Python was the #1 language on GitHub in 2024!

PYTHON SOFTWARE FOUNDATION

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[2024] ANNUAL IMPACT REPORT

PYTHON SOFTWARE FOUNDATION

Our mission is to promote, protect, and advance the Python programming language, and to support and facilitate the growth of a diverse and international community of Python programmers.

By the Community

For the Community

The Python Software Foundation is the organization behind Python. The PSF is an open membership organization, and we are made up of, governed, and led by the community. We exist to support the full Python ecosystem and community, for all uses and users of Python. If you contribute to the Python community in any way, whether as a member of the PSF, a PSF sponsor, a developer, an educator, a member of a local Python group, an organizer or attendee of a PyCon or other Python event, you are a part of the PSF and you make the work we do possible.

Photo by Bartek Pawlik, DjangoCon US 2024



We fulfill **our mission** through these core activities:

The PSF provides the structure and stability that the Python language, its contributors and users need to thrive.

- We distribute Python, free of charge and available to all
- We establish PSF licenses, hold intellectual property rights to most Python releases, and protect Python-related trademarks
- We help coordinate and put resources behind improvements to the Python codebase and new Python releases

The PSF empowers the people who make up the Python community, and we promote connection, diversity, and growth within the Python community.

- We host PyCon US, the annual event for celebrating, learning about, and coming together around Python
- We provide grants to groups across the globe hosting events for and by Pythonistas supporting each other and welcoming newcomers
- We fiscally sponsor 20 Python-related community groups, conferences, and projects to allow them to continue their contributions to the community with organizational infrastructure behind them



The PSF facilitates advances in the Python language, Python-related technology & education resources.

- We host PyPI, the Python Package repository, and we are constantly working on how to best serve PyPI users
- Our Developers-in-Residence amplify volunteer contributors' impact by processing CPython pull requests, tackling structural improvements, and improving security
- We encourage Python-related research in the public interest. and disburse Science and Education Grants to educators, researchers, and learners

Looking forward, the PSF aims to help the Python ecosystem grow and thrive by reaching and welcoming an ever larger and more diverse group of Pythonistas to enjoy using Python and being part of our community.





A Letter from our Executive Director



BY DEB NICHOLSON, EXECUTIVE DIRECTOR

There's never been a better time to be part of a growing international community that is smart, self-directed, and compassionate. This was a great year for Python and the PSF for many reasons, but first, I'd like to share a little bit about the structure that underpins our work.

PYTHON IS A SELF-DIRECTED OPEN SOURCE COMMUNITY

Python isn't a government project. We aren't a company subject to a small group of investors' whims. And we long ago decided that the responsibility for Python and its global community is way too much for any single person to carry alone. Each year, our community chooses our <u>Board members</u>, and our core developers choose the members of the <u>Steering Council</u>. Our staff and board are <u>continually looking to the wider community for input</u> on what makes a successful local event, for ideas for new educational initiatives, and for opportunities to support newcomers and mentors. If it's not working for you, then it's not working for us! The good news is that for most of you, it's working pretty well...

WITH BIG GROWTH COMES BIG CHANGES...

Python continues to attract new users and be pressed into service in new ways. All of this inspiring growth in Al, data analytics, and increased automation comes with an implicit call to increase our capacity and meet the needs of even more users. For code-hosting foundations like the PSF, that means more infrastructure staff, more support staff, and continually improving our workflows to best meet the moment. We may not always get everything right the first time as we grow, but we depend on our funders and supporters to ensure we won't fail for lack of support and timely feedback.

PYTHON IS NOW THE MOST POPULAR LANGUAGE ON GITHUB!

We're really glad that Python is the <u>most popular program-ming language on GitHub</u>. We love seeing a record number of Python events happening around the world. We're excited about being able to increase security and make the experience of using the package index better all the time. We're enthusiastic about the improvements that more packages, multi-threading and faster CPython are bringing.

- **m** We made some big changes to our very successful grant program
- yust finished our first year with three CPython Developers in Residence

 1. Section 2. Section
- We hired a **PyPi Support Specialist** who has been making amazing progress
- **¤** The **Education and Outreach Workgroup** is back and has been very busy
- **x** We created a **User Success Workgroup** to make Python even more accessible

...AND MORE CHALLENGES

We're less excited that inflation makes everything we do and everything you're doing to support the community a little bit more expensive, all the time. Or that many of the tech companies that rely on Python are tightening their belts. We often feel like we're being asked to do more with less. The PSF employs just 13 full-time staffers. That means we are always looking for new ways to bring in revenue and to use what we have even more effectively.

