NYU TANDON SCHOOL OF ENGINEERING

Do I Have to Stop Programming?

The Plight of the “Hackademic”

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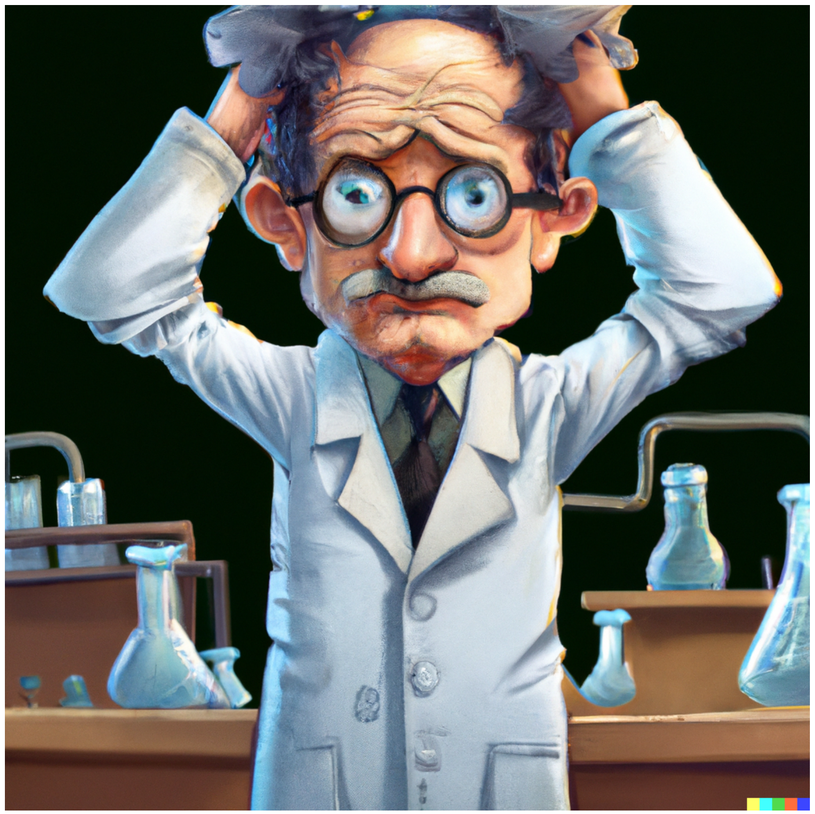
CENTER FOR CYBER SECURITY

My Worries As a Junior Prof
(Abridged)



- How do I find students?
- How can I pay them? How do I get grants?
- How do I learn to teach well?
- How many projects can I juggle at the same time?
- What internal/external service should I say yes to?
- Do I still get to have a life outside of work?
- How can I manage and mentor students effectively?
- **Am I going to have to give up hands-on technical work?**

The Usual Story

During PhD

- Develop world-class technical expertise
- In the software/systems world, this means you spend a *lot* of time gaining technical skills:
  - Programming
  - Debugging complex systems
  - Getting other people's code to run
- Success often depends on how well you, personally, can get things done

After PhD

- Build a strong group of PhD students
- Get and manage funding for your students
- Plan out multi-year research projects
- Mentor students, build their skills, make sure they're making good progress
- Prepare and teach compelling courses
- Participate in internal service and service to your academic community

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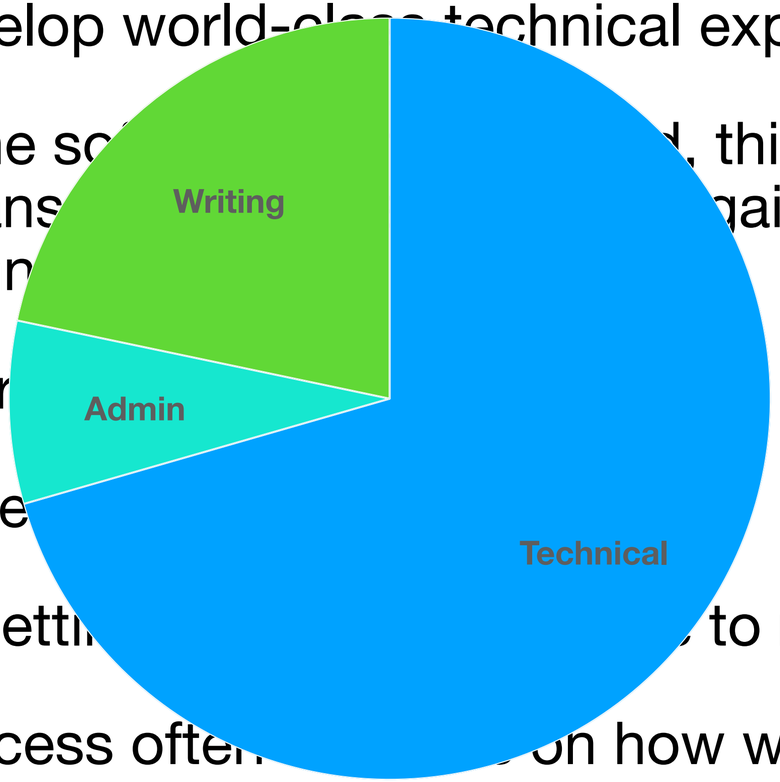

