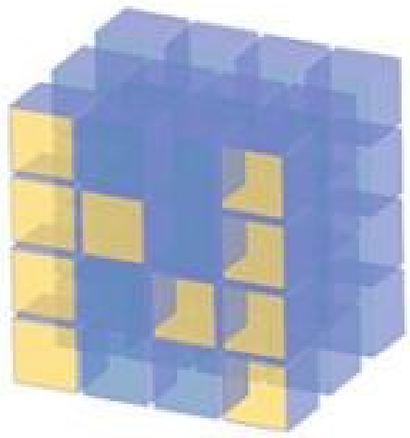


NumPy

Inside NumPy: preparing for the next decade

Matti Picus, Ralf Gommers, Sebastian Berg,
Tyler Reddy, Stéfan van der Walt, Charles Harris

NUMFOCUS
[FISCALLY SPONSORED PROJECT]

Adapted from a talk at SciPyUSA 2019 https://www.youtube.com/watch?v=dBTJD_FDVjU

A very brief history of NumPy: an incredibly mature codebase!

1994: Early Matrix object (Jim Fulton)

1995: Numeric (James Huginin, ...)

2003: NumArray split off (team at STScI)

2005: NumPy created from Numeric and Numarray (Travis Oliphant)

2006: NumPy 1.0

.....: 1-2 releases every year, gradual progress, transition from SVN to git and GitHub

2015: governance and NumFOCUS relationship formalized

2018: first-ever directly paid developers hired

The Sloan & Moore grants to BIDS for NumPy

- Two grants for in total $1.3M, Apr 2018 — Oct 2020
- Current co-PIs: Stéfan van der Walt and Fernando Perez
- Social aims: Improve community engagement Grow core team, Diversify contributors
- Technical aims: More flexible & sustainable code, Frequent & consistent releases, Improve data type system, New array protocol

GORDON AND BETTY MOORE FOUNDATION

Berkeley UNIVERSITY OF CALIFORNIA

ALFRED P. SLOAN FOUNDATION

So who did we hire?

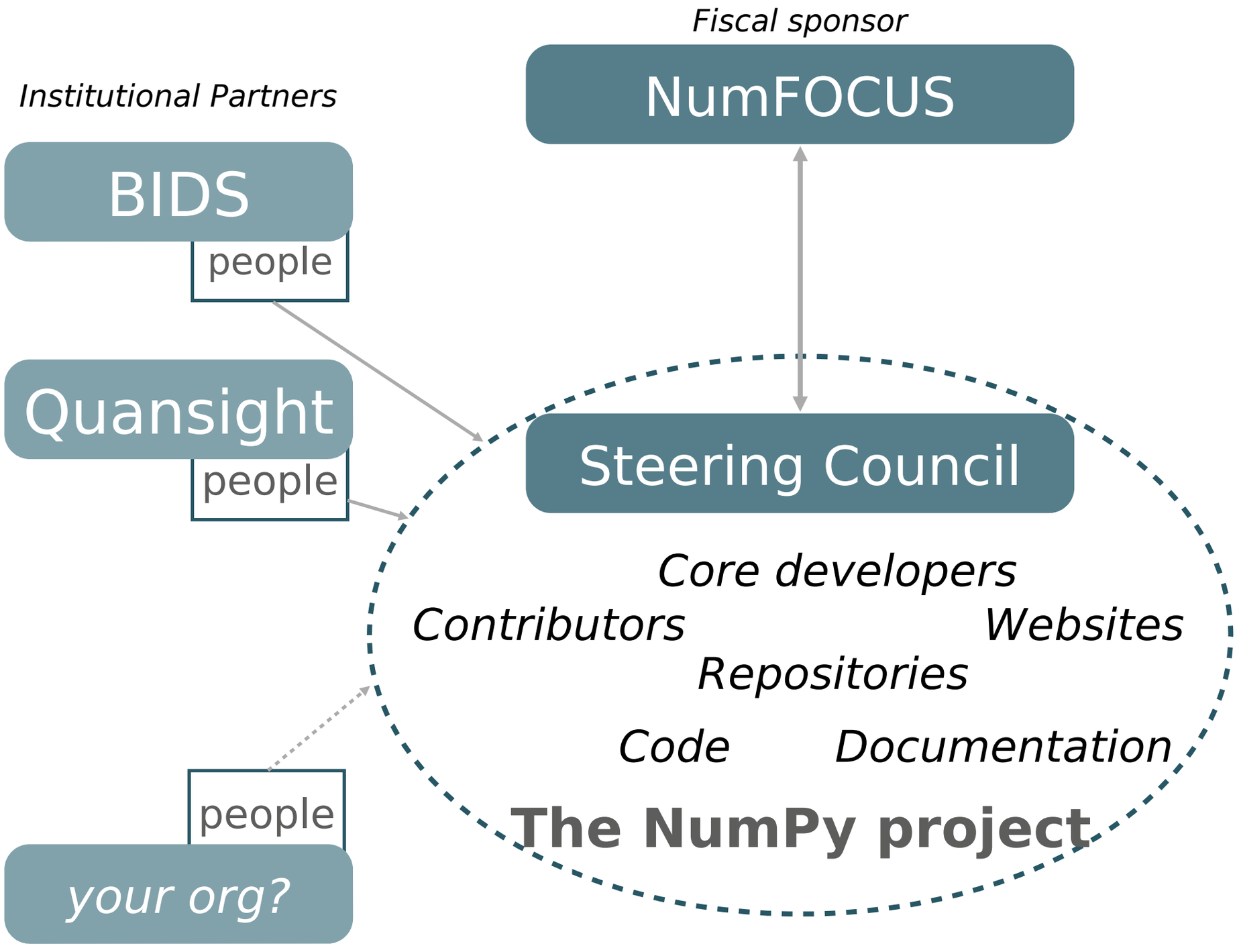
Two-three full-time engineers, ongoing (till Oct 2020 at least):

