How to write a paper

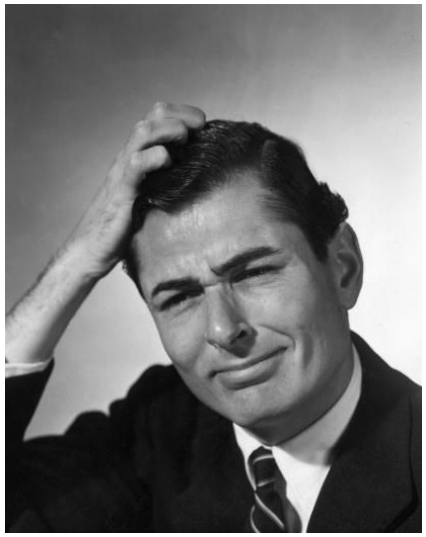
How to write a ~~paper~~ technical report

Why start with a presentation?

- Because it helps us focus on the main points!

What's the problem?

Why should I care?



An Example: ”Good Examples”

```
V = spawn()      -> '<0.27813.1>',
register(a, V)   -> true,
whereis(a)       -> '<0.27813.1>'
```

```
V = spawn()      -> '<0.27164.1>',
register(b, V)   -> true,
register(a, V)   -> {'EXIT', badarg}
```

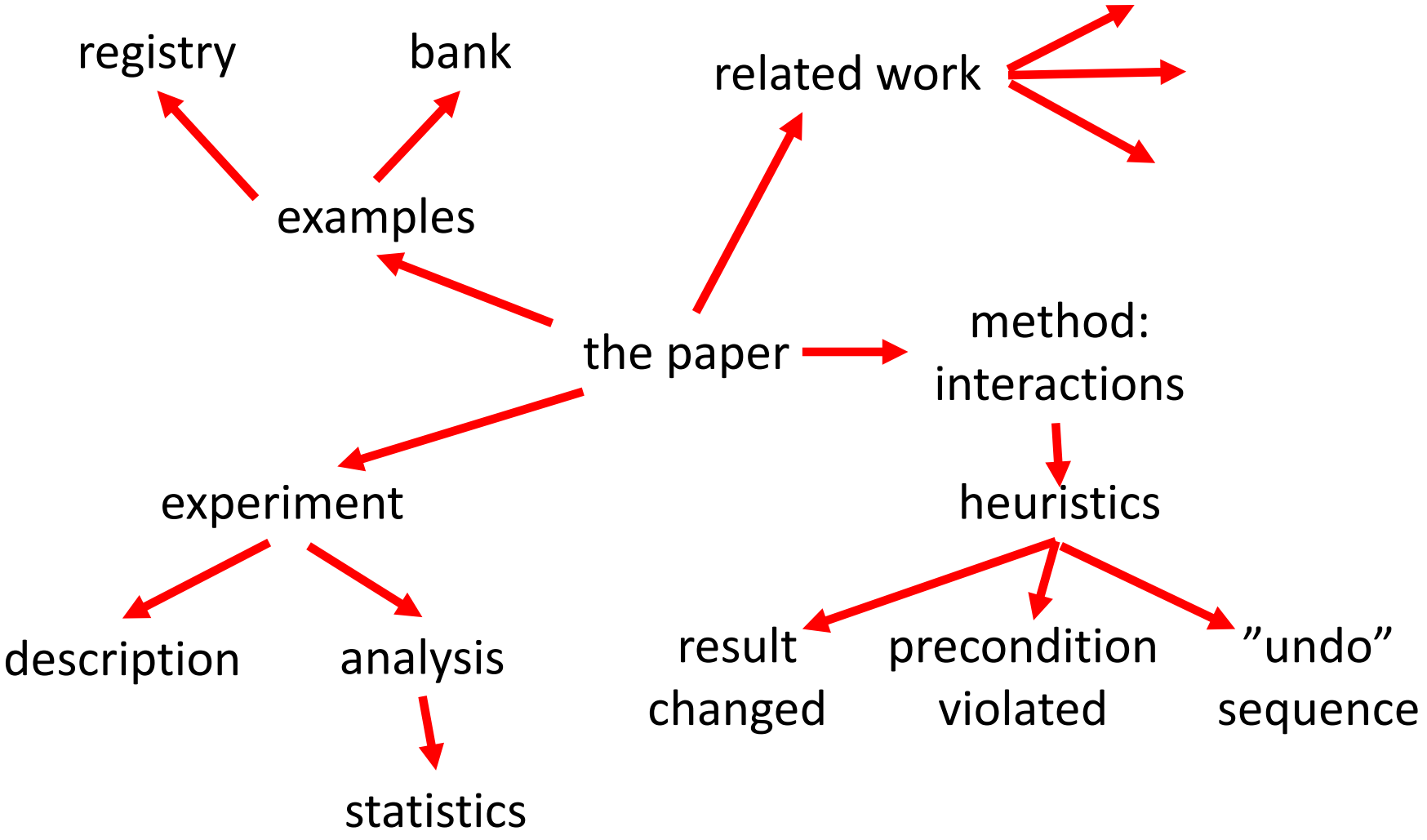
```
V1 = spawn()     -> '<0.28614.1>',
V2 = spawn()     -> '<0.28615.1>',
register(c, V1)  -> true,
register(c, V2)  -> {'EXIT', badarg}
```

ABSTRACT

Formal specifications of software applications are hard to understand, even for domain experts. Because a formal specification is abstract, reading it does not immediately convey the expected behaviour of the software. Carefully chosen examples of the software's behaviour, on the other hand, are concrete and easy to understand—but poorly-chosen examples are more confusing than helpful. In order to understand formal specifications, software developers need *good examples*.

We have created a method that automatically derives a suite of good examples from a formal specification. Each example is judged by our method to illustrate one feature of the specification. The generated examples give users a good understanding of the behaviour of the software. We evaluated our method by measuring how well students understood an API when given different sets of examples; the students given our examples showed significantly better understanding.