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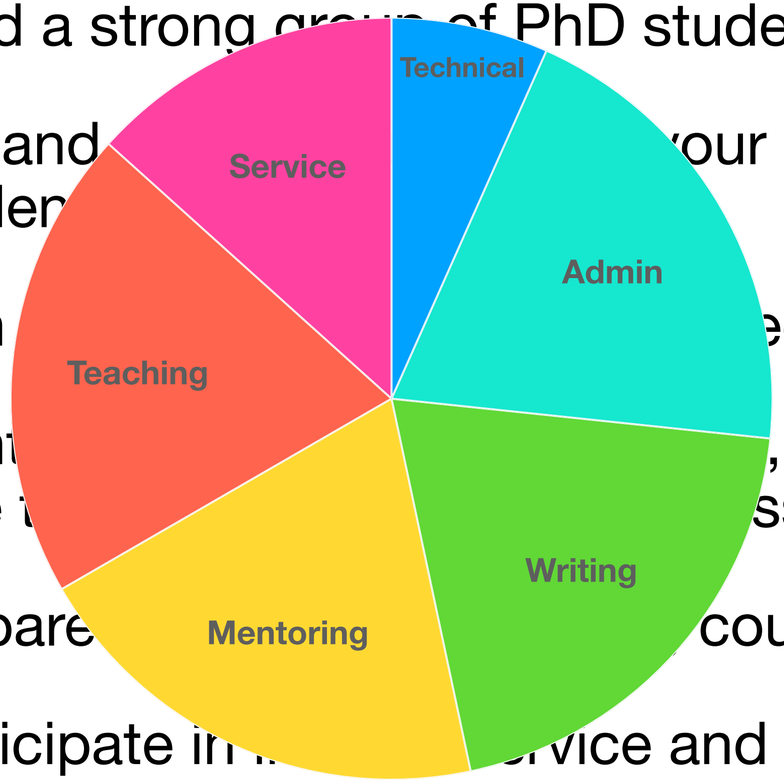


A Confession

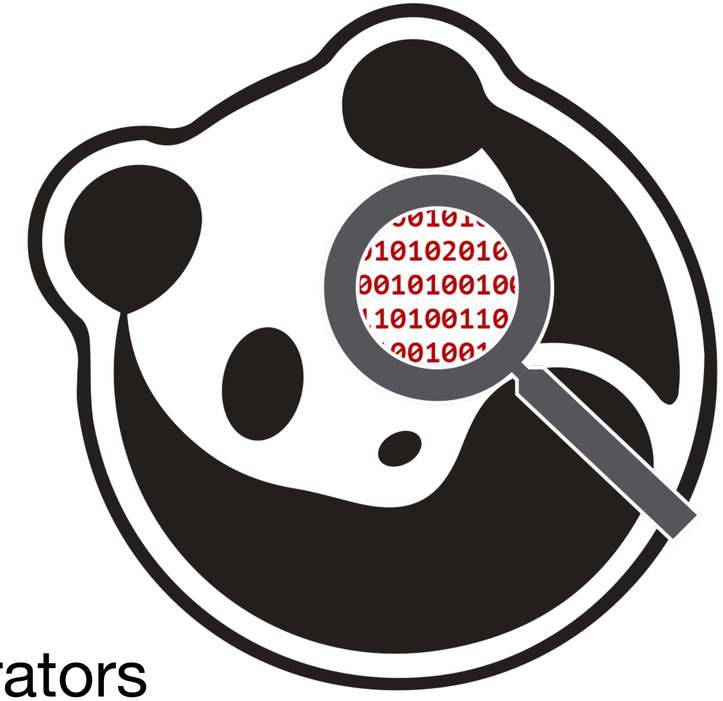
- Actually, I decided pretty early on that I would be miserable if I gave up technical work
- So most of this talk is about retroactively justifying my addiction to programming ;)
- But I do genuinely believe the arguments I'll make here!