MEETING THE MOMENT TOGETHER

When you do everything together, sometimes things take a little longer, but consensus is critical for community-driven endeavors. We want to hear from all our stakeholders, we want to make sure no one is feeling left behind and we want to make sure that we aren't missing critical perspectives on new initiatives. We especially want to make sure our users have plenty of notice for both good and challenging changes.

We can't and won't weather these changes without you. Your passion about what Python could be, what the community could become and what our impact around the world could be is inspiring – but it's also absolutely essential. Every single member of the community is responsible for the success of the Python programming language, the reputation we have as <u>a welcoming community</u> and the current place we occupy in the tech landscape, ready to meet an open source powered future.

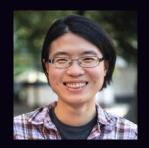
SINCERELY,
Deb Nicholson, Executive Director



Python continues
to attract new
users and be
pressed into
service in
new ways!



Notes from the PyCon US Co-Chairs



BY ELAINE WONG, PYCON US CHAIR

Ever since my first PyCon, I have been greeted with an amazing community that was willing to mentor and foster my journey from journalist to proficient coder and community leader. I have been fortunate that the Python community has allowed me to grow my skills and lead me to amazing friendships and opportunities from traveling around to various regional Python conferences and chairing the biggest Python community conference. I look forward to, along with Jon and the rest of the Python community, creating a welcoming and inclusive environment for all Pythonistas at PyCon US 2025 and 2026!





BY JON BANAFATO, PYCON US CO-CHAIR

The first time I attended PyCon US, I was fortunate enough to meet a group of fellow meetup and conference organizers that I still call friends to this day. Over the years, this experience has grown and shaped both my professional career and my community one. PyCon US offers a unique environment to connect with my communities and to catch up with friends, colleagues, and other familiar faces that I look forward to seeing every year. I'm thrilled to be working with Elaine and the rest of the PyCon US team this year, and I hope that attendees find their communities within PyCon US just as I have.

has allowed me to grow my skills & lead me to amazing friendships and opportunities.







A Note from our PSF Board of Directors

BY DAWN WAGES, BOARD OF DIRECTORS, CHAIR

As the PSF wraps up another impactful year, it's important that we reflect on our journey and continue to share our visions for the future of Python and its community. I am proud of holding true to my objectives as Chair of the PSF Board to deliver, part of which is a larger vision around the dedication and hard work in growing and sustaining the mechanisms that have led to Python's global success.

2024 can be characterized by increased connection to Python users and our PSF membership. More points of engagement with the community, more opportunities for feedback, and more procedures to keep this ever-growing community safe and supported. The PSF has ample opportunity to continue this exciting trajectory in 2025 with our new and renewed work groups, all volunteer-led, which multiplies the effort of our tiny-but-mighty organization's global remit.





Updates from the PSF CPython Developers in Residence

In January of 2024, we welcomed two new Developers in Residence, bringing our CPython DiR team to three: Łukasz Langa, Petr Viktorin, and Serhiy Storchaka. Between Łukasz, Petr, and Serhiy, over 750 pull requests were authored, and another 1,500 pull requests by other authors were reviewed and merged. Let's dive into some of their most interesting work from 2024.

ŁUKASZ LANGA

Łukasz co-implemented the new colorful shell included in Python 3.13, along with Pablo Galindo Salgado, Emily Morehouse-Valcarcel, and Lysandros Nikolaou. This work is documented in PEP 762 which Łukasz co-authored, and the implementation is based on the interactive shell of the PyPy interpreter. Its most visible feature beyond colors is multiline block editing and the ability to correctly copy and paste blocks of code. Łukasz also implemented support for the new shell in the asyncio REPL. The shell is fully featured and sup-

ported on Windows as well, as graciously contributed by Dino Viehland.

Łukasz worked on maintaining the buildbot fleet and making continuous integration more stable and faster. Working with <u>Cirrus</u> <u>Labs</u> and Arm Inc. support for aarch64 on both Linux and macOS got much faster, which unblocked the beta and final releases of Python 3.13.