What should go into the paper?



Structure

- Abstract
- Introduction
- Background
- Main idea
- Details
- Evaluation
- Related work
- Discussion/Conclusion
- References

Structure

- Abstract
- Introduction
- Background
- Main idea
- Details
- Evaluation
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- References

Abstract

- A *brief* summary: what's in the paper?
- Write this last!

Structure

- Abstract
- Introduction
- Background
- Main idea
- Details
- Evaluation
- Related work
- Discussion/Conclusion
- References

Introduction

- What is the problem?
- Why is it important?
- Give an example!

Structure

- Abstract
- Introduction
- Background
- Main idea
- Details
- Evaluation
- Related work
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- References

Background

- Things you really have to explain *before* the key idea
- Keep this short, or you lose people! The reader must already be interested.
- (Preferably introduce background where it is used)

Structure

- Abstract
- Introduction
- Background
- Main idea
- Details
- Evaluation
- Related work
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- References

Main idea

- The key idea in its simplest form
- Give examples!
- Make sure reader understands the gist

Structure

- Abstract
- Introduction
- Background
- Main idea
- Details
- Evaluation
- Related work
- Discussion/Conclusion
- References

Details

- Technical details, handling tricky cases, etc
- Proofs if necessary
- Enable the reader to reconstruct the work

Structure

- Abstract
- Introduction
- Background
- Main idea
- Details
- Evaluation
- Related work
- Discussion/Conclusion
- References

Evaluation

- How should we believe this is a good idea?
- How have you shown that it works?
- Experimental results, applications, etc

Structure

- Abstract
- Introduction
- Background
- Main idea
- Details
- Evaluation
- Related work
- Discussion/Conclusion
- References

Related work

- How have the same (or similar) problems been addressed before?
- How does this solution compare?
- Placed towards the end to permit detailed comparisons

Structure

- Abstract
- Introduction
- Background
- Main idea
- Details
- Evaluation
- Related work
- Discussion/Conclusion
- References

Discussion/Conclusion

- What have we shown?
- What are the natural next steps (”future work”)?

Structure

- Abstract
- Introduction
- Background
- Main idea
- Details
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- Related work
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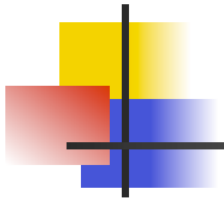
- References

References

- Papers you refer to

Simon Peyton-Jones' advice



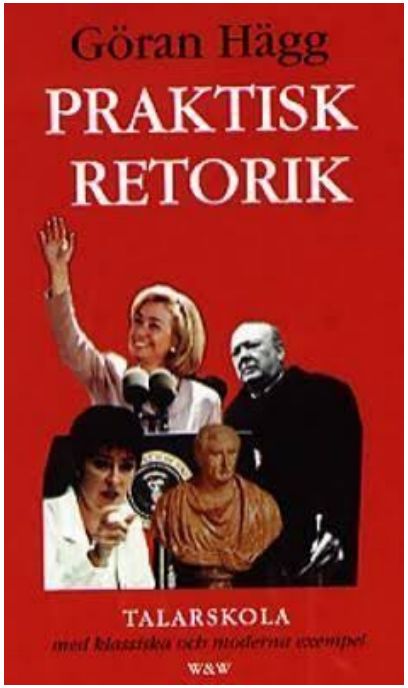
Structure (conference paper)

- 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)

Derek Dreyer's advice

A structure that works

- **Abstract** (1-2 paragraphs, 1000 readers)
- **Intro** (1-2 pages, 100 readers)
- **Main ideas** (2-3 pages, 50 readers)
- **Technical meat** (4-6 pages, 5 readers)
- **Related work** (1-2 pages, 100 readers)



- Exordium (Hello)
- Narratio (Background)
- Probatio (My idea)
- Refutatio (Related work?)
- Peroratio (Conclusion)

”Good Examples” paper

- Abstract
- A Running Example
- The Question
- State Machine Models
- The Idea: Finding Interactions
- Precondition Interactions
- Extensions
- Evaluation
- Comparison to Related Work
- Conclusion

We started with an example!

We pose the problem

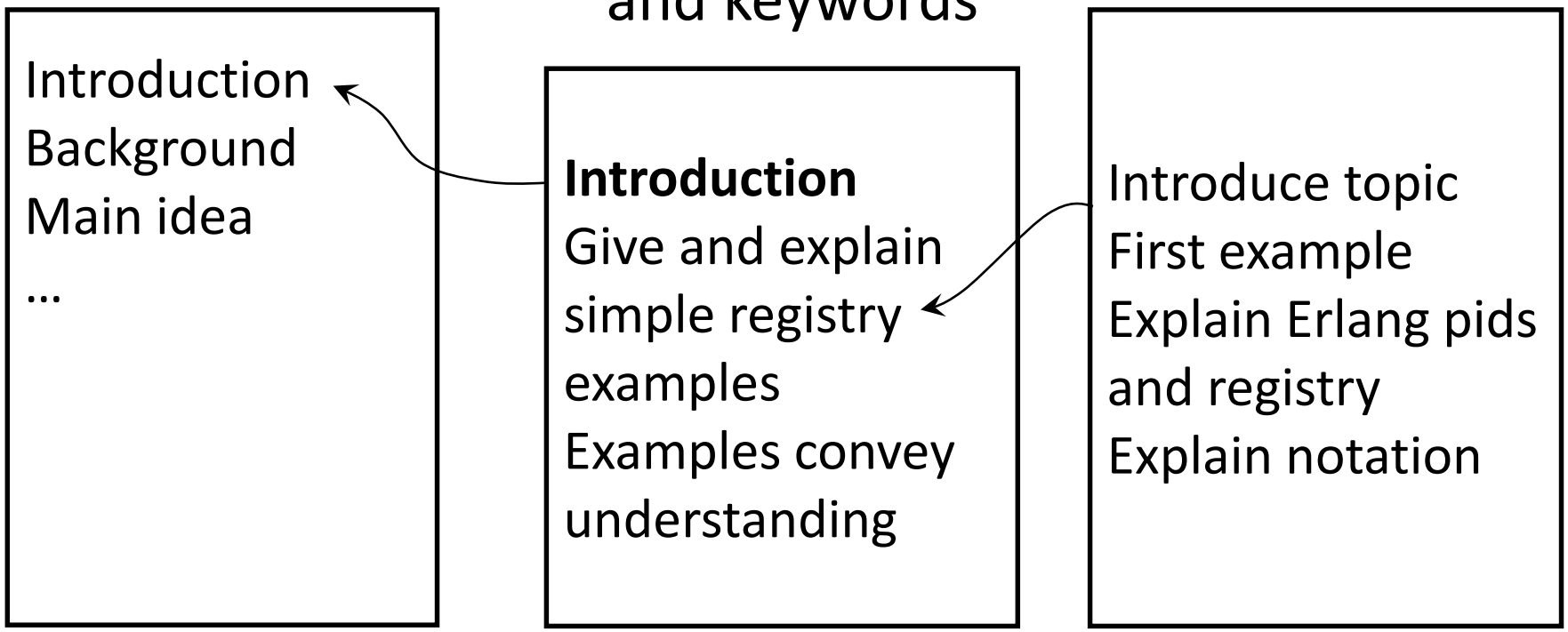
Necessary background (1/2 page)

