

How to Write an
Independent Work Paper
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Outline from Web Site

- Motivation & Goal = Introduction
- Problem Background and Related Work
- Approach
- Implementation
- Results
- Conclusion

Enhanced Outline

- Abstract
- Introduction
- Problem Background and Related Work
- Approach
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- Evaluation
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- Bibliography
- Appendices

Abstract

- Optional
- Good idea
- Succinct!
 - Problem
 - Results
- Not
 - Notation
 - Background

Abstract Example

“This paper details the design, development, and evaluation of a Kinect-powered application to facilitate the instruction of ballroom dance. The application uses the Kinect camera’s skeletal tracking capabilities to teach and evaluate users through various ballroom dance positions and concepts, taking the form of a number of training modules that end with a game-like assessment portion. This application aims to fill a hole in ballroom dance instruction, providing the ease of access of self-study materials alongside the quality of instruction of live coaching.”

“Using Kinect To Learn How To Ballroom Dance”
Michael Li, Fall 2015

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Introduction

- Motivate the work
 - Why do we care?
 - Give examples of real-world problems
 - Concrete, specific examples that have occurred in the real world are the strongest motivators
 - Statistics on the prevalence of the problem can also provide evidence.
- Define the problem you solve clearly
 - Don't make readers guess
- Be explicit about your contribution
- Get to the point

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Background and Related Work

- Context of your work
 - What is known?
 - What is similar?
- May list several works
 - “Several others have proposed approximations [a,b,c].”
- Summarize closest, most important to your work
 - summaries should include need-to-know information
 - ie: don't go on and on about unrelated information
 - what are the similarities to what you have done?
 - what are the differences?
 - the best related work sections provide additional understanding of the field as a whole

Related Work: Before or After?

- Pros of discussing related work at the beginning:
 - answer the questions of knowledgeable readers
 - allow readers to better understand the novelty of the work (and whether they want to keep reading)
- Pros of discussing related work at the end:
 - have already described your solution
 - readers can more easily understand the differences with existing work

Simon Peyton Jones
Microsoft Research Cambridge
“How to write a great research paper”

- Written for **conference papers**
 - Limited pages!
- Advice that is applicable:
 - “Be generous to the competition.”
- Advice that is not applicable:
 - “highly compressed description”

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Approach

- **Big picture** driving details to follow
- What is big idea of your solution?
 - Design?
 - Experimental approach?
 - Theoretical approach?
 - New domain?
 - What makes it different from previous?
- Techniques
 - pictures, diagrams
 - idealized example

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Implementation

- Give details important to
 - achieving your goals
 - proving your claims
- Can someone reproduce your results?
- **Why** as well as **how**
 - often just as useful to report discarded or failed attempts as the successful ones
 - do so when it provides insights
 - Example: Mention chose certain clustering algorithm among several tested

Advice

- Try partitioning the implementation section into multiple modular subsections
 - good writing is sometimes like good code
 - modularize
 - highlight the key ideas
- Structure varies by project
 - Discuss with your adviser!
- **Warning: This is not a diary!**
 - stream-of-consciousness writing does not highlight key ideas

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Evaluation

- How successful is your project?
- What are the criteria for success?
 - You should state the broad criteria earlier
 - But you can be more precise here
- Experiments to show success?
 - Performance evaluation
 - Quantified user studies
 - Comparison to other methods or products
- Quantitative measures of success
 - Statistical significance of results
 - Comparison to “gold standards”

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Conclusions and Future Work

- Can be one or two sections
- Summary of important contributions
- Discuss how you would go forward
- Discuss how others can go forward

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Bibliography

- All papers, videos, ... you mention in the text
- All tools you use (and so mention in the text)
- Other references you may have used but not cited in the text
 - e.g. background reading
- Relevant private communications
 - e.g. researcher sends you unpublished performance numbers that you use in text
“Joe Smith, private communication, 2016”

Bibliographic Form

- Many acceptable forms
 - Different publishers, different forms
- Authors, paper title, publication title, publisher, date, pages. (online pointer)

[8] Jon Kleinberg. “Authoritative Sources in a Hyperlinked Environment.” In Proc. 9th ACM-SIAM Symposium on Discrete Algorithms, pp. 668—677. New York: ACM Press, 1998.

Citations in text

- Use number in brackets to refer to biblio. entry:
“The HITS algorithm[8] also computes a link-based ...”
- Using a bibliographic tool makes things easier
– e.g. bibtex for latex
- Footnotes for asides - sparingly
“... traverse index in reverse chronological order²...”

