Technical Communication for Computer Scientists

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Learning Objectives for Today

Basics of Research

What Is Research in **Natural Science** and **Engineering**?

Making ***novel*** and ***significant*** contributions to our understanding of the world, based on reproducible observations and verifiable results

Who Are Researchers and Who Are Not?

What Do Researchers Do?

- T1: Explore new ideas
- T2: Verify and implement new ideas
- T3: Write up the research outcome

- T4: Review papers and manuscripts
- T5: Administrate academic journals and organize academic conferences
- T6: Attend conferences to present papers

- T7: Apply for research grants
- T8: Supervise graduate students
- T9: Teach graduate and undergraduate courses
- T10: Commercialize research outcome

Academia Industry

What Skills and Abilities Are the Most Important for Researchers?

- Passion and interests in research
- Curiosity and creativity
- Critical and independent thinking
- Risk taking
- High scientific integrity
- Quick learning and strong analytical and problem-solving skills
- Diligence
- Good communication skills

What Are Some **Pros** and Cons of Being Researchers?

- High career satisfaction.
- Protected research environment
- Reasonably good income
- Researchers are highly respected by most societies

What Are Some Pros and **Cons** of Being Researchers?

- **High workload**
- **Long preparation time**
- **Relatively narrow career choice**

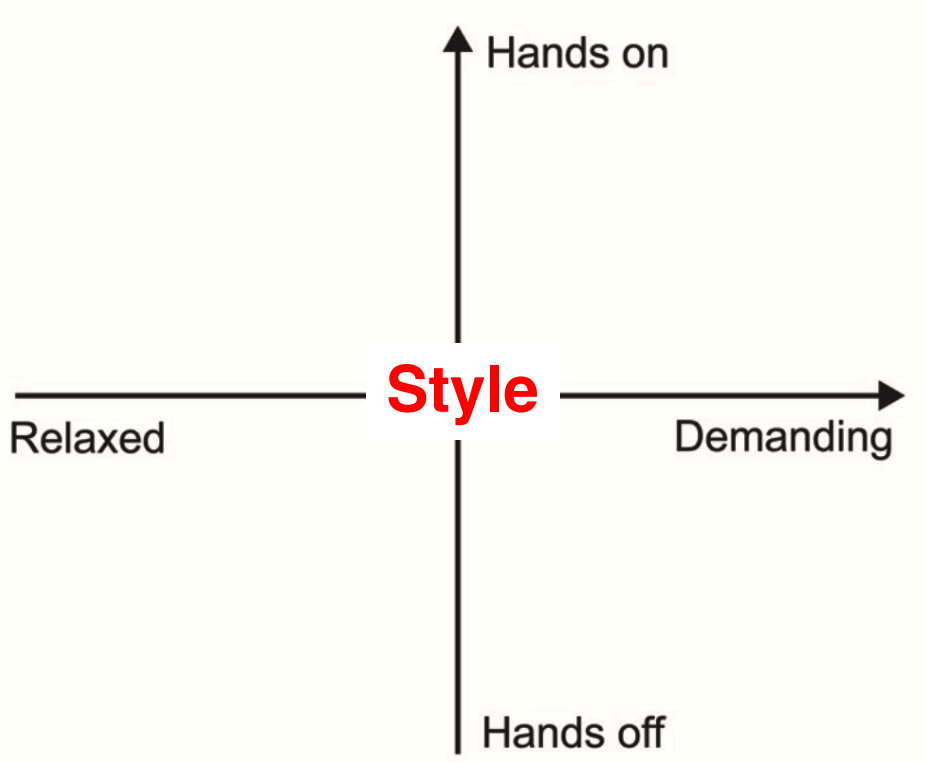
Master's Thesis VS Ph.D. Thesis

- Thesis may not be required by Master degree
  - But advised for pursuing Ph.D.

Master	Ph.D.
A specific problem	A series of problems in a domain
Apply previous work to the problem	New theory, methods, application
Negative results of a seemingly promising approach	Contain positive results in addition to analysis of the negative results
Not required to be an independent researcher	Be independent researcher

How to Find a Suitable Supervisor

- Research areas and interests.
- Supervisory philosophy and style
- Funding availability
- Academic and industrial social networks



How long it take to get a Ph.D. degree?

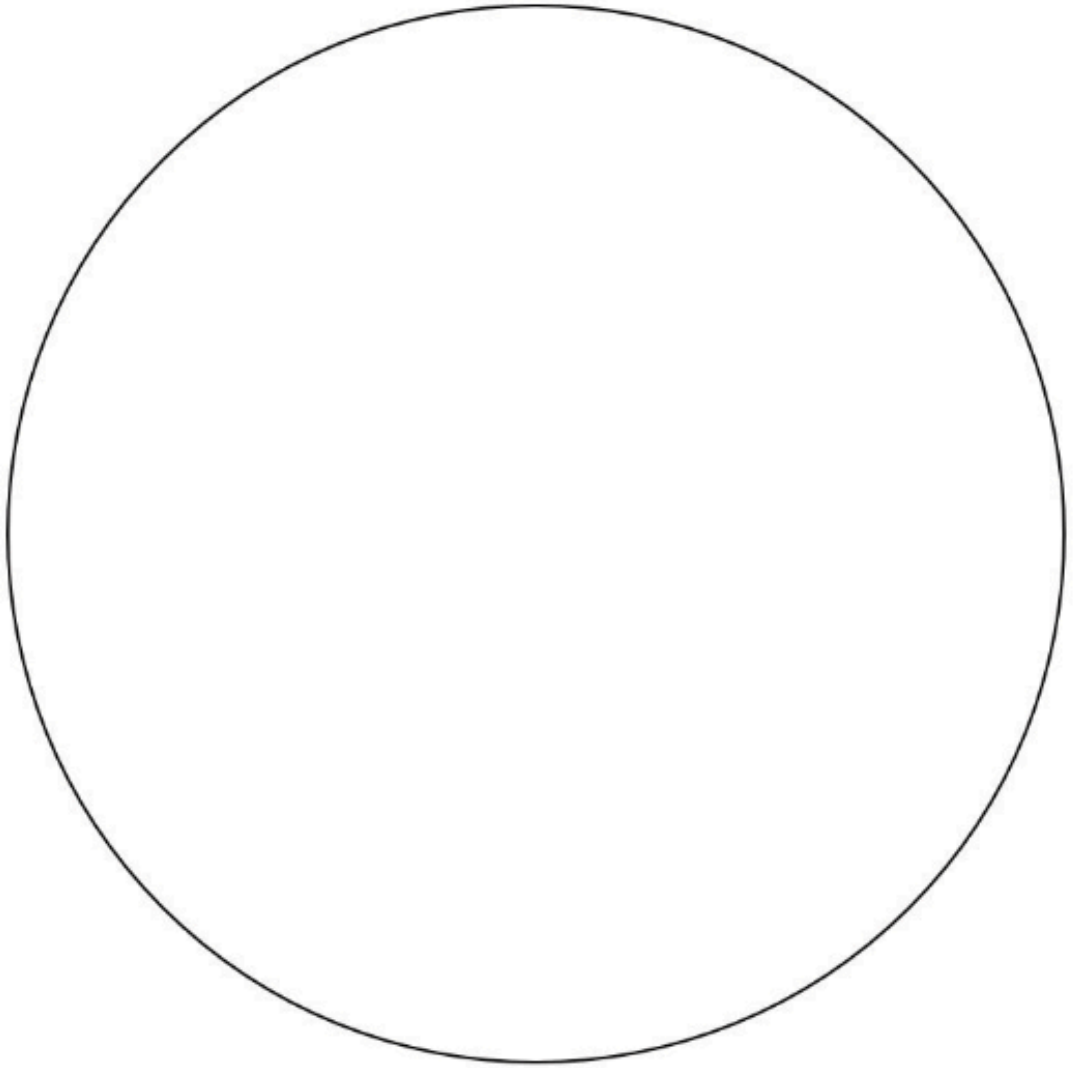
Identify a new and challenging problem by your own