The main idea in its simplest form

Details

Writing Process

- Plan the sections
- Plan each section—notes and keywords
- Plan each paragraph



Then write

We explained a 'pid'

What's Erlang?

1 A RUNNING EXAMPLE

Let us begin by introducing our running example—the Erlang programming language. Erlang is a concurrent programming language in which systems are made up of very many lightweight processes, each with its own process identifier, or '*pid*'. For illustration, we shall create (dummy) processes using a function `spawn()`, which returns the created process' pid as its result. To enable processes to find each other, they may be *registered* under a name, names being Erlang atoms, which are similar to strings in many other languages. For example, we might create and register a process like this:

We introduced spawn

```
V = spawn()     -> '<0.27813.1>',
register(a, V) -> true,
whereis(a)      -> '<0.27813.1>'
```

We explained names

```
V = spawn()     -> '<0.27813.1>',
register(a, V) -> true,
whereis(a)      -> '<0.27813.1>'
```

We explain the notation

Here we show the arguments and results of a sequence of calls in a sample run; `'<0.27813.1>'` is an example of a dynamically created pid, and the atom `a` is the name assigned to the pid in this case. We indicate reuse of a result by binding it to a variable: the result of `spawn` is bound to the variable `V`, then passed as an argument to `register`. Finally, `whereis` looks up a name in the registry and returns the associated pid.

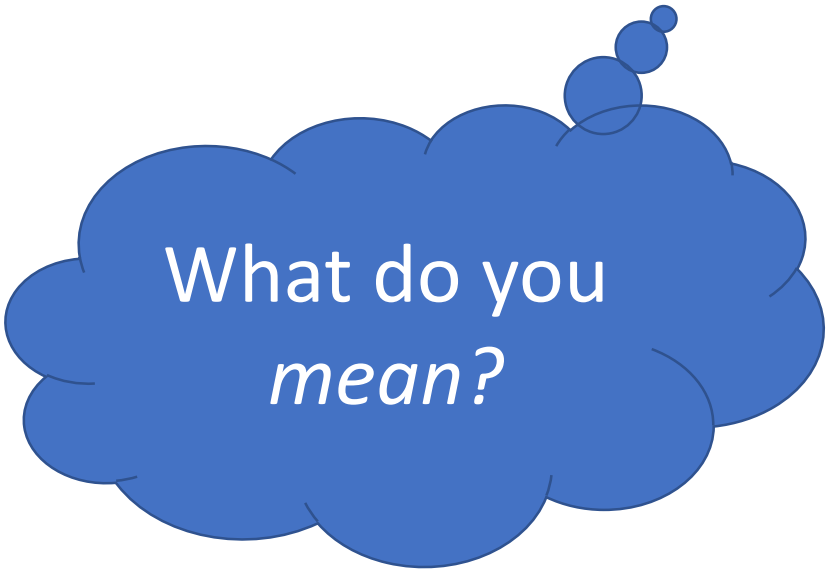
We explain ”V=”

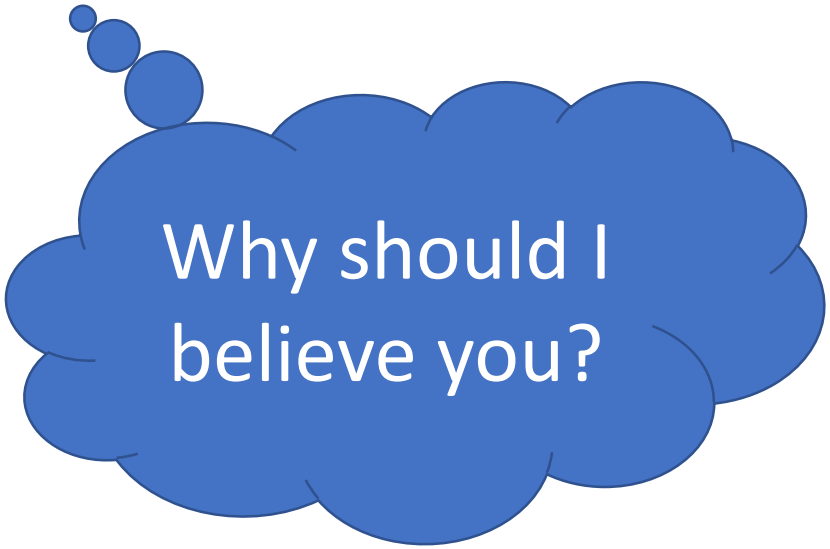
We explain what this example shows

We hope that, thanks to these examples, the reader now has a good understanding of the behaviour of this simple API. The point, though, is that while the words above were written by the authors, *the examples were generated and chosen automatically* from a formal specification of the API, using the methods that are the subject of this paper.

