Preparing Your Thesis Proposal and Becoming a Ph.D. Candidate

CRA-WP IDEALS Workshop

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Dorian Arnold

PhD, Wisconsin · MS, Tennessee ·
BS, Regis (Denver, CO) · AS, St. John's (Belize)

Emory, Since '17
U. of New Mexico, '09 - '17
Sandia, Los Alamos, Livermore Labs (various)

Computer/Distributed Systems: HPC; software systems; CS Education

Married with 3 kids, ages 25, 22 ... and 4 😬
Hobbies: Cycling, Socializing, DJing, sports

Cheryl Seals

PhD, Virginia Tech · MS, NC A&T
BS, Grambling State University

Auburn - Professor CSSE
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Human Computer Interaction, Gaming, Learning Sciences, Augmented & Virtual Reality

Organizations: NSF iAAMCS; NSF STARS, SWE, ACM
Hobbies & Passions: Movies/Sci Fi/Action, Zumba, Yoga, Music, Travel, Family & Friends

In this session …

- What's a thesis
- The thesis proposal
- Stories
- Pitfalls and Best Practices
- Closing thoughts

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The Thesis (aka Dissertation)

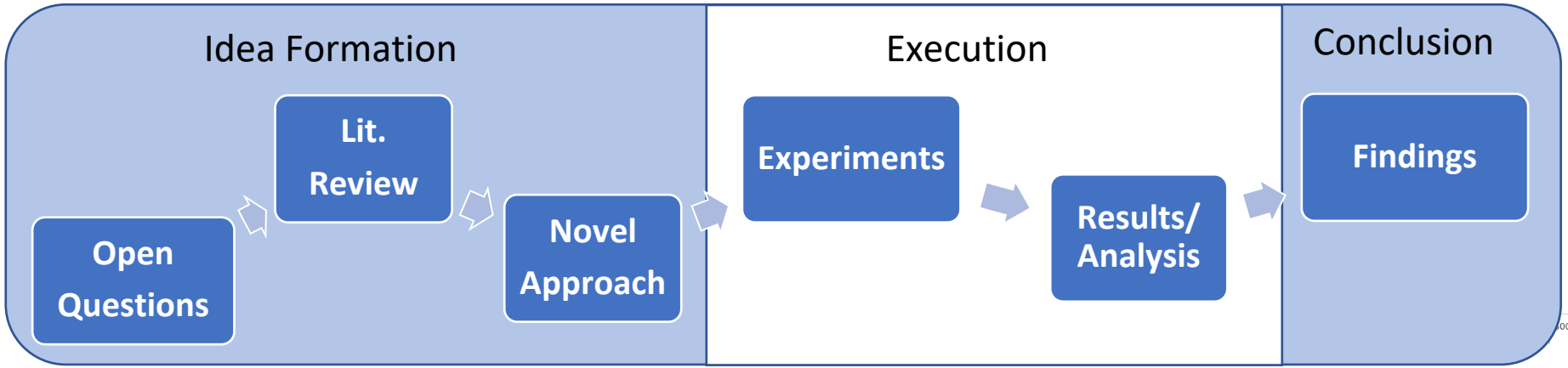
the·sis | \ ˈthē-səs

1: a dissertation embodying results of original research and especially substantiating a specific view *especially* : one written by a candidate for an academic degree

2a: a proposition to be proved or one advanced without proof : HYPOTHESIS

2b: a position or proposition that a person (such as a candidate for scholastic honors) advances and offers to maintain by argument