As the release manager of Python 3.8, Łukasz put this version of Python to rest, as it reached its end-of-life phase in October 2024. The last released version was 3.8.20, released on September 6th. Łukasz continues releasing security fixes for Python 3.9 and building installers for both Windows and macOS for newer versions of Python as well. All in all, Łukasz was involved in essentially every release made in 2024!

PETR VIKTORIN

Petr is an active member of the C API working group, chartered in PEP 731. His work on the API evolution and ABI stability with the group is to ensure that while all the great work on performance optimizations and scalability happens,

Python users can continue to depend on their C extensions that empower their work. As an example, Petr co-authored PEP 743 with Victor Stinner, which aims to help users opt out of using C APIs with known issues.

Code-wise, some of the most interesting contributions by Petr were <u>around the</u> <u>ctypes module</u> that allows interaction between Python and C. He's also an inquisitive bug fixer, a good example of which was fixing a race condition in multiprocessing pools.

Petr also contributed a much needed rework of the <u>release dashboard</u> present in the Buildbot Web UI. Release managers depend on the dashboard to quickly identify whether there are problems blocking an upcoming release. Now, the dashboard is not only more attractive visually but also contains much more information, speeding up the issue discovery process.

Petr's activity goes beyond his immediate areas of interest. Before a dedicated PyPI support person was hired by the Foundation, he was diligently going through the laborious process of handling PEP 541 requests filed by PyPI users. He co-organized the core Python sprint at EuroPython in Prague.

SERHIY STORCHAKA

There is no single area of interest for Serhiy. He's active in so many parts of the interpreter and standard library that we're suspicious if he's really a single person. Serhiy is often the fastest responder on new issues and a champion of resolving and closing old ones. Those are just a few of Serhiy's many contributions in 2024: improving error messages for strings, bytes, and bytearrays; reworking support for var-arguments in the C argument handling generator called "Argument Clinic"; fixing memory leaks in regular expressions; raising the limits for Python integers on 64-bit platforms; adding support for arbitrary code page encodings on Windows; improving complex and fraction number support.

Serhiy's quick reaction and consistent output make him invaluable for fixing crashes, release blockers, and other obscure issues that puzzle the average core developer.



Plans for 2025

What's next? Rumor has it Łukasz wants to add syntax highlighting to the new interactive shell.

Petr continues work on the C API, with the freethreaded version stable ABI looking particularly interesting. And Serhiy has 85 open PRs he authored at the time of writing of this report.

Photo above Bartek Pawlik,
DjangoCon US 2024



PSF Security Developerin-Residence

BY SETH LARSON

Python continues to lead the way for open source security.

Thanks to the investment of Alpha-Omega in 2024, our Security Developer-in-Residence, Seth Larson, continued his work improving the security posture of CPython and the ecosystem of Python packages. Python continues to be an open source security leader, evident by the Linux kernel becoming a CVE Numbering Authority using our guide as well as our publication of a new implementers guide for Trusted Publishers used by Ruby, Crates.io, and Nuget. Python was also recommended as a memory-safe programming language in early 2024 by the White House and CISA following our response to the Office of the National Cyber Directory Request for Information on open source security in 2023.

The importance of software origin was highlighted after the xz-utils backdoor, where modified artifacts were published out-of-band from the typical release process. After a complete migration and audit

of <u>CPython's Sigstore verification materials</u>, it was possible to <u>deprecate PGP signatures</u> <u>for CPython artifacts starting in 3.14</u> as the beginning of using workload identity instead of human identities to verify the provenance of CPython artifacts.

You can't patch what you don't know – but what we do know is that open source software is in almost every software product and service. Software manufacturers have multiple new regulations requiring Software Bill-of-Materials (SBOM) to comply with, such as the NIST Secure Software Development Framework (SSDF) and the EU Cyber Resilience Act (CRA), among others. We predict that accurate SBOM documents will be in high demand from open source users complying with software security regulations, and so the PSF is looking for ways to "get-ahead" of this demand for SBOMs while minimizing the impact on projects.