Examples, examples, examples

Don’t write in abstract generalities!



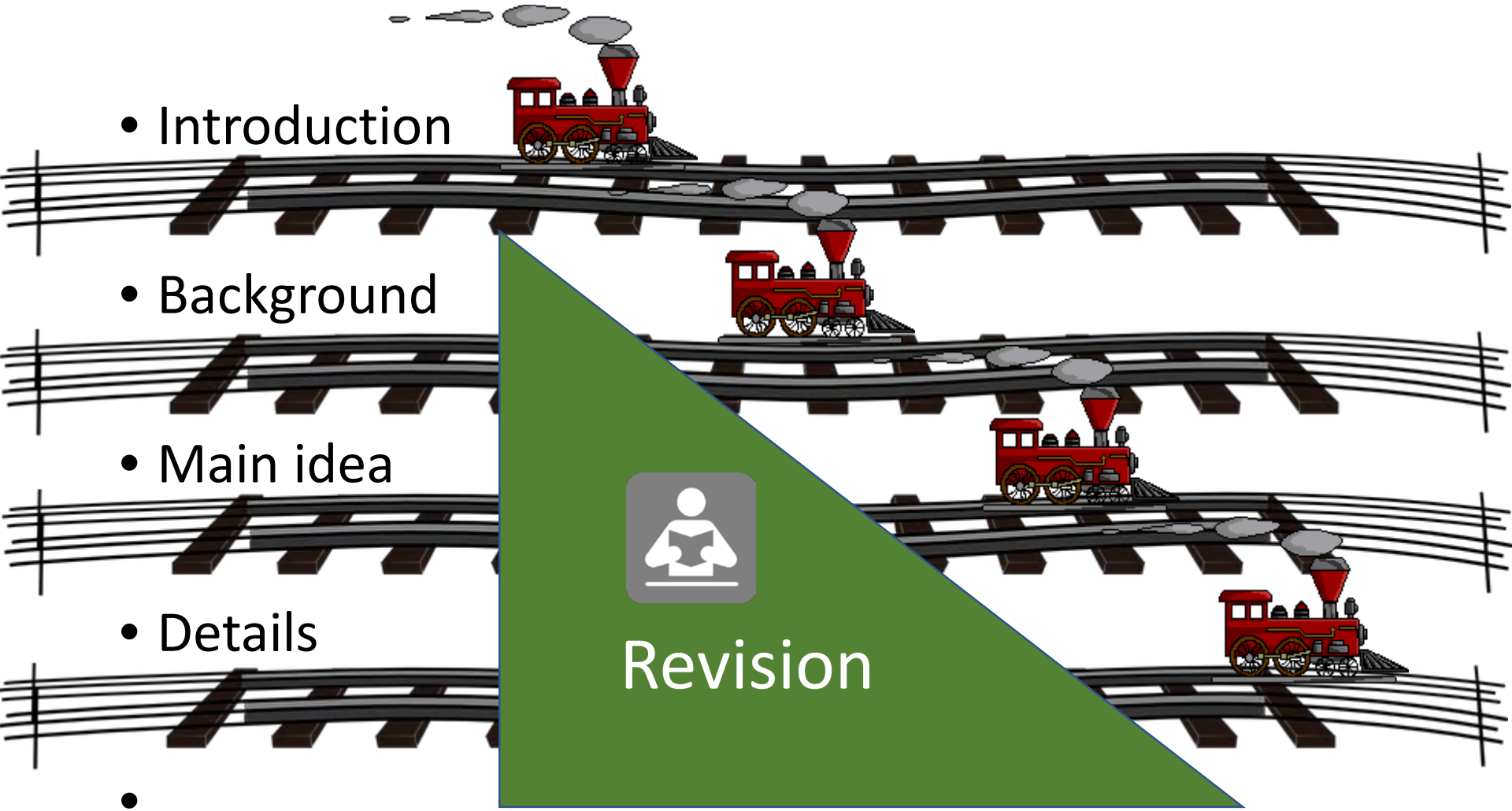


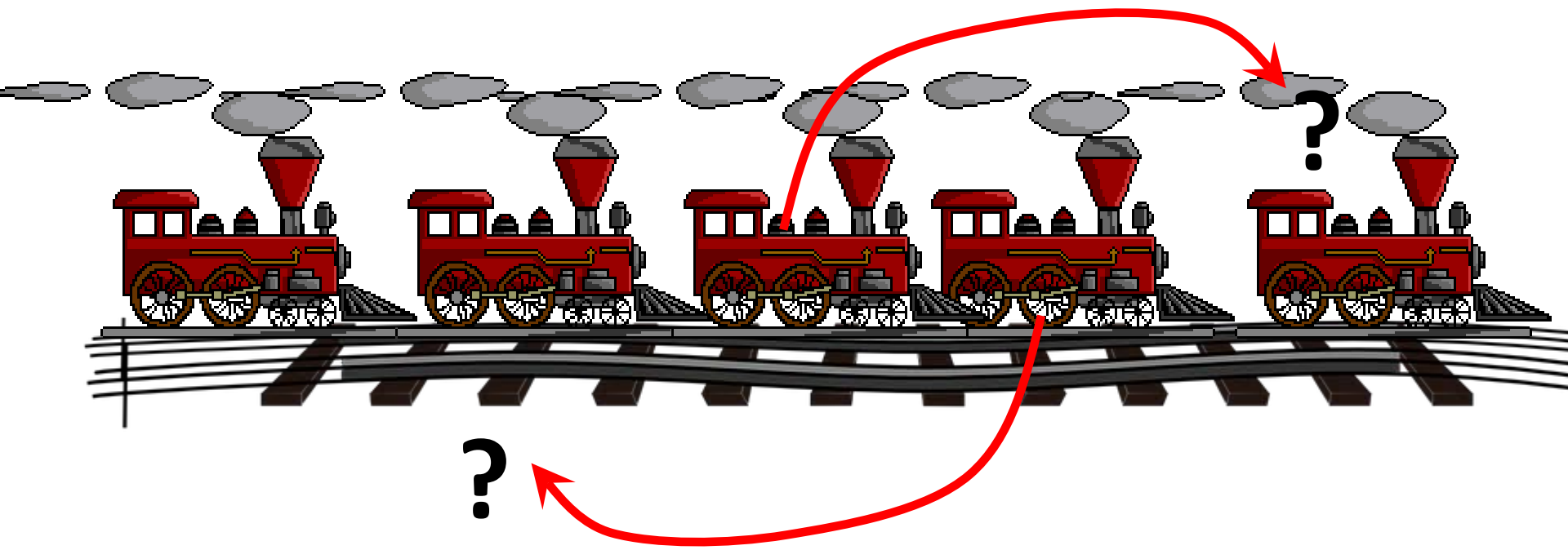
Where should I start writing?

