



**OLD DOMINION**  
UNIVERSITY

# What's PhD Research?

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PhD Gathering

Fall 2017 – Sep 20, 2017

Largely based on "What's Grad School All About?", <https://www.slideshare.net/mweigle/2015-cap-wic>

# MS vs PhD - Jobs

- A masters degree equips you to do high level, complex design and potentially lead software engineering teams.
- A PhD degree equips you to do original research and potentially lead R&D teams.
- “With a Ph.D. you will have a better chance of spending the rest of your life doing what *you* want to do, instead of what *someone else* wants you to do.”
  - William Lipscomb, a Nobel Prize winner in chemistry

<http://www.quora.com/What-are-the-main-differences-between-a-Masters-and-a-PhD-in-computer-science>

Vijay Chidambaram, computer science grad student

# MS vs. PhD – Requirements at ODU

- MS
  - 34 hours of coursework (11 courses)
  - project (only 10 courses) or thesis (only 8 courses)
  - usually partial tuition waiver
  - ~2 years
- PhD (after MS)
  - 48 credit hours
  - 24 hours of coursework (8 courses)
    - 4 "real" courses (not seminar or special topics) with 3 different faculty members
  - 24 hours of dissertation credits
  - full tuition waiver
  - variable (often 3-5 years after MS)

# BS vs. MS vs. PhD

- BS - you are given the questions and the answers
- MS - you are given the questions and mostly you get to find the answers
- PhD – you must come up with the questions and the answers
- It sure is a lot simpler when you are given the questions *and* the answers.

Dr. Kris Cooper (my undergraduate advisor)

# A PhD is All About Questions

- "A PhD teaches you how to ask the right questions" <http://blog.skanev.org/2013/03/why-not-do-phd-in-computer-science.html>
- Your PhD advisor's job is to ask questions about your work
  - why does the output/graph/result look like this?
  - what would happen if you ran the experiment/analysis another way instead?

# So long, and thanks for the PhD!

Ron Azuma's classic article (PhD, UNC 1995)

<http://www.cs.unc.edu/~azuma/hitch4.html>

**“So long, and thanks for the Ph.D.!”**

**a.k.a.**

**“Everything I wanted to know about C.S. graduate school at the beginning but didn’t learn until later.”**

**The 4th guide in the Hitchhiker’s guide trilogy (and if that doesn’t make sense, you obviously have not read Douglas Adams)**

**by Ronald T. Azuma**

**v. 1.13**

**Original version 1997, last revised February 2017**

# What is a PhD?

- A PhD program is very different from getting a Bachelor's degree, and you must treat it as a strange type of job.
  - *Initiative, tenacity, flexibility, interpersonal skills, organizational skills, and communication skills* are all critical and not things that universities typically test for in selecting incoming students.
- A PhD is a means to an end: employment in a startup, commercial business, government or industrial research lab, or academia.

# Where do GRAs Come From?

- Academia is a business, and “graduate student” is a job title.
- Faculty write grant proposals to external agencies (NSF, NEH, IMLS, ...).
  - fund GRA stipends, travel, small amounts of faculty summer support
  - *without grant funding, there is no GRA funding*
- These agencies expect concrete deliverables (software, publications, etc.).



# Treat Your GRA Like a Job

- You must prove to your professors that you are capable of
  - getting the work done,
  - being a team player,
  - communicating your results, and
  - most of the other characteristics needed to do well in regular jobs.

# A PhD is Not About Courses

- Most of what you learn in a Ph.D. program comes outside of classes:
  - from doing research on your own and in collaboration with your advisor
  - attending conferences
  - discussions with your fellow students

# Ph.D. Students Must Break Away From Undergraduate Mentality

- Grades don't matter much anymore
  - main form of evaluation is research progress (i.e., publications)
- There is no one who can tell you exactly what to do, so own your research
  - secret: *your advisors don't know all the answers!*
- When you graduate, you will be the world's expert on your dissertation topic

# Critical Skills Needed

- Initiative
- Tenacity
- Flexibility
- Interpersonal skills
- Organizational skills
- Communication skills

# Initiative

- The dissertation represents a focused, personal research effort where you take the lead on your own, unique project.
- Ph.D. students must show *initiative* to successfully complete the dissertation.
- If you never do any tasks except those that your professor specifically tells you to do, then you need to work on initiative.

# Tenacity

- No one can tell you in advance exactly how long the dissertation will take, so it's hard to see where the “end of the road” lies.
- You will encounter unexpected problems and obstacles that can add months or years to the project.
- If you are not *tenacious* about working on the dissertation, you won't finish.
- The best way to finish the dissertation is to do something every day that gets you closer to being done.

# Flexibility

- *Flexibility* means
  - taking advantage of opportunities and synergies,
  - working around problems
  - being willing to change plans as required

# Interpersonal Skills

- You need to build and maintain interpersonal relationships with your advisor, your committee, your research and support staff and your fellow students.
- Cultivating interpersonal relationships is mostly about treating people with respect and determining their different working styles.
  - Give credit where credit is due.
  - Acknowledge and thank them for their help.
  - Return favors.
  - Respect their expertise, advice and time.
  - Apologize if you are at fault.
  - Realize that different people work in different ways and are motivated by different things



# Organizational Skills

- You will have lots of responsibilities (classes, GRA, GTA, dissertation research, publications)
- You must be *well-organized* and learn to prioritize to make sure the important things get done

Additional time management advice from Randy Pausch (former prof at UVa, CMU)  
<http://web.archive.org/web/20070223065627/www.cs.virginia.edu/helpnet/Time/time.html>

# Communication Skills

- You will write (a lot)
- You will present your ideas (a lot)
- It will be so much better (and more efficient) for you and your advisor if you spend more time talking about research ideas than about organization, grammar, and typos
- ***I cannot over-emphasize how important this is***

# Surviving the PhD

- Read Ron Azuma's guide
- Perseverance
  - it can be slow, it can get boring, some days you just have to get through it
- Initiative
  - your advisor will rarely bug you each day to make sure you're working, must set your own goals
- Curiosity
  - PhD students are usually ready to graduate once they start asking their own questions about their data and research
- Coffee

