# PREPARING YOUR THESIS PROPOSAL AND BECOMING A PHD CANDIDATE


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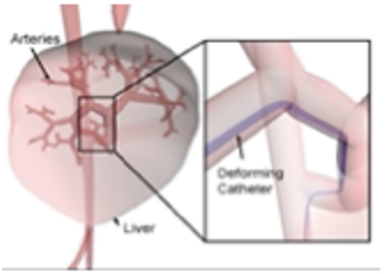
CRA-WP
Computing Research Association
Widening Participation

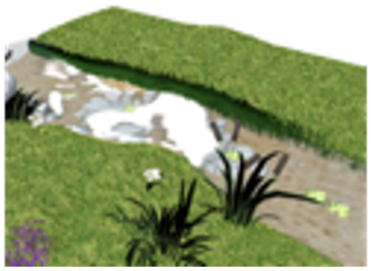
# About this session

- The slides will be online.
- Please ask questions or share ideas throughout!

# Ming C. Lin

- B.S., M.S. Ph.D. In EECS, University of California, Berkeley
- 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***

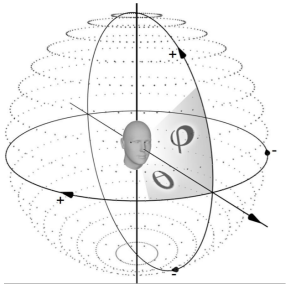


# Kyla McMullen

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 Interactio
- ***Service:***
  - ***Modern Figures Podcast***
  - ***Generation NEXT***