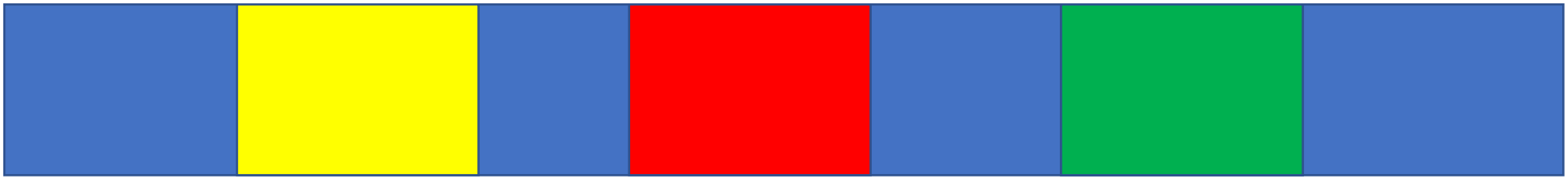
What does the reader know?

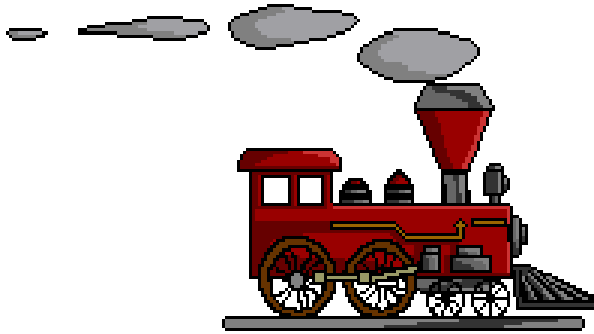
Iteration

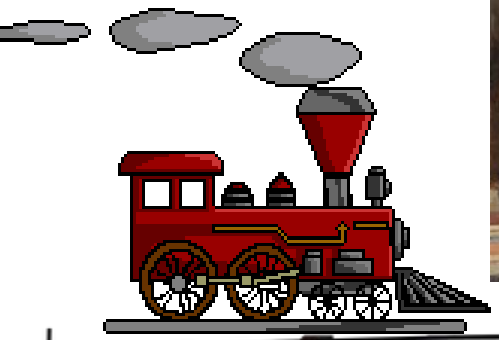
- Introduction
- Background
- Main idea
- Details
- …