Due to the increasing demand for SBOMs,
Seth has taken the initiative to generate
SBOM documents for the CPython runtime
and all its dependencies, which are <u>now</u>
<u>available on python.org/downloads</u>. Seth
has also started work on standardizing
SBOM documents for Python packages
with <u>PEP 770</u>, aiming to <u>solve the "Phantom Dependency" problem</u> and accurately
represent non-Python software included
in Python packages. Stay tuned for more in
2025 about this project.

There's been tons of involvement from the Python community too, the security of CPython contribution model was discussed at the Python Language Summit, the Scientific Python group published a guide on Securing the Release Process (SPEC-8), and the Python Package Index has added support for digital attestations for artifacts published for projects. Thanks to everyone doing their part to keep our ecosystem secure!

PSF PyPI Safety & Security Engineer

BY MIKE FIEDLER

With the continued investment in 2024 by <u>Amazon</u>
<u>Web Services Open Source</u> and <u>Georgetown CSET</u>
for this critical role, our PyPI Safety & Security Engineer, Mike Fiedler, <u>completed his first full calendar</u>
year at the PSF.

In 2024, Mike worked on a variety of impactful initiatives, all designed to improve the overall security of the Python Package Index (PyPI) for all users of the service. Here are some notable callouts, as there's simply not enough room for everything!

Account Security with 2FA for All

As of January 1st, 2024, <u>2FA is required for all PyPI user accounts</u>. Older accounts are prompted to enroll on their next login and barred from any actions until completed. Over 170k accounts have adopted 2FA since it was made available in 2019, and every account registered since must have completed 2FA enrollment to manage projects.

In 2023, as part of the 2FA rollout, Mike <u>added email</u> <u>notifications</u> to let uploaders without 2FA know about the upcoming change. On August 2nd, 2024, Mike flipped the requirement to be consistent for everyone after watching folks follow the guidance and the notices decrease over time. From that point

onward, all uploads must come from PyPI accounts that have 2FA enabled. These changes reduce the potential for credential stuffing attacks as well as minimizing account takeover attacks.

Keeping PyPI safe with new Malware Remediation work

Historically, the only way to report malware to PyPI was to "send an email". This meant that there was little structure to the contents, oftentimes delaying resolutions as PyPI admins may request more information from reporters. In March 2024, Mike added a "Report project as malware" button on the website, creating more structure to inbound reports and decreasing remediation time.

This new button has been used over 2,000 times!
The large spike in June led to <u>prohibiting Outlook</u>
<u>email domains</u>, and the spike in November was
driven by a <u>persistent attack</u>.

Mike developed the ability to place <u>projects in</u> <u>quarantine</u> pending further investigation. Thanks to a grant from <u>Alpha-Omega</u>, Mike will continue his work for a second year. We plan to do more work on minimizing time-on-PyPI for malware in 2025.



PyPI, a critical service in global modern software development, continues to grow every year, in users, projects & downloads.

PyPI Safety & Security Engineer's 2024 in numbers:

HANDLED

2000+ Malware Reports

AUTHORED & SHIPPED

160+ Pull Requests

REVIEWED

260+Pull Requests

COMMENTED ON

6 O+ Issues

Infrastructure & PyPI

We support the Python community by hosting resources and downloads on python.org, documentation on docs.python.org, packages on pypi.org, and much more.

In addition to these public-facing resources, we also support the development workflows of CPython core developers, host mailing lists on mail.python.org, and maintain and improve us.pycon.org for PyCon US. We also support the community by maintaining domain registration, DNS, mail, and more for our fiscal sponsorees as well as projects like PyPy and Jython.

In 2024, we welcomed Jacob Coffee as our Infrastructure Engineer to provide additional capacity and redundancy to our support of the PSF Infrastructure.

PyPI

In 2024, PyPI saw an 84% growth in download counts and 48% growth in bandwidth, serving 526,072,569,160 downloads for the 610,131 projects hosted there, requiring 1.11 Exabytes of data transfer, or 281.6 Gbps of bandwidth 24x7x365. In 2024, 97k new projects, 1.2 million new releases, and 3.1 million new files were uploaded to the index.

Maria Ashna joined the PSF in July 2024 as our inaugural PyPI Support Specialist. When she joined, there was a significant backlog in account recovery and PEP 541 issues. Within six months, Maria was able to resolve over 80% of the account recovery issues and improve triage time. Prior triage time of account recovery was five months, which has been improved to two days. Maria also successfully brought the PEP 541 backlog of a year and four months to current!