SoundPad Lab

GENERATION NEXT

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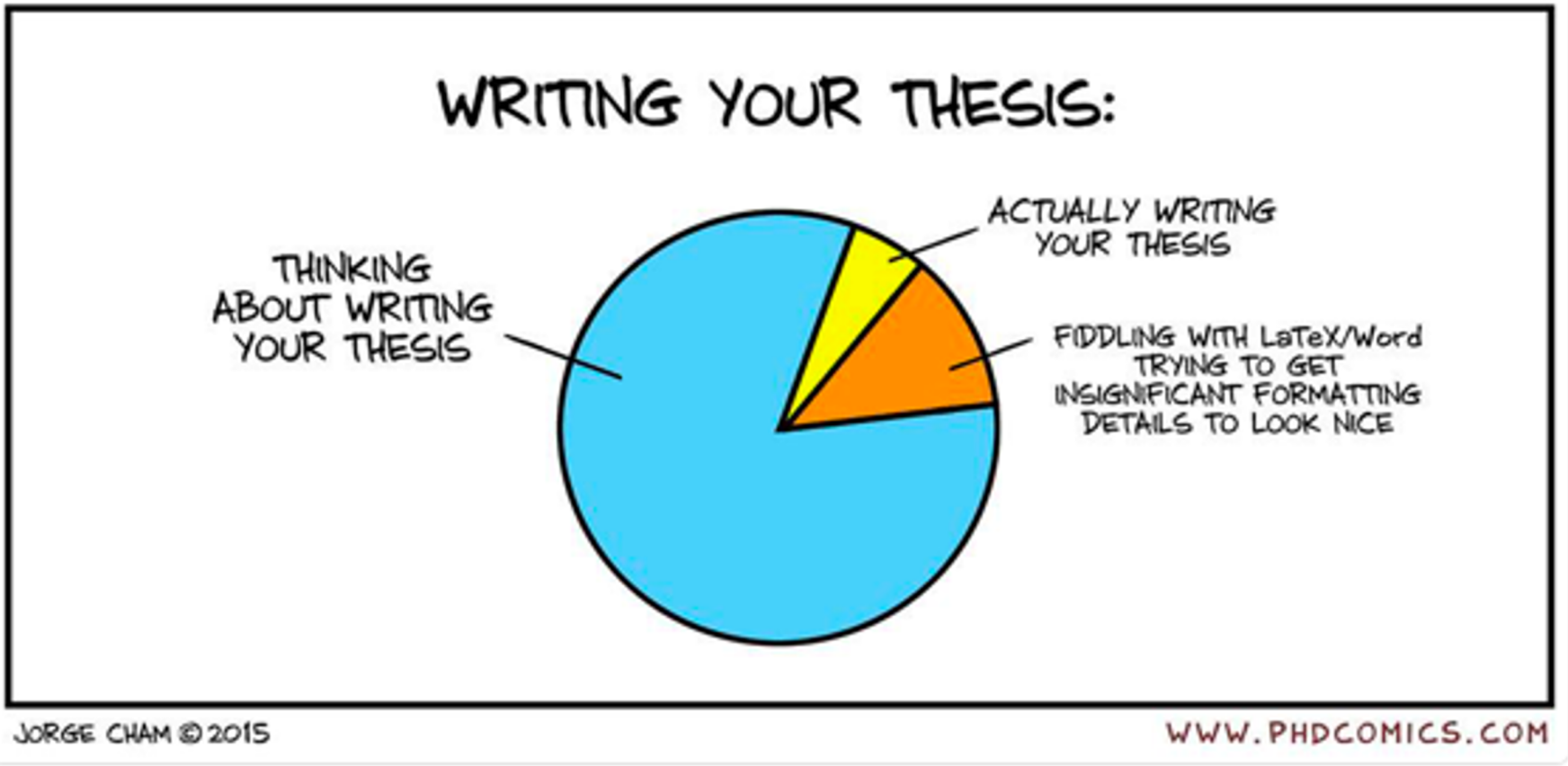
WRITING YOUR THESIS:
ACTUALLY WRITING YOUR THESIS
THINKING ABOUT WRITING YOUR THESIS