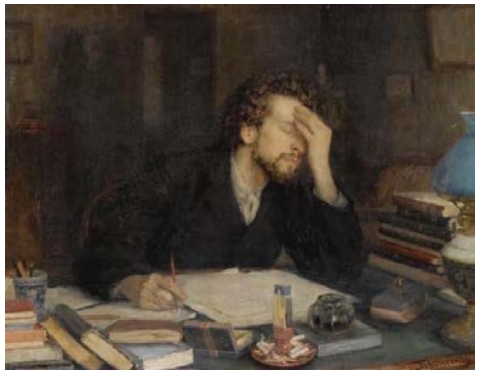






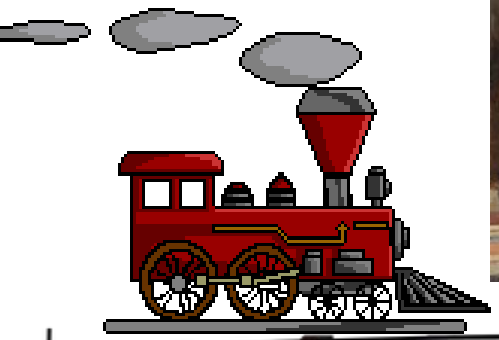






As we will be explaining in section 4, …

As we already explained in section 2, …

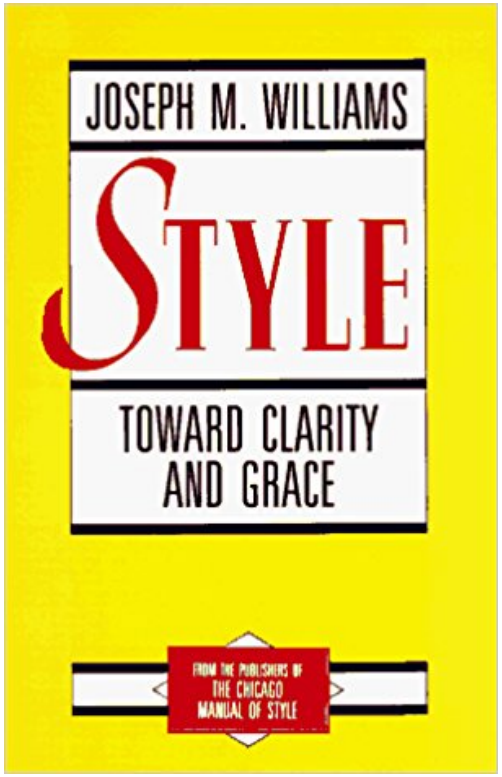


As we will be explaining in section 4, …

As we already explained in section 2, …

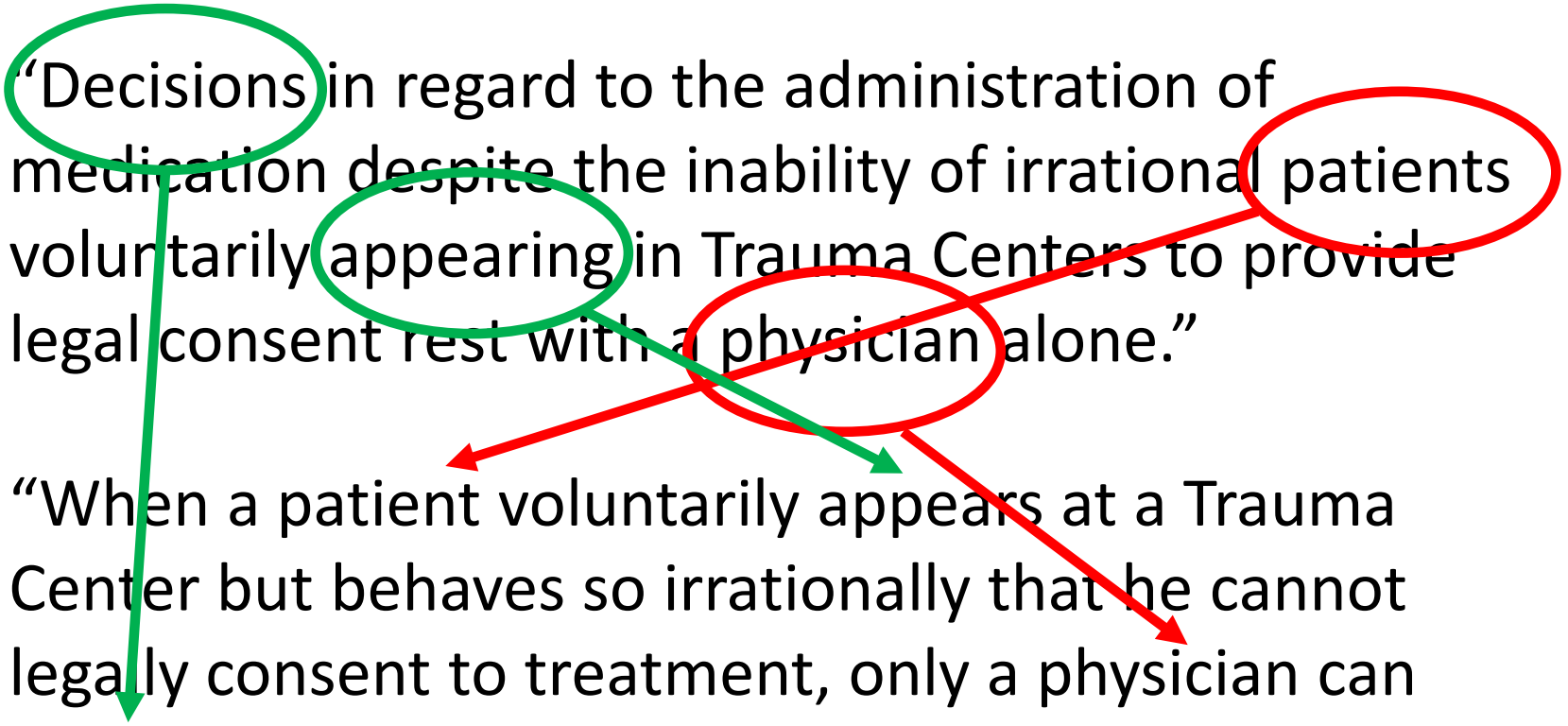
After the first draft, *everyone owns the entire text.*

NEVER
RE-USE
TEXT!!!



- What's wrong with a sentence or paragraph
- *How to fix it!*

Clarity



"Decisions in regard to the administration of medication despite the inability of irrational patients voluntarily appearing in Trauma Centers to provide legal consent rest with a physician alone."

"When a patient voluntarily appears at a Trauma Center but behaves so irrationally that he cannot legally consent to treatment, only a physician can decide whether to administer medication."

***Who* did *what*?**

Clarity

- Who are the main characters?
  - Make them the *subjects* of sentences
- What are the main actions?
  - Make them the *verbs* in sentences

Cohesion: does it flow?

"Security proofs of cryptographic protocols are crucial for the security of everyday electronic communication. However, these proofs tend to be complex and difficult to get right. The game-playing technique, originally proposed by Jones et al., follows a code-based approach where the security properties are formulated in terms of probabilistic programs, called games. This is a general design principle for cryptographic proofs to ease their management."

From Derek Dreyer's PLMW talk

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From Derek Dreyer's PLMW talk

Flow

- Begin sentences with old information
  - Create link to what came before
- Place *new* information at the end of a sentence
  - Create link to what follows
  - Puts new info in a position of emphasis

“Security proofs of cryptographic protocols are crucial for the security of everyday electronic communication. However, these proofs tend to be complex and difficult to get right. To make it easier to manage such proofs, Jones et al. have proposed a new design principle, called the game-playing technique. This technique follows a code-based approach where the security properties are formulated in terms of probabilistic programs, called games.”

Cohesion: topics

”Particular ideas toward the beginning of each clause define what a passage is centrally "about" for a reader, so a sense of coherence crucially depends on topics. Cumulatively, the thematic signposts that are provided by these ideas should focus reader’s attention toward a well-defined and limited set of connected ideas. Moving through a paragraph from a cumulatively coherent point of view is made possible by a sequence of topics that seem to constitute this coherent sequence of topicalized ideas. A seeming absence of context for each sentence is one consequence of making random , shifts in topics. Feelings of dislocation, disorientation, and lack of focus will occur when that happens.”

