

Writing a Research Paper

Overview

1. goal
2. constructing the paper
3. common errors
4. publication process



Goal

Prepare a manuscript so that, with high probability, it will be

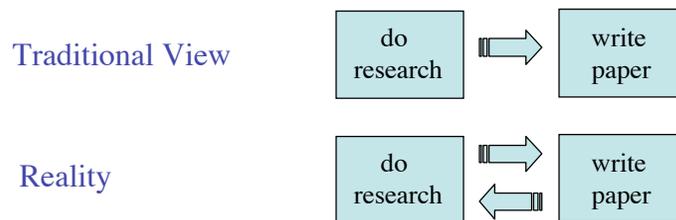
- accepted for publication
- read and understood when published

Why should you care?

- you will be judged based on your publications
- makes acceptance of papers more likely
- writing is very difficult for most of us

Many papers are poorly written.
The good news is that technical
writing is a learnable skill.

The Process of Writing



Writing the paper can

- help develop and clarify your ideas
- force you to be clear and focused
- predict anticipated interesting results
- promote collaboration with others

Assumptions

- already have results
- specific journal selected
- structure and content
- pirates' code of honor



Top Level Structure

- Title Page
 - **Introduction**
 - **Methods**
 - **Results**
 - **Discussion**
 - References
 - Appendices
- Whatever they are called, there are four critical components.

Introduction

- **key questions to answer ...**
 - **What **problem** was studied, and why?**
 - **What is your primary **contribution**?**
- you are teaching the reader your idea and why it is important
- explicitly state your key idea
- conveying the intuition is primary
- examine your assumptions about the reader

Organization of the Introduction

1. Context and Background

2. Make the Problem Clear

- explicitly state the problem
- explain why it is important, interesting
- make it clear the problem is unsolved
- briefly relate to past work

3. Explain Your Contributions

- explicitly state your solution or key idea
- describe how it works, what questions it answers
- explain how it differs from past solutions
- identify relevant hypothesis
- explicitly state what you show (be specific)

4. Overview? (integrate in above)

Use Concrete Examples!

- clarify new ideas, especially if abstract
- choose examples carefully
 - illustrate key ideas
 - but simple enough to understand
- running examples can be economical

Clarify new concepts by presenting them in more than one way.

e.g., picture + text

e.g., equation + picture

e.g., text + example

Methods

- **key question to answer ...**

How was the problem studied?

- method/model/algorithm
- experimental procedures
- analysis methodology



Results

- **key question to answer ...**

What were the findings?

- measurements, analysis, theorems, etc.
- results presented should provide evidence for each contribution*
- check this is so against the introduction
- state each claim first then provide supporting evidence, not vice versa

*top-down organization

Visualizing Information

Heuristic for figures vs. tables ...

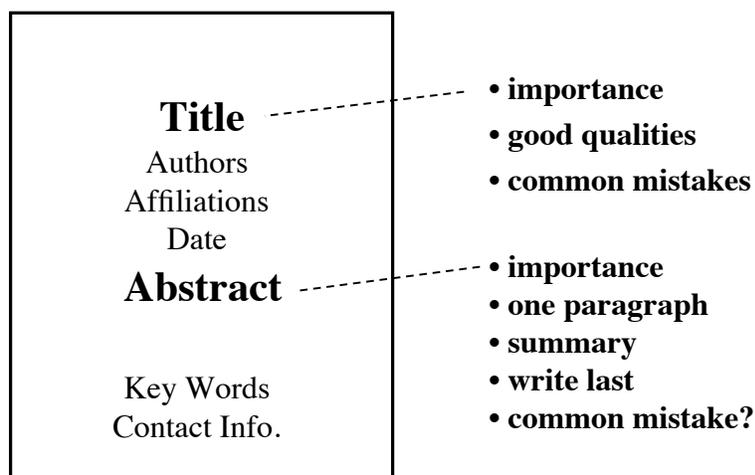
figures to show trends/differences, tables just for exact values

Discussion

- **key question to answer ...**
What do findings mean?
- **how to organize ...**
 - summary + limitations
 - include your conclusions
 - relate to past work + significance
 - directions for future research



Title Page



Common Mistake: Omitting Results

The abstract is a summary, not an introduction.

Always include something like “Here we show ...”

*“Previous computational models of self-replication using cellular automata have been manually designed, a difficult and time-consuming process. **We show here** how genetic algorithms can be applied to discover rules governing self-replicating structures. ... Experimental yields of discovered self-replicating structures are statistically significant, and the structures compared favorably in terms of simplicity with those generated manually in the past, but differed in unexpected ways. ...”*

} problem

} results

J. Lohn, J. Reggia, *IEEE Trans. Evol. Comp.*, 3, 1997, 165-178.

Other Material

- acknowledgements
- references
- appendices
- online supplemental material



Common Mistakes

- writing at the wrong level
- excessive background material
- not explicitly explaining innovation
- overstating significance of your work
- failure to give credit to others
- insulting the reviewer
- describing a system/implementation
- no explicit conclusions

Technical Errors

- material put into wrong section
- no results given in abstract
- including Background after Introduction
- omit key methodology info. (reproducible)
- recapitulating journey in obtaining results
- tabular rather than figure presentation
- inadequate figure captions
- giving tables captions
- failure to use spell checker

- royal we, passive voice, forward refs.

Recurring Issues

- scope of material
- journal vs. conference
- which one
- authorship - who - order
- permissions
- conflict of interest
- multiple submissions
- pre-submission critiques



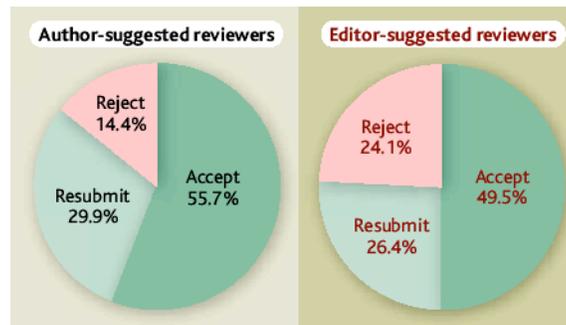
Publication Process

- start early ... very early
- always have your manuscript read by others
(colleagues, experts, naïve readers)
- clarify comments that you want

Common error: starting a paper too late for deadline

Submission Procedure

- journal selection
- suggest/exclude reviewers?



Science, 2005

Review and Publication Process

- review process
- outcome possibilities:
 1. reject
 2. revise and resubmit
 - cover letter
 - common mistake
 3. accept
- value reviewer comments as suggestions for improvement
- this is very difficult but very important

Citation Statistics

- increasingly used to measure researcher “impact”
- caution:
 - name confusions, inaccurate numbers, etc.
 - extraneous influences (length, web posting, etc.)

<http://arxiv.org/abs/0809.0692>

References and Further Information

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