PhD Mentoring Philosophy:

William Layton, November 2018

Me with a few of my students & my advisor

My mentoring philosophy is the same as my teaching philosophy and the same as my research philosophy: ***Act to contribute to human flourishing***. I will give context and consequences below.

Context: the Mathematics PhD. The tradition in Mathematics is that a PhD requires an original contribution of the student (not simply working out an advisor's plan). Traditionally, the papers arising from the thesis are the student's sole product and not joint with the advisor. Practice has veered from this tradition and now most mathematics PhD programs operate like labs where the advisor is part owner in all production. The pressure to publish before entering the job market tilts the field to students with many, multi-authored papers. Yet **the gold standard** that top departments seek in their hires is for PhD students to have **papers beyond the thesis, of independent ideas and execution and not joint with mentors**. Having several such papers is interpreted to be proof that the student is ready to be an independent researcher.

Consequences. One consequence is the commitment that my most important "output" is PhD students of high accomplishment rather than papers, grants etc. I have spread this ethic to my own students (who are also successful mentors of PhD students) and to the junior faculty in computational math so it might persist. This ethical choice means that I involve students in my research plan and try to find research slices they can do to be co-authors of the papers I write. It means that I give my best problems to PhD students and help them develop them into **sole-authored papers**. It means that for their first papers, they write, I edit and they rewrite until they learn to write and edit their own papers independently. While it means fewer papers on my CV, it also means my PhD students have an international reputation for depth, productivity, professionalism and high quality.

My goal, the same as that of my own teachers, is to produce students who are *better than me*, whose research makes a *positive impact on human life* on earth and who *start at the point it took me 30 years*

to get to. My students have done well on the very competitive job market (**a large fraction have been placed in tenure track positions at research universities**) because they leave Pitt with a better research record than most have coming from top 10 programs and a named postdoc. Several have won the SIAM research paper prize for PhD students and many have held elite postdocs. My mentoring is designed to help them write a high impact, high quality thesis, develop a publication record (including **papers beyond their thesis and not joint with their advisor**), delineate a research agenda for the 5 years following their PhD and generally teach them **to do everything I do**, better than I do it, including giving exciting scientific talks.

5 am: ready to drive back from a conference where my students presented their work

While here, they develop an independent research agenda and have a strong draft of their first NSF proposal ready. Almost all have left Pitt with papers beyond their thesis and not joint with any mentor (one reason they do better than many postdocs). I teach them how to write papers, develop research programs, **prepare strong grant proposals**, find their own ideas, communicate[1] research in a compelling way, collaborate with others and, in aggregate, everything a research mathematician must do.

This is consistent with my idea of *C*^{4} *training* to:

- **Create** new mathematics. Creation is difficult and requires nurturing *hopefulness* and *perseverance*.
- **Communicate** it in talks and papers in a compelling way. This requires developing a feeling for the *beauty* of mathematics and the *joy* of doing research.
- **Connect** theory with application areas across science and engineering. This requires building *understanding*.
- **Collaborate** effectively on complex research problems. This requires building a commitment to *community*.

[1] My description on how to give a scientific talk at http://www.math.pitt.edu/~wjl/class.html is used by PhD students around the world. My students read it but also *practice* it.

The first critical time is when research begins. I think hard about the interests and special abilities of each student and pick a first research problem for them that *aligns with their interests*, *requires their special abilities to solve* and, in the solution, forces them to *fill in the holes* of their knowledge. (This is easy to say but hard to do. Most professors assign problems that advance the professor's agenda. This approach leads to disappointment when that agenda is narrow and not aligned with interests and abilities) Early success leads to greater knowledge and, more importantly, a **sharper appetite for problems of greater impact**. After that, we talk about problems and ideas until the student picks (and thereby commits to) the next research problem. One day the student comes into my office with their own good idea we never discussed. On that day, they are *ready*.

Dinner with my family and friends- former PhD students (at all tables)

I have had 34 completed PhD students and have 4 more close to finishing. This year I helped two entering students write NSF graduate fellowship applications. Their interests may evolve but as of now they intend to work with me. This number (38 + 2) puts me numerically among the **top 350 mathematics PhD thesis advisors of all time** according to data at http://www.genealogy.ams.org/extrema.php.[2]

Numbers do not tell the true story. Each former student, now friend, is someone who has used their time at Pitt to build a life for themselves and perform research to improve others lives. Let me brag about my students now.

[2] Mathematicians keep extensive records of academic genealogies. My own includes noted fluid dynamicist Ludwig Prandtl, astronomer Nicolas Copernicus, early enlightenment figure Erasmus and extends to scholars in Byzantium in the 1200's.