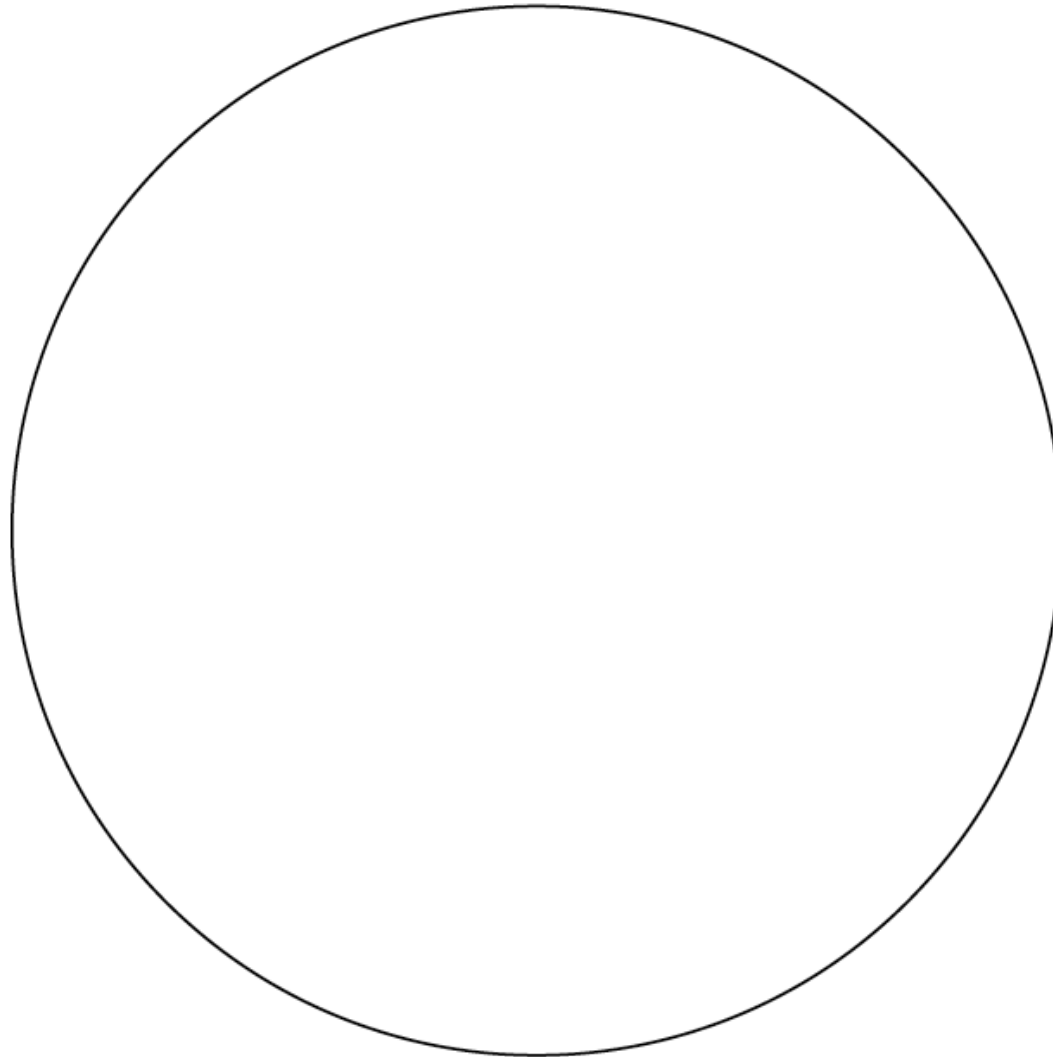
# What is Research?

Matt Might (<http://matt.might.net/>), a professor in Computer Science at the University of Utah, created "The Illustrated Guide to a Ph.D." to explain what a Ph.D. is to new and aspiring graduate students.

[Matt has licensed the guide for sharing with special terms under the Creative Commons license.]

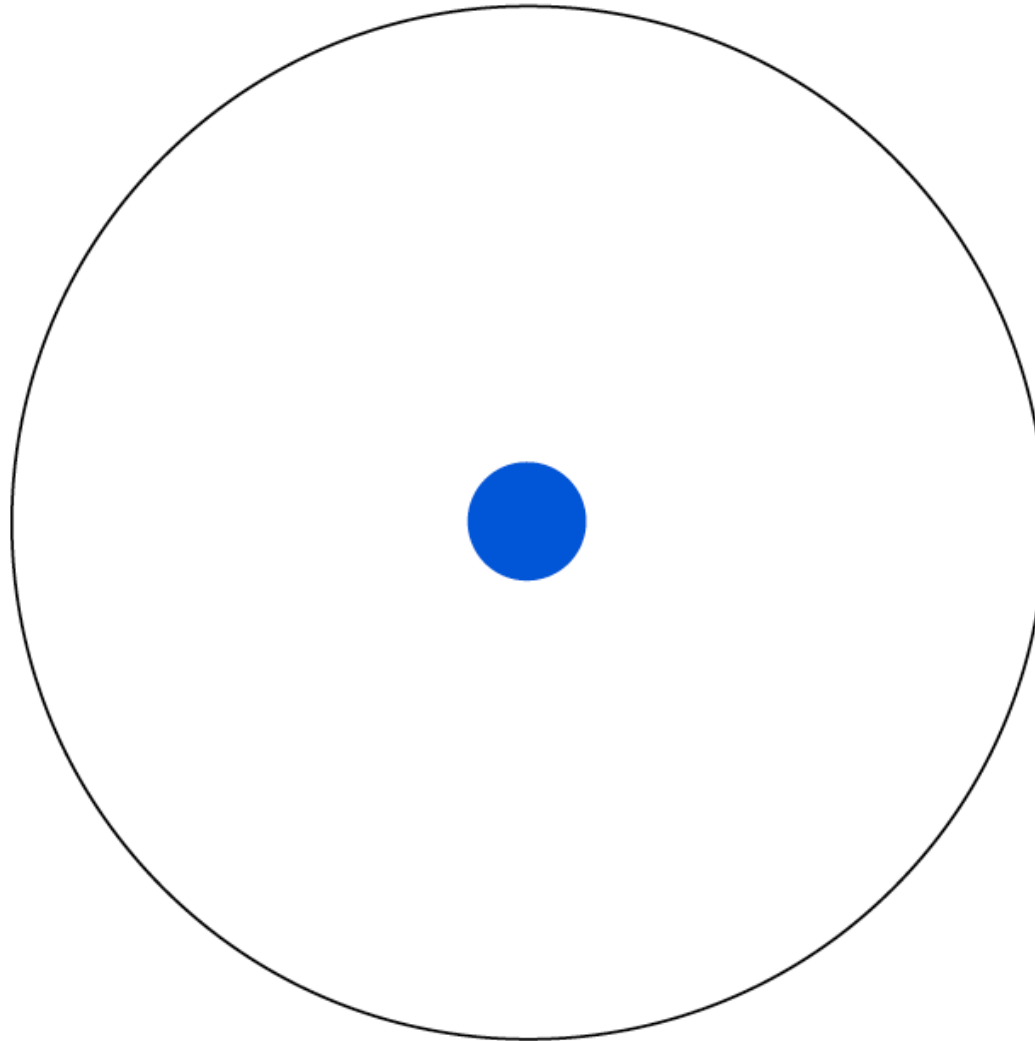
<http://matt.might.net/articles/phd-school-in-pictures/>

