Undergrad, Masters, and PhD Thesis?

Kevin Elphinstone

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Outline

- Define what a thesis is.
- Describe what is expected in thesis/dissertation.
- Explain how to go about doing one.
- Different expectations of Undergrad, Masters and PhD.
- Talk about reviews

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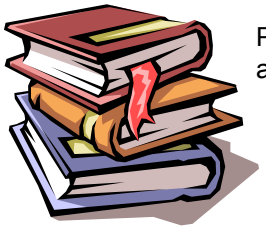
What is a Thesis?



PhD = “Piled higher and Deeper”

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From the dictionary

From www.m-w.com

- **2**
  - **a :** a position or proposition that a person advances and offers to maintain by argument
  - **b :** a proposition to be proved or one advanced without proof **:** HYPOTHESIS
- **4 :** a dissertation embodying results of original research and especially substantiating a specific view

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What does this really mean?

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A Thesis is NOT….

- It is NOT an elaborate term for a
  - specification,
  - report,
  - user or reference manual,
  - text book,
  - a piece of software,
  - a summary of a information available in a particular field,
  - or journal of what you did.

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Thesis

- Systematic investigation of a significant problem resulting in new applications, new solutions, or new insights.
- A hypothesis (a position or solution) and a methodical substantiation or validation.

The major components

- Systematic investigation of a significant problem resulting in new applications, new solutions , or new insights.
- A hypothesis (a position or solution) and a methodical substantiation or validation

- Significant problem
- Systematic investigation
- Proposed position or solution
- Methodical substantiation or validation
- Conclusions
  - New apps, solutions, insights.

Significant *Problem*

- Thesis statement, problem identification, problem statement , research question.
- An example
  - "What is the best way to do memory management?"

A Poor example

- "What is the best way to do memory management?"
  - Imprecise, not focused – virtual, physical, hardware, software, memory allocation.
  - Impossible to succeed – the best always evolves - depends on trade-offs
  - Provides no terms of reference
  - No clear goal – no way to identify success or the END

Characteristics of a Good Thesis Statement

- Short: A paragraph
- Focused – doable in time and space.
- A single theme.
- States the area your working in
- States the position you are taking
- Provides the direction for the thesis

Better Example

- Single Address space systems place differing demands on page table structures when compared to conventional systems.
- This thesis will identify the limitations of existing page table structures in a SASOS environment.
- We propose XYZ Page Tables to address those limitations.

Significant Problem

- The "so what" criteria!
- Must be able to answer
  - Why is this problem important?
  - Who/what will benefit (and how) from the results?

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Systematic investigation

- What are the specific issues/problems?
- What are the problems in general?
- What are current/past approaches?
  - What are there limitations?
  - What assumptions did they make?
- What are alternative new approaches?
- What good/bad about them in comparison?
- What did others learn from their research?
- What have others failed to do? Why?
- What is different about our scenario? ---specializing

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Systematic investigation

- A lot of answers are in the literature.
- Others require thinking.

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Proposed position or solution

- At the least, a statement or characterization of the solution being sought.
  - If you don't what your looking for, how do you know when you find it.
- The systems area is quantitative
  - You usually must take a "position" which you will validate.
  - You will validate it by a quantitative measure - *metric*.
- Qualitative studies are rare
  - Social Sciences
    - Data collection, interviews, surveys, questionnaires etc.
    - Interpretive analysis, identify themes, categories
    - Determine attitudes, feelings, motivations
    - "Why do parents worry about children?"

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Methodical substantiation or validation

- What will be done to test the hypothesis?
  - Experiments, simulations, proofs, etc.
  - What are appropriate metrics?
    - Faster, smaller, more reliable, secure?
- Assume you have the results you want:
  - How will this confirm or deny your hypothesis?
  - Why will the results be believable?
  - How will you present your results?
- Can other researchers reproduce your results?
- What equipment do you need?

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Results/Conclusions

- Is your position substantiated? How?
  - If not, why not?
    - This can also be a "successful" result!!

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Research Project vs. Thesis

- Research project
  - Usually something tangible
    - A piece of software, a hardware prototype, a specific goal.
  - Uses "state of the art" in design
- Project report is not a thesis!!
- Instead, research projects produce problems that become thesis and papers!!!

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Undergrads, Masters, PhDs?

