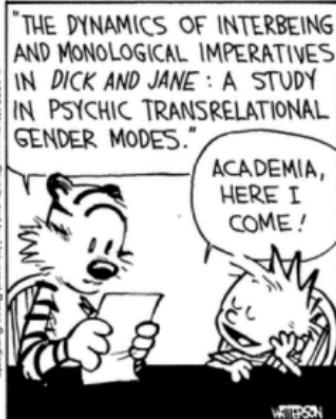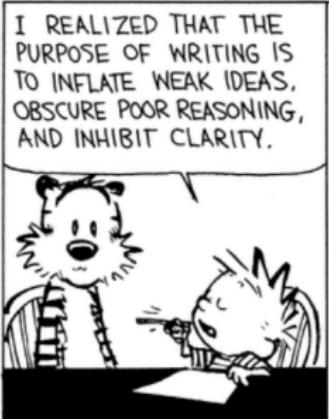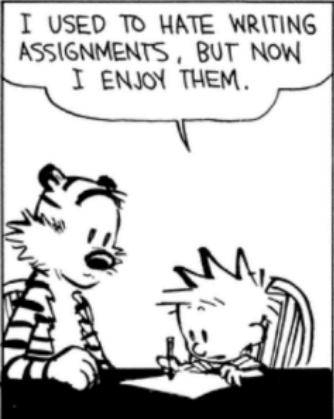
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