Seminar on Enterprise Software

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Thesis plan

OK, I NEED A PLAN FOR WRITING MY THESIS.

STEP 1: MAKE A PLAN.

STEP 2: SET A DEADLINE.

STEP 3: FREAK OUT.

WWW.PHDCOMICS.COM
Structure of the Thesis

• Introduction
• Background / State of the Art
• Contribution
• Validation
• Discussion and Conclusion

Introduction

• Introduction
  – Motivation
  – Scope
  – Research problem
    • Research question
  – Contribution
  – Structure description
• Background / State of the Art
• Contribution
• Validation
• Discussion
• Conclusion
Background / State of the Art

• Introduction

• Background / State of the Art
  – Survey of existing technology
  – Survey of existing related work

• Contribution

• Validation

• Discussion

• Conclusion


http://www.elsevier.com/__data/promis_misc/525444systematicreviewsguide.pdf

Contribution

• Introduction

• Background / State of the Art

• Contribution
  – Research method
  – ...

• Validation

• Discussion

• Conclusion
Validation

• Introduction
• Background / State of the Art
• Contribution
• Validation
  – Theoretical validation
  – Empirical validation
  – Experimental validation
• Discussion
• Conclusion

Discussion

• Introduction
• Background / State of the Art
• Contribution
• Validation
• Discussion
  – Limitations
  – Related work
    • Comparison of your results (method, framework, calculations, findings) to similar studies
    • Differences, advantages and limitations
• Conclusion

Proof-of-concept
e.g., Prototype
Conclusion

• Introduction
• Background / State of the Art
• Contribution
• Validation
• Discussion

• Conclusion
  – Not ONLY summary !!!
  – Summarising the thesis
    • 1 paragraph, 5 lines at most.
  – Concluding remarks
    • Contribution to theory
    • Contribution to practice
  – Generalisation
  – Future work

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A good research paper or thesis should answer a number of questions
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• What, precisely, was your contribution?
  – What question did you answer?
  – Why should the reader care?
  – What larger question does this address?

• What is your new result?
  – What new knowledge have you contributed that the reader can use elsewhere?
  – What previous work (yours or someone else’s) do you build on? What do you provide a superior alternative to?
  – How is your result different from and better than this prior work?
  – What, precisely and in detail, is your new result?

• Why should the reader believe your result?
  – What standard should be used to evaluate your claim?
  – What concrete evidence shows that your result satisfies your claim?

If you answer these questions clearly
  – You will probably communicate your result well
  – Your result represents an interesting, sound, and significant contribution
  – You will have a good chance of getting thesis accepted for publication in a conference or journal

• Why should the reader care?
  – What is your new result?

What, precisely, was your contribution?

What kinds of questions do software engineers investigate?

<table>
<thead>
<tr>
<th>Type of question</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method or means of development</td>
<td>How can we do/create/modify/evolve (or automate doing) X?</td>
</tr>
<tr>
<td></td>
<td>What is a better way to do/create/modify/evolve X?</td>
</tr>
<tr>
<td>Method for analysis or evaluation</td>
<td>How can I evaluate the quality/correctness of X?</td>
</tr>
<tr>
<td></td>
<td>How do I choose between X and Y?</td>
</tr>
<tr>
<td>Design, evaluation, or analysis of a particular instance</td>
<td>How good is Y? What is property X of artifact/method Y?</td>
</tr>
<tr>
<td></td>
<td>What is a (better) design, implementation, maintenance, or adaptation for application X?</td>
</tr>
<tr>
<td></td>
<td>How does X compare to Y?</td>
</tr>
<tr>
<td></td>
<td>What is the current state of X / practice of Y?</td>
</tr>
<tr>
<td>Generalization or characterization</td>
<td>Given X, what will Y (necessarily) be?</td>
</tr>
<tr>
<td></td>
<td>What, exactly, do we mean by X? What are its important characteristics?</td>
</tr>
<tr>
<td></td>
<td>What is a good formal/empirical model for X?</td>
</tr>
<tr>
<td></td>
<td>What are the varieties of X, how are they related?</td>
</tr>
<tr>
<td>Feasibility study or exploration</td>
<td>Does X even exist, and if so what is it like?</td>
</tr>
<tr>
<td></td>
<td>Is it possible to accomplish X at all?</td>
</tr>
</tbody>
</table>
What do thesis committees look for?

