

THE NEXT GENERATION OF SOFTWARE DEVELOPERS



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ABOUT ME



<http://denaeford.me>

Originally from the DMV area

- ▶ B.S., M.S. + Ph.D. Computer Science
- ▶ Grad Minor in Cognitive Science
- ▶ Triple Packer: All degrees from N.C. State University
- ▶ Did conduct undergraduate research

Fun Facts: Division 1 Collegiate Track & Field Athlete

Research Area:
Software Engineering
Human Computer-Interaction
Online Communities



What does a software engineer look like?



Elliot Anderson from Mr.Robot



Kaya Thomas via <http://wogrammer.org>

PROBLEM: WE NEED MORE DEVELOPERS

The Great Lockdown
will accelerate digitization

Digital job capacity
from 2020-2025



149M
new jobs
by 2025

- 1M Privacy and trust
- 6M Cyber security
- 20M Data analysis, machine learning, and AI
- 23M Cloud and data roles
- 98M Software development

Data Source: Microsoft Data Science using LinkedIn data. Methodology and assumptions can be found in the white paper "Methodology: Digitalization Capacity of the World Economy"

Software Engineer Shortage in the World



ALEX MELNICHUK

Published: 06 Nov 2019

SOFTWARE DEVELOPMENT

Share: [in](#) [t](#) [f](#)

Our estimate of 149M new, technology jobs will vary by country, industry and sector

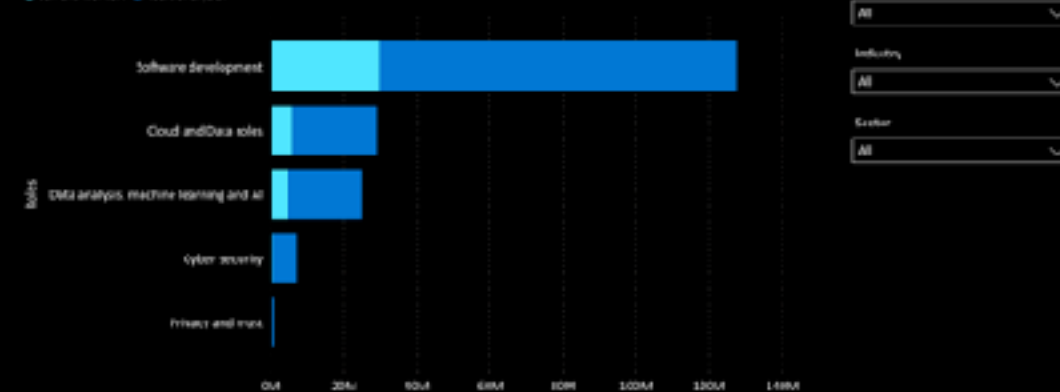
The Software Developer Shortage in the US and the Global Tech Talent Shortage in 2021

POSTED NOV 13, 2020

TRENDS

Estimated capacity of technology jobs by 2025

Current workers Additional jobs



Data Source: Microsoft Data Science using LinkedIn data. Methodology and assumptions can be found in the white paper "Methodology: Digitalization Capacity of the World Economy"

Microsoft U.S. Data Science and Analytics

How do we **empower** more people to become software developers?

NEXT GEN DEVS → NEXT GEN DEV COMMUNITIES

NEXT GENERATION OF DEVELOPERS



**SOCIAL
TRANSPARENCY**



**SOCIETAL
IMPACT**



HYBRID WORK

DEVELOPERS WHO VLOG





Source: a day in the life of a software engineer. Author: Mayuko. Video Link: <https://youtu.be/rqX8PFcOpxA?t=99>

RESEARCH QUESTIONS

RQ1



What are the **motivations** and **intentions** for creating 'day in the life' vlogs?

RQ2



What **kind of content** do developers share?

RQ3



What kind of **interaction** happens around these videos?

How are these videos perceived by the **broader community**?

APPROACH

RQ1



16 Dev Vloggers

Interviewed

→ across 4 continents

→ 30-45 min interviews

ID	LOCATION	AGE	GENDER	EXP _{PROG}	EXP _{VLOG}	JOB TYPE	JOB TITLE
P01	Japan	32	M	7	1	Remote	Software Engineer
P02	USA	33	W	8	1	Freelance	Creator
P03	India	23	M	5	2	Remote	Software Engineer
P04	UK	33	M	20	2	In-office	Software Development Engineer
P05	Spain	25	M	15	2	In-office	Software Engineer
P06	Philippines	24	W	4	2	In-office	Front-End Web Developer
P07	USA	24	M	7	2	NA	NA
P08	India	23	M	7	1	In-office	Senior Developer
P09	USA	23	M	4	0	In-office	Full Stack Software Engineer
P10	Iraq	26	W	7	0	In-office	Developer
P11	USA	25	M	6	2	Freelance	Developer
P12	USA	27	M	3	2	In-office	Software Engineer
P13	USA	24	W	4	1	Freelance	Creator
P14	USA	27	W	10	3	Freelance	Creator
P15	USA	28	W	4	1	In-office	Software Engineer
P16	Germany	26	W	6	0	In-office	Engineer