- Mar 2018 - ? : Matti Picus (PyPy team member)
- Jun 2018 - Jun 2019: Tyler Reddy (SciPy team member)
- May 2019 - ? : Sebastian Berg (NumPy Steering Council member)
- August 2019 - ? : Warren Weckesser (SciPy team member)

Additionally:

- Supporting Kriti Singh through Outreachy (docs work)
- Participating in GSOD and growing a web/doc team

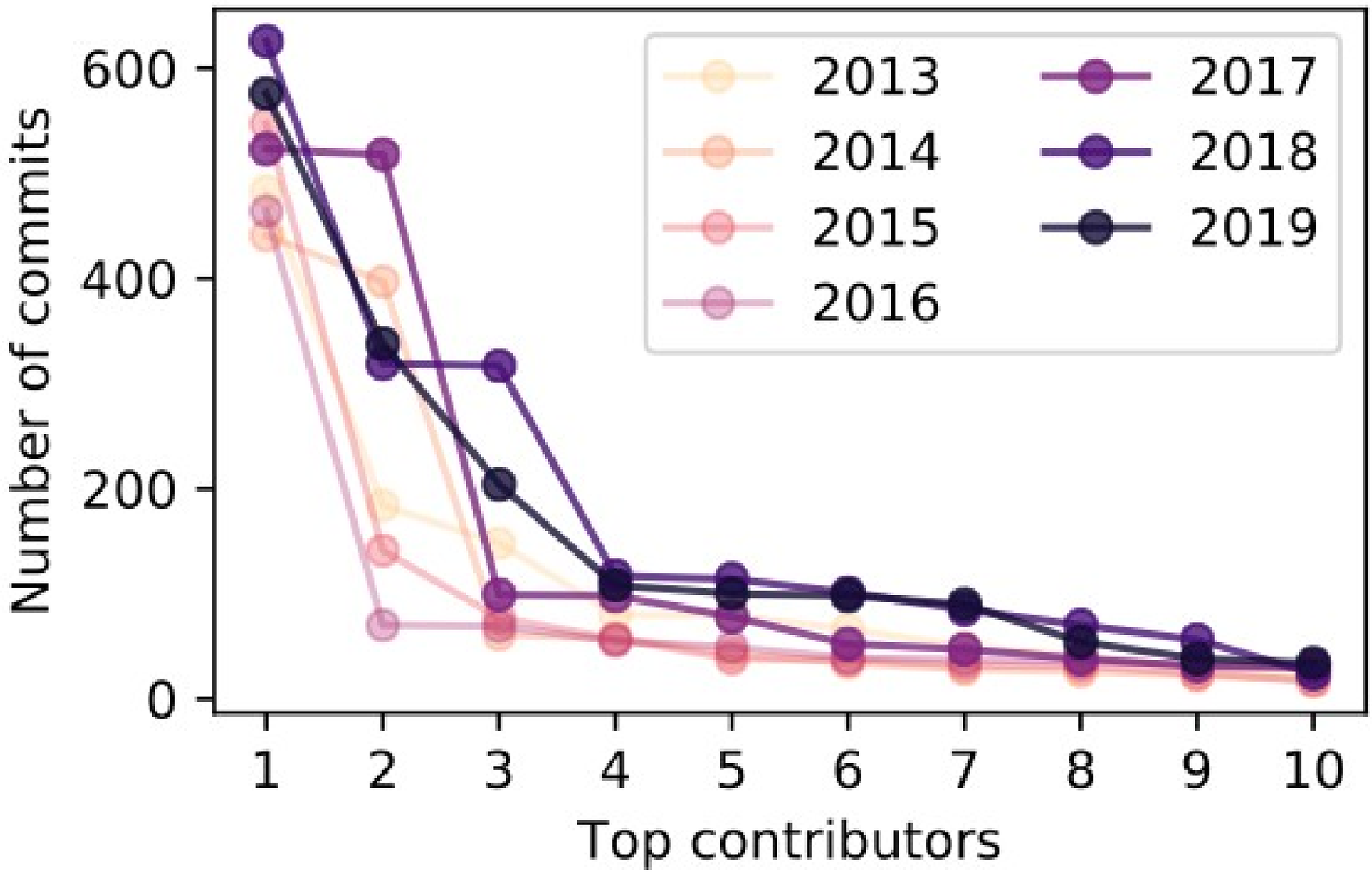
