Writing Your Literature Review
One Paper at a Time

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Preface

My previous pamphlet *Writing Your Dissertation One Paragraph at a Time* includes a series of writing exercises, each one paragraph long, that together produce a first draft of Chapter 1 of your dissertation, its introduction. This pamphlet repeats the exercise for Chapter 2 of your dissertation, the literature review. In practice, the literature review often comes first, so this exercise can be done independently.

The exercises proceed in four stages: reviewing one paper; comparing two papers; producing an annotated bibliography; and producing a literature review. In the first stage, you will extract information from a single paper. In the second stage, you will learn how to criticise, by contrasting two papers. In the third stage, you will decide which papers belong in the bibliography by refining your topic. In the fourth stage, you will arrange the review to expose the gap in knowledge that you want to fill.

This guide will help you even though you have not yet mastered the literature, by revealing the common structure of research papers, how they are organised. This will also help you to organise your own writing. Each section contains a mix of questions for you to answer or actions for you to take. Once done, you will have a draft of your literature review.

Contents

1 A Single Paper

Your first paper is the hardest of all, as this is when the gap between what you know and the author's expectations of you is greatest. A common experience is to get stuck on the first sentence, which begins with something of the form

> There is a considerable body of research on widgets [3,6,19,22,23,37].

That is, before getting properly started, you are being invited to read half a dozen other papers first. And each of those papers is likely to have the same problem. Well, this happens to everyone, at least for your first few dozen papers. So try to find a survey paper, which does not assume too much prior knowledge but cites many other papers. Alternatively, try to find a seminal paper, that is highly cited but does not cite many others. Get some help with this!

So, you have the right paper, with its opening sentence on widgets. Rather than try to understand this sentence straight away, we are going to take the paper apart, or at least the introduction, to understand how it is organised. This is done by answering a few questions.

Question 1.1 *What is the title of the paper?*

This is an easy question to get started, but examine the words of the title one by one. Google the title to see if there are other versions of the same paper, or if there are other papers with a similar title.

Question 1.2 *Who are the authors?*

Is there a lead author? What is their reputation in the field? What does google.scholar tell you about them? Can you find short bios? What are they best known for?

Question 1.3 *What are the keywords in the paper?*

These are commonly supplied as part of the frontmatter. If not, suggest some. Which of the key words appear in the title?

Question 1.4 *Which of the keywords are of interest to you?*

Even on the first day, you should have some idea of your interests.

Question 1.5 *What is the ordering principle for the background?*

Most papers begin with a paragraph or more of background. Possible orderings include: chronological (old to new); familiar to unfamiliar; simple to complex; particular to general; general to particular; and problem to solution. Which words in the paper explain the ordering principle? Examples include "In the beginning,..." and "The most popular ...".

Question 1.6 *Where does the new material begin?*

Which words are used to indicate this? The most common answer is "In this paper ...".

Question 1.7 *What is the thesis of the paper?*

Is there a single statement in the paper that describes their position, the new contribution to knowledge? If not, can you supply one? To what extent is the thesis implicit in the title? If the connection is not clear then discuss.

Question 1.8 *Is there an example to illustrate the thesis?*

If so, describe it. Is it relevant to you? If no canonical example is given, can you suggest one?

Question 1.9 *Who are the stakeholders?*

It is usually the case that other researchers will care, so try to focus on other stakeholders.

Question 1.10 *What is the significance of the thesis?*

Explain this for each class of stakeholders. Do they appreciate the canonical example, the research method?

Question 1.11 *What is the evidence for the thesis?*

Options include: experimental results; real-world observations; mathematical proofs.

Question 1.12 *How was the evidence obtained?*

What research method was used? Is there a citation for this?

Question 1.13 *To what extent does the evidence provided support the thesis?*

Is the evidence conclusive? suggestive? insufficient?

Question 1.14 *Do you accept the thesis? Do you care?*

Discuss.

Question 1.15 *How can you use the thesis to further your own goals?*

Will your work refine the thesis? exploit the thesis? reject the thesis?

1.1 An Example

Here is an example from *Principles of Programming Languages 2016*, written by a couple of my collaborators.

The paper is *Breaking through the Normalization Barrier: a Self-Interpreter for F-omega* by Matt Brown and Jens Palsberg [1]. I obtained the bibliographic details from Google Scholar, but have had to fix some punctuation, especally capitals. Matt is Jens' student at UCLA. Jens is a highly regarded researcher, very active in conferences and an editor at ACM TOPLAS. Jens works on the implementation of programming languages in the broadest possible sense, from formal calculi to compiler algorithms. They wrote a prequel to this paper for POPL 2015. Since POPL is the top conference in programming languages, Matt is doing very well.

