

In Pursuit of a Pythonic PhD

Stéfan van der Walt

SciPy India, December 2010

Who's This Guy

- **Who's This Guy**

- A Realistic Perspective on a PhD
- Motivation: The Pursuit of Victory
- From PhD to Open Source
- Lesson 1: Small Fish in a Big Ocean
- The Scientific Python Community
- Lesson 2: The Impact of Being Connected
- Interlude: Personalities in Software
- Being Connected: The NumPy Doc Project
- Being Connected: Software Distribution
- Lesson 3: Incremental Changes Add Up
- Lesson 4: Rewards and Motivation
- Giving Back
- Evaluation
- Summary and Thanks
- If there's still time...



Where I Work

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Remember This (2009)?

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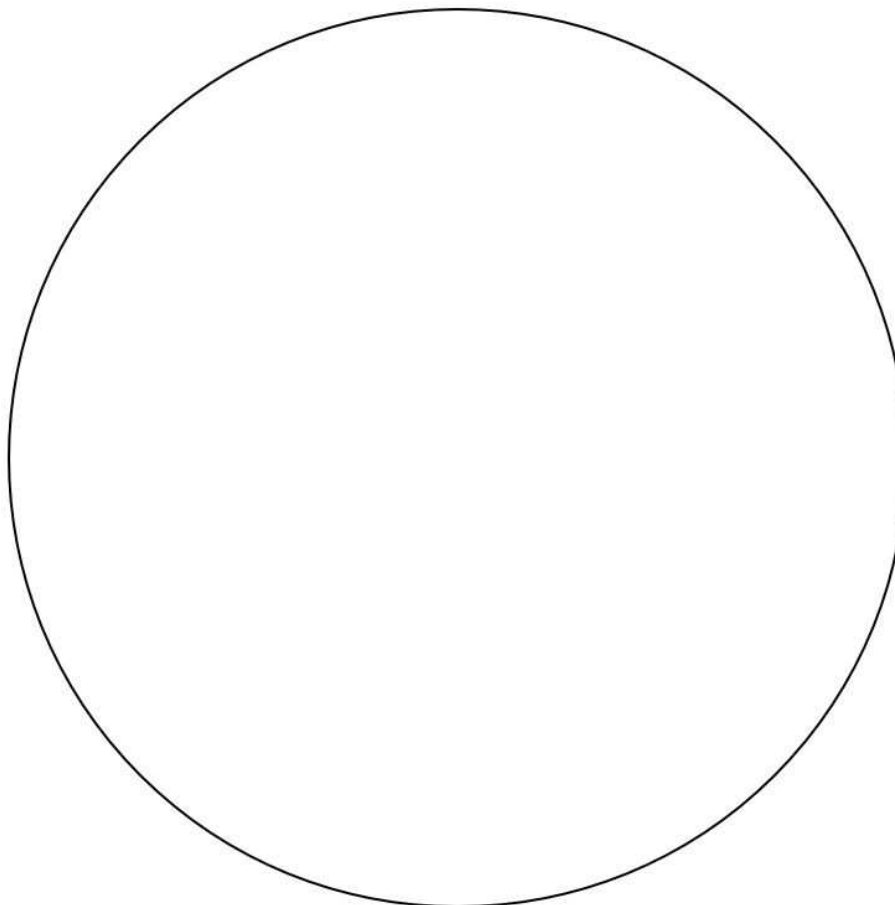
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The Illustrated Guide to a Ph.D.

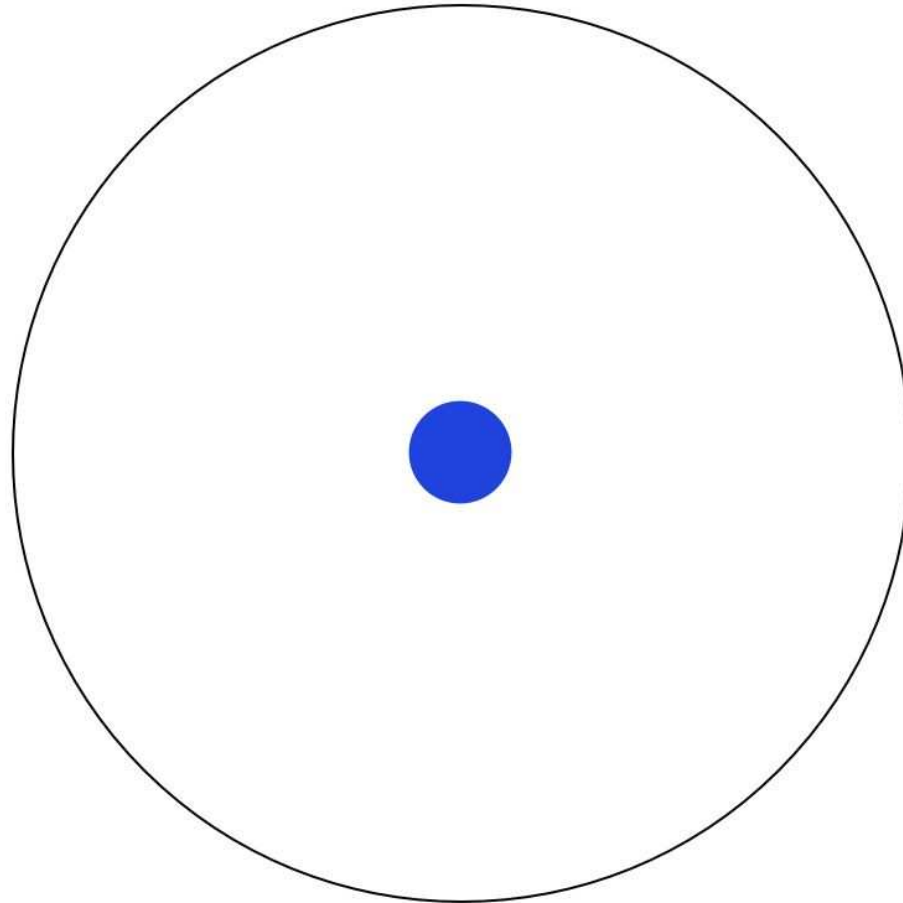
(<http://matt.might.net/articles/phd-school-in-pictures/>)
by Matt Might (<http://matt.might.net>).