An organizational view of the project



Key questions we'll try to answer in this talk

- Has grant funding over the last year invigorated the NumPy project?
- How healthy/sustainable is NumPy today?
- What does NumPy need in order to thrive?
- What's our vision for NumPy, and what is our plan to achieve that vision?

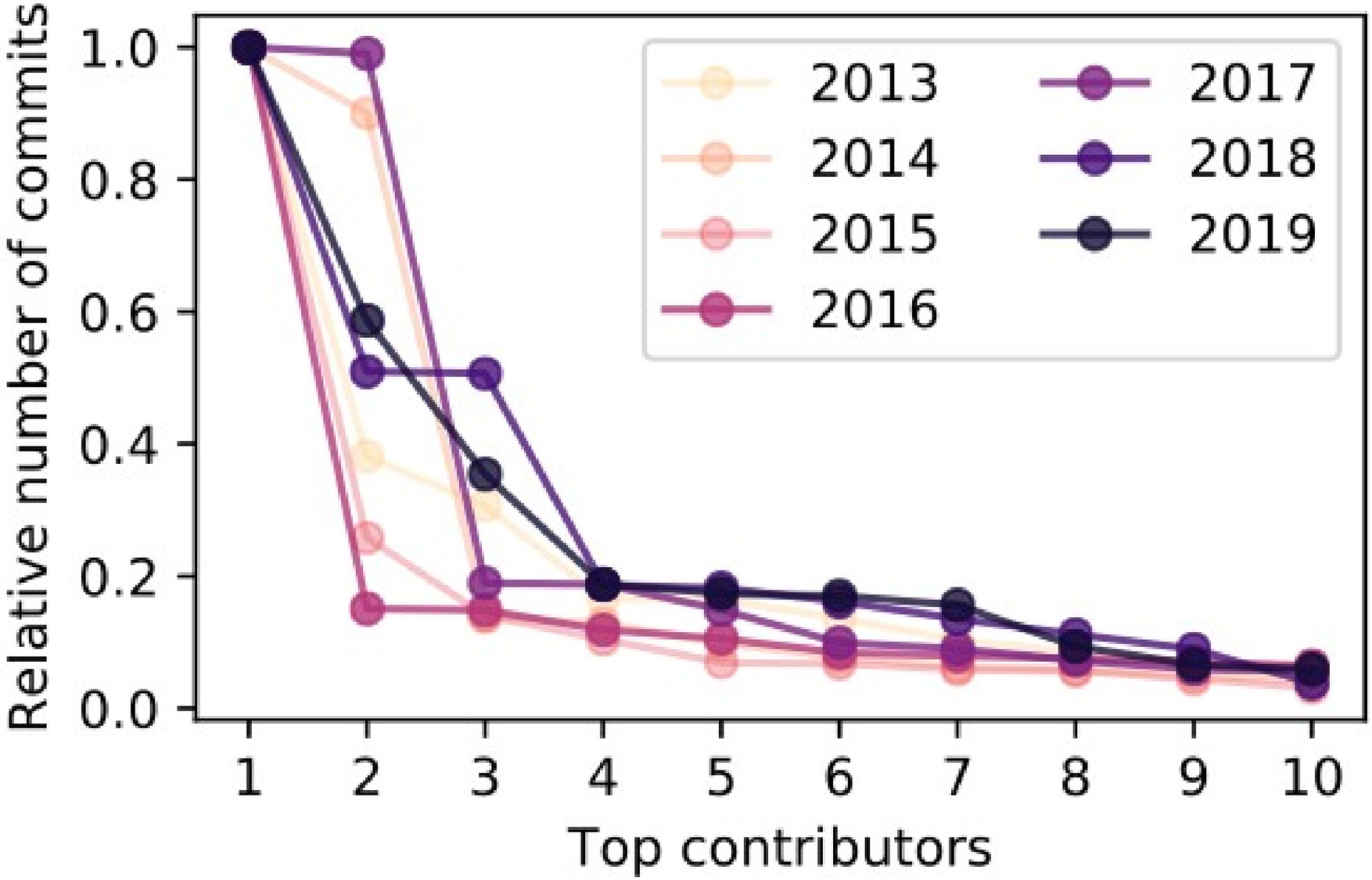
Impact of grant funding — an attempt to quantify