# Imagine a circle that contains all human knowledge



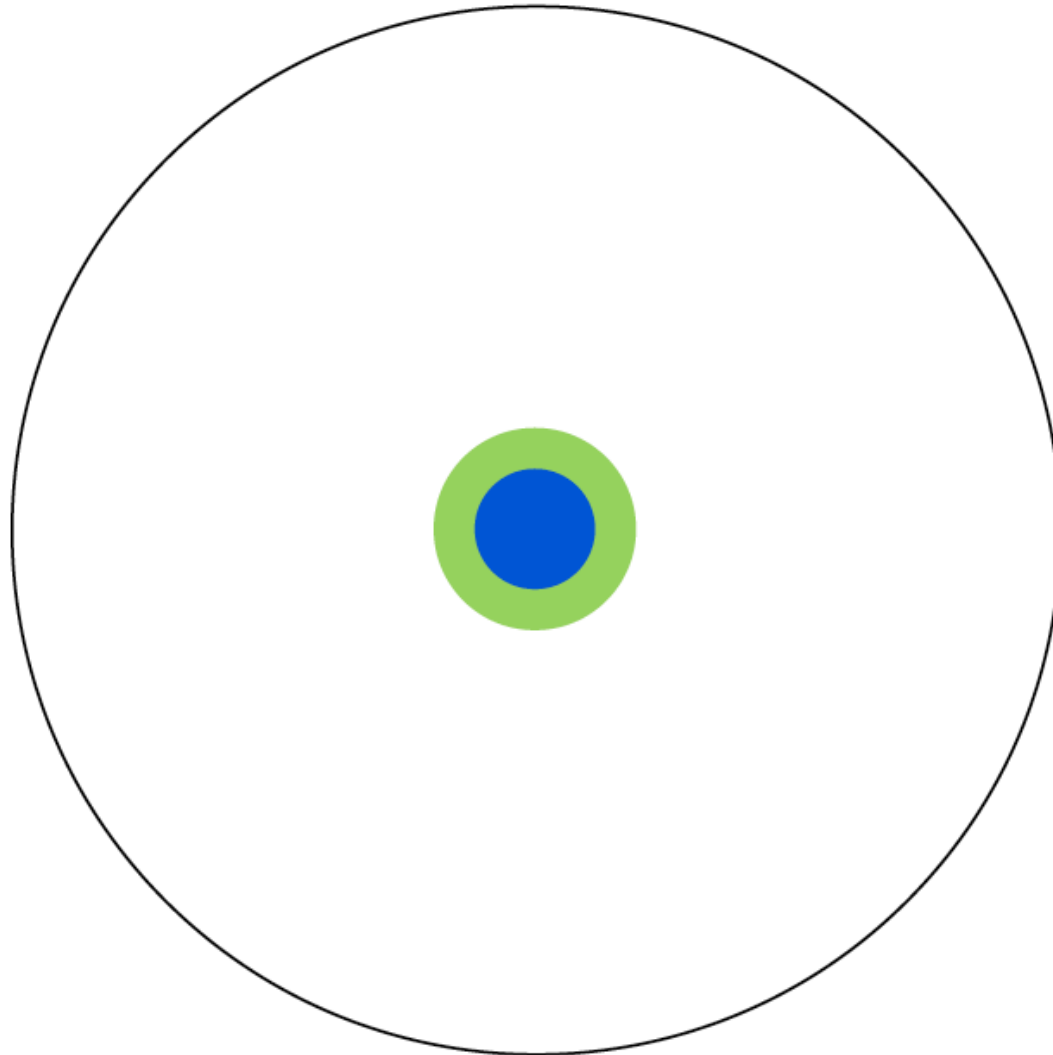
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**By the time you finish elementary school, you know a little**



