

How to Write an Independent Work Paper

Andrea LaPaugh

April 11, 2019

Outline from Web Site

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

Enhanced Outline

- Abstract
- Introduction
- Problem Background and Related Work
- Approach
- Implementation
- Evaluation
- Conclusions and Future Work
- 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

Enhanced Outline

- Abstract
- Introduction
- Problem Background and Related Work.
- Approach
- Implementation
- Evaluation
- Conclusions and Future Work
- Bibliography
- Appendices

Introduction

- Motivate the work
 - Why do we care?
 - give examples of real-world problems
 - concrete, specific examples are strongest motivators
 - statistics on prevalence of problem helps
- Define the problem you solve clearly
- Be explicit about your contribution!
- Get to the point!
 - No abstract => state your goals early!

Enhanced Outline

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

Background and Related Work

- Context of your work
 - What is known?
 - What is similar?
- Summarize closest, most important to your work
 - Include need-to-know information
 - don't go on and on about unrelated information
 - What are **similarities** to what you have done?
 - What are **differences**?

Related Work: more remarks

- Best related work sections provide additional understanding of field as a whole
- May mention several works in passing
 - “Several others have proposed approximations [a,b,c].”
- **You have the time (pages)!**
 - Compare Simon Peyton Jones' advice

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

- Written for **conference papers**
 - Limited pages!
- Applicable advice:
 - “Be generous to the competition.”
- Advice not applicable
 - “highly compressed description”
- Advice debatable
 - Put related work at end

Related Work: Before or After?

- Pros of discussing related work at beginning
 - Give fuller context of your work
 - Answer the questions of knowledgeable readers
 - Give better understand of novelty of the work
 - reader: “Do I want to keep reading?”
- Pros of discussing related work at end
 - Readers now know your work and can more easily understand the differences with existing work

Enhanced Outline

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

Approach

- **Big picture** driving details to follow
- What is big idea of your solution?
 - Design?
 - Experimental approach?
 - Theoretical approach?
 - New domain?

Approach - advice

- What makes your approach different from previous work or competitors?
- Use aids to clarify
 - Pictures, diagrams
 - Idealized example

Enhanced Outline

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

Implementation

- Give details important to
 - achieving your goals
 - proving your claims
- Can someone reproduce your success from the details?
- Highlight the key ideas
- **Why** as well as **how**

Implementation - Advice

- **This is not a diary!**
 - stream-of-consciousness writing does not highlight key ideas
- **However**, sometimes failed or discarded attempts worth mentioning
 - Do so when provides insight for the “why”
 - Example: Mention chose certain clustering algorithm among several tested

Implementation - Organization

- Often one section not best organization
 - Try multiple modular subsections
 - Sometimes want a couple high-level sections
 - Varies by project
- Discuss with your adviser!

Enhanced Outline

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

Evaluation

- How successful is your project?
- What are the criteria for success?
 - Should state these earlier
 - 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”

Enhanced Outline

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

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

Enhanced Outline

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

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

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

[8] Jon Kleinberg. “Authoritative Sources in a Hyperlinked Environment.” *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-what not to do

- **Do not use citations as a noun.**
– 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

Enhanced Outline

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

Appendices

- Optional
- **Never ever** expect reader to look at
- Uses
 - Data tables summarized in paper
 - Details of long proof, 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 (2016)

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

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 - Approach

- Put yourself 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?
- Eliminate redundancy
 - “What is the information content of this word or sentence?”
 - remove redundant words, phrases, sentences, paragraphs

Writing Advice - Details

- Avoid unnecessary complexity and jargon
 - Read George Orwell's essay on *Politics and the English language*
- Only use notation when necessary
- Define **technical terms, jargon** and **notation** clearly - **before** using!
 - write out domain-specific abbreviations first time use, e.g. “The Domain Name System (DNS) becomes a bottleneck.”
- Proofread! Spell-check!

Writing Advice – Graphics

- Use figures to help clarity
 - data interpretation
 - architectures
 - interfaces
- Do not overuse figures
 - What does reader gain by seeing this figure?
- Figure sizes
 - Large enough to easily read
 - Don't pad paper with unnecessarily large figures

More writing advice additions from Simon Peyton Jones

- Don't end "Introduction" with enumeration of sections to follow
- 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**
- Use **headers and sub-headers**
 - helps illuminate **logical flow** of paper
- “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]

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 by day
- See posted examples at <http://www.cs.princeton.edu/ugrad/independent-work/guidelines-and-useful-information>

Acknowledgement & Reference

- Thanks to independent work co-coordinators [Aarti Gupta](#) and [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/>