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Cohesion: topics

Confusing topic string!

”Particular ideas toward the beginning of each clause define what a passage is centrally "about" for a reader, so a sense of coherence crucially depends on topics. Cumulatively, the thematic signposts that are provided by these ideas should focus reader’s attention toward a well-defined and limited set of connected ideas. Moving through a paragraph from a cumulatively coherent point of view is made possible by a sequence of topics that seem to constitute this coherent sequence of topicalized ideas. A seeming absence of context for each sentence is one consequence of making random , shifts in topics. Feelings of dislocation, disorientation, and lack of focus will occur when that happens.”

Cohesion: topics

"Topics are crucial for a reader because they focus the reader's attention on a particular idea toward the beginning of a clause and thereby notify a reader what a clause is 'about.' Topics thereby crucially determine whether the reader will feel a passage is coherent. Cumulatively, through a series of sentences, these topicalized ideas provide thematic signposts that focus the reader's attention on a well-defined set of connected ideas. If a sequence of topics seems coherent, that consistent sequence will move the reader through a paragraph from a cumulatively coherent point of view. But if through that paragraph topics shift randomly, then the reader has to begin each sentence out of context, from no coherent point of view. When that happens, the reader will feel dislocated, disoriented, out of focus."

Emphasis

“No one can explain why that first primeval superatom exploded and thereby created the universe in a few words.”

Emphasis

"No one can explain why that first primeval superatom exploded and thereby created the universe in a few words."

"No one can explain in a few words why that first primeval superatom exploded and thereby created the universe."

Moving the important information to the end of a sentence is another way to manage the flow of ideas.

Another way you can manage the flow of ideas is to move the most important information to the end of the sentence.

We hope that, thanks to these examples, the reader now has a good understanding of the behaviour of this simple API. The point, though, is that while the words above were written by the authors, *the examples were generated and chosen automatically* from a formal specification of the API, using the methods that are the subject of this paper.

Coherence

"Lions and tigers are some of the [illegible]c and awe-inspiring species of cats. Mos[illegible] however, are currently facing extin[illegible]as been more evolutionarily [illegible]t. Although house cats are c[illegible] pet in the world, they are in [illegible]would therefore be interestin[illegible]se cats can be trained to be more socia[illegible]

What is the point?

From Derek Dreyer's PLMW talk

Coherence

- It should be clear how each sentence relates to the *big picture.*

- A paragraph should have *one main point*, expressed in a *point sentence* at (or near) the beginning.

Coherence: point sentence at the beginning

"There appears to be a negative correlation between the charisma of a species and its ability to survive. Lions and tigers, for instance, are among the most majestic creatures in the animal kingdom, yet they are currently facing extinction. In contrast, the house cat is evolutionarily quite successful, even though it is mostly known for stupid pet tricks."

Concision

“The point I want to make here is that we can see that American policy in regard to foreign countries as the State Department in Washington and the White House have put it together and made it public to the world has given material and moral support to too many foreign factions in other countries that have controlled power and have then had to give up the power to other factions that have defeated them.”

“Our foreign policy has backed too many losers.”

Concision

consider

"~~In my personal opinion,~~ we must ~~listen to and think over~~ carefully ~~in a punctilious manner~~ each ~~and every~~ suggestion ~~that is offered to us~~."

We must consider each suggestion carefully.

Any revision that shortens a sentence is likely to be a good one.

You *will* write long, unwieldy sentences. We all do!

Reading and re-reading reveals them.

Use names consistently

”John is giving a lecture. The Professor is using the projector to show his slides. Hughes thinks nomenclature is important.”

References

…
This insight has been described more appropriately by **Hughes**, Thompson, and surely others [**19**,33].
…

References

[1] L. Augusteijn, Sorting morphisms, in: S. Swierstra, P. Henriques, J. Oliveira (Eds.), ...
...
[**19**] J. **Hughes**, Why functional programming matters, The Computer Journal 32 (2) (1989) 98–107.

LaTeX

```
…
This insight has been described more
appropriately by Hughes, Thompson,
and surely others
\cite{hughes,thompson}.
…
```