Imagine a circle that contains all of human knowledge:



A Realistic Perspective on a PhD

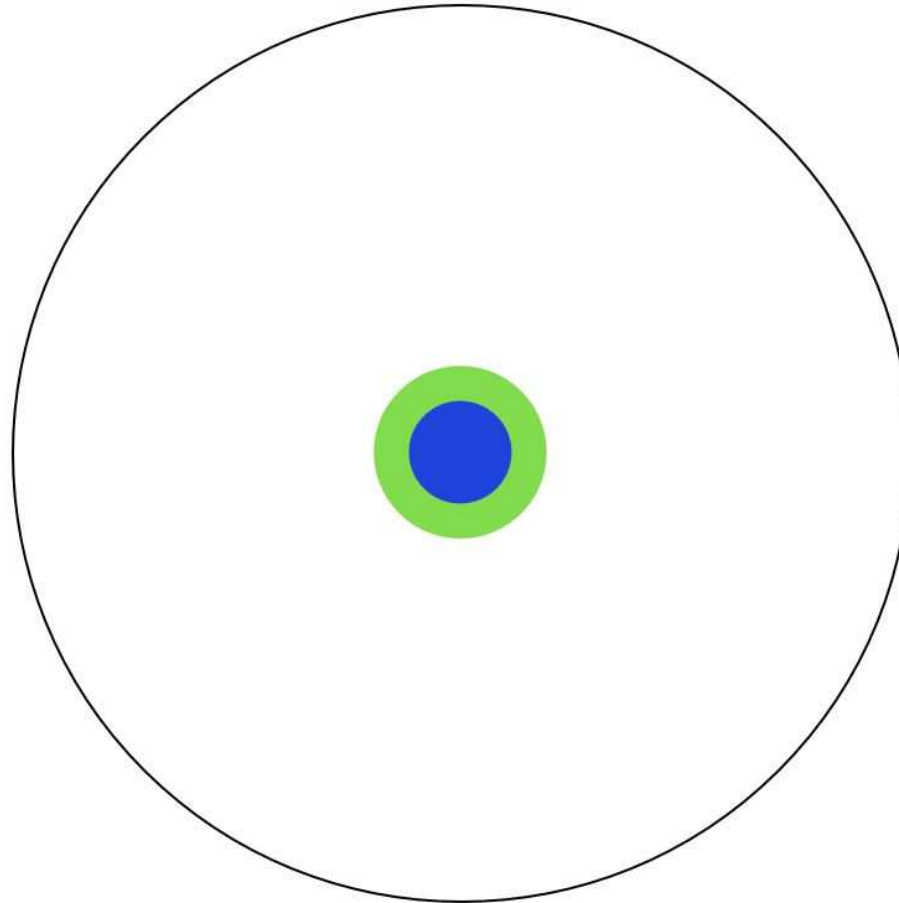
By the time you finish elementary school, you know a little:



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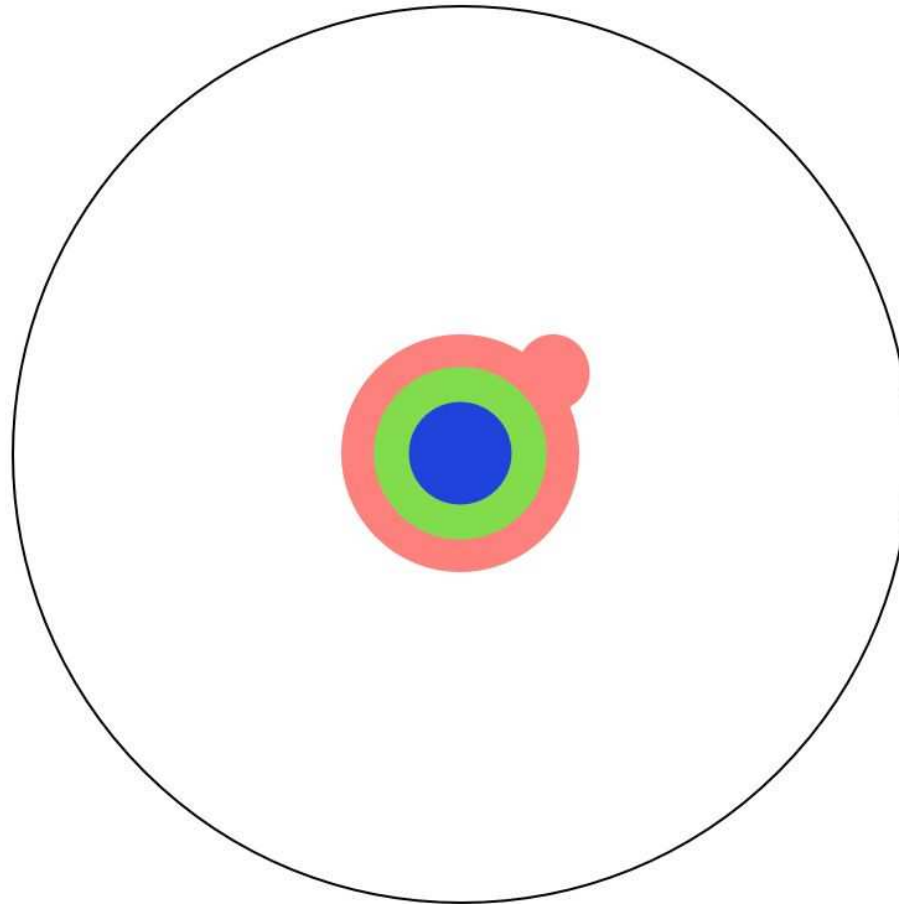
By the time you finish high school, you know a bit more:



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A Realistic Perspective on a PhD