APPROACH



16 Dev Vloggers
Interviewed
→ across 4 continents
→ 30-45 min interviews



130 videos analyzed
→ 17.8 hours,
→ 35.2 million views on
*“A Day in the life of a
software developer”*
→ 21 countries



1176 vlog comments
analyzed
→ Up to the top 10
comments on vlogs



RESULTS: MOTIVATIONS

Demystify the Identity

“[Devs are] living, breathing human people who are dynamic and have their own lives and have interests outside of coding”

Find and Build Community

Promote Diversity

Create Awareness

“Spread the message that anyone can basically learn to code and get into tech” and creates videos and vlogs about “the technologies and how to learn these things and how they can help.”

Professional Growth

RESULTS: CONTENT ANALYSIS

Stages of Learning

Collaboration & Creativity

Several videos described how important it was for developers to have adequate communication skills since, “often you can get a lot more done by having a quick conversation with the rest of your team”

Career as a Developer

Remote Work

Pre COVID vlogs: co-working spaces, WFH focused work
During COVID vlogs: stories of overcoming social engagements, job loss

Managing Stress at Work

Lifestyle and Social Life

RESULTS: COMMENTS

Finding Information

Viewers find value in vlogs focusing on developer lifestyle as well as those sharing work related information like specific tools/ languages. These vlogs eventually encourage viewers to consider pursuing a career in development.

Seeking Advice

Expressing Empathy

“This video goes on to show a very important point - software engineering is not equal to just coding. It is about human interactions to come to a decision and then execute that decision (of which a part is coding other part may be documentation or operations).”

Discovering Community

Dissent and Sarcasm

“I am a disabled Veteran. It’s never too late. Coding has changed my life.”

“I’m so happy to find this video!! I am also a mom software engineer & can’t wait to get this show on the road!”

DISMANTLING DEVELOPER STEREOTYPES

Stereotype / Links to Evidence

WHO IS/CAN BE A DEVELOPER

- S1 Developers are mostly male and mostly white (of European descent)
→ Sections 4.2.1, 5.2.3, 6.2.1, 6.2.2, 6.2.4 [V6, V78, P10, P14, V6-8, V79-2, V109-6]
- S2 Developers are a young crowd, with no responsibility other than themselves
→ Sections 4.2.3, 6.2.4 [V30, V59, V20, P02, V92-6, V63-7]
- S3 Developers are math wizards and they are born with coding skills
→ Sections 4.2.1, 5.2.1, 5.2.3, 6.2.2 [V38, V64, P10, P13, V121-9, V3-10]
- S4 Getting a traditional CS degree is essential to be a developer
→ Sections 4.2.4, 5.2.1, 6.2.2 [V3, V9, V78, V80, P11, V63-7, V126-5]
-

WORK LIFE OF DEVELOPERS

- S5 Developers code all day and knows nothing beyond it
→ Sections 4.2.3, 5.2.2, 5.2.5, 6.2.3 [V17, V39, V40, V77, P02, P10, V80-7, V92-1, V112-6]
- S6 Developers seldom talk to others
→ Sections 5.2.2, 6.2.3 [V27, V66, P04, P05, V22-5, V5-6]
- S7 Stereotypes about job titles, startups, freelancing, and organizations
→ Sections 5.2.3, 5.2.4 [V21, V9, P05, P09, P04, V21-10, V28-6]
-

PERSONAL LIFE OF DEVELOPERS

- S8 Developers have no time for fun
→ Section 5.2.6 [V2, V109, P05, P07, P03, V4-2, V80-8]
- S9 Developers are asocial or anti-social, and prefer to be left alone
→ Sections 4.2.2, 5.2.6 [V19, V29, V54, P08, V102-8, V55-3]
- S10 Developers lead an unhealthy lifestyle
→ Sections 5.2.5, 5.2.6 [V12, V34, V119, P01, P15, P16, V13-5, V89-1]
-

