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Ph.D. Students Must Break Away From Undergraduate Mentality

Jason Hong considers how students working on their doctorates in computer science must adapt and evolve to succeed.

Jason Hong
Ph.D.'s from the Faculty's Perspective
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One of Blog@CACM's bloggers, Philip Guo, has been doing a great job in discussing grad school from the Ph.D. student's perspective. I figured it would be good to offer a complementary perspective of graduate school, distilling what I have learned over the past years in advising and working with Ph.D. students.

Break Out of the Undergraduate Mentality

A common challenge for a lot of new Ph.D. students is that they still have an "undergraduate mentality," where they believe grades still matter (they do, but only marginally so), and there will always be someone there to tell you what to do.

It is natural that a lot of new Ph.D. students think in this way. The primary form of evaluation for undergrads is grades, and new Ph.D. students have had 4+ years optimizing their thinking and work processes for that system. Similarly, most undergrad courses are geared toward "demonstrate that you can build this" rather than trying to answer more important questions like "what should we build, and why?"

As such, grades in graduate school do not really matter beyond the fact that you are above the minimum bars as set by your department. Instead, the main form of evaluation for Ph.D. students is progress toward research which, for better or for worse, can be approximately boiled down to research publications.

Now, having said that, you should do more than the bare minimum amount of work needed for your courses. The instructors for your course will be on committees reviewing your progress, and they will also be your future peers. Leaving a bad impression here will not help your case. Furthermore, you might miss a lot of wonderful opportunities for learning new things if you only do the bare minimum.

Most Ph.D. students grow out of this undergrad mentality in a semester or two. The best thing you can do is realize this frame of thinking exists, and to watch out for it if you feel it creeping over you.

Own Your Research

If you are waiting around for someone to tell you what to do, you are doing it wrong. The most impressive story I have ever heard about owning your research is from Ron Azuma's retrospective "So Long, and Thanks for the Ph.D." Azuma tells the story of how one graduate student needed a piece of equipment for his research, but the shipment was delayed due to a strike. The graduate student flew out to where the hardware was, rented a truck, and drove it back, just to get his work done.

Note that, however, it is very likely you actually *will* start out by having someone telling you what to do. The vast majority of new Ph.D. students are very smart and energetic individuals. However, the main things new Ph.D. students lack are an understanding of the research process and experience with the research literature. As such, it is usually easier to start out with a directing style of research with new students, with advisors telling you to read this paper, install this software, or build this app.

Over time, as you become more familiar with research methods and what

has been done in the past, you need to take more initiative and ownership in your work. As you progress in your research career, you should still listen to your advisor, but take what they say only as advice. Ultimately, you have to own your research. You are the person who has to drive it forward, and you have to do what it takes to get it done.

How do I know when a student is doing really well? It is when the best thing I can do for them is to just get out of their way.

Be Willing to Push Back

The second-worst talk I have ever witnessed in my life was actually by someone quite famous in their field. I came away from the presentation feeling quite embarrassed, pretty much the same way you feel after watching Ricky Gervais doing another one of his cringe-worthy performances. The work this researcher presented made no sense whatsoever. There was no stated problem being solved, no rationale for why he did it the way he did, no new and interesting insights, and no clear innovation. It was pretty clear that this person had not read any research papers or seen any related commercial products in the area in over a decade.

I think there were two reasons why someone with such an accomplished career could make such a major misstep. First, this individual had a very strong personality and could easily dominate any conversation. Second, I think he inadvertently surrounded himself with people who were simply unwilling or unable to push back. In this particular case, without a strong counterweight, this researcher led his team into unfruitful directions that just made no sense, either from a research perspective or from a product perspective.

I tell new students this story as a cautionary tale.

I tell them this story because I want them to be able to stand up for themselves and make a strong case for what they are doing or what they want to do. Do not forget, if you are working full-time on a project, you are spending far more time thinking about the issues than your advisor is. You have 40+ hours a week to think about the problem you are working on, while your advisor probably has 5–10 hours (on top

of teaching, travel, committees, and interactions with other students—this is why all faculty seem to exhibit varying degrees of brain damage).

If something does not make sense, or if you think there is a better way to do something, you need to push back and make a solid case for what you think is the right thing to do. In situations like these, I have always found Heilmeier's Catechism to be an effective tool for thinking about problems. My students will tell you that I often have them take a step back and go through Heilmeier's standard set of questions to make sure they have thought through what they want to do and why.

Be Active in the Social Dimension of Research

A common mistake I have seen with some graduate students is overlooking the social aspects of research. Graduate school is more than just taking classes, doing research, writing papers, and going to conferences. Graduate school is also about becoming a member of a larger community. It is about becoming familiar with the methods, tools, and values of your community. It is about participating in workshops, sharing your ideas with others, and helping to grow the field. And it is also about learning from each other, building on other people's work, and communicating with others what you have learned.

This same perspective also applies to your role in your university, in that you should be a good citizen for your local community as well. This might include helping to organize student lunches, participating in reading seminars, and making bridges with folks outside of your area.

There are several reasons why Ph.D. students who can navigate the social dimension of research do better. They can absorb ideas from more areas, increasing their potential to make connections that others have not seen yet. They can rely on more people for help, whether it is getting simple questions answered or getting access to more data or resources. Perhaps most importantly, they have a stronger social support network that can help them get through tough times (of which there will be many in grad school).

Build Up Your Skills, but Get Out as Soon as You Can

Although computer science is quite diverse, the best Ph.D. students across all areas are actually quite similar. They are the ones who have solid critical thinking skills, a high degree of creativity, a strong work ethic, good writing and presentation skills, and a demonstrated ability to work independently with little supervision. Most students do not start with all of these skills, and so these are the goals you should be aiming for and critiquing yourself against as you make progress in your graduate work.

Graduate studies can be and will be tough. There will be numerous dead ends, frustrations, hardware and software that does not work the way it should, countless deadlines, and sleepless nights. On the other hand, there will be a lot of rewards — in the joy of making lifelong friends, mastering new skills, discovering new findings, and helping others. Perhaps the best way to close this column is with something I once heard attributed to Stu Card, a pioneer the field of human-computer interaction: "Grad school will be the best years of your life. Having said that, get out as soon as you can."

Comments:

One thing I would add is that, when you have passed your preliminary exams and present your research plan to your committee, consider it a binding contract. Do what you agreed to, and graduate.
—Anonymous

In addition to almost all the agreeables, I think good research starts with being 'challenged with a good problem,' accomplished with 'sustained never-say-die efforts,' 'self-evolutionally rather revolutionary approach' and 'rigorosity overall in all the stages,' and finished with 'acceptable answers and other challenging problems.' Though commonly thought to be as output, it appears mythical to aim and windup by publishing. The dissemination and sharing may be immediate/intermediate gain only, but not 'fine-grains' to be looked up to.
—K. Mustafa, JMI

Jason Hong is an associate professor at Carnegie Mellon University.