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

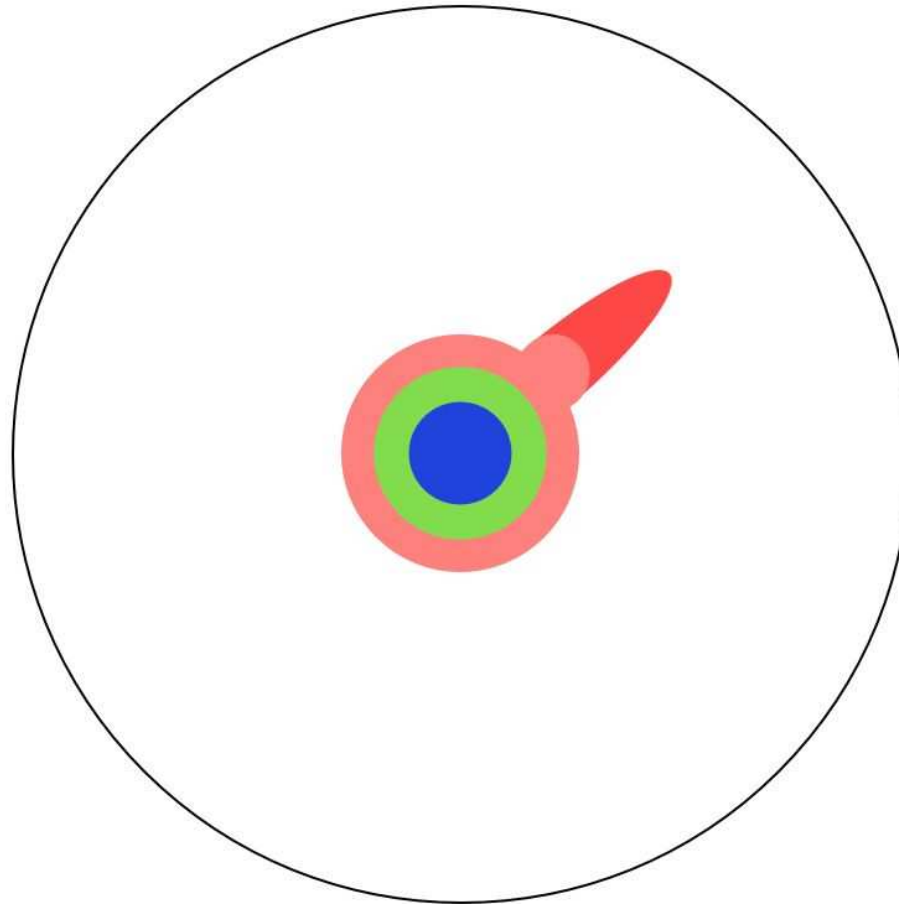


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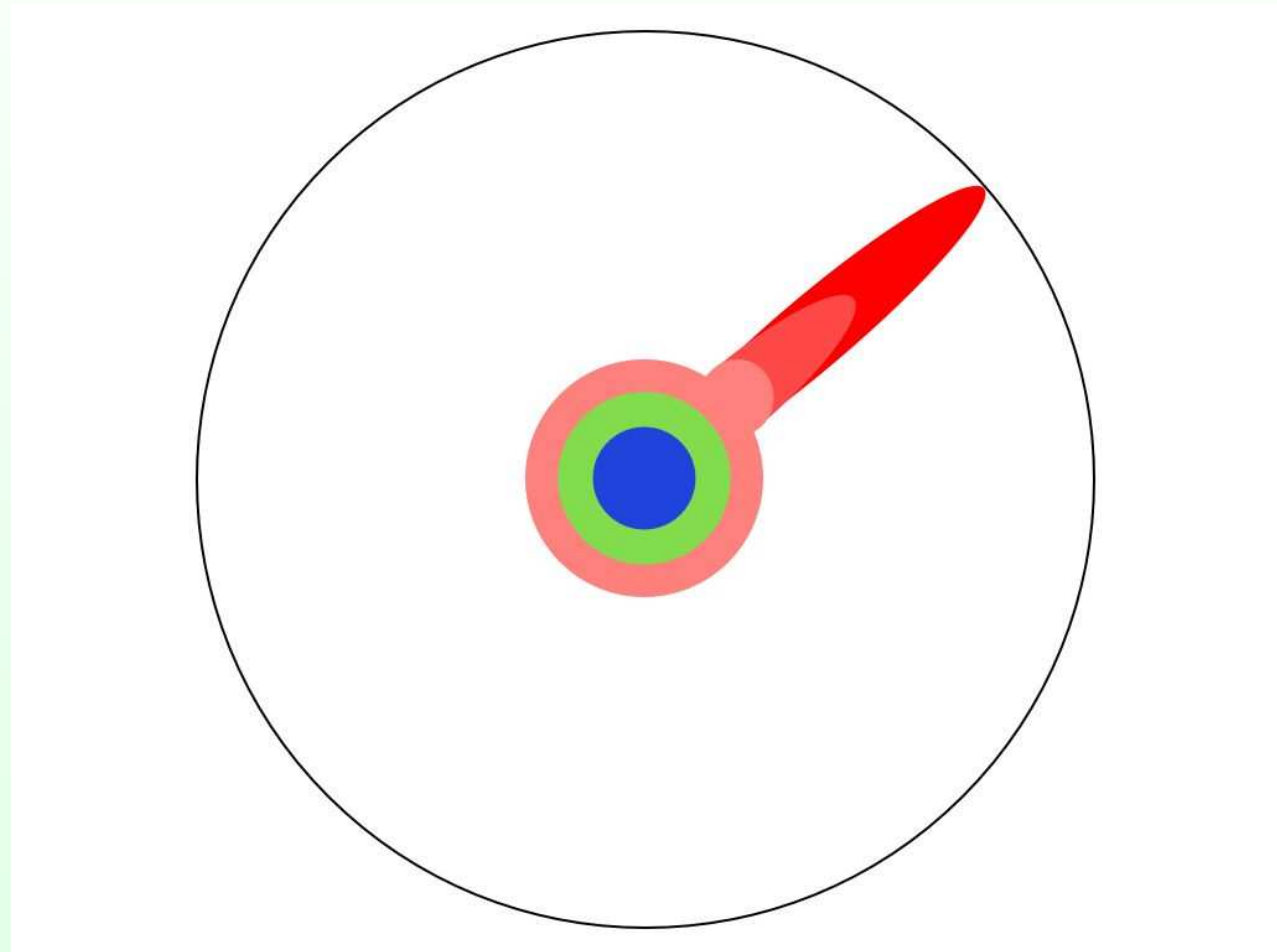
A master's degree deepens that specialty:



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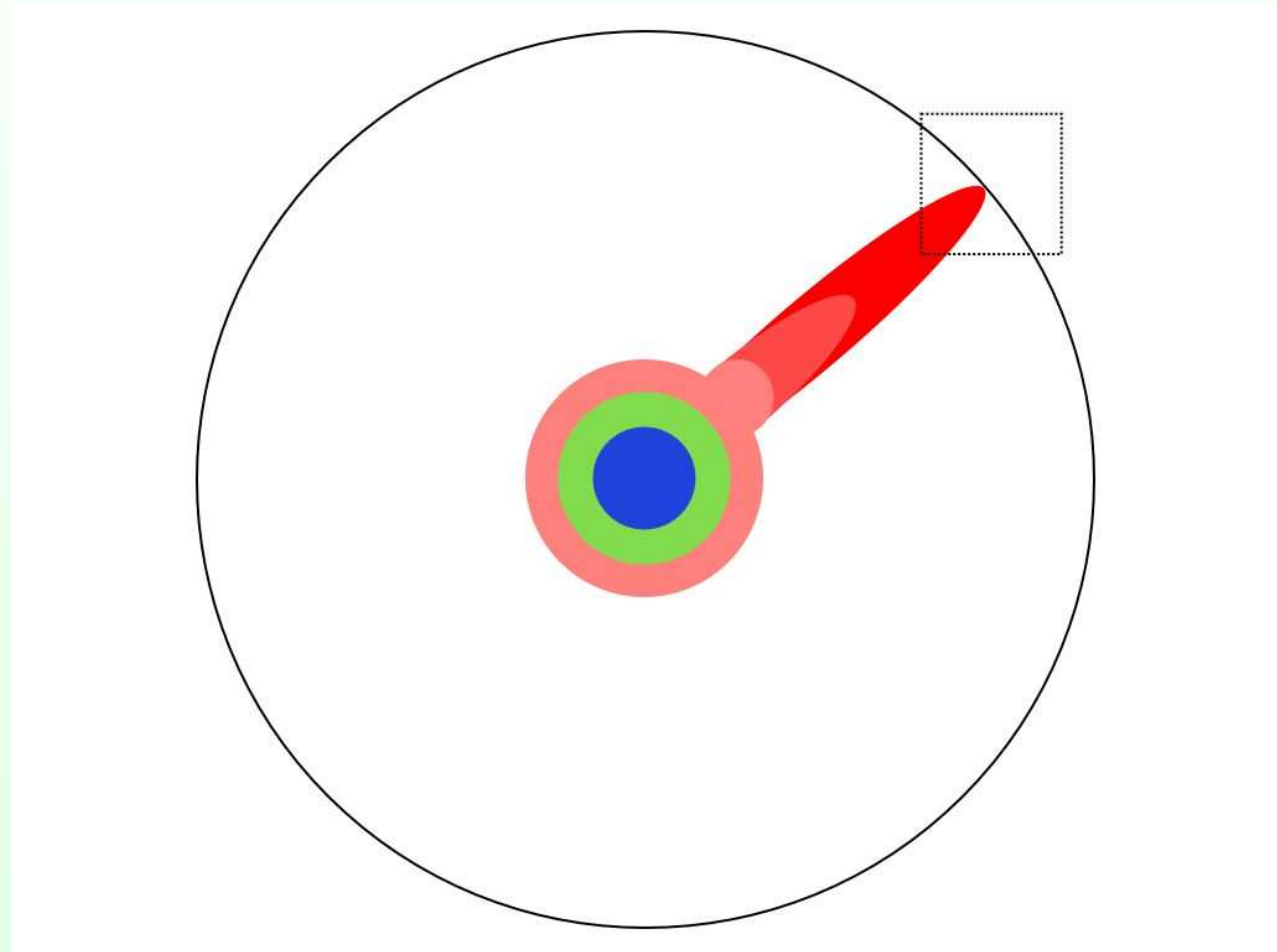
Reading research papers takes you to the edge of human knowledge:



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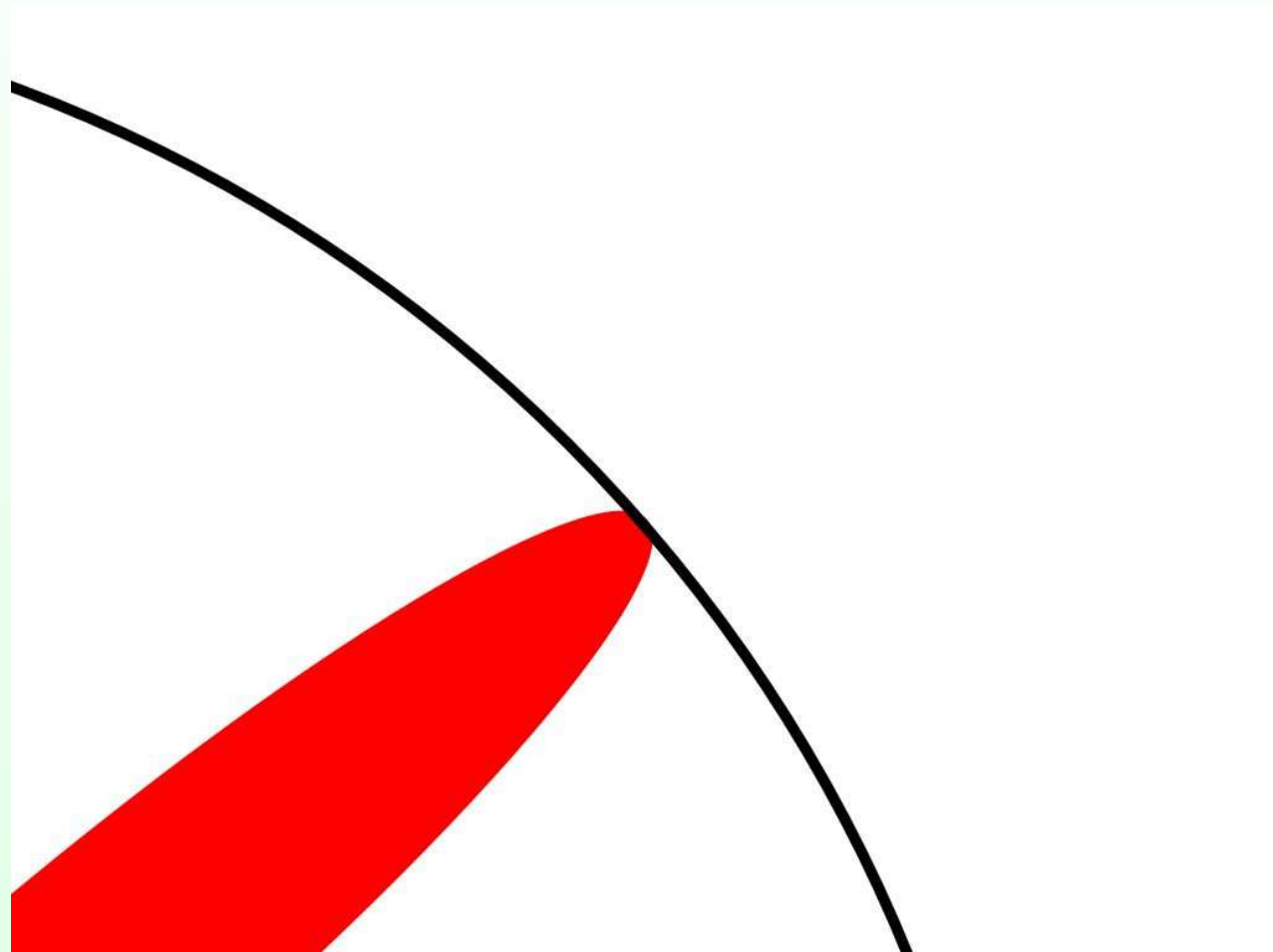
Once you're at the boundary, you focus:



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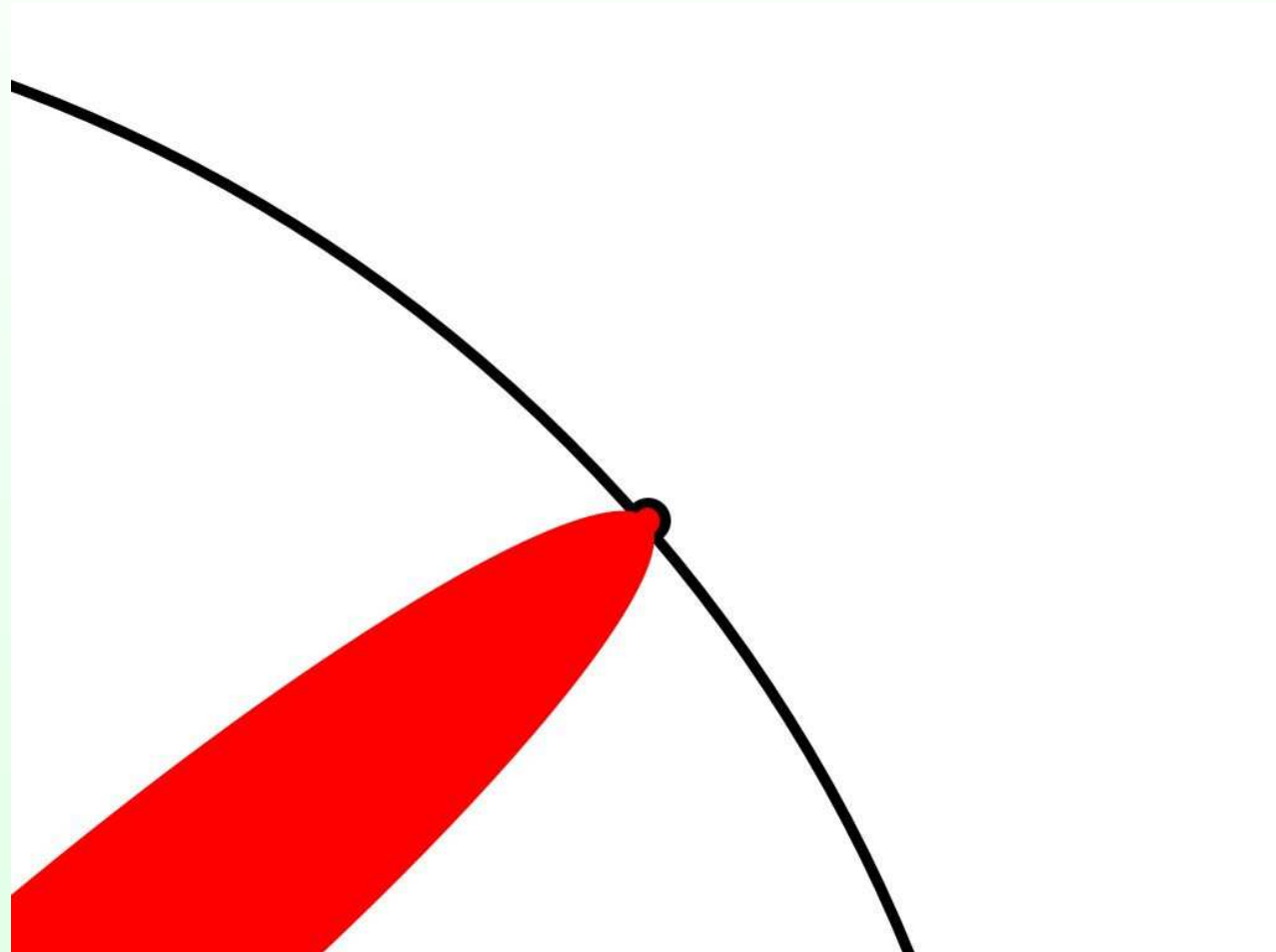
You push at the boundary for a few years:



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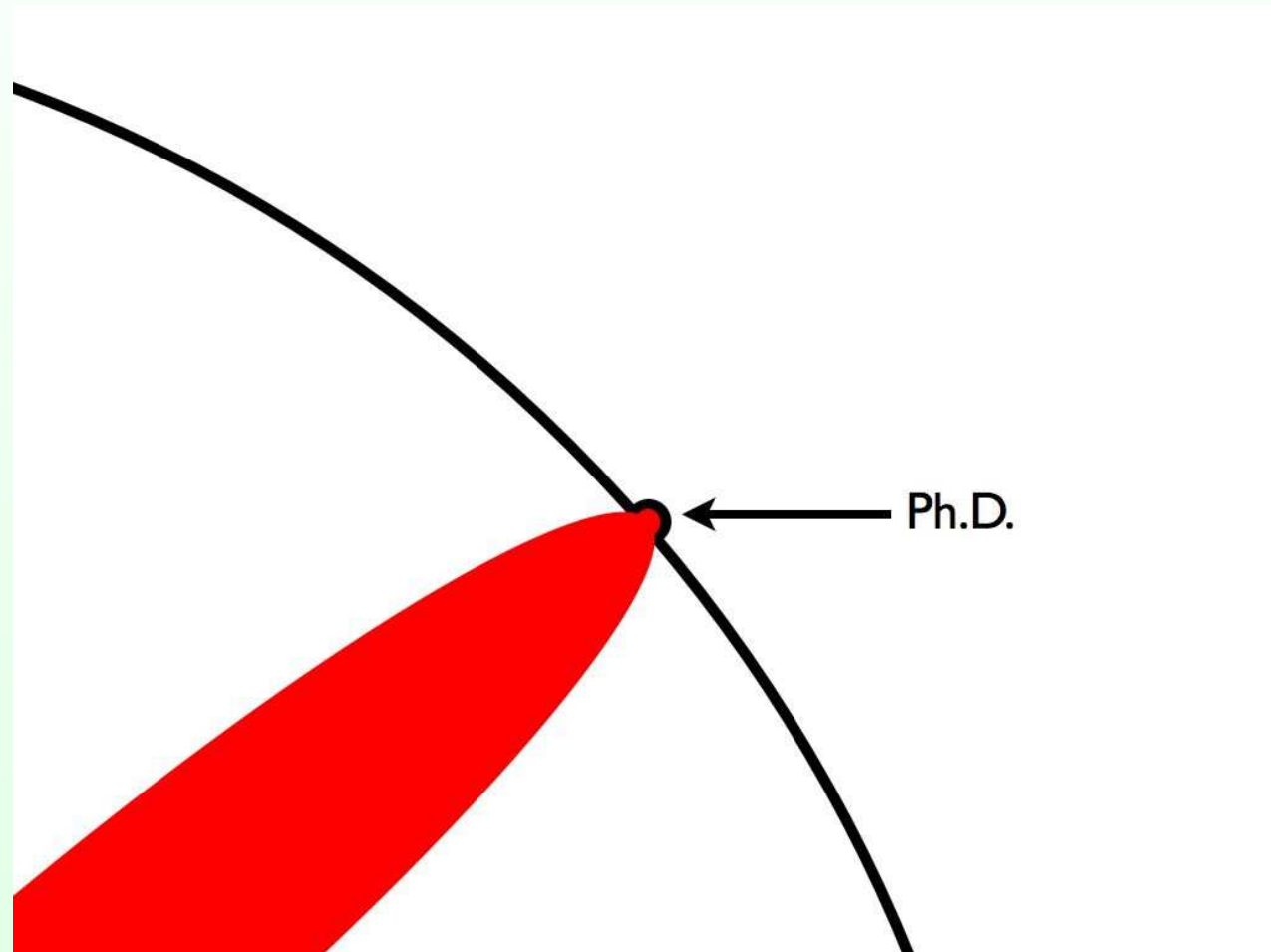
Until one day, the boundary gives way:



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



A Realistic Perspective on a PhD

Of course, the world looks different to you now:

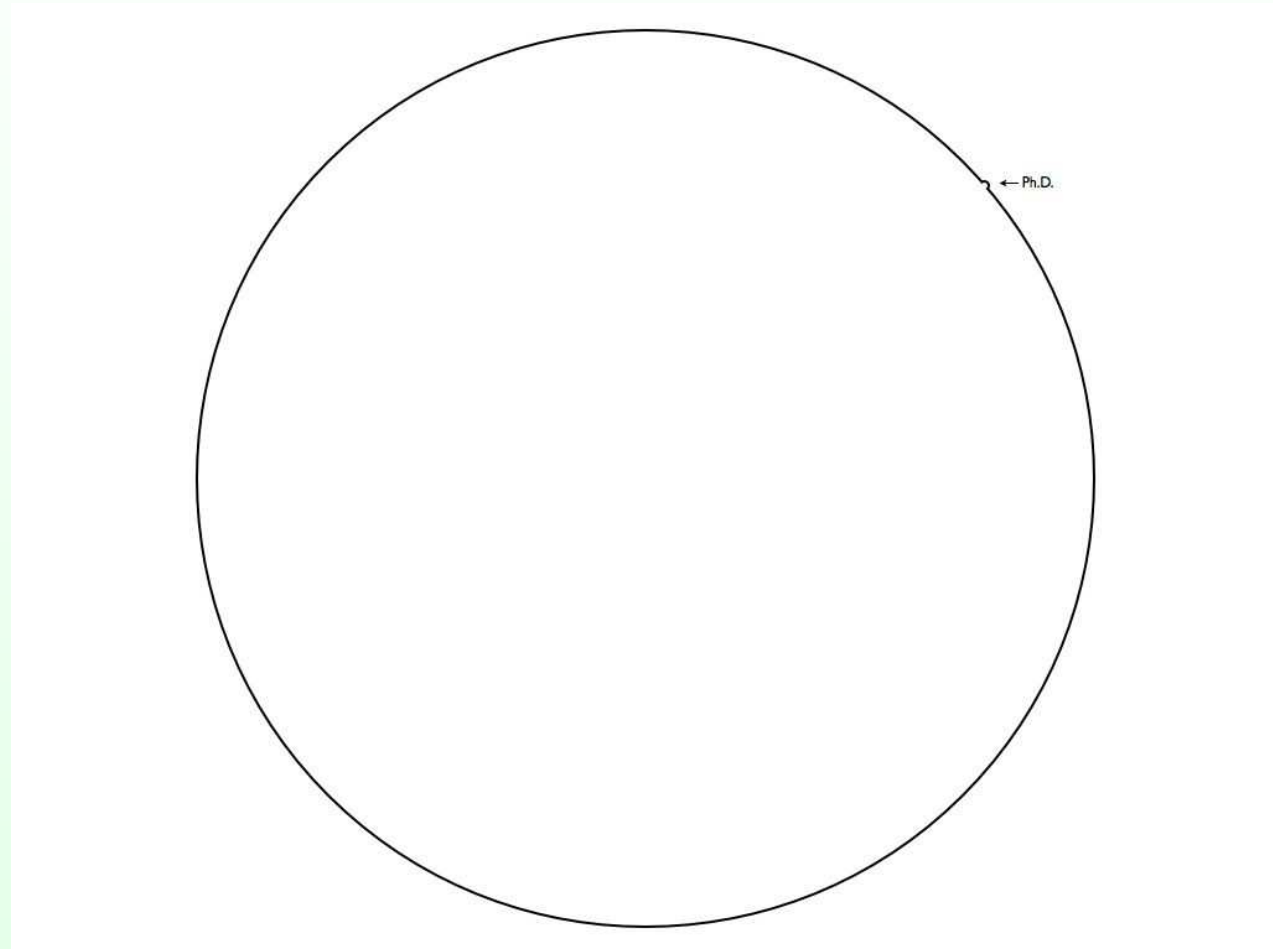


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So, don't forget the bigger picture:



Keep pushing.

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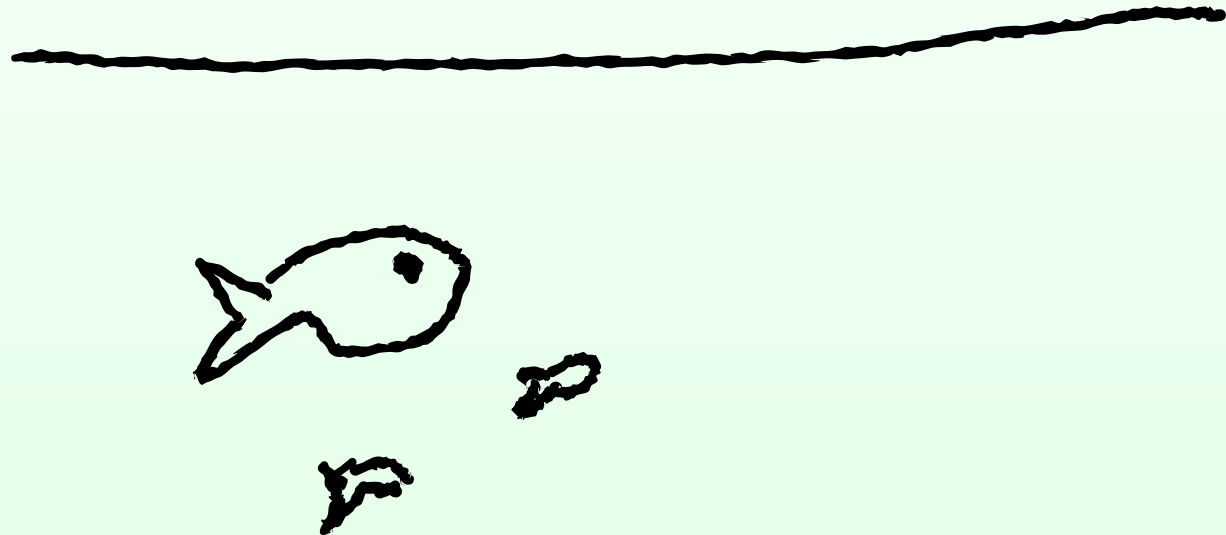
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- Why do post-grads tend to become involved in these projects? Due to the condition indicated in the previous slide: procrastination (to paraphrase: redefined priorities).
- How many big, open source projects are due to students/researchers doing “what they’re not supposed to do”?
- Due to the *associated advantages*, one could argue that this is often an excellent way to procrastinate.
- My involvement: Prof. Ben Herbst → Fernando Perez → numpy →... (year 1)
- For those of you unfamiliar with NumPy, SciPy and scikits, let me briefly introduce those
- A PhD is educational in more than an academic way...

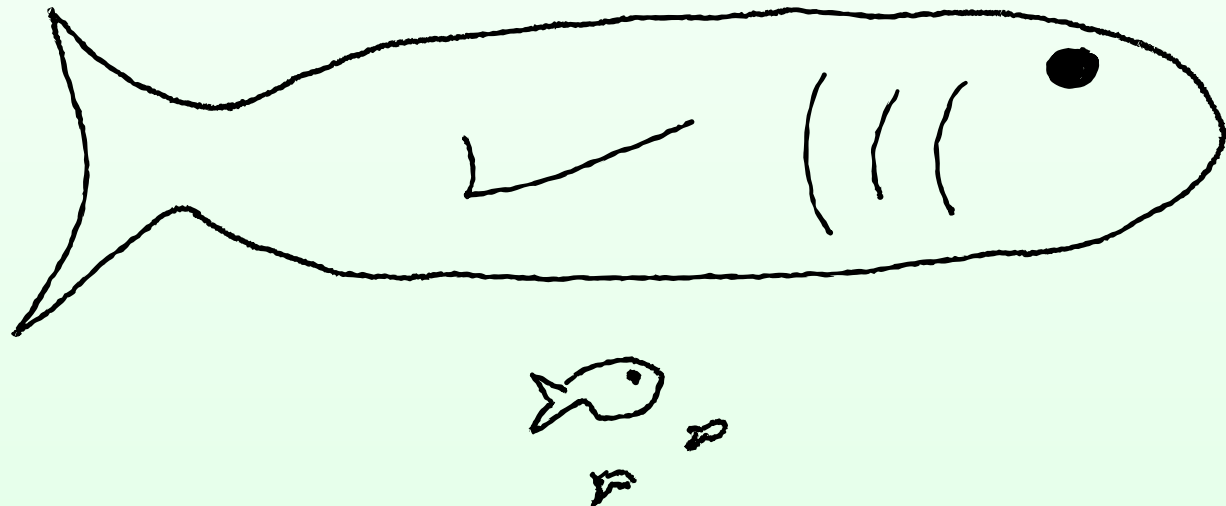
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- We are the products of a local community (big fish, small pond)
- Exposure to international researchers/thinkers/developers gives us perspective
- One easy way to gain this perspective is via open source development
- Suddenly, a lowly post-grad from some small african country is now in contact with the CEO of a scientific software development house, researchers at national laboratories, a physicist at UC Berkeley, a professor in astronomy, a doctor from Cambridge, post-docs at MIT, Yale, etc. (This would not even have been possible 20 years ago.)

