PREPARING YOUR THESIS PROPOSAL AND BECOMING A PHD CANDIDATE

Ming C. Lin

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About this session

The slides will be online.

Please ask questions or share ideas throughout!
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- J.R. & L.S. Parker Distinguished Professor Emeritus, UNC-CH
- Barry Mersky & Capital One Endowed Professor, University of Maryland at College Park

Research:
- ML/AI/Robotics
- Virtual Reality
- Human-Computer Interaction
- Physically-based Modelling, Simulation & Animation
Kyla McMullen
Assistant Professor, University of Florida

- B.S. in Computer Science, University of Maryland, Baltimore County (UMBC)
- M.S. & Ph.D. in Computer Science and Engineering, University of Michigan
- Research:
  - 3D Audio for VR / AR / XR
  - Brain-Computer Interfaces
  - Psychoacoustics
  - Human-Computer Interaction
- Service:
  - Modern Figures Podcast
  - Generation NEXT
WRITING YOUR THESIS:

- Thinking about writing your thesis
- Actually writing your thesis
- Fiddling with LaTeX/Word trying to get insignificant formatting details to look nice
Select/Ask Committee
Set Proposal Date

Write Proposal
Refine Proposal
Give Proposal to Committee (2-3 weeks ahead)

Prepare/practice presentation

Present/defend Proposal

Plan for Questions

Celebrate!
How to Choose a Dissertation Topic

- Spin-off from an existing research project
- Own individual interest
- Literature review
- Current interests in the community
- Given by advisor (rare)

Goal for your dissertation topic is to be something you come up with organically through process of developing as an independent researcher.
Scoping your Dissertation Topic

• Read papers...
  – *Future research questions they identify*... *synthesis of multiple papers*...

• Write papers...
  – *Each linked paper might form a ‘chapter’ of your eventual dissertation*...

• Talk with others...
  – *Advisor, committee, labmates, cohort, senior peers, other researchers you meet at conferences, etc*...
What makes a Good Dissertation?

• **Original**
  - Exhibits independent thinking
  - No plagiarism
  - Advances literature

• **Significant**
  - Addresses an important problem
  - Of interest to broader community

• **Well-written**
  - No language mistakes
  - Clearly describes problem

• **Organized**
  - Has a logical structure
  - Reads and flows well

• **Coherent**
  - Connects different components seamlessly
  - Argument is focused, rigorous, logical and sustained

• **Theoretically grounded**
  - Well-researched
  - Shows deep understanding of relevant theories and concepts

- **Solid methodology**
  - Research design is valid and appropriate

- **Thorough analysis**
  - Comprehensive, complete, sophisticated and convincing
  - Addresses the research questions posed

- **Clear contributions**
  - Opens new areas of research and raises new questions

Important things to remember

- Your PhD research / dissertation research is **not** the only topic you will ever work on in your career!
- The specific topic of your dissertation matters more or less depending on your future career plans.
- All examples are not created equal.
Finding a Research Topic

• You all already have at least some topic, based on the projects you are working on in your advisor’s labs...

• To get to the next step:
  – What papers do you find the most interesting to read?
  – What papers seem to have a lot of potential future work?
  – What topics do you find you personally identify with or motivate you?
  – What kind of researcher do you want to be in the future?
Research Topic ≠ Research Question
Research Topic vs. Research Question

• A **research topic** is a specific area of study in the context of a broader area of study.
  - Ex: Security -> IoT device security in ad-hoc wireless systems

• A **research question** aims to further narrow down the scope of the study.
  - A possibility you explore through your dissertation aiming to solve the problem of your study and is expressed in the form of a question.
  - You may need to develop **several potential questions** before deciding on a final question.
  - Quals helps by making you versed in the literature on this topic.
  - The final question becomes the **hypothesis** of the study.
    - It is a tentative answer to the that you will seek to address in your situation.
    - The hypothesis is expressed in **the form of a statement** rather than a question.
Proposal Components

1. Introduction
2. Background
3. Proposed Research
4. Preliminary Results
5. Conclusion
# 1. Introduction

## Content

- **Problem Statement**
  - This is what I am interested in doing and why
    - Helmeir’s Catechism
  - Organizational Overview
    - Explain Chapters
  - Introduction to Problem (general to specific)
  - Where is research needed?
  - Where is the Information Gap?
  - Your Specific Research Questions
  - Common Terminology Definitions

## Chapter Goal

- Orient the reader
- Show clarity and reasoning skills
- *Showcase your grant writing skills*
Heilmeier’s Catechism (DARPA)

• What are you trying to do? Articulate your objectives using absolutely no jargon.
• How is it done today, and what are the limits of current practice?
• What is new in your approach and why do you think it will be successful?
• Who cares? If you are successful, what difference will it make?
• What are the risks?
• How much will it cost?
• How long will it take?
• What are the mid-term and final “exams” to check for success?