Photo by Bartek Pawlik, DjangoCon US 2024

Thank You Fastly!

The astounding traffic demands on the PSF infrastructure continue to grow year over year. Thanks to Fastly's support—including their five-year commitment to PSF sponsorship in 2024—the teams maintaining our services, particularly PyPI, have been able to focus on improvements and new features rather than just scaling to meet increased demand. We are deeply grateful to Fastly for enabling the PSF to provide reliable online services, allowing us to invest time and resources into advancing our infrastructure to better serve the community's evolving needs.







Assembled under one (green!) roof as well as immersed in the PyCon US cybersphere, attendees engaged in insightful discussions and forged meaningful connections.

Live-streaming of the main conference days returned for the third year via the PyCon US virtual platform, Hubilo, with the returning feature of providing access to all registered attendees, whether registered for online or in-person attendance. PyCon US was also able to provide live captioning for all tracks of the main conference days, including "live-remote" captioning for our Spanish Charlas Track, to increase and promote diversity and accessibility for our community.

2,991

Session Attendees

We had 2,551 in-person attendees and 440 online attendees! 1,752 first time attendees joined us!



\$297k 552

AWARDED IN TRAVEL GRANTS

TRAVEL GRANT **RECIPIENTS**

198 95

PYCON US SPEAKERS

COUNTRIES REPRESENTED









Photo above by Bartek Pawlik, DjangoCon US 2024

Photo below: Bartek Pawlik, DjangoCon US 2024



Python Software
Foundation enabled
us to provide free,
high-quality coding
education to children
who otherwise might
not have access to such
opportunities.





The PSF has
unlocked a world
of opportunity
for aspiring
women programmers
in Ekpoma—now we
can empower more
women to build
their skills and
careers in web
development!

Photo below: Bartek Pawlik, DjangoCon US 2024





The support received from the PSF plays a crucial role in realizing our overarching objectives—to improve the teaching skills & further the advancement of ICT teachers, strengthening female enrollment in this sector & generating interest in Python.



Photo Above & Below: Bartek Pawlik, DjangoCon US 2024





Python Software Foundation enables us to do what we do best—bring people together, share knowledge, and grow as a community.

Photo Below: Bartek Pawlik, DjangoCon US 2024



Fiscal Sponsorees

The PSF maintains a fiscal sponsorship program to support Python events and projects by providing a non-profit umbrella, handling back-office needs, and facilitating donations so the projects can concentrate on furthering their goals. The program continued to support 20 amazing Python groups in 2024.

Our fiscal sponsorees include:

Bandit

Bay Area Python

Association°

Boston

Python

ChiPy

Denver Python Users Group Jazzband

North Bay Python

Pallets

PhillyPUG

PuPPy

PyCascades

PyBeach

PyHawaii

PyLadies

PyMNtos

PyOhio

PyPA

PyRVA

Python San

Diego User Group

Joup

Twisted





Photo above by Bartek Pawlik, DjangoCon US 2024



To the Python Software Foundation (PSF), thank you for being the heart and soul of the Python community—your unwavering support, dedication, and commitment to fostering innovation & inclusivity have empowered countless individuals & organizations worldwide, making Python not just a language, but a global movement.

PSF Sponsors

Goo	gle	fastly. Meta		NVIDIA.
Bloom	berg			
N	1icrosoft	SUSTAINABILITY	/\nsys	
MongoDB.		aws	AMERICAN	Red Hat
Streamlit	Cubist Systematic Strategies	Capital One	EXPRESS	QRT
JET BRAINS		Python PI	î	ndeed





Staff

DEB NICHOLSON Executive Director

LOREN CRARY

Deputy Executive Director

EE DURBIN

Director of Infrastructure

JACOB COFFEE

Infrastructure Engineer

JAIME BARRERA

Community Events Coordinator

LAURA GRAVES Senior Accountant MARIA ASHNA

PyPI Support Specialist

MARIE NORDIN

Community **Communications Manager**

MIKE FIEDLER

PyPI Safety & Security Engineer

OLIVIA SAULS

Program Director

PHYLLIS DOBBS

Controller

SETH LARSON

Python Security Developer-in-Residence

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CHRISTOPHER NEUGEBAUER (Vice Chair)

DEB NICHOLSON (Secretary)

GEORGI KER (Treasurer)

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CRISTIÁN MAUREIRA-FREDES

DENNY PEREZ

JANNIS LEIDEL

KUSHAL DAS

KWON-HAN BAE

SIMON WILLISON

TANIA ALLARD

Syconus 2025

Join Us May 14th-22nd in Pittsburgh, PA!