Solve the problem with a new methodology

Expert and leader

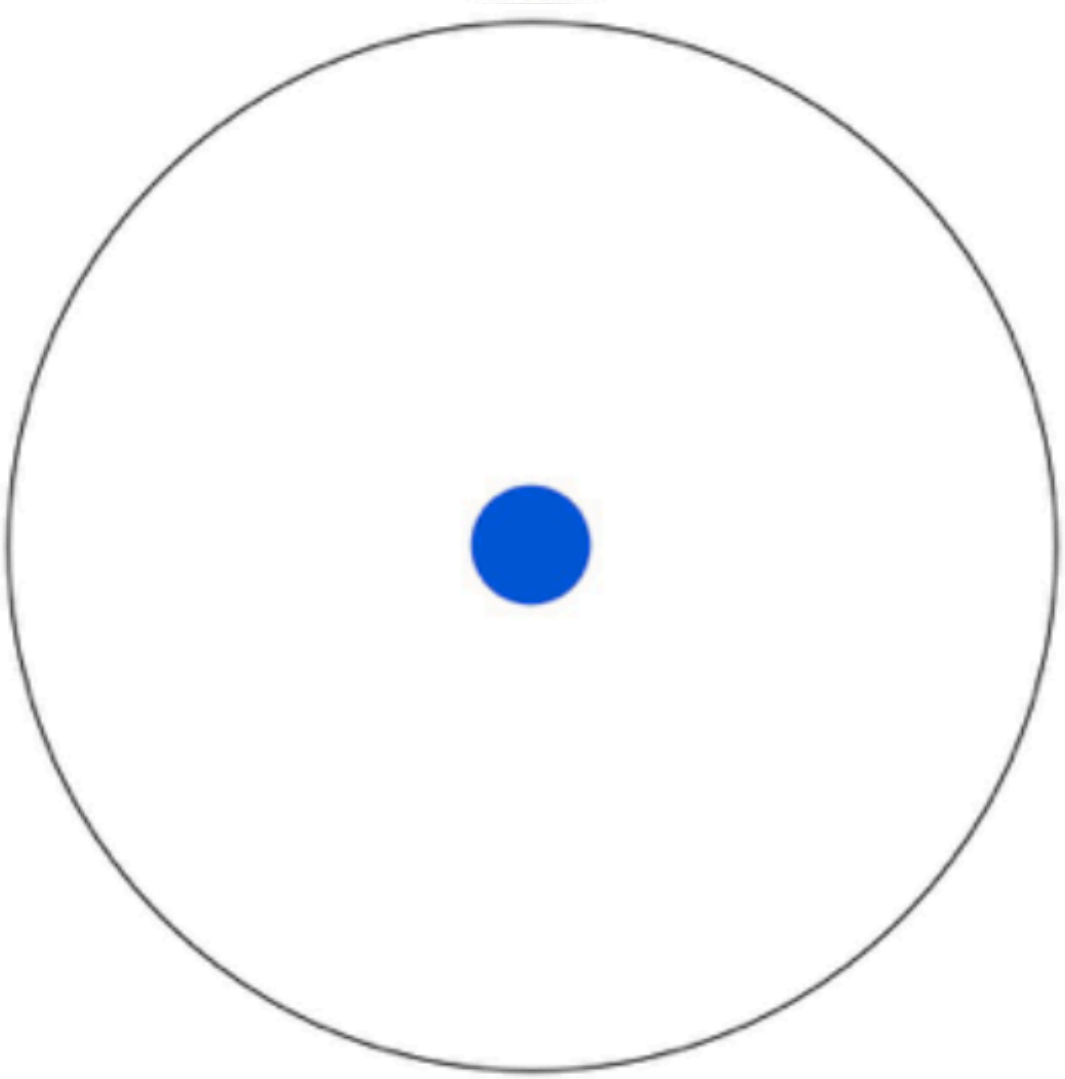
How it looks like to be a Ph.D. ?

- Human knowledge



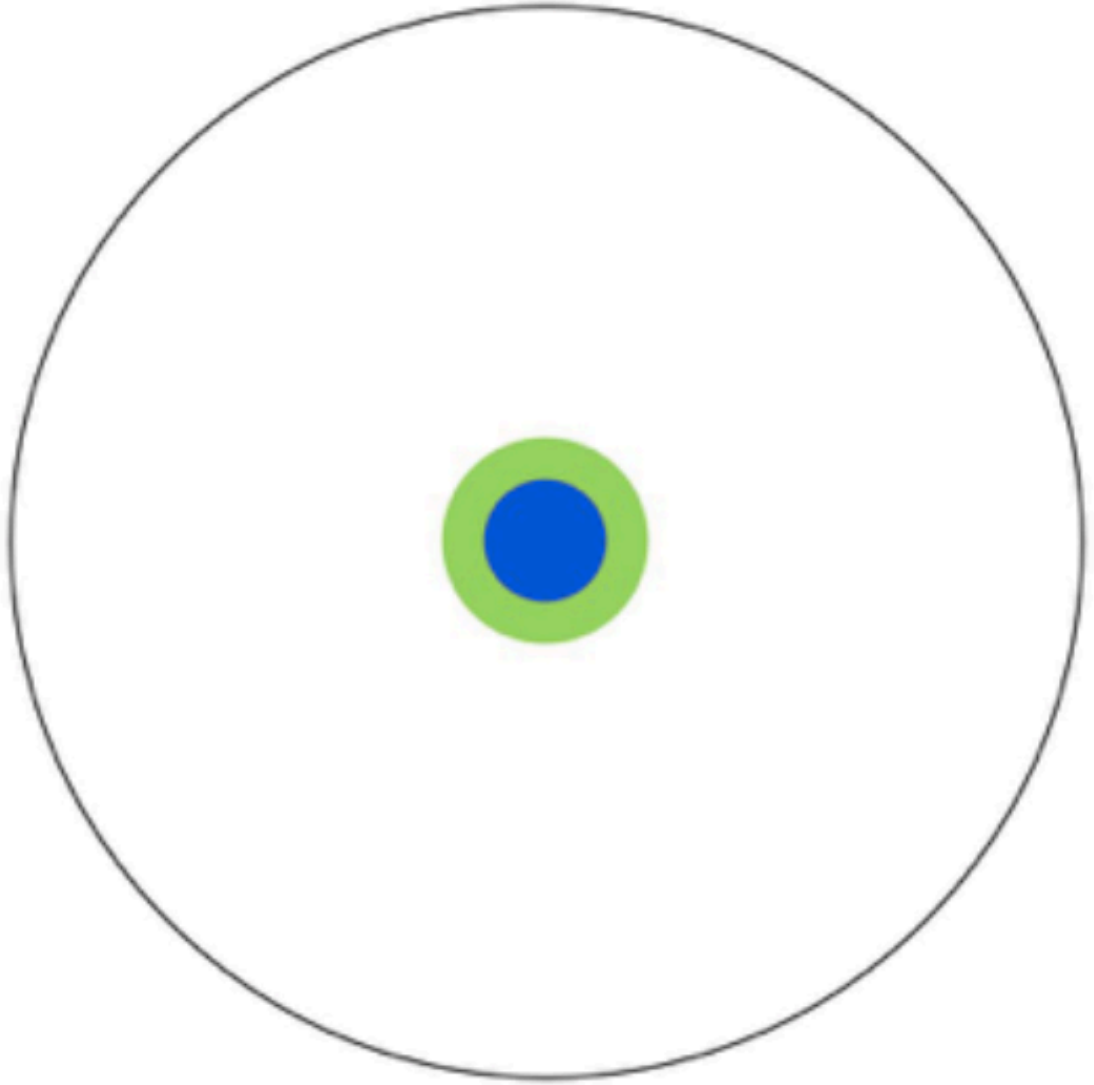
How it looks like to be a Ph.D. ?

