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

What is a Thesis?

PhD = “Piled higher and Deeper”

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

What does this really mean?

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 information available in a particular field,
  – or journal of what you did.
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 you’re 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?

**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

**Proposed position or solution**

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

**Methodical substantiation or validation**

- What will be done to test the hypothesis?
  - Experiments, simulations, proofs, etc.
  - What are appropriate metrics?
    - Faster, safer, 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?

**Results/Conclusions**

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

Undergrads, Masters, PhDs?

<table>
<thead>
<tr>
<th>Research Projects</th>
<th>Thesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undergrads</td>
<td>Masters</td>
</tr>
</tbody>
</table>

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

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
- References
- Appendices

Phases of doing a thesis

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

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

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?

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

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

So what about the PhD reviews

In Principle

• The committee tries to assess how the student is progressing towards producing the PhD.
For an End of Year 1 Review

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.

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?

Some Questions the Committee Asks Itself

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

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.

Red Flags

• From the committee’s perspective  
  – 1: a warning signal  
• From students perspective  
  – 2: something that attracts usually irritated attention
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.

Some “Red Flags”

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

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.

Some “Red Flags”

• “The goal of this thesis is 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?

Some “Red Flags”

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

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.
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?