The Scientific Python Community

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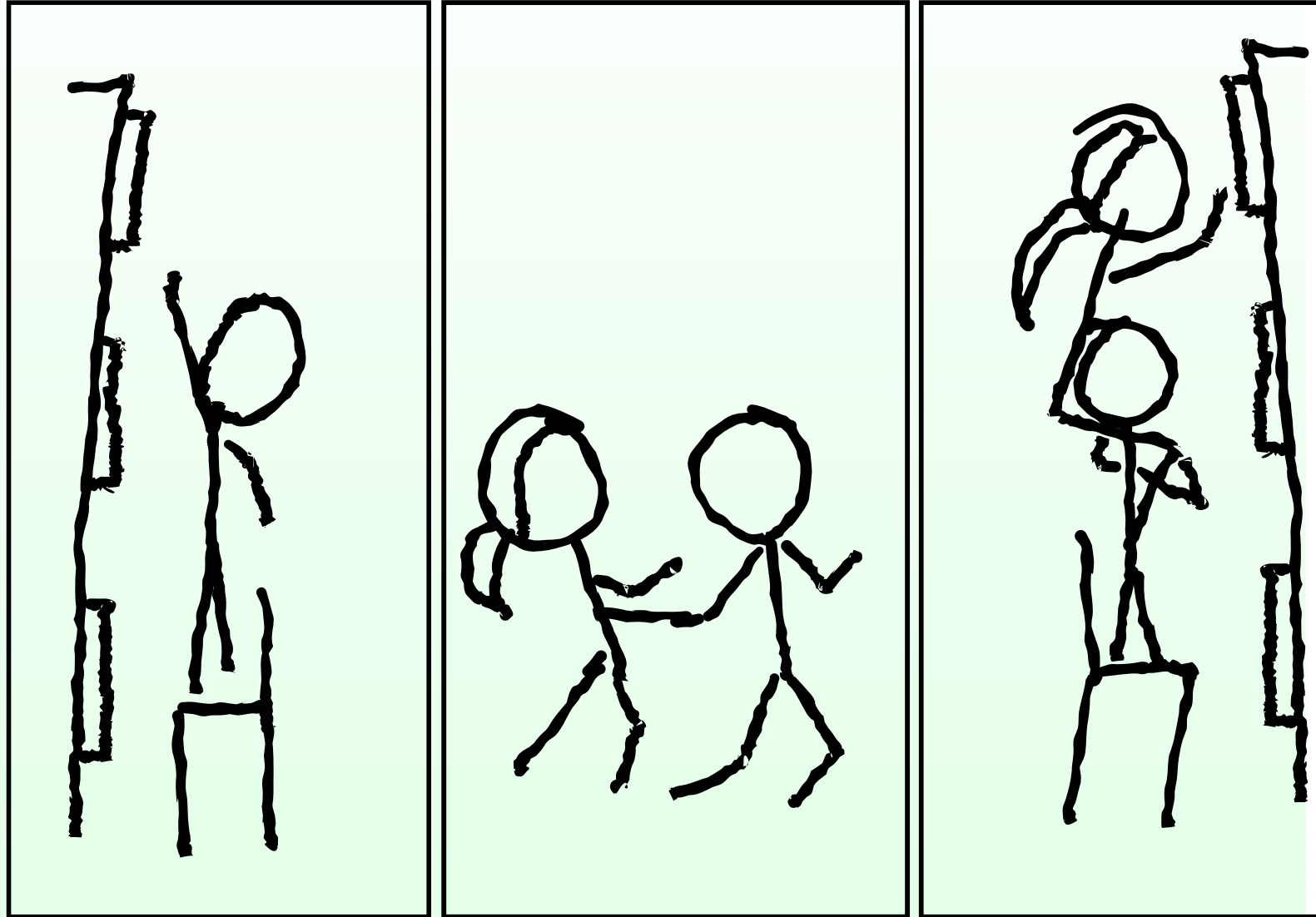
The Scientific Python Community

- Is inclusive and friendly
- Consists mainly of highly qualified, professional people
- Is fairly pragmatic without too much zealotry
- Is growing steadily, with new contributors appearing on the scene frequently

Of course, no community is perfect. Ours is rather vulnerable to bike-shedding (positively phrased: everyone gets to air their view)!

Lesson 2: The Impact of Being Connected

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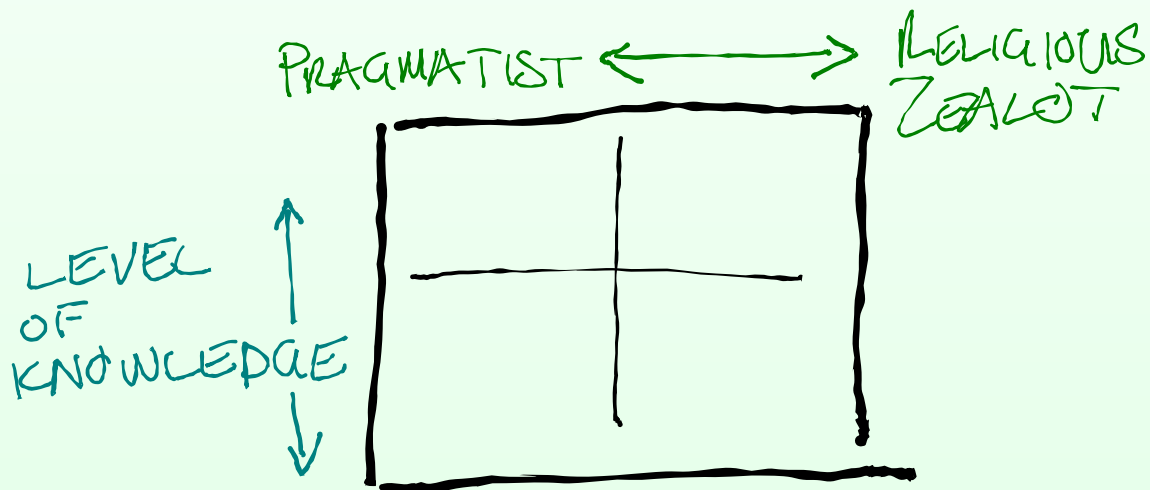
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- As a single human being, with limited time and resources, there is only so much you can do
- Two brains are often better than one (Trento Pacman example) (see “Interlude: Personalities in Software” below)
- Your network exposes you to new opportunities

Interlude: Personalities in Software

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Take a couple of popular personalities (Richard M. Stallman, Linus Torvalds, Sarah Palin, yourself) and find their positions on the chart below. Where are the danger zones? Open source development increases knowledge, may influence pragmatism either way.



Being Connected: The NumPy Doc Project

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Ingredients to *The NumPy Documentation Project* (year 3):

- An idea
- Enough concentrated man-hours to drive it through infancy (may require money)
 - Money may not be the ideal *motivator*, but it is a great *enabler* (we'll talk about this later)
 - Community congregates later, but to get started you need a constant driving force
- A crowd (to write the docs)
 - Paid to write the minimal core, community contributed all the rest
 - This is how I lost a bet to Joe Harrington

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Being Connected: Software Distribution

- A successful software system needs to be capable of doing what it says (pertains to quality control), and users must be able to *verify* this for themselves (what does it help if it doesn't work for me?).
- As soon as this happens, word of mouth and other marketing channels kick in.
- Major problem with scientific Python packages for a long time: installation almost impossible
 - This quickly dampens excitement; potential users lose interest if they can't use the product.
 - Focus should not be on administrative effort, rather on students learning, practitioners doing, etc. (we're not in the business of installing software for a living, after all)
- To remain connected to the world, the packaging problem had to be addressed. Vast improvement (used to be a trending topic at Python USA conferences, but no more), but *this is an ongoing problem* (see David Cournapeau's Bento, for example).