- After elementary school



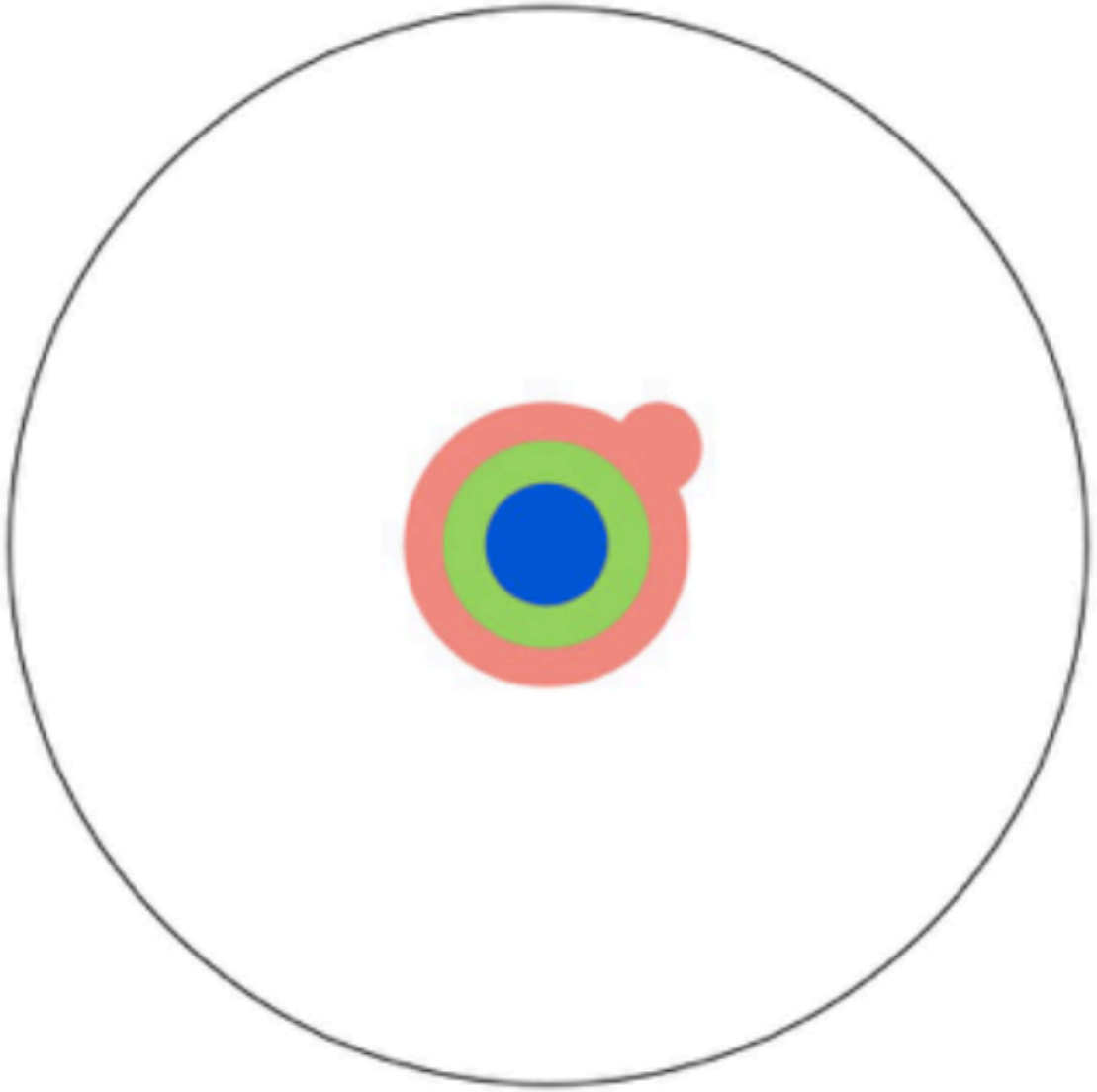
How it looks like to be a Ph.D. ?