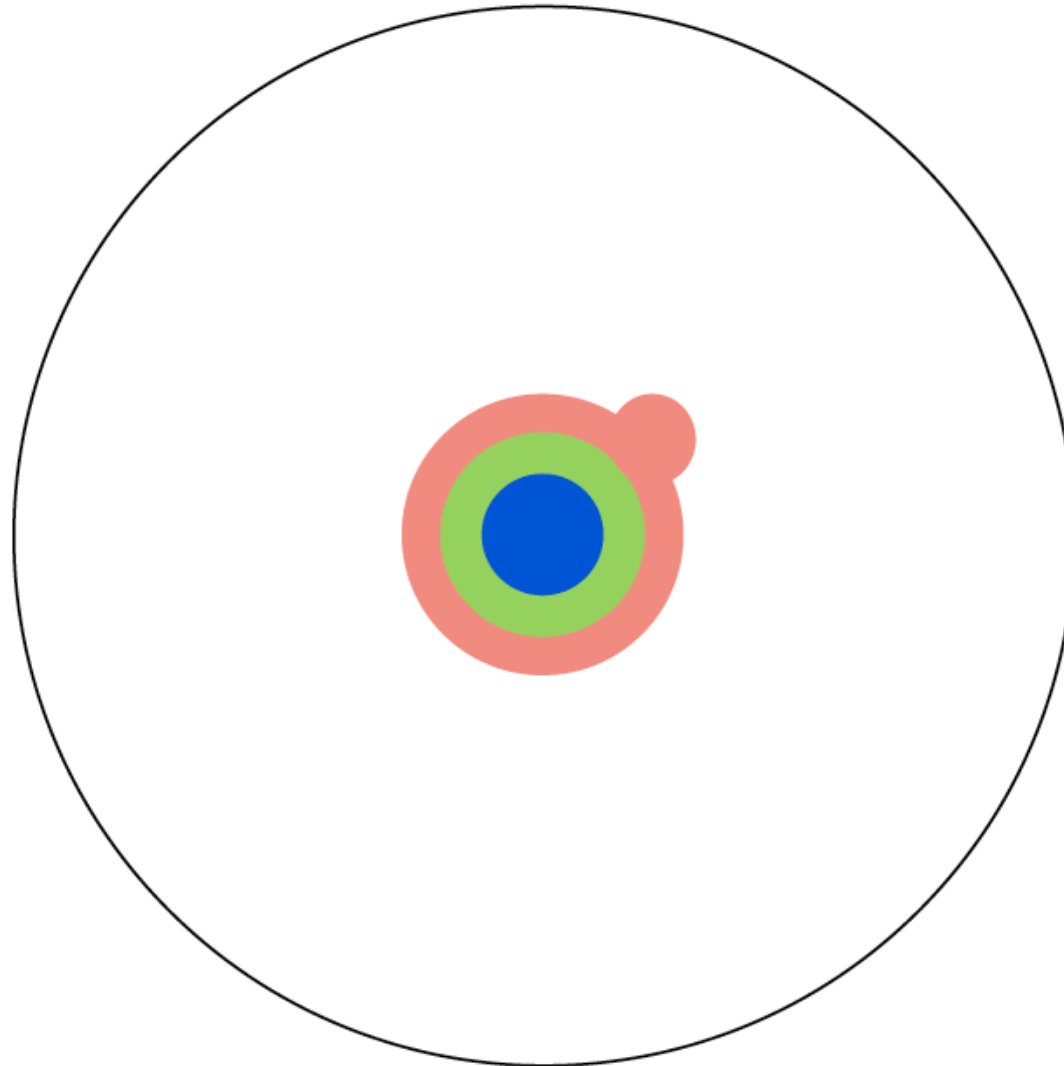
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# By the time you finish high school, you know a bit more



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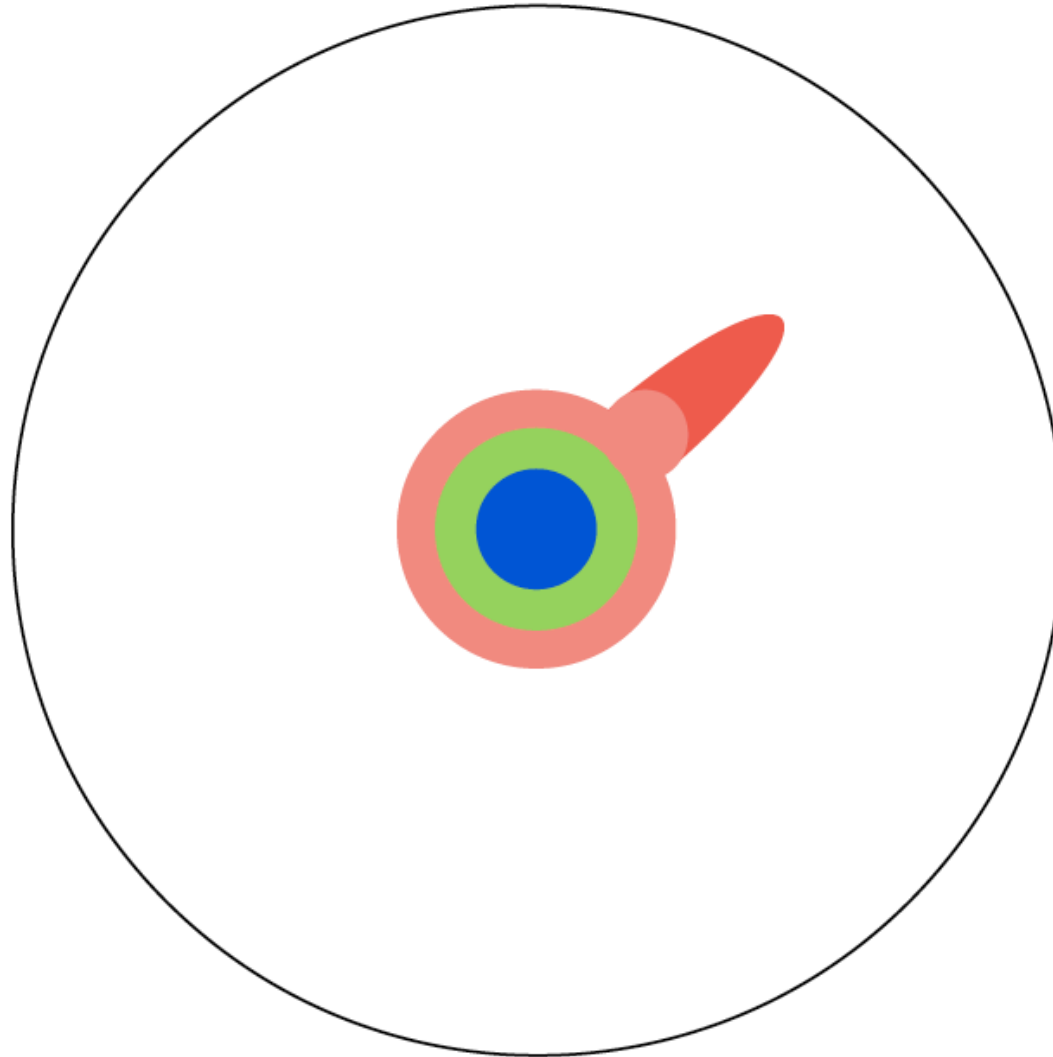
# With a bachelor's degree, you gain a specialty