## 2. Background

<table>
<thead>
<tr>
<th>Content</th>
<th>Chapter Goal</th>
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<tbody>
<tr>
<td>• Focus the evidence</td>
<td>• Show that this problem is worth looking at</td>
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<tr>
<td>• What has already been done?</td>
<td>• High impact / Great questions</td>
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<td>• What are the outstanding questions?</td>
<td>• Set up the questions you want to ask</td>
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<tr>
<td>• Multifaceted/multidisciplinary research topics</td>
<td>• Shows your ability to organize and teach</td>
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<tr>
<td>- Empirical Studies Relevant to the Problem</td>
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<td>- Methodologies employed by others</td>
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<td>- Major theories that the research will test</td>
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<tr>
<td>- Specific Research needs</td>
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3. Preliminary Results

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<tr>
<th>Content</th>
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<tbody>
<tr>
<td>• Experiment 1, ..., n</td>
<td>▶ Confirmation of the things hoped for in Chapter 4</td>
</tr>
<tr>
<td>• Research Paper/Papers or publishable unit demonstrating that you have done some work in this area with favorable results</td>
<td>▶ Shows you have the “chops”</td>
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<td></td>
<td>▶ Shows that you can interpret results</td>
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## 4. Proposed Research

### Content

- $\forall$ hypotheses $\in$ in Dissertation
  - Research Question
  - Proposed Experiment
    - Method
    - Analysis
    - Evaluation Metrics / Success Milestones
  - “Hoped-for” result
  - Contingency Plan

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<tbody>
<tr>
<td>Show that the work is doable and relevant</td>
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<td>Present a realistic plan</td>
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<td>Assessment Focused</td>
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<td>Resource Management</td>
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# 5. Conclusion

## Content
- Restating the overall purpose of your work and what you seek to answer
- If successful, the future contributions of your work
- Timeline for Completion
  - Experiments, Study, Simulation, Publish, Write Dissertation, etc.
- What will I do if the hypothesis goes bust?
- Limitations and Assumptions
- *Budget

## Chapter Goal
- Show that the work can be completed in the time allotted
- Shows that the work has importance to the broader research community
- “Sanity Check” for amount of work needed
The Committee
What is the role of the Committee?

Throughout the process ...
– Guidance and understanding of what to expect
– Feedback
– Eventually, reference letters

At the proposal, they...
– Make sure you know what you’re talking about
– Make sure you know the state of the art
Selecting the PhD Committee

Know your department rules

Ideally

– PhD advisor
– Faculty in the related topic area to provide useful direction
– Faculty outside topic to provide high-level, broader perspectives
– External member: potentially someone in research area who could write a reference letter
The Proposal Defense
Proposal Defense Format

Presentation + Questioning

Presentation mirrors writing highlights
Proposal Presentation Tips

Attend others’ proposal defenses in your area
Thank committee, introduce yourself and background
Practice presentation many times
Be polite during interruptions with questions
Have someone take notes of questions
Be open to suggestions
Prepare for questions
Don’t be afraid to say ‘I don’t know’ but ask for direction/help on those questions
Be confident. Don’t look to advisor for answers.
Some Sample Questions

Topic too large? too small? doable in the timeframe? Focused? What problems haven’t you foreseen? What happens if your planned experiments fail (backup plans)?

Evaluation (plan, statistics, validity)
Related work missing?
Practicality/scalability
Vision of where this can go...
Last Tips on Defense

– Make sure you know the tough issues and have some answers

– Make sure your plan is reasonable, especially the timeline

– Certain people have go-to questions
  • Watch your committee members on other proposal defenses
  • Especially if your thesis touches on work they have done or know a lot about
  • Ask your advisor
Prepare for hard questions
– reread proposal as a committee member

Present and defend proposal

Celebrate this big milestone!