-Merriam Webster



To Advance the Discipline

with new professionals

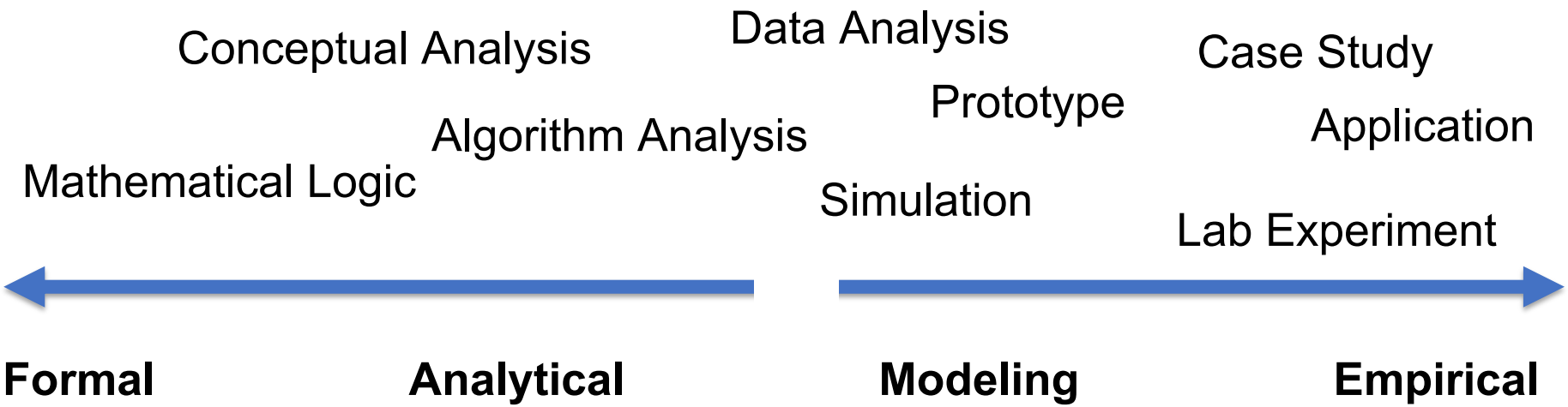
- trained to be proficient and independent researchers
- with fundamental knowledge and skills appropriate for the discipline
- adept with deep expertise appropriate for specialty area

with new knowledge

- new fundamental concepts about computation
- better capabilities in computer design, programming, or usage
- new methods or algorithms to solve new problems in other fields
- render useful computer application, tool or data artifacts

CS Research Methods

Exploratory research based on the formulation and study a hypothesis



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Example Thesis Design Patterns

Problems + Research Methods = Outcomes

- Theoretical: A study based on mathematical logic and principles to develop new theorems
- Analytical: Conceptual analyses to evaluate an algorithmic solution to an existing problem, compared to current techniques
- Experimental: Implementing and evaluating a software or hardware prototype that renders new capabilities
- Observational: Understanding new concepts of human behavior in relation to technology

Real Thesis Examples

The Elevator Pitch

How far along was the project when you proposed?
Where did the problem/project come from?
How close was the final project to the original proposal?
Was your proposal and defense committee the same?

Thesis Proposal

The Thesis Proposal

Your proposal is a formal documentation of your thesis execution plan, which provides many (not so) hidden opportunities to ...