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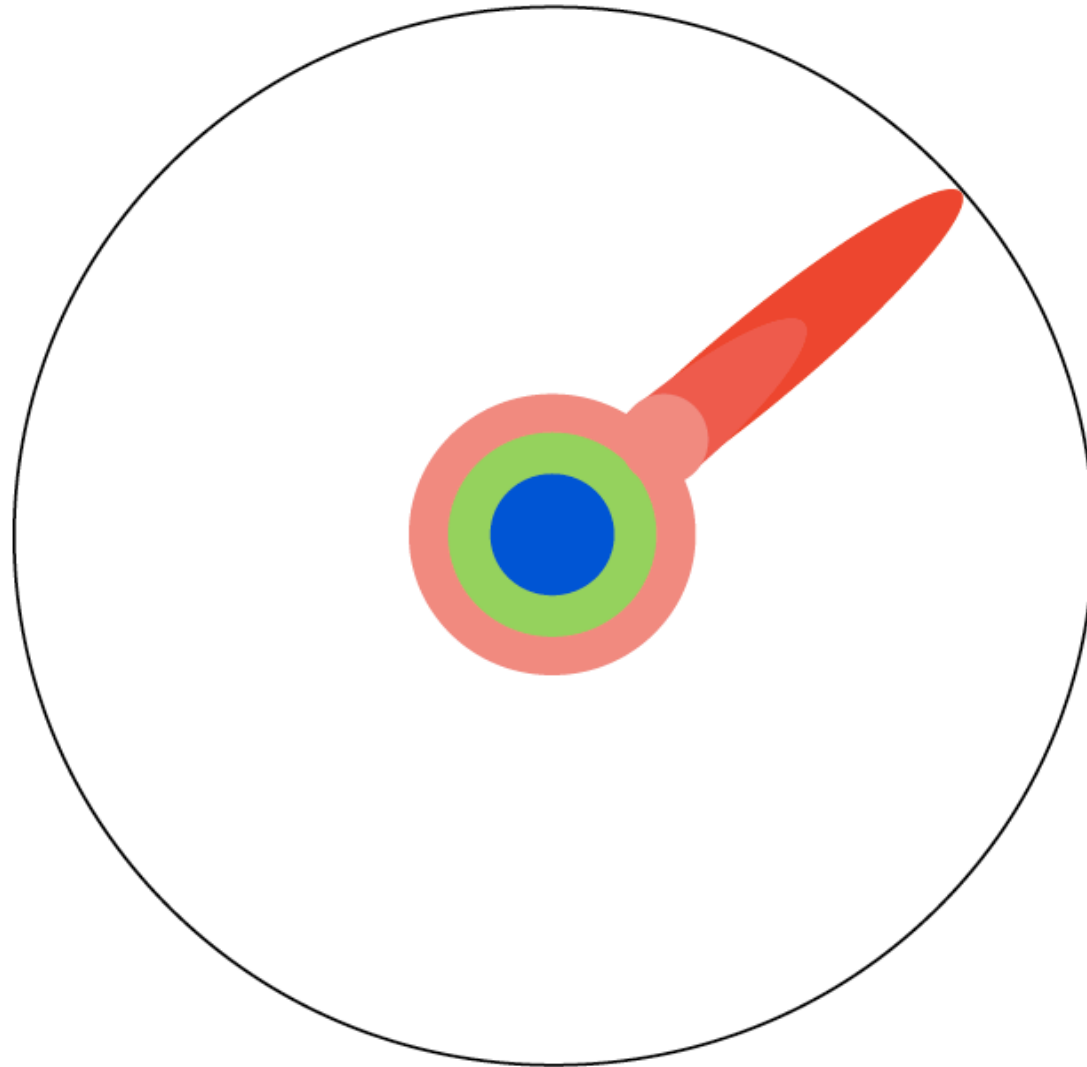