Thank committee, meet with advisor (and committee members) to discuss questions and directions

Move forward on research

Select/Ask Committee

Set Proposal Date

Write Proposal

Refine Proposal

Give Proposal to Committee (2-3 weeks ahead)

Prepare/practice presentation

Plan for Questions

Present/defend Proposal

Celebrate!
So now you know why....
THANKS! AND QUESTIONS?
Questions?

Email: Kyla <drkyla@ufl.edu>
or Ming <lin@umd.edu>
OLD & BACKUP SLIDES (MCL)
What is a PhD Proposal really?

A brainstorming and planning process

A succinct write-up of your proposed research goals, strategies, justification, & foreseen contributions

A good time to get feedback & direction from experts

Sometimes a stressful period of graduate school
When you have
completed the rest of your PhD requirements
a clearly defined problem
some preliminary work to demonstrate promise of your approach
some notion of the major subproblems
an advisor who recommends you are ready
The Written Proposal
In Summary...

The proposal should clearly answer:

1. What is the problem you are studying?
2. Why is it important?
3. What results have you achieved so far and why matter?
4. How is this substantially different from prior work?
5. How will you systematically evaluate your work?
6. What do you need to do to complete your work?
7. What is your timeline?
To answer these questions, how do you organize a proposal?

Introduction

– *Problem statement and importance*

Background and State of the Art

Preliminary Work

Proposed Research

– *Subsections on each research contribution*

Evaluation Plans

Research Plan

Summary of your Contributions and Timeline
Think about the Audience

Your Committee
– Not necessarily all in your general topic area
– Not familiar with your specific problem
– Not aware of your prior work
– Not aware of your skills, infrastructure

Implications
– Background: terminology, problem,…
– State of the art related to your problem
– Convincing motivation for importance
– Demonstration of feasibility/promise of success
How long should a proposal be? Your presentation?

Check your department rules/Ask for examples.

Examples:

**University of Minnesota**
- Proposal: 20-25 pages
- Presentation: 30-35 min plus Q&A
- Last about 2 hours

**University of Maryland & UNC Chapel Hill**
- Proposal: 15-20 pages
- Presentation: 35-45 min with Q&A
- Last 2-3 hrs in general
What would help BEFORE I start writing?

Think about what YOU want to accomplish
Write a succinct thesis statement/hypothesis
Discuss your ideas with others
Present parts of the research at seminars, workshops, PhD workshops, conferences
Think about 3-4 major contributions/papers
Formulate these contributions in writing
Challenges, Frustrations, Misconceptions

“The proposal is just a hurdle. I can just propose ideas off the top of my head now and then figure out what I really want to do later.” – the lazy path

“How can I propose something when I don’t know the details yet?” – the unknown path

“I don’t know how to organize the different parts of the research on the page.” – writer’s block

“I’m not ready yet. I might as well solve the problems and then present them.” – postpone, postpone, postpone....
How do I GET STARTED writing?

Examples in your department, with same or different advisor(s), in your area

Break it down into manageable chunks?
– Subprojects
– Writing style: problem statement, hypothesis
– Organization
  • Overall outline and flow
  • Within each proposed project section
More Details on Proposal Sections
The Introduction

General, high level problem for people outside area to appreciate
Quick overview of what state of the art does not address
Thesis statement – specific open problem and proposed strategy
Brief overview of key insights and why your approach is promising
List of your likely contributions
Proposed Research

Overview of project – maybe a figure
Specific project in steps
For each –
  – Problem
  – Strategy
  – Details known now
  – Plans for remaining challenges
  – Evaluation plan
Evaluation: Experimental Design

Questions you will ask to judge success of your approach

Independent variables – what is being varied/compared
– Eg, your technique versus other techniques

Dependent variables and measures – what is being measured
– Effectiveness – precision and recall, f measure
– Cost – efficiency
Evaluation Methodology continued

• What actions are you going to perform to conduct the experiment?
• Human subjects?
Research Plan

• What steps do you plan to take next?
• What will you save for post-thesis work? Why?
Conclusion

• Summary of contributions to the state of the art – intellectual merit
• Repetition of broader impact on society