master background of chosen sub-field

demonstrate your research readiness

brainstorm and refine thesis project ideas

receive (early) feedback and advice

get your thesis plan formally endorsed

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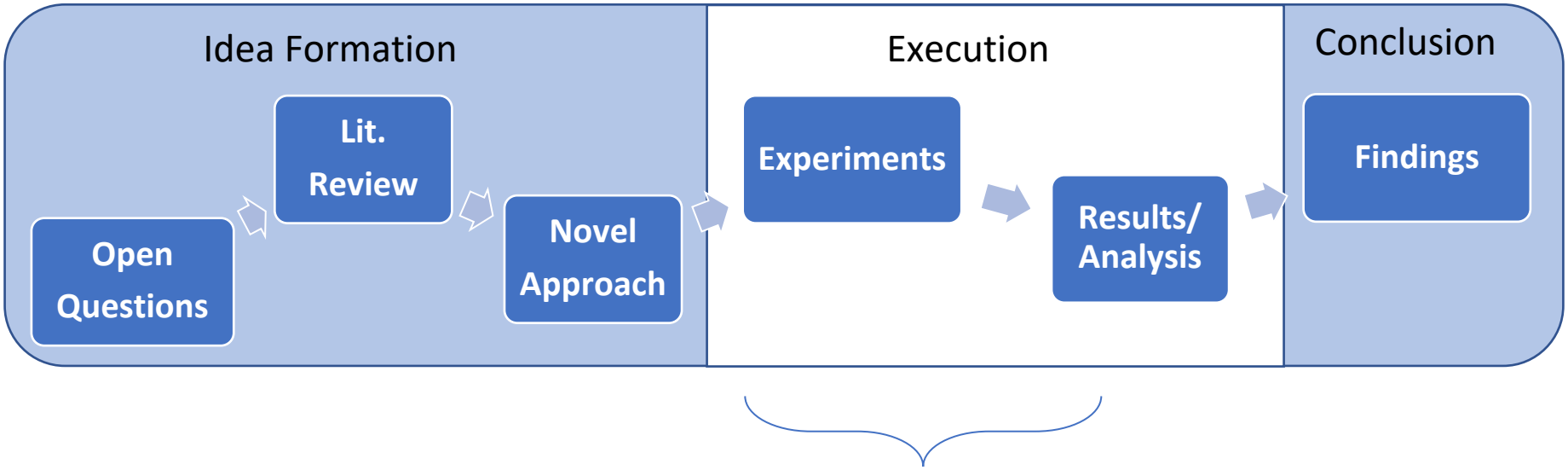
Proposal process



Are you ready to propose?

1. Demonstration of feasibility
2. Formal writeup
3. Committee formation
4. Presentation/Defense

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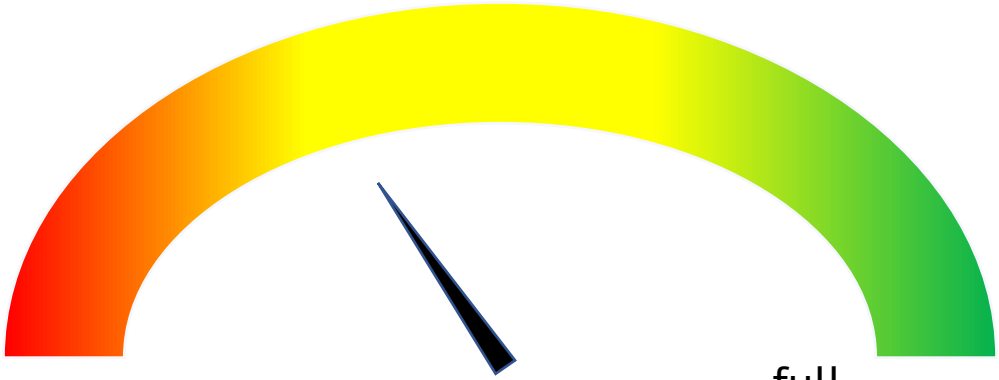
When to Propose



partial conceptualization

full realization

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Executing a Strong Proposal

A strong research proposal …

Motivates …

- background for the target problem and challenges
- inspiration for who should care and why
- limitations of state of the art and field

Describes …

- objectives or target problems, questions and challenges
- a novel approach for addressing the problems
- a hypothesis of anticipated outcomes
- a convincing methodology for evaluating the hypothesis
- feasibility arguments for proposed methodology
- an assessment, including risks, costs, resources and time

Arnold's RIPE Project Assessment

Score project as "High/Medium/Low" in …

Risk: How feasible is the project? How high is risk of "failure"?

Impact: If successful, how impactful will results/outcomes be?

Passion: How excited/motivated are you about the project?

Effort: How much time/resources required to complete project?

PhD Candidacy

aka “**A**ll **B**ut **D**issertation”

Publishing your thesis work

Implicit or explicit program/advisor publication requirements?

- papers published? written? researched?

How do I turn my publications into my thesis document?