- A clear statement of the specific problem you solved
- The question about software development you answered
- An explanation of how the answer will help solve an important software engineering problem

What is your new result?
What kinds of results do you produce?

<table>
<thead>
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<tbody>
<tr>
<td>Procedure or technique</td>
<td>New or better way to do some task, such as design, implementation, maintenance, measurement, evaluation, selection from alternatives; includes techniques for implementation, representation, management, and analysis; a technique should be operational—not advice or guidelines, but a procedure</td>
</tr>
<tr>
<td>Qualitative or descriptive model</td>
<td>Structure or taxonomy for a problem area; architectural style, framework, or design pattern; non-formal domain analysis, well-grounded checklists, well-argued informal generalizations, guidance for integrating other results, well-organized interesting observations</td>
</tr>
<tr>
<td>Empirical model</td>
<td>Empirical predictive model based on observed data</td>
</tr>
<tr>
<td>Analytic model</td>
<td>Structural model that permits formal analysis or automatic manipulation</td>
</tr>
<tr>
<td>Tool or notation</td>
<td>Implemented tool that embodies a technique; formal language to support a technique or model (should have a calculus, semantics, or other basis for computing or doing inference)</td>
</tr>
<tr>
<td>Specific solution, prototype, answer, or judgment</td>
<td>Solution to application problem that shows application of SE principles – may be design, prototype, or full implementation; careful analysis of a system or its development, result of a specific analysis, evaluation, or comparison</td>
</tr>
<tr>
<td>Report</td>
<td>Interesting observations, rules of thumb, but not sufficiently general or systematic to rise to the level of a descriptive model.</td>
</tr>
</tbody>
</table>

What do thesis committees look for?

- Interesting, novel, exciting results that

Significantly enhance the ability

- to develop and maintain software
- to know the quality of the software
- to recognize general principles about software
- to analyze properties of software
Questions that committee asks about your thesis

What, precisely, do you claim to contribute?

- If your result ought to work on large systems
  - explain why you believe it scales
- If you claim your method is "automatic"
  - should **not** require human intervention
    - automatic when it's operating but requires manual assistance to configure
    - automatic except for certain cases how often the exceptions occur
- If you claim your result is "distributed"
  - should not have a single central controller or server
    - If it does, what part is distributed
    - what part is not
- If you're proposing a new notation for an old problem
  - why your notation is clearly superior to the old one
- If your thesis is an "experience report"
  - use of a previously-reported tool or technique in a practical software project
    - what idea the reader can take away from the thesis to use in other settings


<table>
<thead>
<tr>
<th>What’s new here?</th>
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<tbody>
<tr>
<td>Awful</td>
</tr>
<tr>
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</tr>
<tr>
<td>Poor</td>
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### What’s new here?

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<tbody>
<tr>
<td>Awful</td>
<td>▼</td>
<td>• I completely and generally solved … (unless you actually did!)</td>
</tr>
<tr>
<td>Bad</td>
<td>▼</td>
<td>• I worked on galumphing. (or studied, investigated, sought, explored)</td>
</tr>
<tr>
<td>Poor</td>
<td>▼</td>
<td>• I worked on improving galumphing. (or contributed to, participated in, helped with)</td>
</tr>
<tr>
<td>Good</td>
<td>▲</td>
<td>• I showed the feasibility of composing the standard detector. (or proved, demonstrated, created, established, found, developed)</td>
</tr>
<tr>
<td>Better</td>
<td>▲</td>
<td>• I automated the production of flitz tables from specifications.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• With a novel application of the blivet transform, I achieved a 10% increase in speed and a 15% improvement in coverage over the standard method.</td>
</tr>
</tbody>
</table>