# A master's degree deepens that specialty



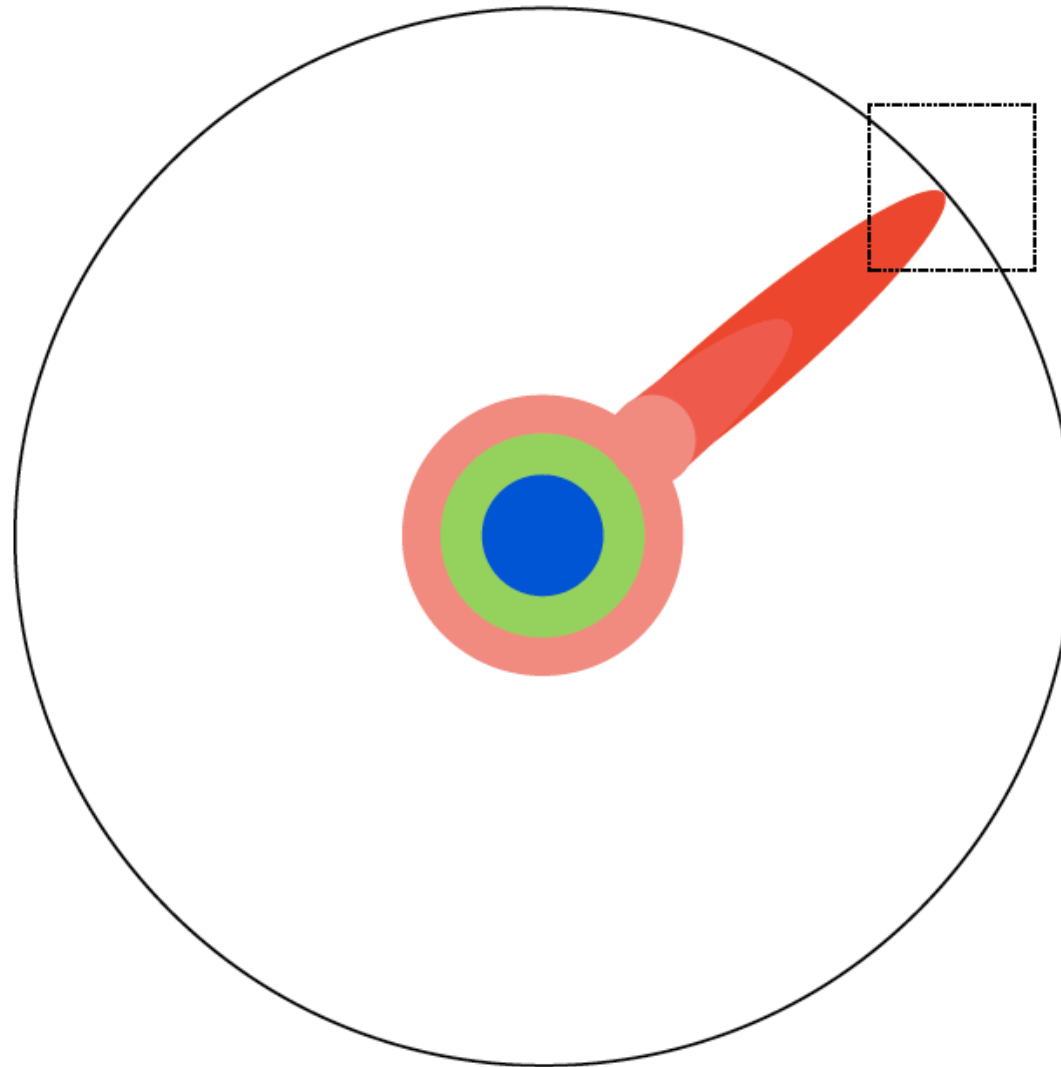
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# Reading research papers takes you to the edge of human knowledge



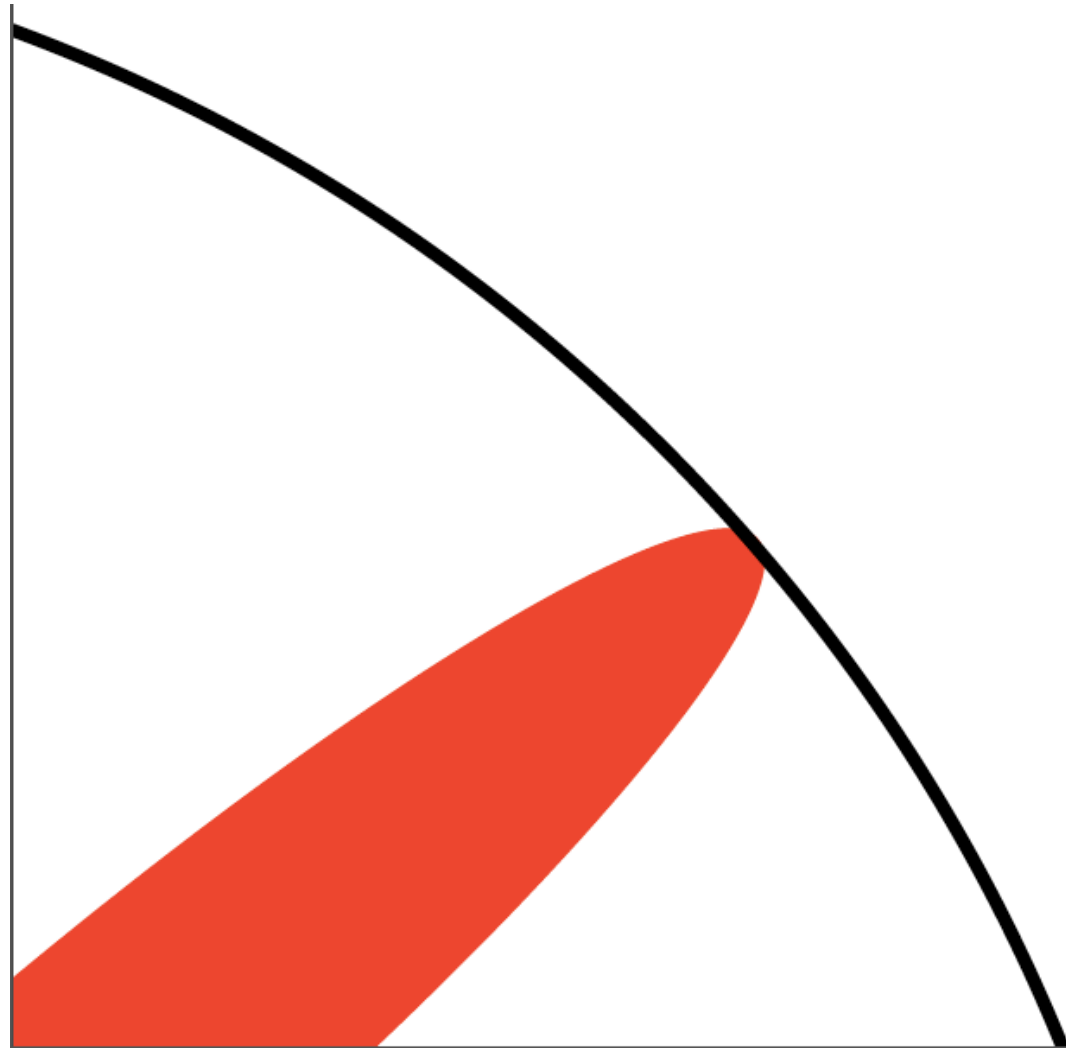
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# Once you're at the boundary, you focus