Lesson 3: Incremental Changes Add Up

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“Water is fluid, soft, and yielding. But water will wear away rock, which is rigid and cannot yield. As a rule, whatever is fluid, soft, and yielding will overcome whatever is rigid and hard. This is another paradox: what is soft is strong.” —

Lao-Tzu (600 B.C.)



But Lao-Tzu's quote touches on something else: that something, even as harmless as water, can cut away rock *simply by being persistent.*

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Lesson 3: Incremental Changes Add Up

- In the open source world, the *changelog* very clearly encapsulates this idea.
- Let's have a look at the GitHub contributor logs for some big project (touches on connectivity, again).
- The nature of open source software is evolutionary.
- In a landscape where things change so quickly, it can hardly be any different. Yet, a *stable API* is fundamental to growth.
- Not only incremental changes in individual packages; combining packages as building blocks, e.g., (IPython, NumPy, SciPy, matplotlib) as a numerical software suite.
- Do not feel dissuaded because you cannot change the world in one day; change takes time. The media today emphasises instant gratification; think of this more as art—painting an inspiring portret takes patience, consistent effort, and dedication. Even if often the intermediate rewards (teaching, coding, learning) are small, the ultimate reward is massive.

Lesson 4: Rewards and Motivation

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- Often, money is a weak motivator
 - If monetary reward does not match our impression of worth, productivity is reduced
 - As mentioned earlier, money is a great *enabler* (without money, some things simply won't happen, e.g., getting a large block of time from a skilled worker)
- We all love to play
 - What if play yielded tremendous rewards other than money?
 - What are the rewards generated by open source development? (See Lesson 2)

Giving Back

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- Unlike objects in the real world (minerals, for example), software can be copied without cost. Implication: a single contribution can assist many.
- We therefore *receive* a lot from the open source community, without necessarily giving.
- By contributing ourselves, we make it worth-while for others to contribute (win-win).
- How can I contribute?
 - Take part in discussions (become involved), write documentation / articles, market (blogs, community, otherwise) – need wide adoption, contribute code; i.e., do not be a passive observer.
 - You can contribute *irrespective of your current level of expertise*. Like in any large organisation, there are multiple roles to fulfill; especially for someone willing to learn the ropes.

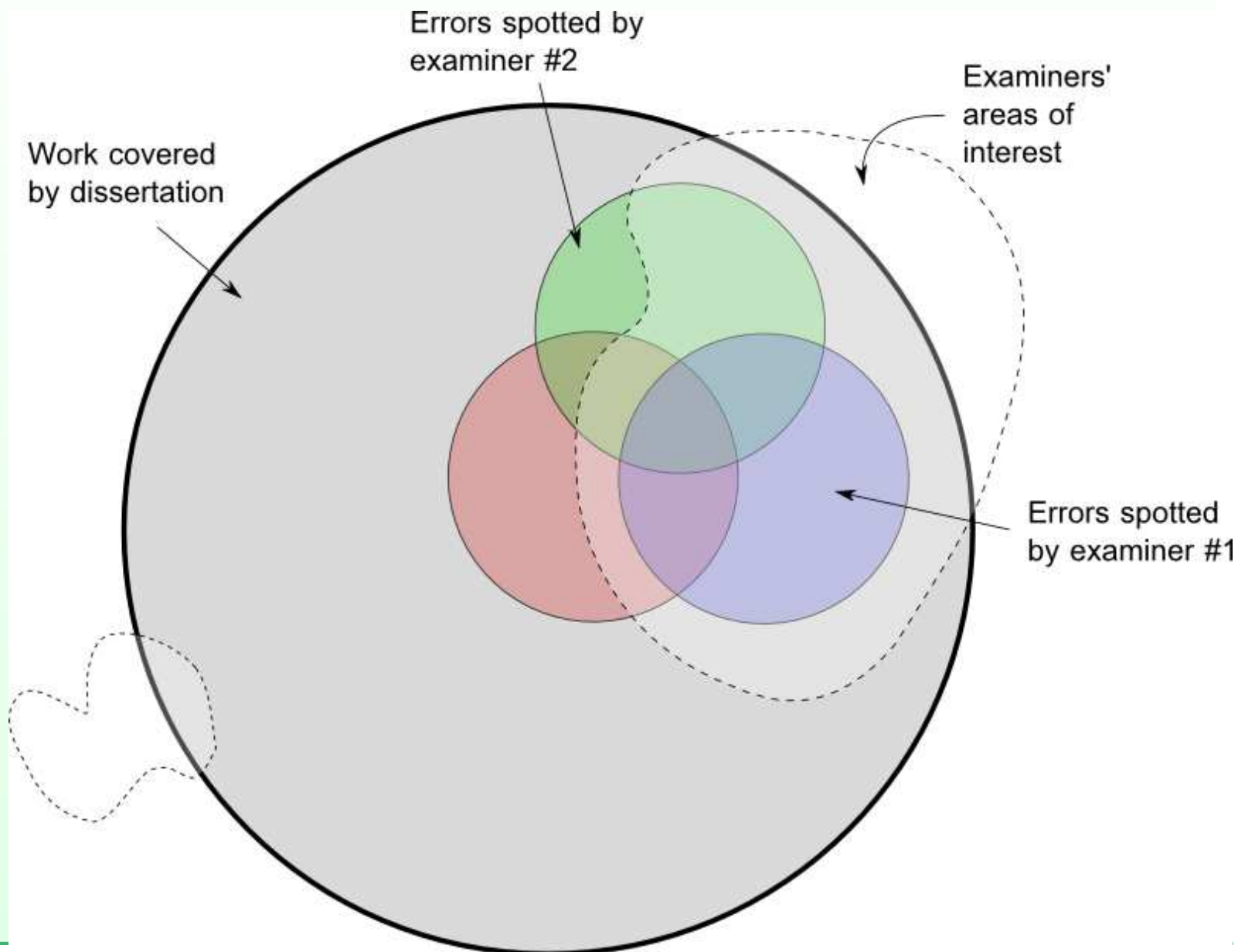
Evaluation

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- At the end of almost any large project comes some sort of evaluation, examination, overview, review, quality assurance, etc. (someone checks up on you)
- In the case of a PhD, these are the members of your committee (see diagram on next page).
- Clear advantages to more than one pair of eyes.
- The open source world extends this idea even further.

Evaluation

- Who's This Guy
- A Realistic Perspective on a PhD
- Motivation: The Pursuit of Victory
- From PhD to Open Source
- Lesson 1: Small Fish in a Big Ocean
- The Scientific Python Community
- Lesson 2: The Impact of Being Connected
- Interlude: Personalities in Software
- Being Connected: The NumPy Doc Project
- Being Connected: Software Distribution
- Lesson 3: Incremental Changes Add Up
- Lesson 4: Rewards and Motivation
- Giving Back
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Summary and Thanks

1. We're but a cog in a big machine.
2. Get connected: friends open doors and united we reach higher.
3. A house is built of many bricks (persistently making small steps can carry you far).
4. The biggest reward is being fulfilled by what you do.

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- Every person in the open source community that contributed to this work, knowingly or otherwise.
- The FOSSEE team — keep up the good work!

If there's still time...

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We can talk about super-resolution imaging...