The Case for Coding

- I will try to argue that there are good reasons to keep doing low-level technical work after the PhD:
  - To give meaningful help when students get stuck on tricky technical problems
  - To build **infrastructure** that can be used by many students over many years
  - To explore **new ideas** and research areas that may be too risky for a PhD student to take on yet
  - To help create **collaborations** and **outreach** as people use and build on your software

Case Study I: PANDA

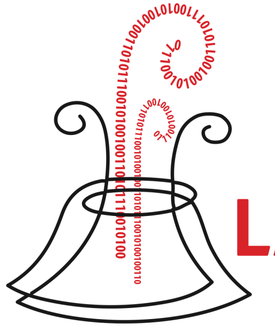
Programming as Infrastructure



- PANDA is a fork of QEMU designed for whole-system dynamic analysis + record/replay
- Started building it in 2013 (still in grad school) w/collaborators at MIT Lincoln Lab
- Fairly successful – 2K stars on GitHub, lots of community support
- Many projects from my lab & others' have been able to use PANDA as a base to investigate cool new research ideas!

Case Study I: PANDA

Research using PANDA



IRQDebloat: Reducing Driver Attack Surface in Embedded Devices

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Drifuzz: Harvesting Bugs in Device Drivers from Golden Seeds

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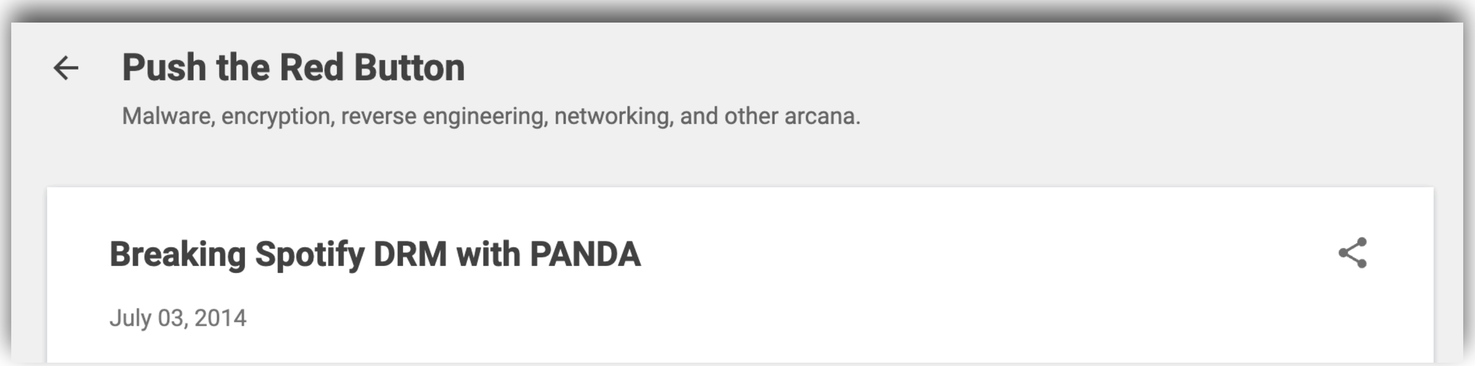
Case Study I: PANDA

Lessons Learned

- Building *infrastructure* software can be a great accelerant for research
- Finding good collaborators in industry who find your software useful helps a lot – the bulk of PANDA maintenance is done by MIT LL folks
- Publicize what you've done! I gave talks on PANDA at industry conferences like REcon, wrote blog posts about it, talked about ongoing dev work on Twitter, etc.