- After high school



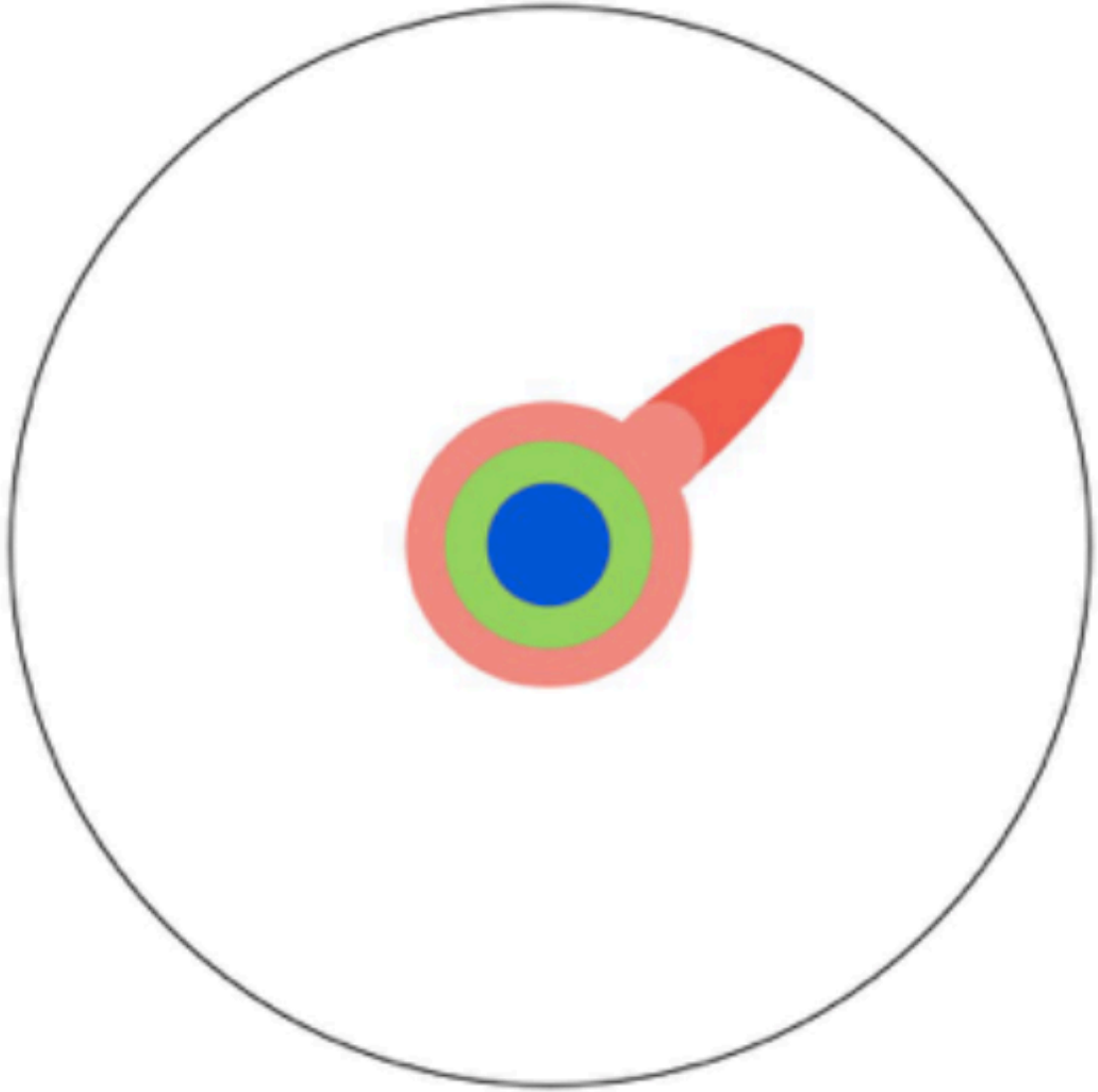
How it looks like to be a Ph.D. ?

- After a bachelor’s degree



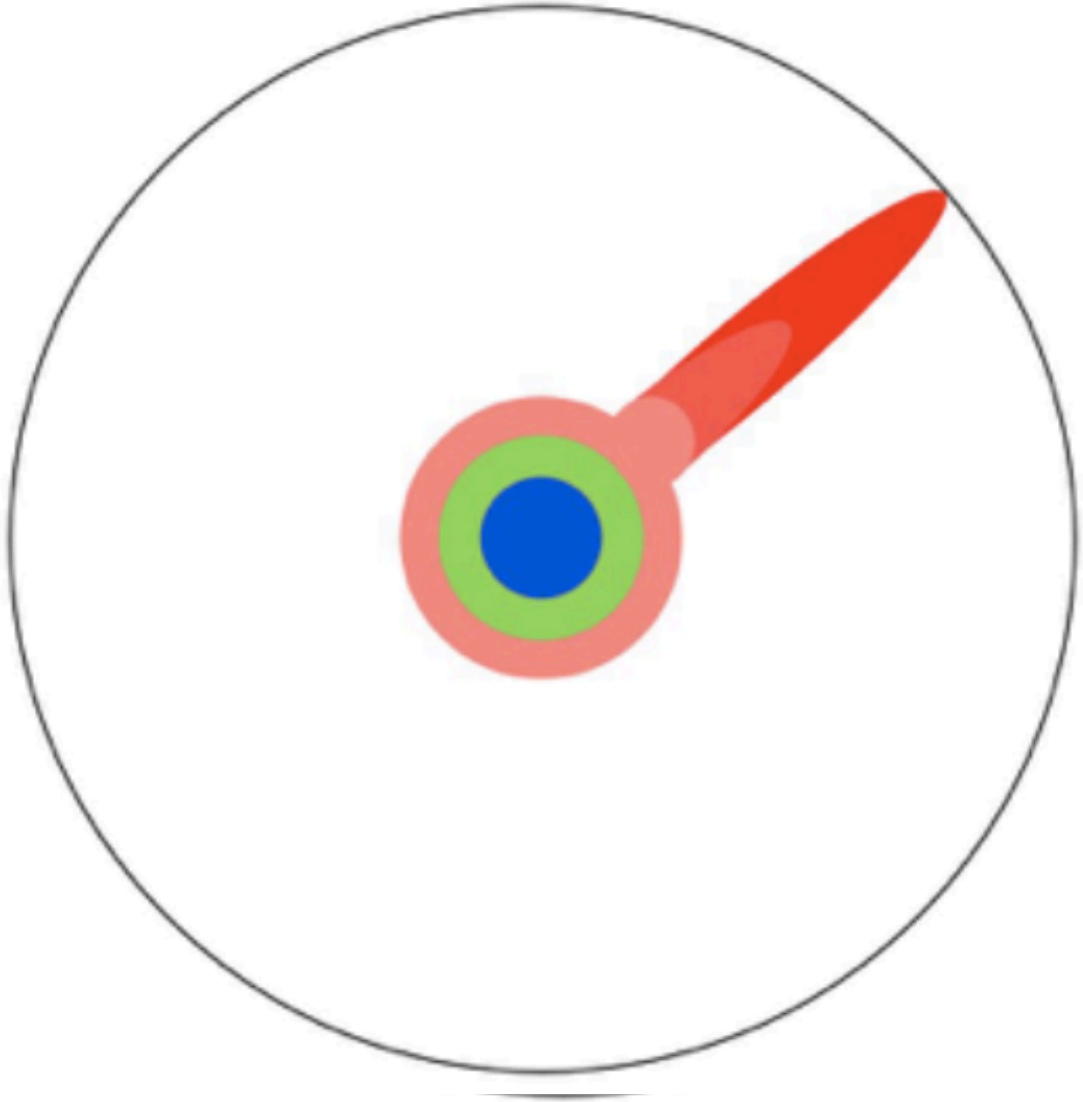
How it looks like to be a Ph.D. ?