²Although this is not an absolute requirement ...”

Citations in Text

- *Do not use citations as a noun.*
 - Dave's pet peeve
 - You will see lots of published authors do this. They are wrong.
- You have used a citation correctly when it can be removed from the sentence and it is still a sentence.
 - good: "The HITS algorithm[8] computes ..."
 - "The HITS algorithm computes ..." is still a sentence
 - bad: "[8] defines the HITS algorithm to compute ..."
 - "defines the HITS algorithm to compute ..." is not a sentence

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Appendices

- Optional
- **Never** expect readers to look at them
- Uses
 - Data tables summarized in paper
 - Details of long proof, a detailed example, code of a key algorithm
 - Other details important to deep readers
- A luxury of a thesis or “mini thesis”

What everyone wants to know: How many pages?

Averages for a small sample of A-level papers

Section	1 sem. proj.	thesis
Introduction	avg. 1.5	2-8, avg. 3.5
Related Work	avg. 4.5	avg. 7.5
Approach	1 – 8, avg. 3	1-8, avg. 3.5
Implementation	avg. 10	avg. 13.5
Evaluation	avg. 5.5	avg. 11.5
Conclusions	avg. 1.25	1-7, avg. 3.5

Look at some examples

[http://www.cs.princeton.edu/ugrad/independent-work/
guidelines-and-useful-information#Example_Single-Semester_Projects_from_Previous_Years](http://www.cs.princeton.edu/ugrad/independent-work/guidelines-and-useful-information#Example_Single-Semester_Projects_from_Previous_Years)

[https://dataspace.princeton.edu/jspui/handle/88435/dsp01mp48sc83w/
simple-search?query=2014](https://dataspace.princeton.edu/jspui/handle/88435/dsp01mp48sc83w/simple-search?query=2014)

Writing advice- high level

- Write for a **general technical audience**
 - e.g. all your COS classmates
 - not for your adviser!
- **Don't blur your contributions** with those of others.
 - “We know that ...” Your result? Someone else's?
- **Get feedback** on drafts
 - classmates, parents, ...

Writing advice - details

- Good writers put themselves in the place of the reader
 - what does my reader know so far?
 - am I saying something my reader can't understand given what they know so far?
 - what do they need to know next?
- Define technical terms and notation clearly
 - define terms before they are used!
 - including domain-specific abbreviations
 - “The Domain Name System (DNS) becomes a bottleneck.”

Writing advice - details

- Avoid unnecessary complexity and jargon
 - Read George Orwell's essay on *Politics and the English language*
 - define necessary jargon
- Eliminate redundancy
 - I write my first draft *quickly* to get the ideas out
 - the first draft is very hard
 - I revise my first draft
 - I ask "what is the information content of this word or sentence?" Can it be eliminated without loss of meaning?
 - remove redundant words, phrases, sentences, paragraphs
- Proofread! Spell-check!

Writing advice – graphics

- Use figures to help clarify
 - data interpretation
 - architectures
 - interfaces
 - ...
- Do not overuse figures
 - don't pad paper with unnecessarily large figures
 - again: what does a reader gain by seeing this figure?
- Figure sizes
 - large enough to easily read

More writing advice

additions from Simon Peyton Jones

- Don't end "Introduction" with enumeration of sections to follow
 - this often has little information content
- Use examples when describing your problem (but don't substitute for a clear specification)
- Use active voice; passive voice "deadens the paper"
- "Use simple direct language"

Writing advice - form

- 12pt Times-Roman font
- 1-inch margins
- double-spaced
- Latex template files posted
 - No latex “journal format”

Writing advice - procedure

- Start with **extended outline**
- Don't try to write it all at once
- **Write something**, even a few lines, **every day**
- “Don't fall in love with your prose: writing and rewriting is what every author does to create papers that are both convincing and clear”
[Dr. Rob Fish]
- Use **headers and sub-headers**
 - helps illuminate **logical flow** of paper

Summary

- Follow outline but don't be shackled by it
- Don't lose the big picture for the details
- Will this be clear to others?
- Give yourself time to develop the paper day
- See posted examples

Acknowledgement & Reference

- Thanks to independent work co-coordinator [Rob Fish](#) for comments and contributions

- Reference

Simon Peyton Jones of Microsoft Research

Cambridge, “How to write a great research paper”

<https://www.microsoft.com/en-us/research/academic-program/write-great-research-paper/>