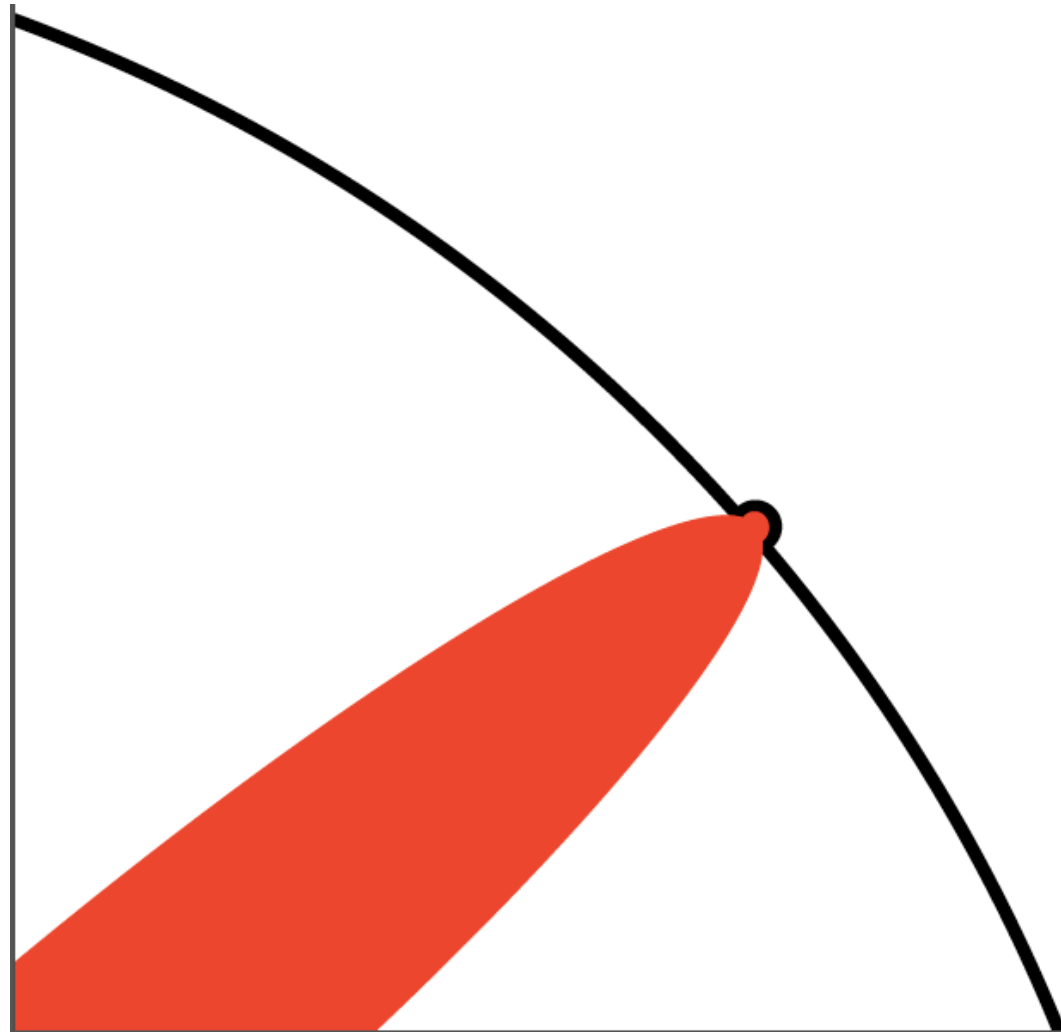
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# You push at the boundary for a few years



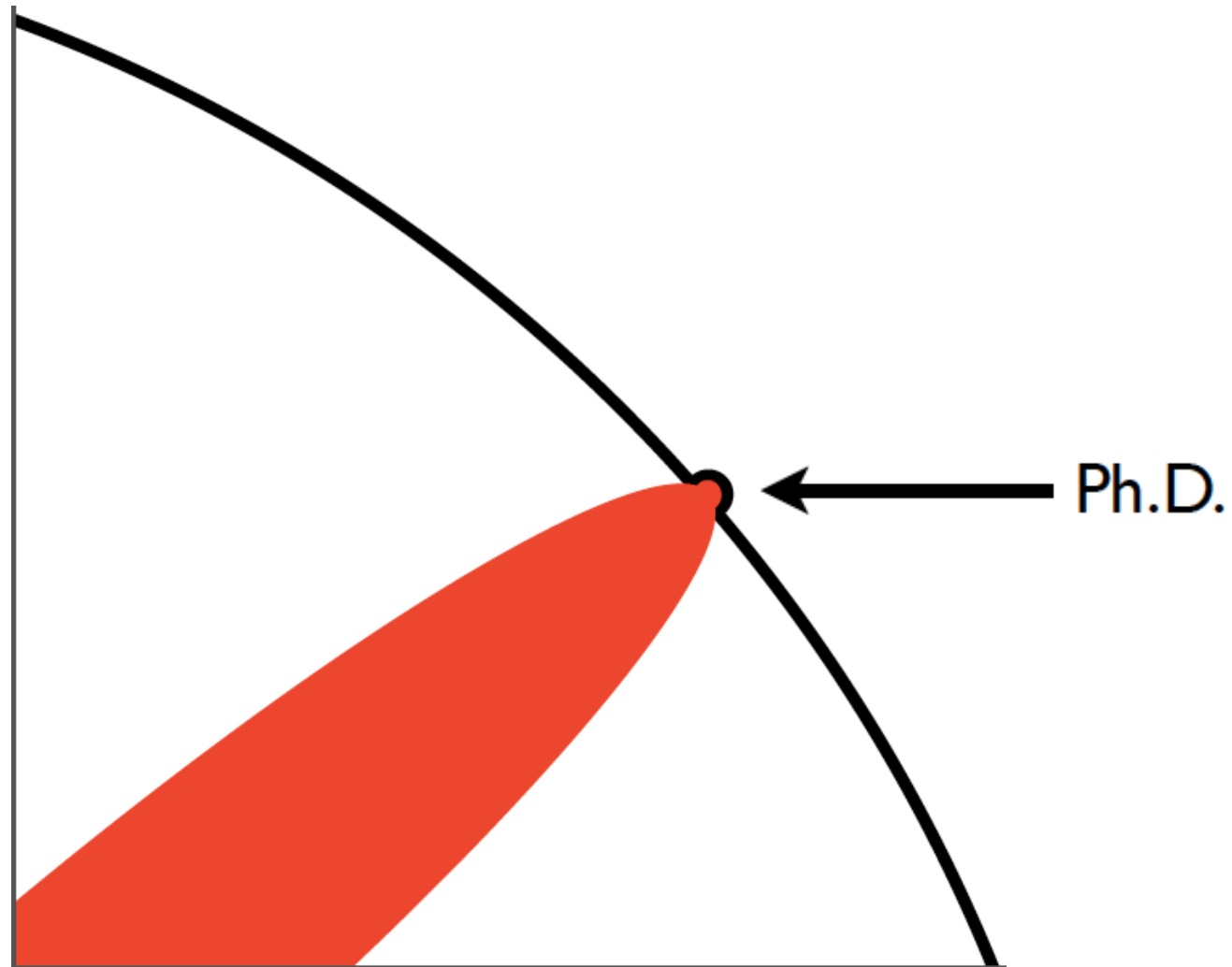
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# Until one day, the boundary gives way