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When are you finished?

Easiest answer: *When the proposal is fully executed.*

Hardest answer: *When your advisor/committee says so.*

Truest answer: *When you are able to convince your advisor and committee!*

Common Pitfalls

Some Proposal process pitfalls

- Ineffective proposal document: vague, incomplete, unnecessarily long, unfocused, poorly written, unresolved research plan, …
- Committee members not seeing your work before the proposal
- Presentation crams entire proposal document in a short timespan

Some Dissertation Process Pitfalls

- Your research gets scooped
- Your results are not as expected
- You encounter unexpected technical challenges
- You deviate far from proposal plan
- You face challenges with your advisor or other collaborators (incompatibility, departure, etc.)
- Life happens
- You burnout

Interactive Q&A

slido

Which topics would you like to discuss? (Up to three)

ⓘ Start presenting to display the poll results on this slide.

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Closing Thoughts

Cheryl’s Closing Thoughts

Dorian's Closing Thoughts

- Face the difficult problems early
  - You'll have to face them at some point; might as well get them out of the way
- Communicate with your committee
  - It's OK to get feedback before the proposal and before the defense
- Get feedback from your peer group
  - "Dissertation Support Groups" can be very helpful
- Build good routines
  - In what location do you do your best brain work?
  - What time of day do you work best?
  - What distractions do you need to take care of so you can focus?
  - What else do you need (food, exercise, idle time, family)?

Additional Resources

Worksheet: Thesis Proposal Preparedness

Activity: Next Steps

Worksheet: Elevator Pitch

Judith Olson's 10 Questions

Heilmeier Catechism

Worksheet: Are you ready to propose? (tinyurl.com/thesis-proposal-checklist)

1. Preliminaries:
   a. Have you identified a research area of interest?
   b. Do you have a research advisor?
   c. Are you actively engaged in research in your interest area?
   d. Have you focused your research activities to a single (or small number of) topic(s)?

1. *Research Topic Motivation*: *How complete is your research motivation?*
Your proposed topic must address a fundamental, interesting, impactful problem or set of questions.

1. *Related Work and Background*: *How complete is your background and related work?*
Your thesis should (1) solve an open problem; (2) with a novel approach or set of studies; and (3) properly leverage or contrast prior works. (In this context, it is also useful to identify the appropriate research communities, i.e., relevant conferences, workshops, research groups, etc.).

1. *Problem Statement*: *How refined is your problem statement?*
You must refine your planned studies into a specific set of target problems or questions.

1. *Methodology and Expected Results*: *How prepared is your research methodology and expected contributions?*
Your proposal must describe your research methodology, that is, a detailed plan for evaluating your proposed ideas and the projected qualitative (and perhaps quantitative) results.

1. *Thesis Statement*: *How complete is your research hypothesis or thesis statement?*
Your thesis should challenge a fundamental, a priori position about how your ideas will solve or address your target problems. You should synthesize your problem, approach and expected outcomes into a thesis statement.

1. *Technical Feasibility*: *How complete is your feasibility analysis?*
You must make an evidence-based case for the feasibility of your ideas and approach. This includes your preliminary qualitative or quantitative analyses or results from your preliminary research. A strong proposal also will elaborate necessary hardware, software and data resources and anticipated technical challenges.

1. *Milestones and Timeline*: How complete are your set of milestones and timeline?
Your proposal must itemize all expected milestones. Milestones and the timeline for reaching them should be reasonable and practical; often they include development of theoretical or experimental frameworks, conducting experiments, collecting/analyzing data and research publications.

1. Environment: How much thought have you given to external or environmental factors?
You explicitly should consider the necessary, supportive non-technical elements in your environment, including funding, moral support, conducive writing habits/environments, recreational escapes, etc.

Activity: To Do list for next steps

- Pair up with a neighbor

- Make a list of next steps
  - Questions to ask your advisor
  - Papers to read
  - Potential committee members to talk to
  - Dissertations (and proposals) to read
  - etc.