Research Projects — Thesis

Undergrads Masters PhDs

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What Should Be in A Thesis

- Introduction
  - *General* intro to the thesis
  - *Summary* of the problem
  - Some motivation
  - Overview of results and contributions
- Review of state of the art
  - Organized by idea
- Problem statement
  - A concise statement of the problem
  - Justification that the question is unanswered
  - Motivation that it is worth answering
    - Must reference review section.
- Hypothesis, position or solution
- Methodology
- Results
- Discussion
- Conclusions
  - Conclusions
  - Summary of contributions
  - Future research
- References
- Appendices

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What Should Be in A Small Project Report

- Introduction
  - *General* intro to the project
  - Description of goal
  - Motivation
  - Overview of report
- Review of state of the art
  - Organized by idea
- Issues in achieving goal
  - Identify precisely the issues
    - Reference the review section
- Report of the investigation
  - Describes how you tackled the issues
  - States design decisions
    - including justification of design choices over the alternatives
  - Validation of work
- Conclusions
  - Conclusions
  - Future research
- References
- Appendices

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How to do a thesis

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Phases of doing a thesis

1. Familiarization and thinking
2. Preparing a proposal
3. Conducting the research
4. Writing the thesis

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PhD - Phases and time

1. Familiarization and thinking } 6 – 12 months
2. Preparing a proposal
3. Conducting the research 1 – 2 years
4. Writing the thesis 3 – 6 months

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Before starting the proposal

- Some things to ask yourself
  - Am I familiar with other research in the area?
  - Do I have a clear understanding of the steps to complete the project?
  - Do I have the resources (especially time) to complete the project as planned?

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What should be in a proposal?

- Problem identification, background, motivation
- Review of the literature
  - Do it now, not at the end.
    - It shows the research is needed
    - It justifies your methodology is appropriate
- Proposed position or solution
  - At least a characterization of solution
- Methodology
  - The thing you plan to implement
  - The experiments you plan
  - The results you are seeking

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In an ideal world…

- Your proposal becomes the first three chapters of your thesis
  - Simply change from future to past tense
  - Modify the description to describe what actually happened

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So what about the PhD reviews

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In Principle

- The committee tries to assess how the student is progressing towards producing the PhD.

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For an End of Year 1 Review

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Some Questions the Committee Asks Itself

- Has the student clearly identified a "problem"?
  - Is the problem significant enough?
  - Is the problem small or focussed enough?
- Does the student demonstrate he has a clear understanding of the field his problem lies in?
  - Does he know similar work in detail (especially strengths and weaknesses)?
    - Convinces committee that there is a problem, and that it is significant.

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Some Questions the Committee Asks Itself

- Has the student conveyed or characterized his proposed approach to the problem?
  - Has he "placed" his solution within the body of existing work?
    - Helps convince the committee it's novel and feasible.
  - How does the student propose to validate it?
  - Is the validation too much or too little work?
  - Does his approach actually validate his position on the stated problem?

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Some Questions the Committee Asks Itself

- What does the student envisage his contribution would be?
- Are his presentation skills adequate?

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Make the Committee's Life Easier!!

- Explicitly try to not leave the previous questions unanswered.
  - Don't let us have to dig too hard for them
    - Committee members (especially those not working directly in the field) are not good miners.

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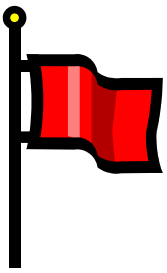
Red Flags

- From the committee's perspective
  - **1 :** a warning signal
- From students perspective
  - **2 :** something that attracts usually irritated attention



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Some “Red Flags”

- “I am going to find the holy grail!!!!”
  - E.g. I will build a simple, internet scale, general purpose, high performance, secure, transparent, distributed operating system that satisfies everyone's requirements.

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Some “Red Flags”

- “There is no related work!!!!”
  - Are you really creating a new field?

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Some “Red Flags”

- “This has been done before, but I’m going to do it better!!!”
  - Committee replaces “This” with “The wheel”, and becomes sceptical.

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Some “Red Flags”

- “The goal of this thesis it to build XYZ!!!”
  - E.g. “the goal of my thesis is to build a new operating system”
  - Does XYZ solve a conceptual problem?
    - If so, what is it?
    - Is XYZ a novel approach to solving the problem?
    - Are you just implementing stuff?

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Some “Red Flags”

- Lots of implementation
  - Without a focussed problem.
  - Without a proposed approach to the problem.

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Some “Red Flags”

- Lots of benchmarks
  - Without a focussed problem.
  - Without a proposed approach.
  - Without an clear idea of how the benchmarks substantiate the approach.

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Some "Red Flags"

- "My idea must be novel as Linux (or substitute your favourite OS) does not do it yet"
  - Linux (or your favourite OS) is **not** necessarily state-of-the-art

Second Year Review

- Same as first year review, except the "thesis" should be taking shape.

Committee Asks

- Does the student have a focussed problem with a clear approach to the problem and a clearly identified contribution that is "placed" within the field?
  - A years refinement of initial proposal

Committee Asks

- Is there significant progress towards validating the approach?
  - e.g. implementation, some preliminary results.
  - Is the approach working out?
  - What is left to do?
  - Does it look finishable?

Committee Asks

- Has the student published anything yet?
  - Did he attempt to?
  - What were the reviews like?