FIDDLING WITH LaTeX/Word TRYING TO GET INSIGNIFICANT FORMATTING DETAILS TO LOOK NICE
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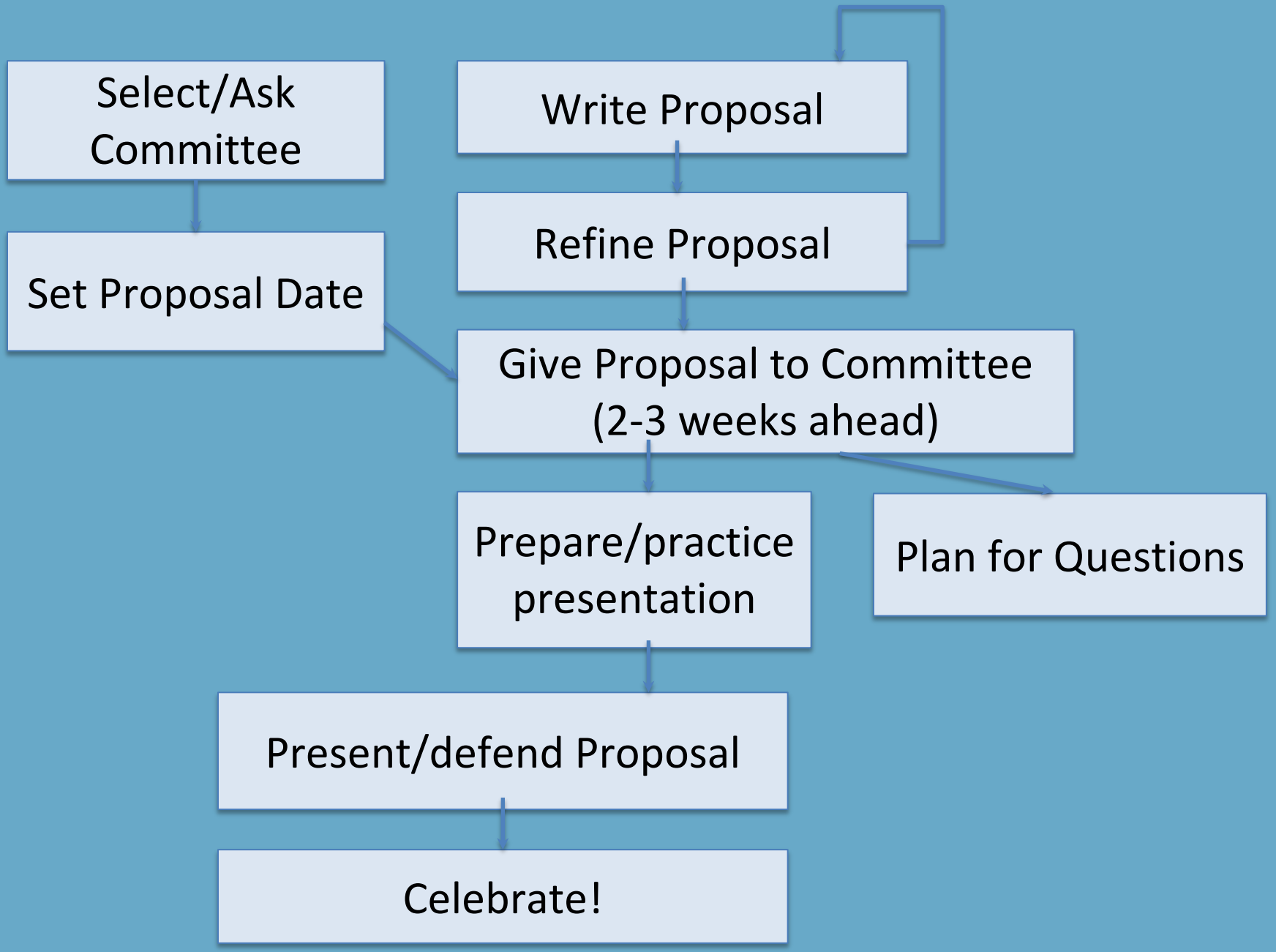

