What's PhD Research?

Michele C. Weigle

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

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"


• 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.!”

d.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.

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

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

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

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

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

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

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

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

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

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

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

http://matt.might.net/articles/phd-school-in-pictures/
By the time you finish elementary school, you know a little

http://matt.might.net/articles/phd-school-in-pictures/
By the time you finish high school, you know a bit more

http://matt.might.net/articles/phd-school-in-pictures/
With a bachelor's degree, you gain a specialty

http://matt.might.net/articles/phd-school-in-pictures/
A master's degree deepens that specialty

http://matt.might.net/articles/phd-school-in-pictures/
Reading research papers takes you to the edge of human knowledge

http://matt.might.net/articles/phd-school-in-pictures/
Once you're at the boundary, you focus

http://matt.might.net/articles/phd-school-in-pictures/
You push at the boundary for a few years

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

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

*Keep pushing.*

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

Vijay Chidambaram, computer science grad student