Heavier-tailed distributions in 2018-19: bus factor increased.

Fernando Perez, Ten years of (interactive) scientific computing

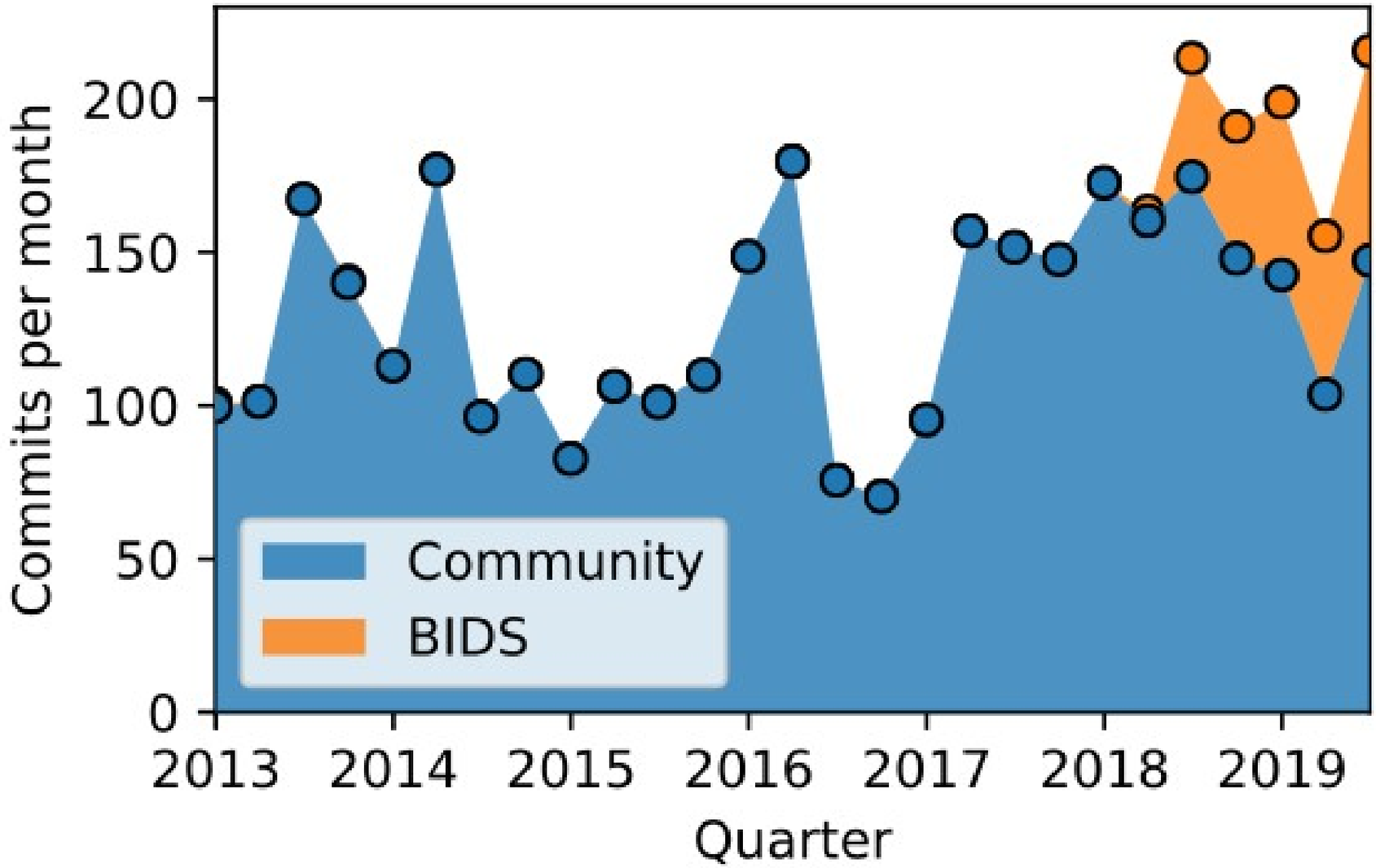
Impact of grant funding — an attempt to quantify