Select/Ask Committee
Write Proposal
Refine Proposal
Set Proposal Date
Give Proposal to Committee (2-3 weeks ahead)
Prepare/practice presentation
Plan for Questions
Present/defend Proposal
Celebrate!

# 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

Reference: https://www.unthsc.edu/graduate-school-of-biomedical-sciences/wp-content/uploads/sites/13/Dissertation_Standards_Academe1.pdf

# 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?

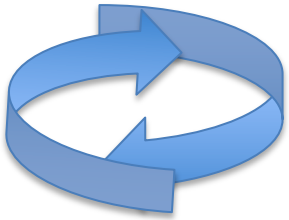
# Research Topic ≠Research Question

# 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
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# 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?

https://www.darpa.mil/work-with-us/heilmeier-catechism

# 2. Background

**Content**

- Focus the evidence
- What has already been done?
- What are the outstanding questions?
- multifaceted/multidisciplinary research topics

– Empirical Studies Relevant to the Problem

– Methodologies employed by others

– Major theories that the research will test

– Specific Research needs

## Chapter Goal

- Show that this problem is worth looking at
- High impact / Great questions
- Set up the questions you want to ask
- Shows your ability to organize and teach

# 3. Preliminary Results

**Content**

- Experiment 1, …, n
- Research Paper/Papers or publishable unit demonstrating that you have done some work in this area with favorable results

**Chapter Goal**

- Confirmation of the things hoped for in Chapter 4
- Shows you have the "chops"
- Shows that you can interpret results

# 4. Proposed Research

**Content**

- ∀ hypotheses ∈ in Dissertation
  - Research Question
  - Proposed Experiment
    - Method
    - Analysis
    - Evaluation Metrics / Success Milestones
  - "Hoped-for" result
  - Contingency Plan

## Chapter Goal

- Show that the work is doable and relevant
- Present a realistic plan
- Assessment Focused
- Resource Management

# 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

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# 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

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# Proposal Defense Format

Presentation + Questioning

Presentation mirrors writing highlights

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# 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.