- After a master’s degree



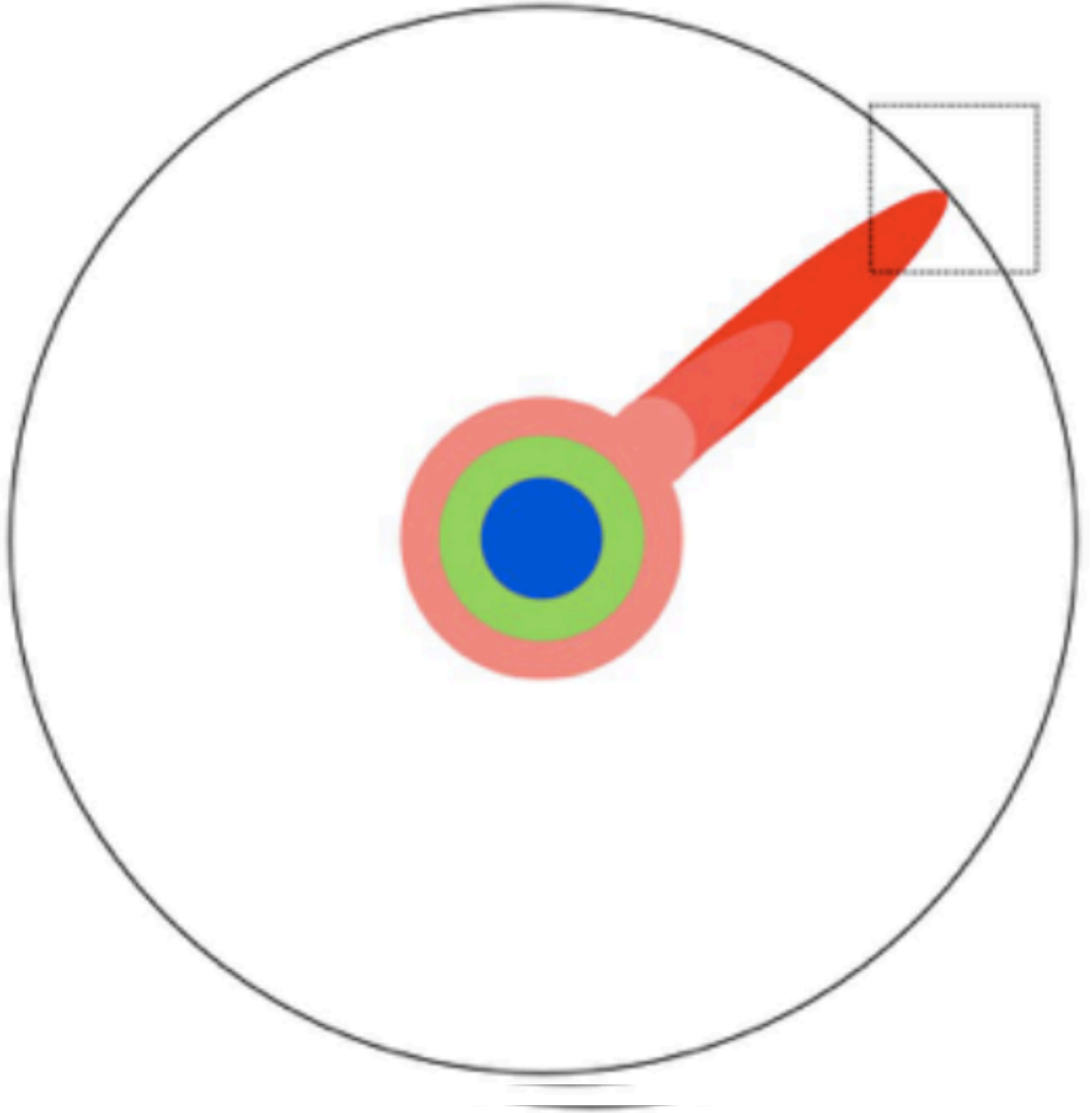
How it looks like to be a Ph.D. ?

- Reading research paper



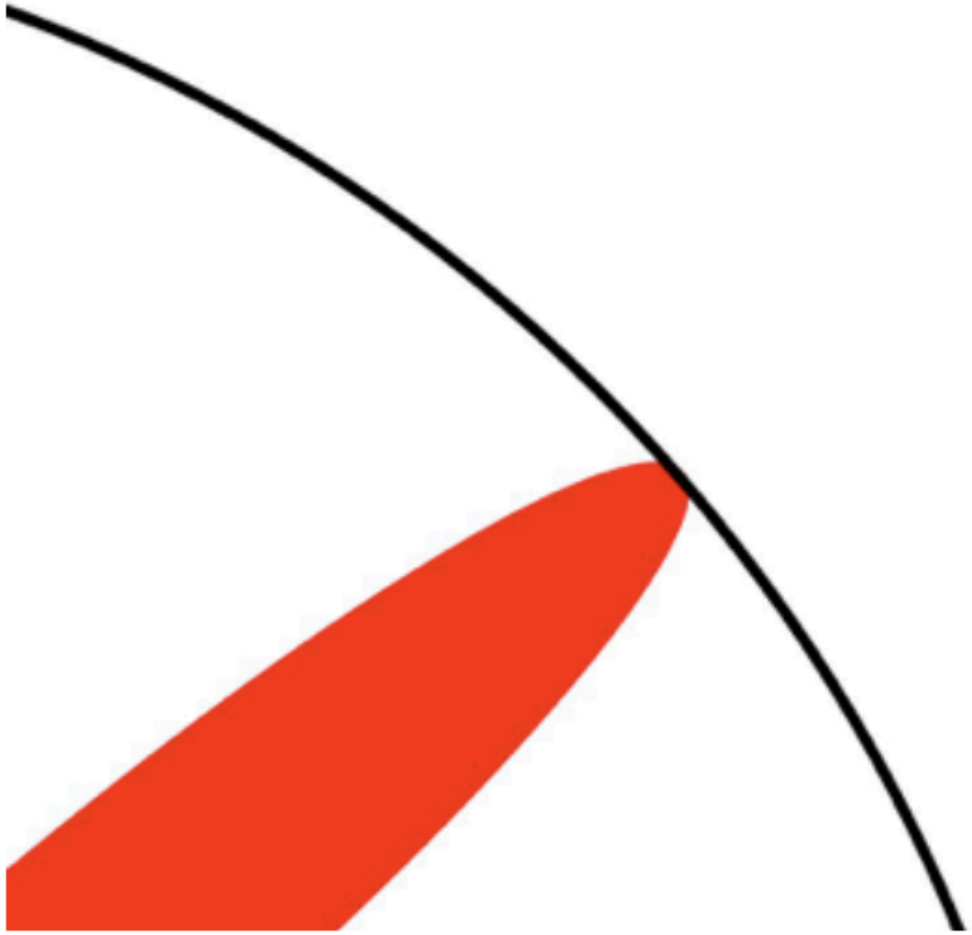
How it looks like to be a Ph.D. ?