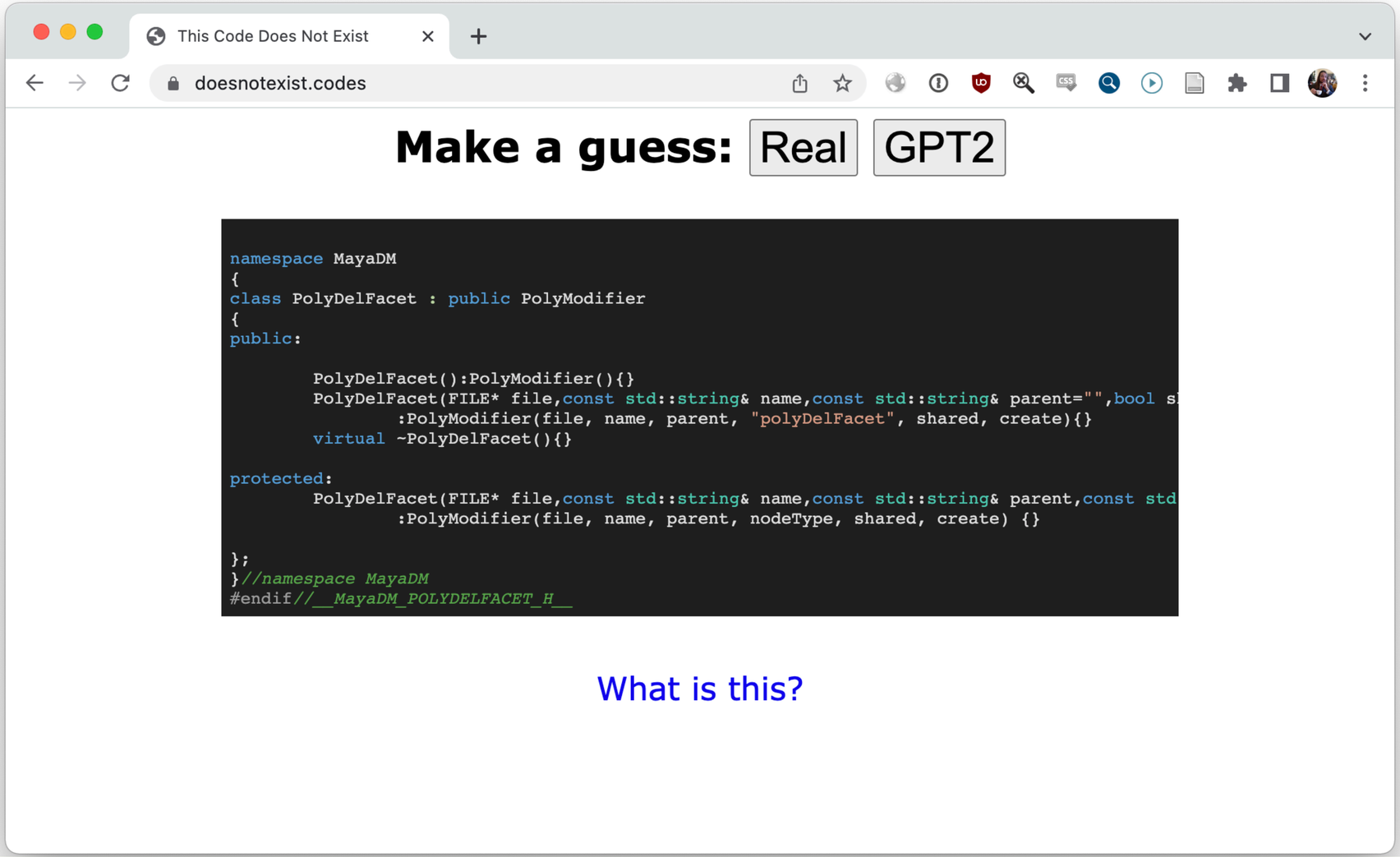
Case Study II: GPT-CSRC

Programming as Experimentation

- After GPT-2 was released I got interested in the possibility of using large language models for program synthesis (late 2020)
- ...but none of my students knew anything about ML!
- **Solution**: play around with building and training ML models like this on my own, explore feasibility
- Trained a 774M parameter GPT2 model on C/C++ source code over winter break
- Built a gamified “guess if code is human or GPT2” site
- Eventually became a key piece of my successful NSF CAREER proposal!