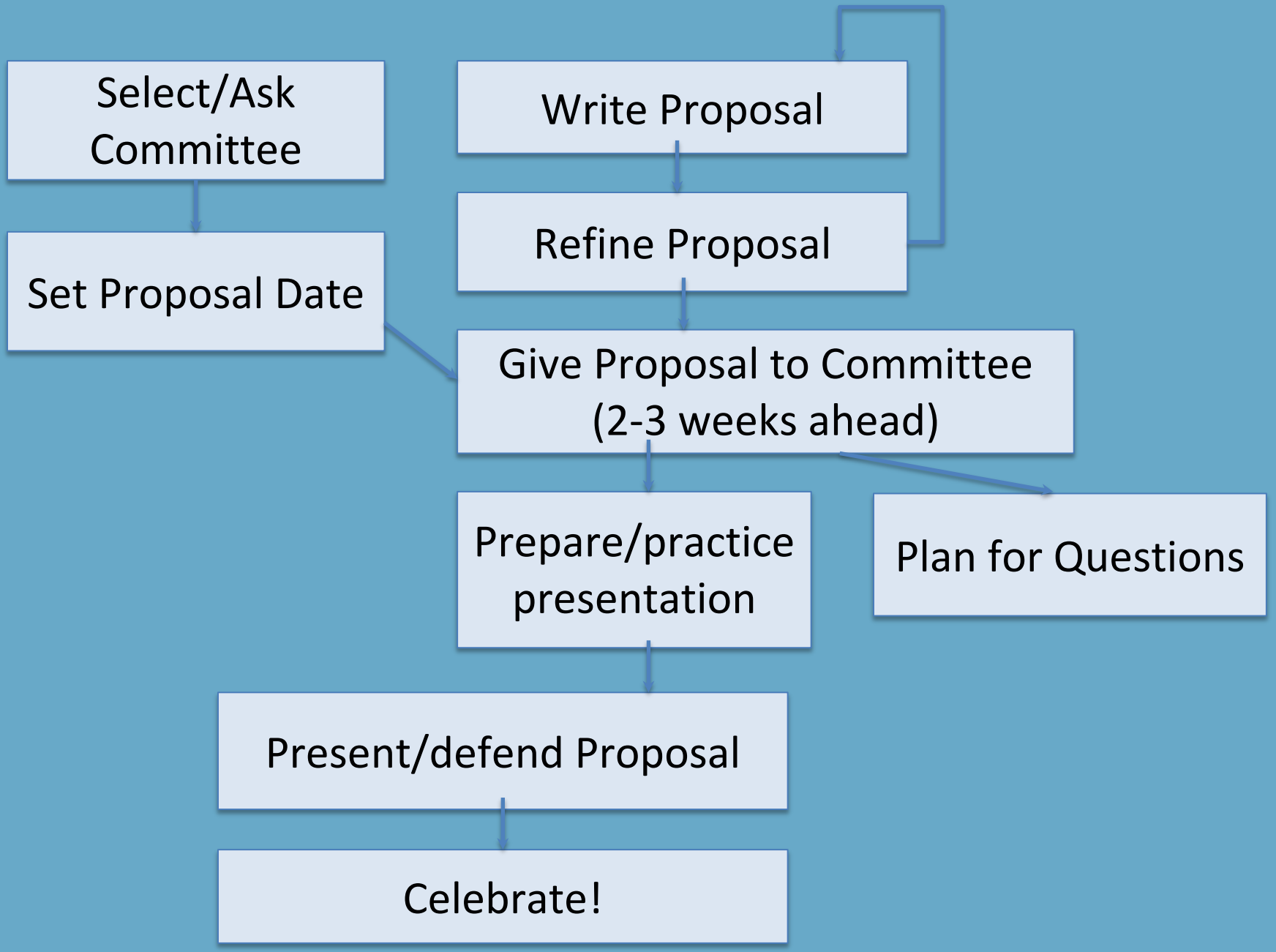
# Some Sample Questions

- 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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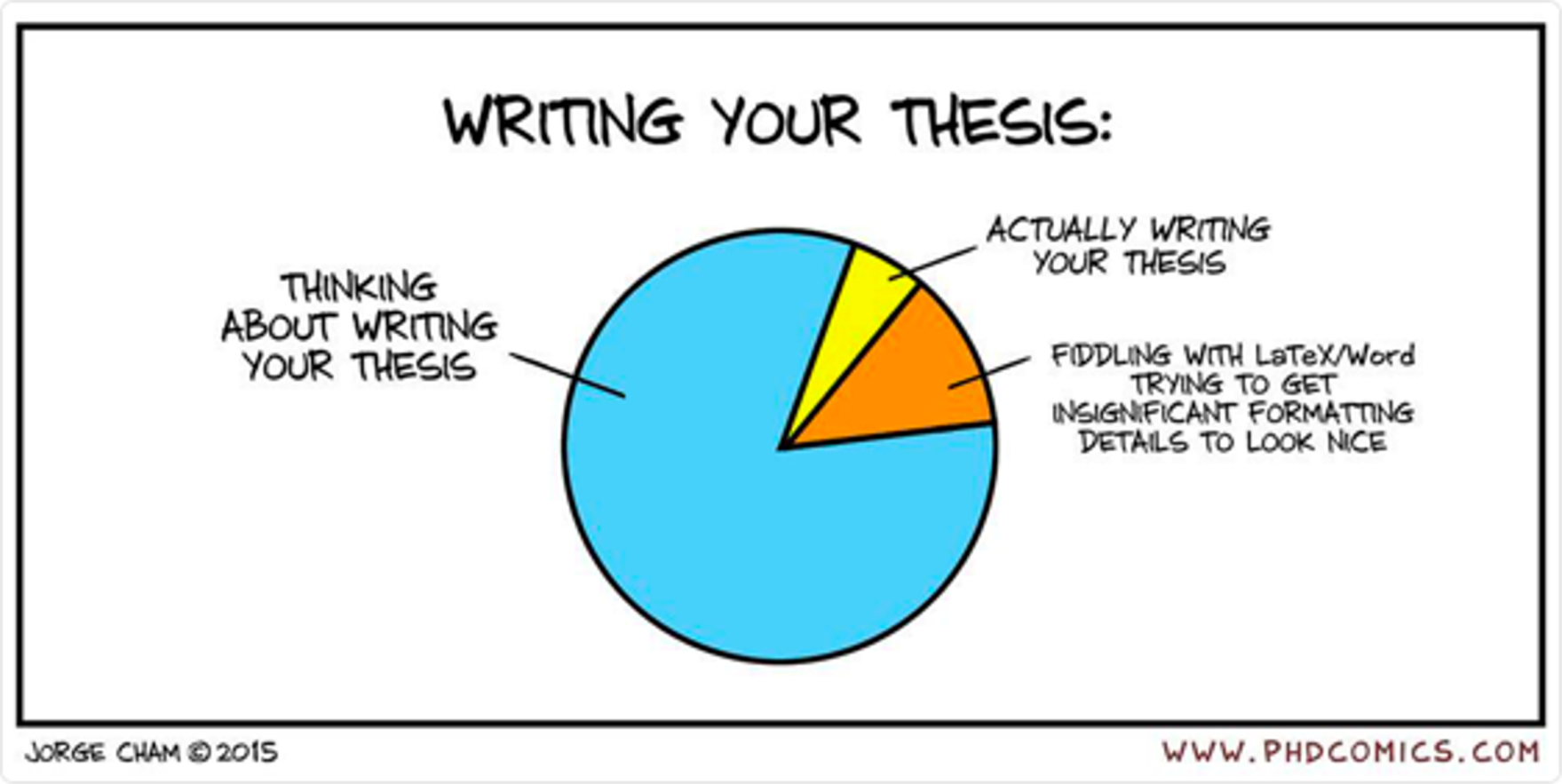
# So now you know why….



# 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 should I write and present my PhD Proposal?

**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

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# 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

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# 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