BibTeX

```
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  chapter = {Why Functional
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  title = {Research Topics in Functional
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  year = {1990}}
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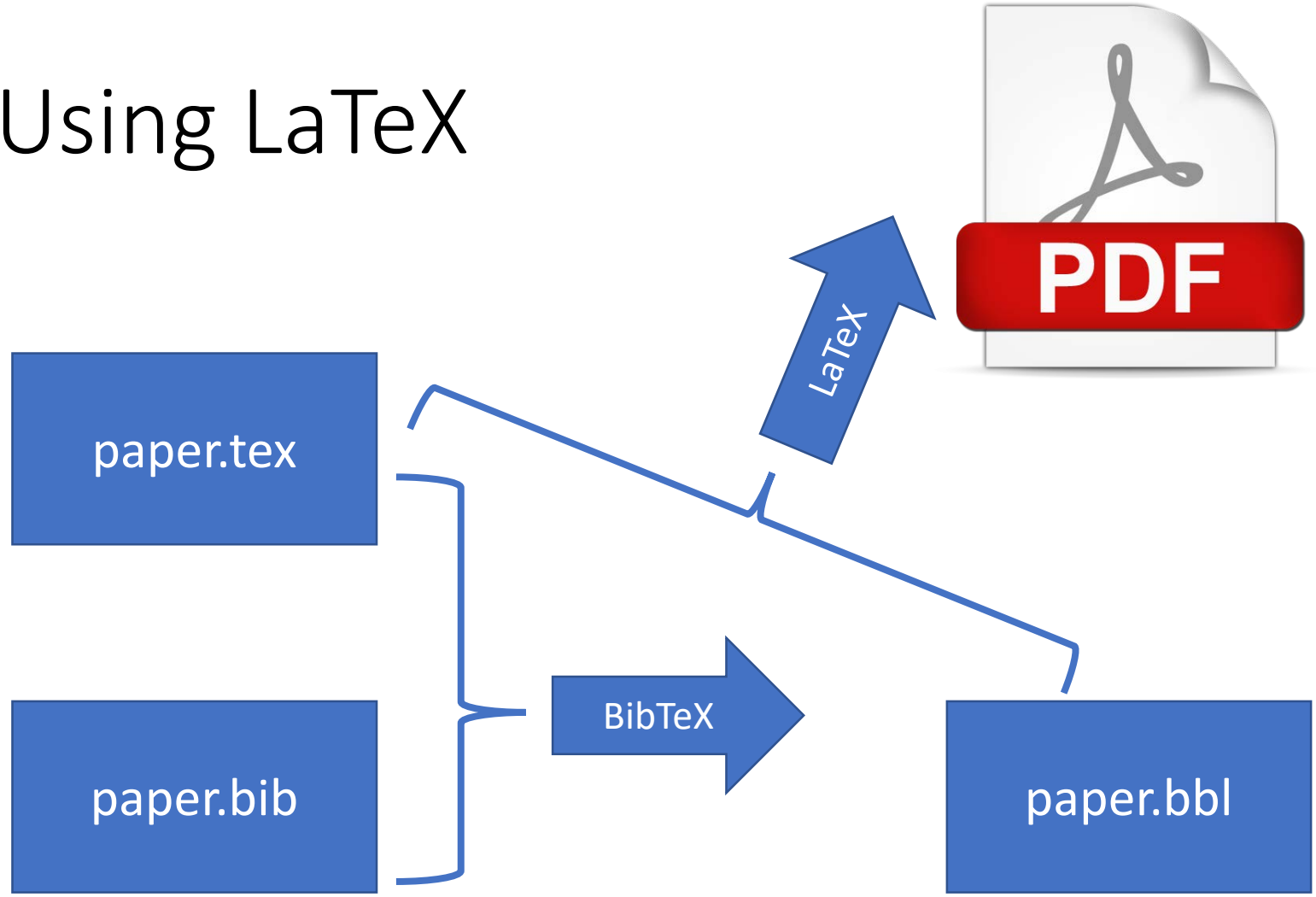
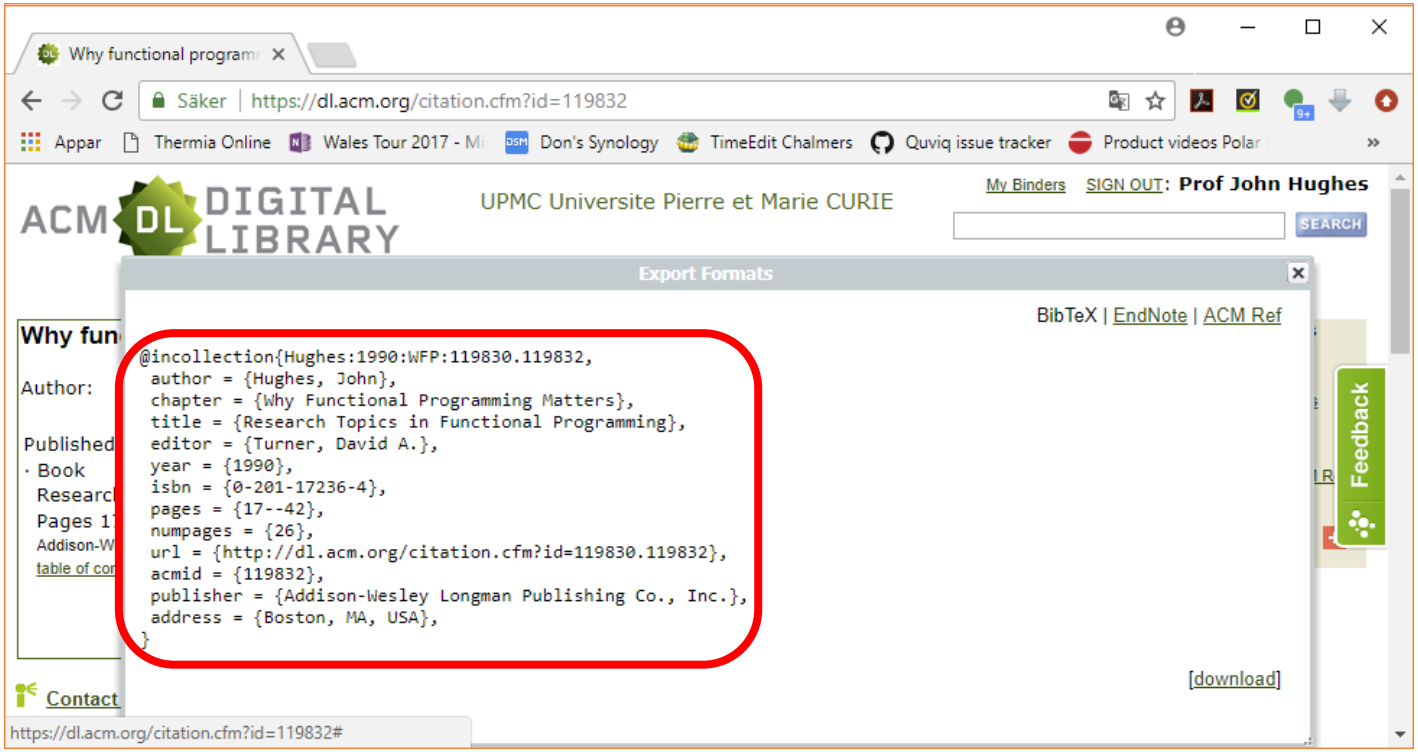
Using LaTeX



Where do BibTeX entries come from?



LaTeX installations

- MikTex for Windows
- Sharelatex.com
- …

Go forth and write…