<http://matt.might.net/articles/phd-school-in-pictures/>

# And, that dent you've made is called a Ph.D.



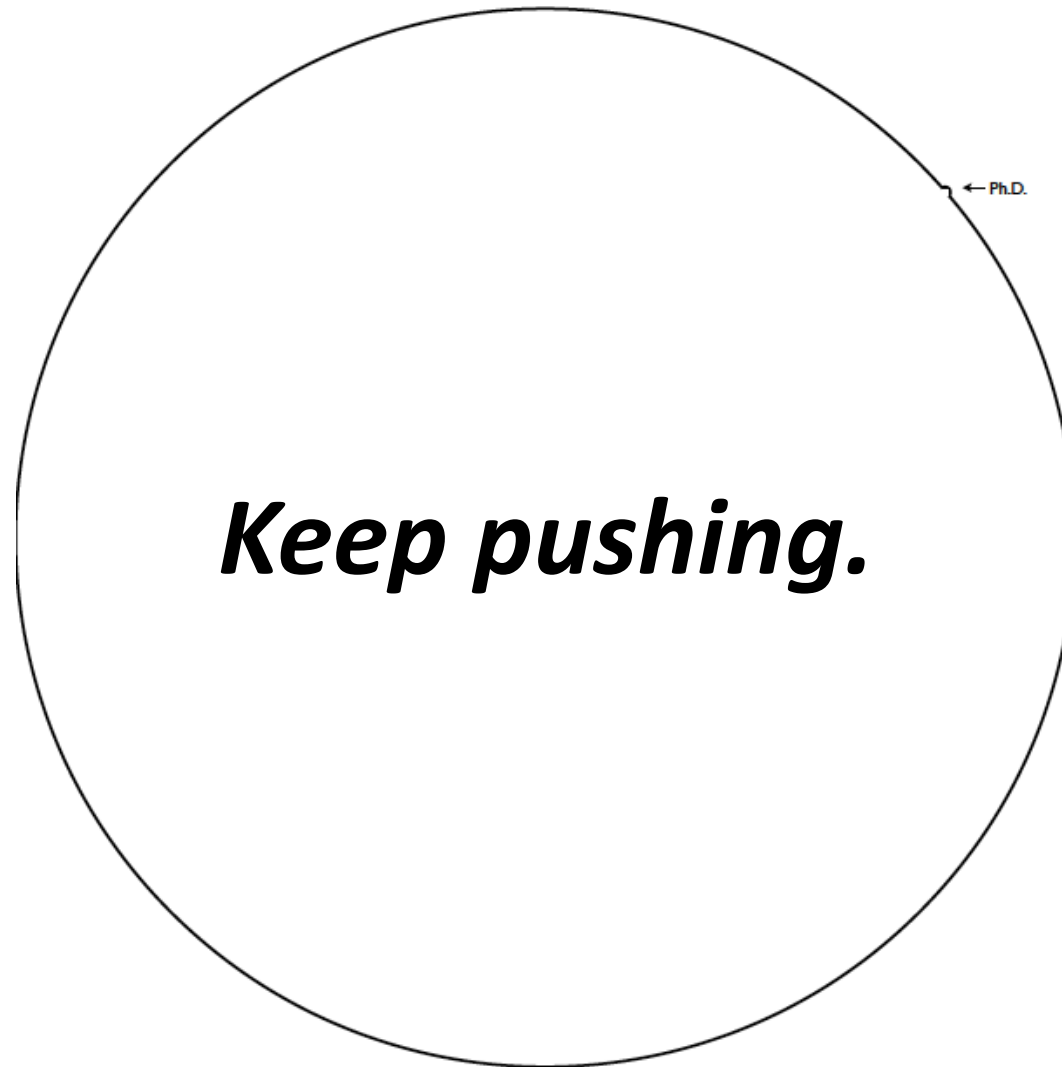
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# Of course, the world looks different to you now



<http://matt.might.net/articles/phd-school-in-pictures/>

# So, don't forget the bigger picture





# Skills Gained Through PhD

- **Ability to work independently**
- **Critical thought**
  - A PhD candidate learns to critically examine the thoughts of others and pick out the pros and cons.
- **Perseverance**
- **Ability to work with poorly defined goals**
  - One of the bigger hurdles of the PhD is that there is no clear cut goal.
  - No one can exactly say these are the things you need to do every day.
  - Research as such involves going back and forth, exploring blind alleys and so forth.
- **Effective communication**

<http://www.quora.com/What-are-the-main-differences-between-a-Masters-and-a-PhD-in-computer-science>  
Vijay Chidambaram, computer science grad student