Case Study II: GPT-CSRC

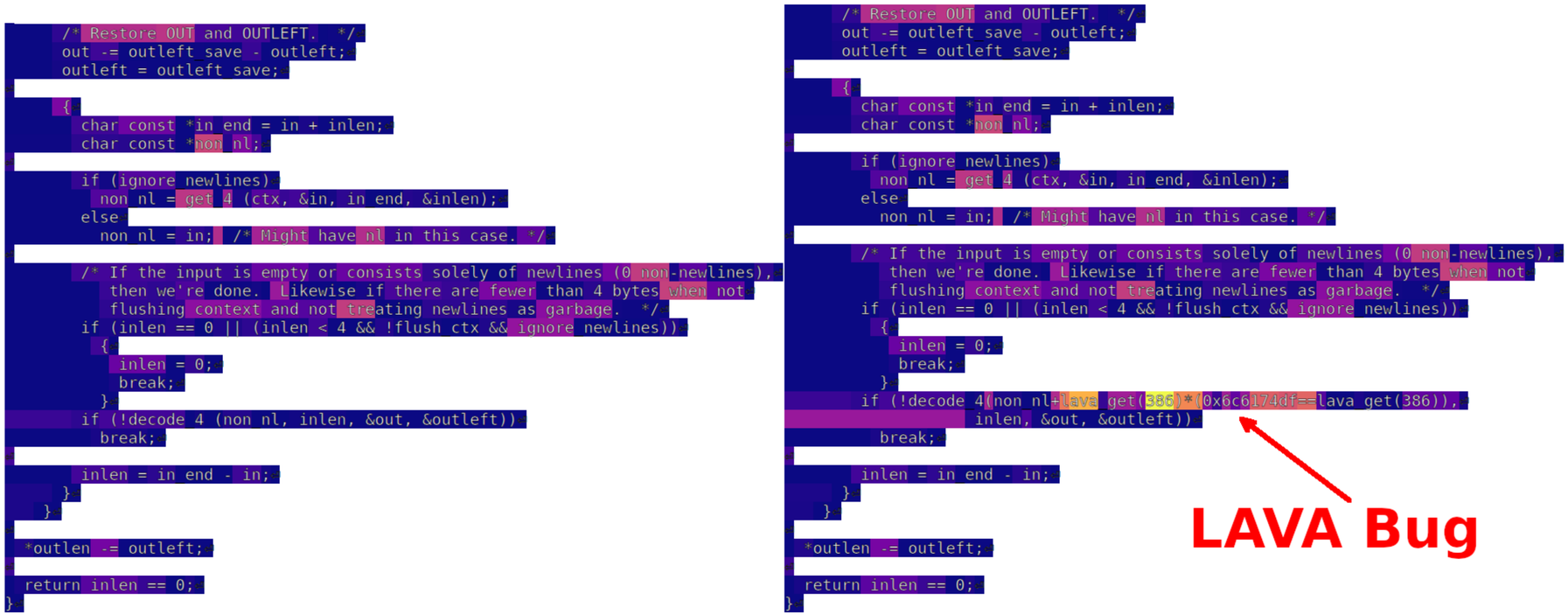
Prototyping



Case Study II: GPT-CSRC

New Research Ideas for Proposal

4 Research Thrust 2: Generality



(a) Original `base64` code.

(b) LAVA-injected `base64` code.

Figure 4: Visualization of the per-token likelihood of original and LAVA-injected code as assessed by a GPT2 model trained on C/C++ code. Brighter colors indicate tokens that are surprising to the model and may be unrealistic.

Case Study III: FauxPilot

Programming as Outreach

- When GitHub Copilot came out, we began doing research on it and the underlying Codex model
- Became clear we would need some way to plug in our own models and use them with
- Over summer 2022, I took some open code models from Salesforce, combined them with NVIDIA's Triton & FasterTransformer, and wrapped it in a Copilot-compatible proxy
- Way more popular than I expected: ~6K stars on GitHub in the first month!

Case Study III: FauxPilot

Programming as Outreach

- But what has been really exciting is how the project has contributed to *outreach*
- Lots of users and contributors to help with development and give feedback on functionality
- GitLab has decided to use it as the basis for their own AI autocompletion offering
- Has been a great way to start conversations with lots of folks in industry who can help answer research questions for us by e.g. sharing data!

Where to find the time?

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- June

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- June
- July

Where to find the time?

- June
- July
- August

Where to find the time?

- Just kidding
- There’s winter break too!
- Realistically: you are sometimes going to have to say no to other things
- One strategy I have found helpful is to dedicate a day or half a day each week to technical work, and defend it vigorously

Institutional Barriers & Incentives

How to get your tenure committee to care

- Building software is not rewarded/incentivized in academia the way top conf/ journal publications are
- You will have to keep track of and **quantify** impact to justify it
  - Is industry using your software? (Can you set up some way to let you know when someone is?)
  - Download counts, GitHub stars, other measures of “popularity”
  - What academic work is building on your software? (Make it easy to cite!)

Conclusions

- The adjustment from PhD to prof is not easy, and you won't be able to spend days at a time deep in code (at least during the school year)
- But it is really important to stay in touch with technical work; resist the urge to manage entirely at a high level
- Can pay off very well with new opportunities, big impact!
- Make sure to make these contributions **visible** and **legible** to folks who will be evaluating you!