- Focus



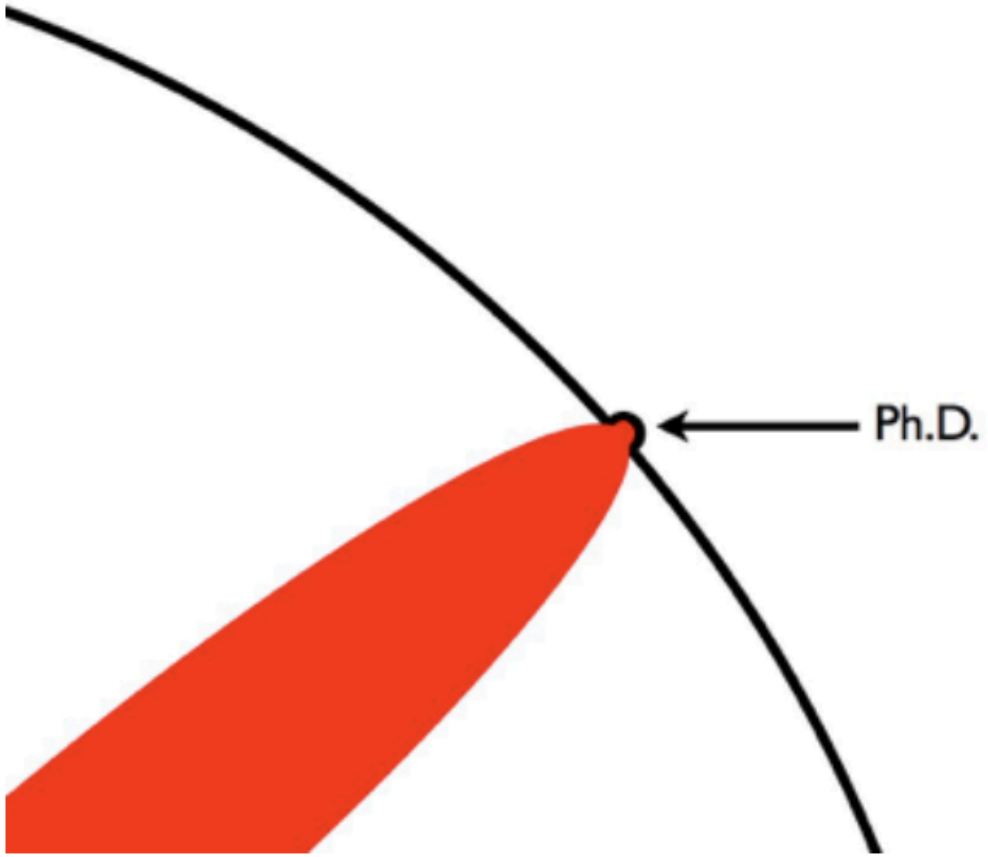
How it looks like to be a Ph.D. ?

- Push the boundary



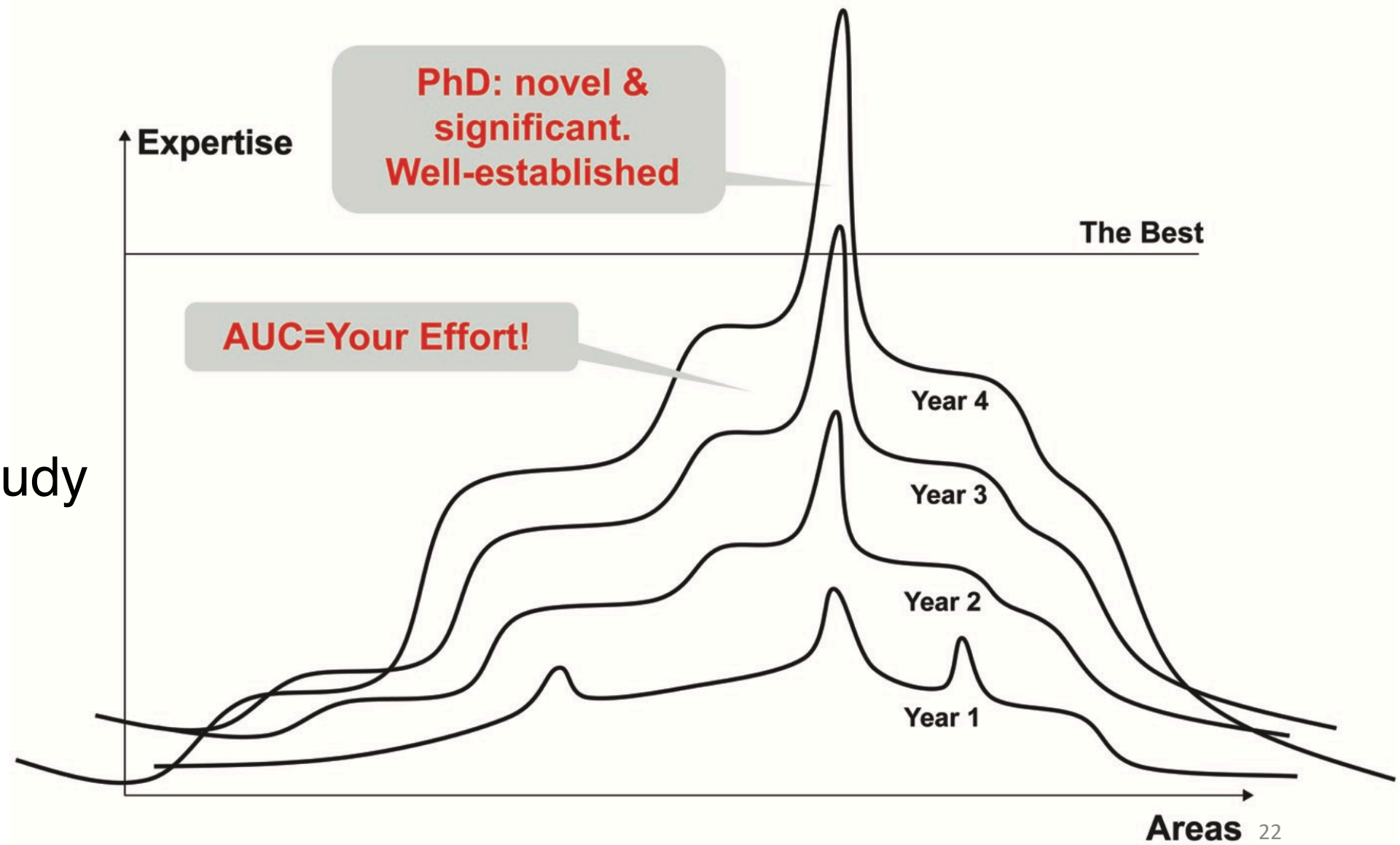
How it looks like to be a Ph.D. ?

- Ph.D.