The keywords are: Lambda Calculus; Self Representation; Self Interpretation; Meta Programming. I am interested in them all. In particular, Jens and I published a paper about these things in 2013.

The background is given in two parts, on self-interpretation and the normalisation barrier. The first begins with Barendregt's definition and then proceeds in chronological order. The second part is in no clear order.

The new material begins with the challenge and the result, at the end of page 1. The thesis is that there are strongly-typed lambda calculi that have self-interpreters, in particular, System F-omega. The particulars are clear from the title. The generalities are stated in a paragraph that resists compression to a single sentence.

The stakeholders are those interested in "type-checking self-applicable meta-programs, with potential for applications in typed macro systems, partial evaluators, compilers, and theorem provers". That is, people interested in compiler construction. The results expand the space of what is possible in language design and compilation. It is not clear to me how strong normalisation relates to the implementation of languages that are not normalising, i.e. all proactical languages, but Morrisett (from Harvard) describes F-omega as the "workhorse of modern compilers" so perhaps I am missing something.

The evidence for the result is by mathematical proof, presumably done by hand, without formal verification. Detailed proofs are given in an appendix.

I am willing to accept the thesis, as the authors give a plausible account of why prior claims to the contrary are false. My interest arises because I am developing typed, strongly normalising version of our lambda-SF-calculus with a view to supporting a rich variety of program analyses, including self-interpreters, etc. My approach differs from theirs in that I want to use strong normalisation as a stepping stone to handle programs whose evaluation may not terminate. This paper may give me some useful ideas, or technical tricks. I hope to go further.

Note: from downloading to finishing this page took about an hour.

2 Comparing Papers

It is hard to criticise a single paper, since it is the only standard by which to judge it. So let us begin by comparing two papers. Repeat the exercises of the previous section for a second paper that is related to your first. Then compare the answers. In particular, how do they relate in terms of:

Question 2.1 *keywords?*

Question 2.2 *papers cited?*

Question 2.3 *theses?*

Question 2.4 *examples?*

Question 2.5 *stakeholders?*

Question 2.6 *methods?*

3 Writing an Annotated Bibliography

An annotated bibliography is a collection of commentaries similar to those of Section 1 for all papers on a given topic. Before you can write the commentaries, you have to find the papers.

Question 3.1 *What is your topic?*

Question 3.2 *What are your keywords?*

Aim for 3-5 keywords.

Question 3.3 *What is your search strategy for finding relevant papers?*

Make sure to try synonyms for your keywords.

Action 3.1 *Execute your search strategy.*

Question 3.4 *Of the papers you have found, which use most of your keywords?*

Action 3.2 *Clean up your annotations.*

Once you have mastered the writing of annotations in the style of Section 1, revise your annotations to remove the headings, and anything boring, to create a paragraph or three of salient information per paper.

4   Writing a Literature Review

A literature review is like an annotated bibliography except that it has a particular purpose. Here, the goal is to identify a gap in our knowledge, a gap that you intend to fill through your research.

Question 4.1 *What gap in our knowledge do you hope to fill?*

Question 4.2 *What is your research question?*

Question 4.3 *What are the keywords in your question?*

Action 4.1 *Redo your search for papers using the keywords in your research question.*

Action 4.2 *Drop any papers in the bibliography that no longer seem relevant.*

Action 4.3 *Produce annotations for the new papers.*

Action 4.4 *Revise your annotated bibliography as follows.*

For each paper in your list, what is the relationship between the thesis of this paper and your research question? Add this to the annotation.

Action 4.5 *Construct a table of keywords versus papers.*

The columns are your keywords. The rows are the papers under consideration, followed by a row for your research.

Action 4.6 *Revise your keywords to improve the table.*

Your row should be the only one with success in every column. If not, revise your keywords, and start over from Action 4.1.

Action 4.7 *Permute the rows and columns of the table.*

As much as possible, success increases as you move through the table, down and to the right. Where possible order the rows to put older papers higher up.

Action 4.8 *Group papers according to the similarity of their rows in the table. Write a paragraph about each group.*

Action 4.9 *Write the literature review as a continuous narrative that explores the literature, with an emphasis on isolating the gap in our knowledge that you have identified. Exploit the groups of papers identified earlier. Choose an ordering principle for the groups.*

References

[1] Matt Brown and Jens Palsberg. Breaking through the normalization barrier: a self-interpreter for F-omega. In *Proceedings of the 43rd Annual ACM SIGPLAN-SIGACT Symposium on Principles of Programming Languages*, pages 5–17. ACM, 2016.