*“Try not. Do, or do not. There is no try.” -- Yoda*

### What has been done before?

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<tr>
<td>Awful</td>
<td>▼</td>
<td>The galumphing problem has attracted much attention [3,8,10,18,26,32,37]</td>
</tr>
<tr>
<td>Bad</td>
<td>▼</td>
<td>Smith [36] and Jones [27] worked on galumphing.</td>
</tr>
<tr>
<td>Poor</td>
<td>▼</td>
<td>Smith [36] addressed galumphing by blitzing, whereas Jones [27] took a flitzing approach.</td>
</tr>
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<td>Good</td>
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<td>Smith’s blitzing approach to galumphing [36] achieved 60% coverage [39].</td>
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<td>Jones [27] achieved 80% by flitzing, but only for pointer-free cases [16].</td>
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<td>We modified the blitzing approach to use the kernel representation of flitzing and achieved 90% coverage while relaxing the restriction so that only cyclic data structures are prohibited.</td>
</tr>
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</table>
Questions that committee asks about your thesis

**What, precisely, is the result?**

- If you introduce a new model
  - be clear about its power
    - empirical data, formal semantics, mathematical principles
- If you introduce a new metric
  - define it precisely
- If you introduce a new architectural style, design pattern, or similar design element,
  - treat it as if it were a new generalization or model
- If your contribution is principally the synthesis or integration of other results or components
  - be clear about why the synthesis is itself a contribution

Questions that committee asks about your thesis

**What, precisely, is the result?**

- If your paper is chiefly a report on experience applying research results to a practical problem
  - say what the reader can learn from the experience
- If a tool plays a featured role in your paper
  - what is the role of the tool?
- If a system implementation plays a featured role in your paper
  - what is the role of the implementation?
    - architecture, implementation technique, capability, performance, system is a result itself
Why should the reader believe your result?

<table>
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<th>Type of validation</th>
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| **Analysis**       | I have analyzed my result and find it satisfactory through rigorous analysis, e.g. …  
|                    | For a formal model … rigorous derivation and proof  
|                    | For an empirical model … data on use in controlled situation  
|                    | For a controlled experiment … carefully designed experiment with statistically significant results  
| **Evaluation**     | Given the stated criteria, my result…  
|                    | For a descriptive model … adequately describes phenomena of interest …  
|                    | For a qualitative model … accounts for the phenomena of interest…  
|                    | For an empirical model … is able to predict … because …, or … generates results that fit actual data …  
|                    | Includes feasibility studies, pilot projects  
| **Experience**     | My result has been used on real examples by someone other than me, and the evidence of its correctness/usefulness/effectiveness is …  
|                    | For a qualitative model … narrative  
|                    | For an empirical model or tool … data, usually statistical, on practice  
|                    | For a notation or technique … comparison of systems in actual use  
| **Example**        | Here’s an example of how it works on  
|                    | For a technique or procedure … a "slice of life" example based on a real system …  
|                    | For a technique or procedure … a system that I have been developing …  
|                    | For a technique or procedure … a toy example, perhaps motivated by reality  
|                    | The "slice of life" example is most likely to be convincing, especially if accompanied by an explanation of why the simplified example retains the essence of the problem being solved.  
|                    | Toy or textbook examples often fail to provide persuasive validation, (except for standard examples used as model problems by the field).  
| **Persuasion**     | I thought hard about this, and I believe passionately that…  
|                    | For a technique … if you do it the following way, then …  
|                    | For a system … a system constructed like this would …  
|                    | For a model … this example shows how my idea works  
| **Blatant assertion** | No serious attempt to evaluate result. This is highly unlikely to be acceptable |
What do committees look for?

**Why should the reader believe your result?**

- **If you claim to improve on prior art**
  - compare your result objectively to the prior art

- **If you used an analysis technique**
  - follow the rules of that analysis technique

- **If the technique is not a common one**
  - explain the technique and standards of proof, and be clear about your adherence to the technique

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How do you combine the elements into a research strategy?

1. Formulate the research question
2. Prepare the structure of your thesis
3. Write abstract
4. Investigate needed technology
5. Review related work
6. Develop contribution
7. Validate contribution
8. Write conclusion and introduction
9. Write introduction
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Read/review everything carefully
Re-write to improve !!!
Next Introductory Seminars

30 September

• Few more quick tips for presentation
• How to write 2 page problem statement?
• How to write introduction?
• How to write thesis?
• How to perform literature review?
• How bibliography needs to be organised?