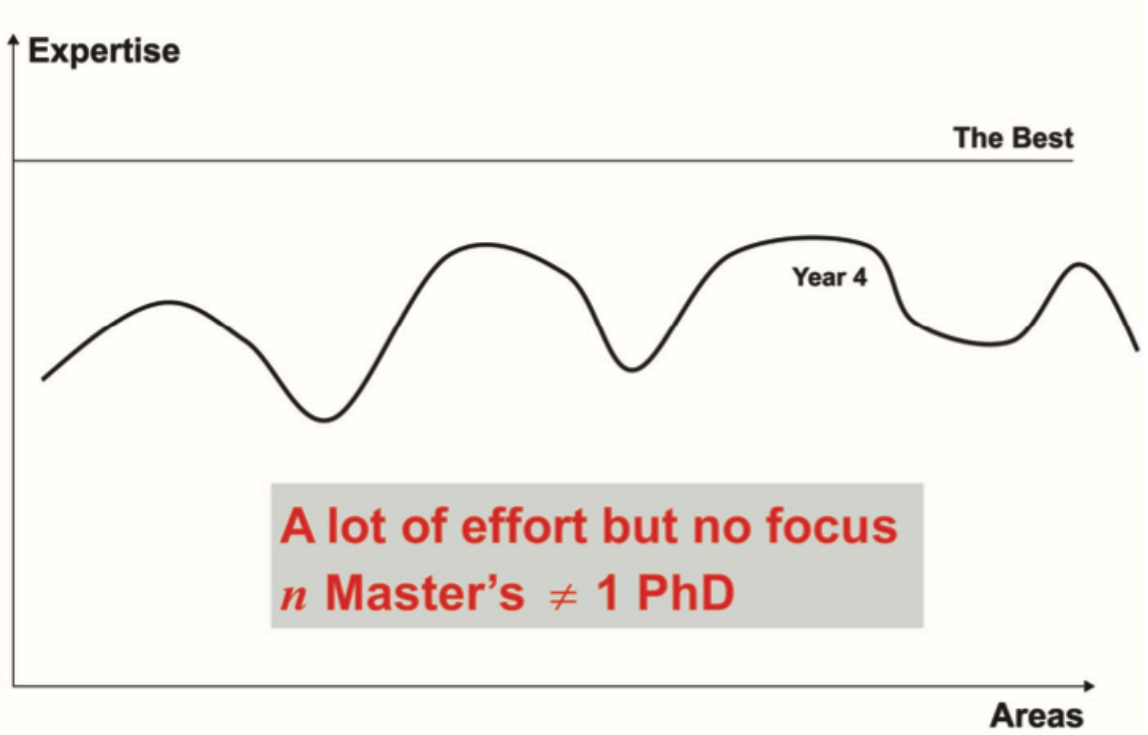


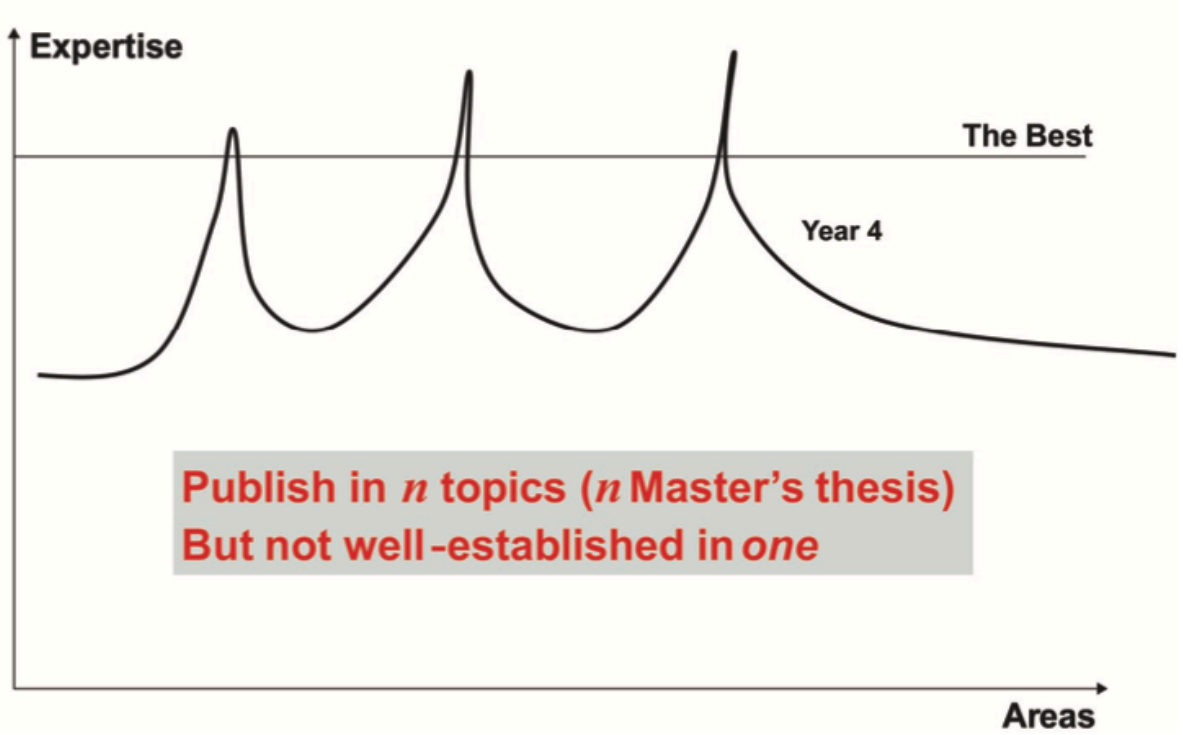
Goal of Ph.D. Research (1): Be the best in the field

Progress in four years of Ph.D. study



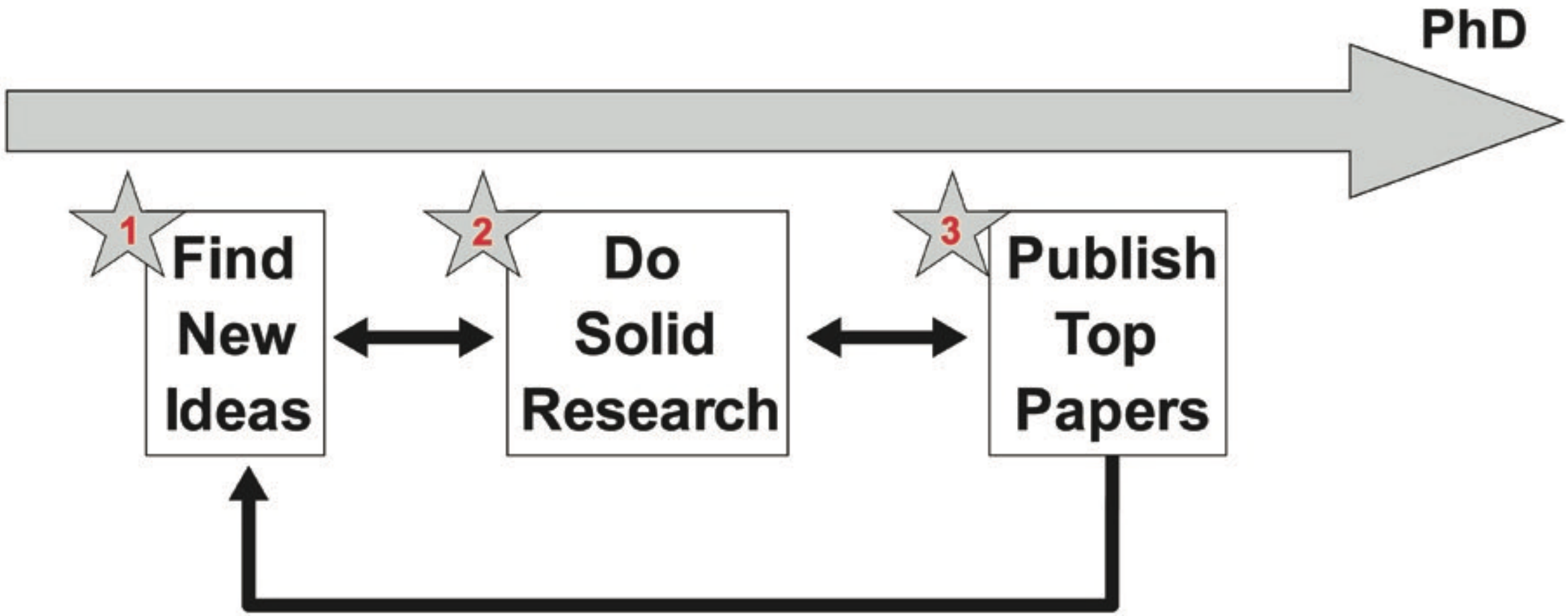
Some poor examples





Goals of Ph.D. Research (2): Be Independent

Three Major Tasks for Getting PhD



The Milestones of Getting a Degree

Course	Complete all course credits (one to two years)
Qualifying	Pass a written or oral Ph.D. qualifying exam (~2nd year)
Proposal	Pass a written or oral Ph.D. proposal defense (~3rd – 4th year)
Defense	Pass the final Ph.D. thesis defense (~4th – 5th year)

What Are Top Venues for CS

- **CSRankings**
  - Three Conferences in each domain
- Core Conference Ranking
  - A*, A, B, C, Other
- CCF Recommendation
  - A, B, C

What Are The Professional Organizations for Researcher?