Heavier-tailed distributions in 2018-19: bus factor increased.

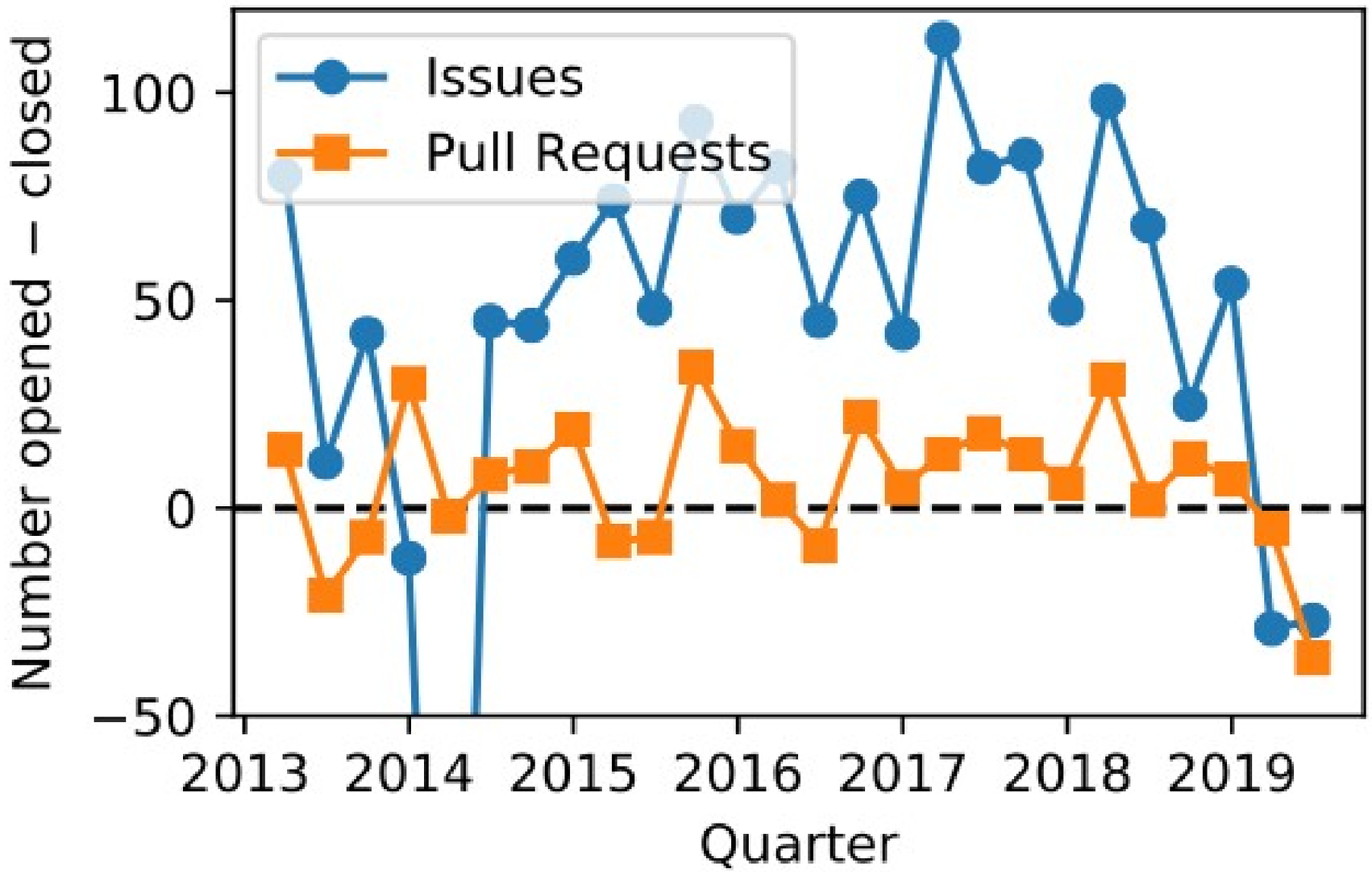
Fernando Perez, Ten years of (interactive) scientific computing

Impact of grant funding — an attempt to quantify



Volunteer contributions relatively stable; total activity up.

