How to write a great research paper

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adapted from and largely based on slides by:

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Why invest in Writing?
Writing papers is a skill

- Many papers are badly written
- Good writing is a skill you can learn
- It’s a skill that is worth learning:
  - You will get more brownie points (better grades, more salary, etc)
  - Your ideas will have more impact
  - You will have better ideas
The purpose of your paper
Papers communicate ideas

- Your goal: to infect the mind of your reader with your idea, like a virus
- Papers are far more durable than programs (think Mozart)

The greatest ideas are (literally) worthless if you keep them to yourself
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 (using X: details, facts)
- Here’s how my idea compares to other people’s approaches

I wish I knew how to solve that!

I see how that works. Ingenious!
Structure (6 pages total, English)

- Title (1000 readers)
- Abstract (4 sentences, 100 readers)
- Introduction (0.5-1 page, 100 readers)
- The problem (0.5-1 page, 10 readers)
- My idea (0.5-1 pages, 10 readers)
- The details (2 pages, 3 readers)
- Related work (1-2 pages, 10 readers)
- Conclusions (0.5 pages, 50 readers)
The abstract

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
Structure (6 pages total, English)

- Title
- Abstract (4 sentences)
- **Introduction** (0.5-1 page)
- The problem (0.5-1 page)
- My idea (0.5-1 pages)
- The details (2 pages)
- Related work (1-2 pages)
- Conclusions (0.5 pages)
The introduction

1. Describe the problem
2. State your contributions

...and that is all!
1 Introduction

There are two basic ways to implement function application in a higher-order language, when the function is unknown: the push/enter model or the eval/apply model [11]. To illustrate the difference, consider the higher-order function `zipWith`, which zips together two lists, using a function \( k \) to combine corresponding list elements:

\[
\text{zipWith} :: (a \to b \to c) \to [a] \to [b] \to [c] \\
\text{zipWith} \; k \; [] \; [] = [] \\
\text{zipWith} \; k \; (x:xs) \; (y:ys) = k \; x \; y : \text{zipWith} \; xs \; ys
\]

Here \( k \) is an unknown function, passed as an argument; global flow analysis aside, the compiler does not know what function \( k \) is bound to. How should the compiler deal with the call \( k \; x \; y \) in the body of `zipWith`? It can’t blithely apply \( k \) to two arguments, because \( k \) might in reality take just one argument and compute for a while before returning a function that consumes the next argument; or \( k \) might take three arguments, so that the result of the `zipWith` is a list of functions.
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 “gosh, if they can really deliver this, that’s be exciting; I’d better read on”
Contributions should be refutable

<table>
<thead>
<tr>
<th>NO!</th>
<th>YES!</th>
</tr>
</thead>
<tbody>
<tr>
<td>We describe the WizWoz system. It is really cool.</td>
<td>We give the syntax and semantics of a language that supports concurrent processes (Section 3). Its innovative features are...</td>
</tr>
<tr>
<td>We study its properties</td>
<td>We prove that the type system is sound, and that type checking is decidable (Section 4)</td>
</tr>
<tr>
<td>We have used WizWoz in practice</td>
<td>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.</td>
</tr>
</tbody>
</table>

We will evaluate your paper based on the contributions it claims.
Structure

- Abstract
- Introduction
- The problem
- My idea
- The details
- Related work
- Conclusions and further work
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.

  - I feel stupid
  - I feel tired
Structure (6 pages total, English)

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- My idea (0.5-1 pages)
- The details (2 pages)
- Related work (1-2 pages)
- Conclusions (0.5 pages)
Presenting the idea

- 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.
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
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- Conclusions (0.5 pages)
Related work

Fallacy

To make my work look good, I have to make other people's work look bad
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- Related work (1-2 pages)
- Conclusions (0.5 pages)
Conclusions and further work

- Be brief.
Summary

If you remember nothing else:

- Identify your key idea
- Make your contributions explicit
- Use examples