- IEEE (Institute of Electrical and Electronics Engineers)

- ACM (Association for Computing Machinery)
  - Special Interest Groups
  - (SIGKDD, SIGCOMM, SIGSOFT, SIGMOBILE)

- USENIX: Support operating system related research

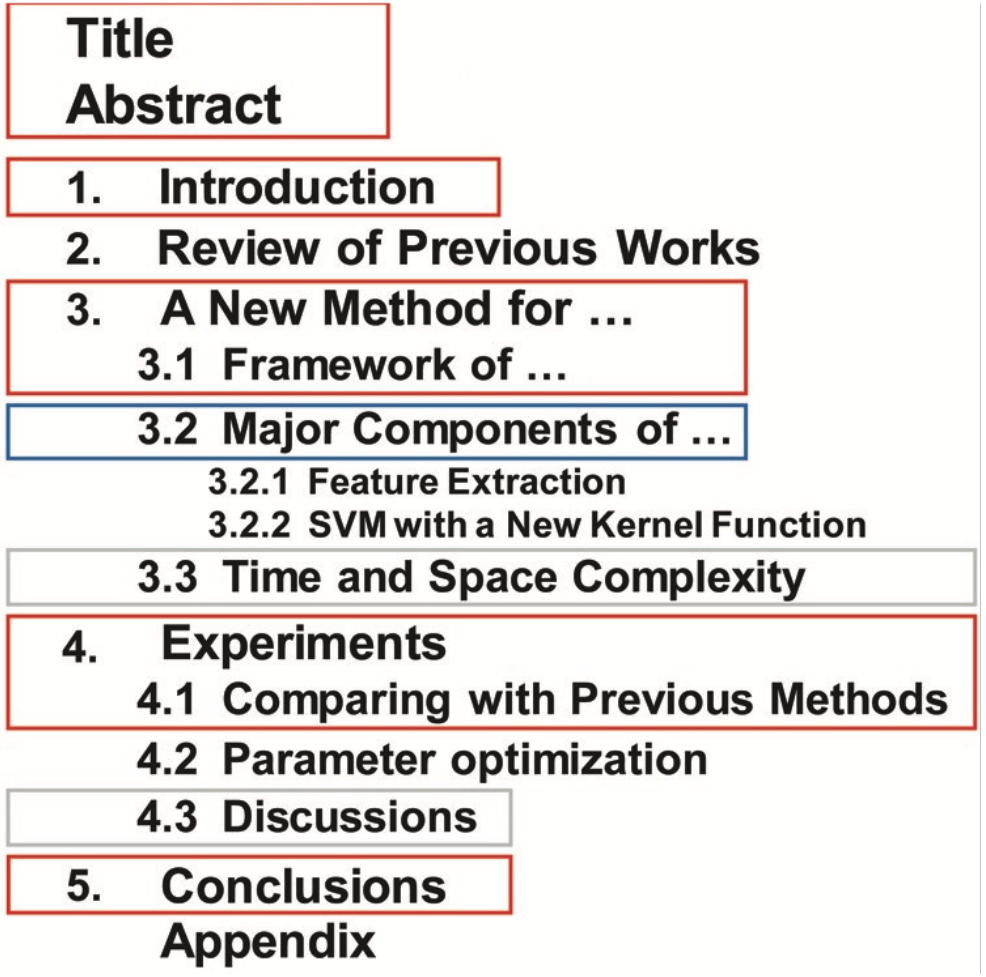
- AAAI: Support artificial intelligence related research

How to Find Relevant Papers

- Conference Website
  - Explore the state-of-the-art in an area
- Search Engine
  - Google Scholar (General)
  - DBLP: https://dblp.uni-trier.de (Computer Science Specific)
- New to an area?
  - Start from a survey paper (e.g., ACM Computing Surveys)

How to Read A Paper

Paper Structure



Three-Pass Approach (1)

(*Srinivasan Keshav,* University of Cambridge)

The First Pass

1. Carefully read the title, abstract, and introduction
2. Read the section and sub-section headings, but ignore everything else
3. Read the conclusions
4. Glance over the references, mentally ticking off the ones you've already read

After The First Pass

- Category
- Context
- Correctness
- Contributions
- Clarity

Three-Pass Approach (2)

The Second Pass

1. Look carefully at the figures, diagrams
2. Remember to mark relevant unread references for further reading
3. Read the conclusions
4. Glance over the references, mentally ticking off the ones you've already read

After The Second Pass

- Grasp the content of the paper
- Summarize the main thrust

Three-Pass Approach (3)

The Third Pass

1. Virtually re-implement the paper
2. Pay attention to detail
3. Identify and challenge every assumption in every statement
4. Think about how you yourself would present a particular idea

After The Third Pass

- Reconstruct the entire structure of the paper from memory
- Identify its strong and weak points

Big Picture about a Paper (PSOC)

- Problem: (i) Input (ii) Output (iii)Significance
- State-of-the-art (SOA):
  - What are the SOA?
  - What are the limitations?
- Opportunity:
  - What is your opportunity to address the limitations?
  - New observations? New techniques?
- Challenge:
  - What is the challenges of using the Opportunity to address the limitations?

Where To Get New Ideas

- By three-pass reading
  - Identify the assumptions in others' work
  - Any limitation of these assumptions?
  - What is not done?
  - In what scenario it does not work?

- By re-implementation
  - Why I failed?
  - What the weakness?
  - Any new observation?

From Ideas To Research Topic

- Your passion and interests in the topic
- Your technical strengths
  - Theoretical and math oriented?
  - Good at design?
  - Good at applications?
- How new and how “hot” the topic is
  - Too old or Too new?
- Your supervisor’s vision and opinions
- Your future career
  - Universities or Companies?

Am I On The Right Track?

- *You complete your first iteration of the three main tasks (find new ideas, do solid research, publish papers) early in your Ph.D. study*.
- Discuss your potential topic with your supervisor and other colleagues and Ph.D. students extensively
- Discuss your ideas with other researchers who work in the same field via emails.
- Get feedback by submission
  - Peer-review

Homework: Read & Summarize a Paper

- Find a paper from the Conferences in CSRankings
- Summarize the big picture of this paper
- (no more than one page)

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