In 2025, PyCon US will return to Pittsburgh, Pennsylvania, for our second year at the David L. Lawrence Conference Center. Our attendees will join us in person for a program filled with tutorials, talks, sprints, summits, and keynotes presented by our community, celebrating our theme "By the community, For the community."

For more details, visit the conference website.



PSF Financials 2023-2024

CONSOLIDATED FINANCIAL STATEMENT

Excludes in-kind revenue & expense (\$ in thousands)

REVENUE	2024	2023
Program Service Revenue	\$ 3,137	\$ 2,827
Contributions, Membership Dues, & Grants	\$ 1,077	\$ 1,135
Other Revenue	\$ 79	\$ 151
TOTAL REVENUE	\$4,293	\$4,113

EXPENSES	2024	2023
Program Service Expenses	\$ 4,941	\$ 3,599
General & Administrative	\$ 610	\$ 536
Fundraising	\$ 204	\$203
TOTAL EXPENSES	\$5,755	\$4,338
NET INCOME	-\$1,462	-\$225

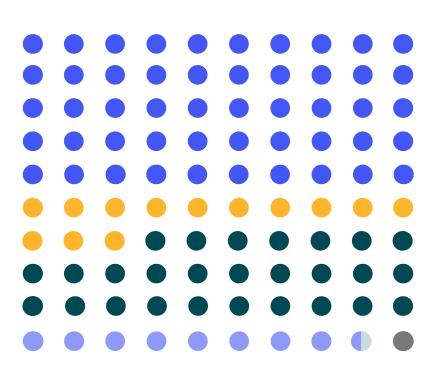
ASSETS	2024	2023
Cash and Cash Equivalents	\$ 3,656	\$ 5,051
Accounts Receivable – Net	\$ 444	\$ 284
Other Current Assets	\$156	\$ 119
TOTAL ASSETS	\$4,256	\$5,454

LIABILITIES	2024	2023
Deferred Revenue	\$ 642	\$ 357
Accounts Payable & Liabilities	\$164	\$194
TOTAL LIABILITIES	\$806	\$551

NET ASSETS	2024	2023
Net Assets without Donor Restrictions	\$ 1,553	\$ 2,707
Net Assets with Donor Restrictions	\$ 1,897	\$ 2,196
TOTAL NET ASSETS	\$3,450	\$4,903

Program Service Expenses

2024 EXPENSES BY CATEGORY (\$ in thousands)



- PyCon US \$2,491 (50.4%) | Grants \$640 (12.9%)
- Packaging Work Group/Infrastructure/Other \$1,337 (27.1%)
- Fiscal Sponsorees \$423 (8.6%) | Code of Conduct \$35 (0.7%)
- Community Awards & Expenses \$15 (0.3%)

Growth of Assets

PSF ASSET TRENDS FROM 2019-2024 (\$ in thousands)