Worksheet: Thesis Statement and Elevator Pitch (tinyurl.com/thesis-elevator-pitch)

Outcome: an effective thesis statement or elevator pitch.

Activity description:

1. develop your thesis statement or elevator pitch;
2. recite your statement to a partner;
3. receive constructive criticism; and
4. refine your initial development.

Ideas for Developing Thesis Statements and Elevator Pitches

A thesis statement requires:

- a specific problem or set of problems
- an approach/methodology
- anticipated outcome(s)

Sample thesis statement structure: My thesis is that we can use `<methodology>` to solve `<problem>` leading to `<outcome>`.

An elevator pitch requires:

- Motivation: Problem domain and challenges and relevance
- Problem
- Approach
- Expected Outcome

Sample elevator pitch structure: `<Domain>` is important because … However, in `<domain>` we often face `<challenges>`. These challenges are critical because `<relevance>`. In this context, my work addresses the specific `<problems>` by using `<approach>`. We believe this approach will be impactful because it will lead to `<expected outcomes>`.

Judith Olson's 10 questions

1. What is the problem?
2. Who cares about this problem? Why is it important?
3. What have other researchers done to address this problem?
4. What is your approach to this problem?
5. What, specifically, will you do?
6. What do you expect will happen? What results do you already have?
7. What do your results tell us about the problem? What does this mean?
8. Who cares about these findings?
6. Where will you publish these results?
7. What will you be doing in 5 years?

Can you answer these questions for your current research interest?

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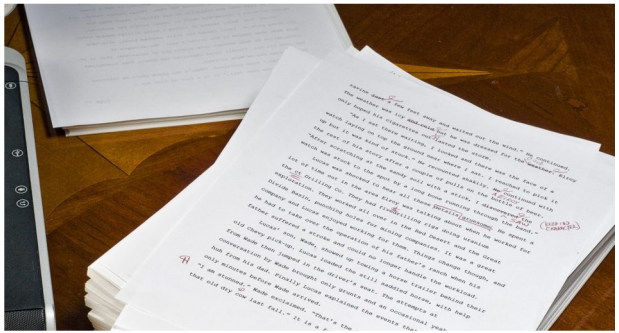
Heilmeier Catechism - DARPA

- 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?

Q&A Slides

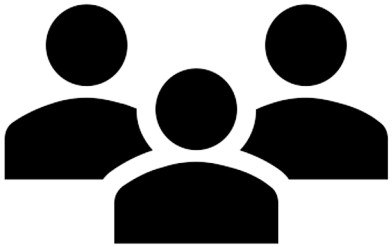
Proposal Document and Structure

- A formal, comprehensive, refined exposition
- Written basis of proposal defense
- Jumpstart to dissertation manuscript
- Length will vary



Structure

1. Introduction
2. Background and Related Work
3. Proposed Research
4. Milestones and Timeline



Committee Formation

- Things to consider
  - Program requirements
  - Your advisor's perspective
  - Expertise: Subtopic? Topic area? Discipline?
  - Networking/exposure opportunity
  - External committee members
  - Personalities
  - Final dissertation committee

Presentation/Defense

- Your proposal defense is an examination!
- Understand the culture and expectation from your advisor and peers
  - What is the session format?
  - How long should it be?
  - Is it open or closed to the public?
  - Should I bring food?
  - Possible outcomes

Writing tips

- Iterate, iterate, iterate
- Get feedback from advisor, lab mates, committee …
- Learn from others
  - Get prior examples of proposals and dissertation documents
  - Attend proposals, defenses, and job talks
- Writing consultants and groups

Presentation Tips

- Practice, practice, practice …
  - with self, advisor, lab mates, peers
- Know your timing
  - You can’t present it all!
- Anticipate the questions
  - Minimize the “unknown unknowns”
  - Master the technical bases of your work
  - Know the limits of your work
  - Have contingency plans for high risk activities