Impact of grant funding — an attempt to quantify



Issue/PR count rate of change is key indicator of project health.

Nadia Eghbal, [Methodologies for measuring project health]

Impact of grant funding — qualitative

- We now have a **roadmap**
- We've been able to organize **core team sprints** about every two months with around 5-10 participants
- **NumPy Enhancement Proposal** process revived:matmul, random, __array_function__ protocol, and more
- We paid down a decent amount of **technical debt** around CI, esoteric platforms, open issues and Prs
- The 1.17.0 release is the **largest release** since 1.7.0 in 2013.
- Planning the ***Array Developer Summit*** for next March for all tensor/array-like projects

Has grant funding over the last year invigorated the NumPy project?

Yes, we think so.

Faster progress and more hands for maintenance also makes it *more fun*, more bandwidth for outreach and education.

The package’s popularity enables it to engage with top-of-the field domain experts

How healthy/sustainable is NumPy today?

More healthy than a year ago.

Still a worry though. Bus factor estimate: 5-7

Parts of the code base still lag: financial, polynomial, ... After the dtype system is revamped we should revisit the handling of **not-available values** and **MaskedArrays**

Successfully straddling the worlds of academia and industry with sponsors/contributors from both.

Funding

Funding — what to pay for?

- Pay for things that are important *and* otherwise won't get done.
- Think broadly. There's more to a project than code!
- Balance maintenance & innovation: keep people motivated!
- Plan for sustainability. Don't start depending on funding unless you’re fairly certain it’s stable.
- Make the life of volunteer maintainers **easier**, not harder!

Funding — who to pay?

- All else being equal, give preference to existing maintainers.
- Pay attention to communication and self-management skills, in addition to technical skills and motivation.
- Consider this an opportunity to make your project more diverse.

Challenges

Sustainability — maintainer bandwidth

Of the 11 Steering Council members:

- 3 are very active (Chuck, Eric, Stephan)
- 3 are paid to work on NumPy
  (Sebastian full-time,
   Stéfan & Ralf a small part of their time (~1 day/wk))
- 5 are in low-activity mode (infrequent emails/commits)

This is still a major challenge! NumPy depends both on a handful of people, and probably on continued funding.

The project beyond code

It’s still hard getting work done on:

- High-level documentation
- Website
- Community building
- Governance and project management
- Long-term planning (both technical and organizational)

Improving NumPy’s culture

- We still struggle with a lack of diversity: *all* maintainers are white and male.
- Our GitHub and mailing list culture is infrequently not as friendly and welcoming as we’d all like it to be.

Vision

Scope & Vision

The key thing NumPy offers is:

an array object (*N-dimensional, in-memory, on CPUs*)
and array computing APIs
and some utility routines like random numbers

NumPy lives at the heart of the numerical Python ecosystem. We want to:

evolve while remaining a stable base,
address bottlenecks that limit how the
wider ecosystem can grow,
and grow and diversify our team and community.

What does NumPy need in order to thrive?

- Sustained funding at a higher level than today.
- More bandwidth from key people for long-term planning, managing the project
- Attracting people in roles that primarily focus on activities other than coding
- Also fund other key components in OSS data science: SciPy, Matplotlib, pandas, Scikit-learn, ...

Parts of a plan to get there

- In the next year, work with tech writers and web developers to start building a docs/web team.
  Efforts already ongoing.

- Build a diverse and robust funding quilt:
  Express our **needs** as a community (not just NumPy), and **ask** funders and major users for contributions:
  Recently started (e.g. pitched to NASA), want to make this much more concrete.

Maintenance		
Key Improvements		

How can you help?

- Become a contributor to your favorite project (most of you already are)
- Re-negotiate with your employer for time to work on your project
- Encourage your employer or clients to engage with NumFocus or any of the other intiatives to fund Open Source

Thanks for listening.

Questions?