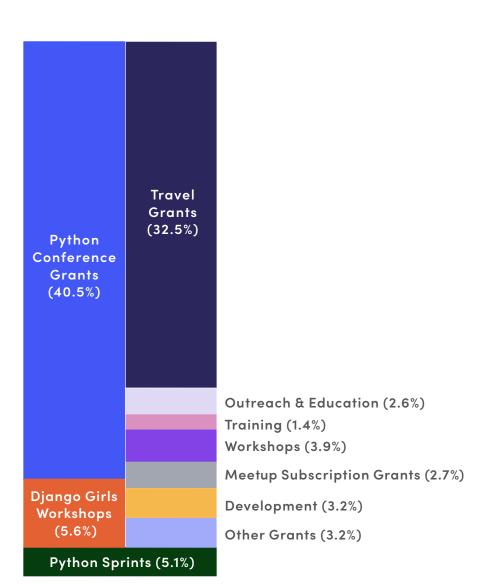


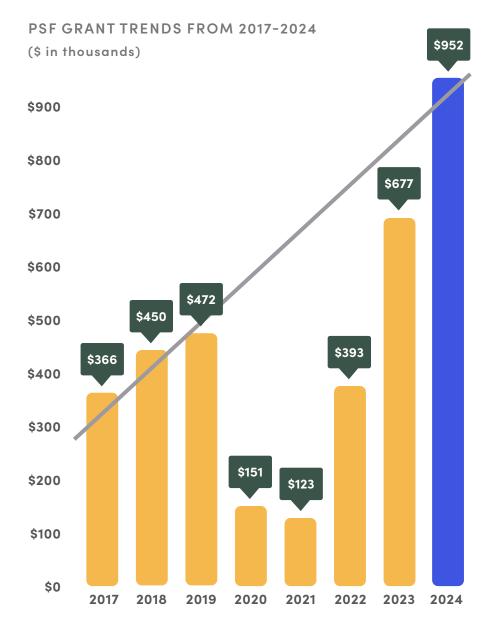
TRENDLINE

25

Grant Disbursement Grant Trends

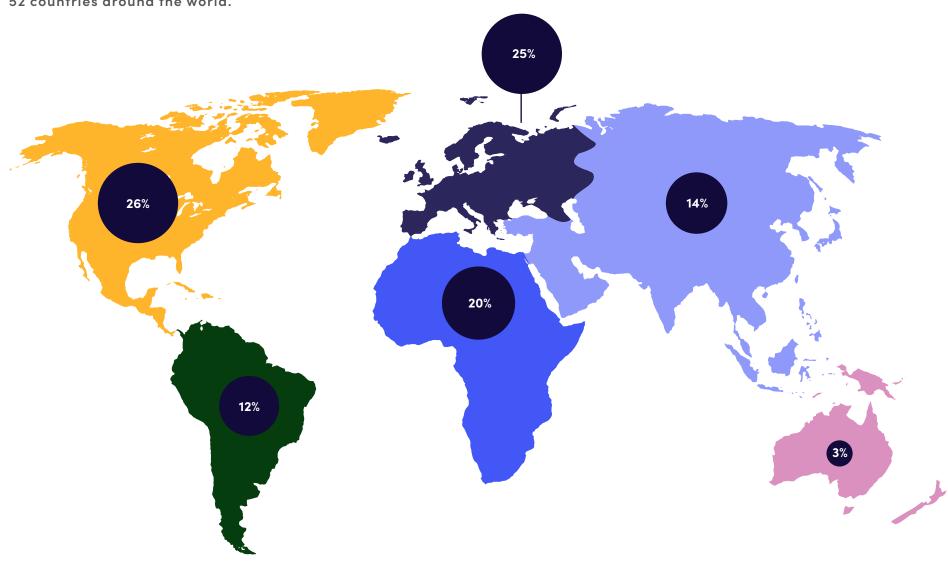
PSF GRANT DISBURSEMENT FROM 2017-2024 (\$ in thousands)





Grants by Continents

In 2024, the grants program focused on virtual and in-person events. The PSF distributed \$952K in grants in 2024, to 174 groups in 52 countries around the world.







I'm in! How Can I Help?

Follow us!

We want to talk about Python and the Python community with you everywhere.

Support us financially!

- Become an individual champion of the PSF through our <u>membership</u> <u>program</u> or <u>donate directly</u>.
- If your company relies on Python, talk to your boss about <u>sponsorship</u> we have lots of options!
- If your organization would like to contribute to making PyCon US an amazing event, contact us about our <u>sponsorship program</u>. You can email <u>sponsors@python.org</u>.

Volunteer

- Rather support the Python community with your time? We have lots of volunteer opportunities!
- We can always use volunteers at <u>PyCon US</u>—there are lots of ways to pitch in!
- Many of our friendly workgroups are seeking new members
- Or you can help new folks with their questions in Python Help.
- Consider running for the <u>PSF Board</u> of <u>Directors</u>.

The PSF is recognized by the IRS as a 501(c)(3) non-profit charitable organization in the United States. Want to collaborate on a grant or donate something that needs to go to charity? Get in touch with us, sponsors@python.org.

VISIT US AT PYTHON.ORG