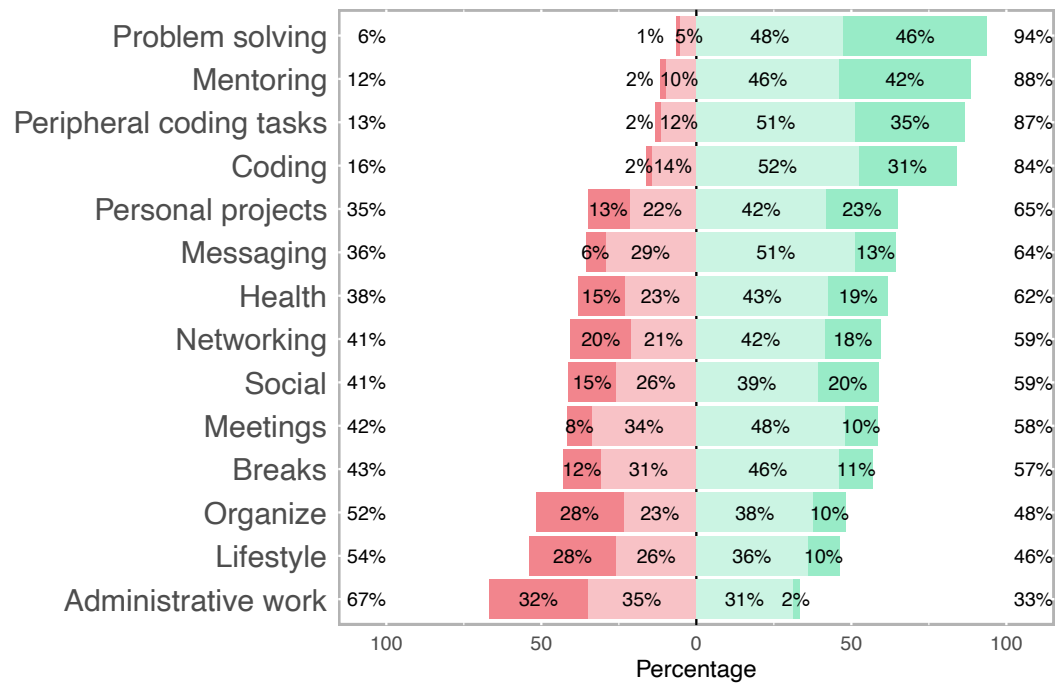
DIFFERENCES BETWEEN DEVS IN INDUSTRY

Industry Devs Age

15%: 18-24 years
 28%: 25-29 years
 20%: 30-34 years
 28%: 35-44 years
 9%: 45 years +

How do industry developers interest in activities vary from vlog developers?

n= 130 Videos
 n=335 responses from industry devs



■ Don't show at all
 ■ Show less frequently
 ■ About the same
 ■ Show more frequently

Activity	Personal brand	Diversity	Awareness
Coding	32%	29%	35%
Peripheral coding tasks	36%	35%	36%
Problem solving	43%	50%	46%
Administrative work	2%	1%	4%
Mentoring	41%	56% (*)	33% (*)
Organize	12%	12%	8%
Meetings	6%	17% (*)	9%
Networking	11%	26% (*)	17%
Messaging	9%	17%	11%
Personal projects	23%	30%	16% (*)
Social	16%	27%	17%
Health	14%	22%	21%
Lifestyle	11%	7%	10%
Breaks	6%	18% (*)	9%

OPEN QUESTIONS

Is it motivations for becoming a developer?

Is it interests in impact of projects?

What defines a generation w.r.t. developers?

Is it interest in non-traditional career paths?

Using age alone may not yield the intended results

NEXT GENERATION OF DEVELOPERS



**SOCIAL
TRANSPARENCY**



**SOCIETAL
IMPACT**



HYBRID WORK

OPEN SOURCE FOR SOCIAL GOOD

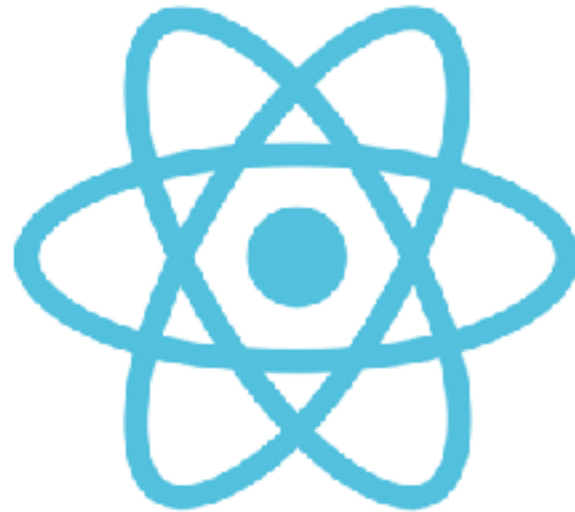
Project Website: <http://aka.ms/OSS4SG>



TRADITIONAL OSS CONTRIBUTIONS



TensorFlow



React JS

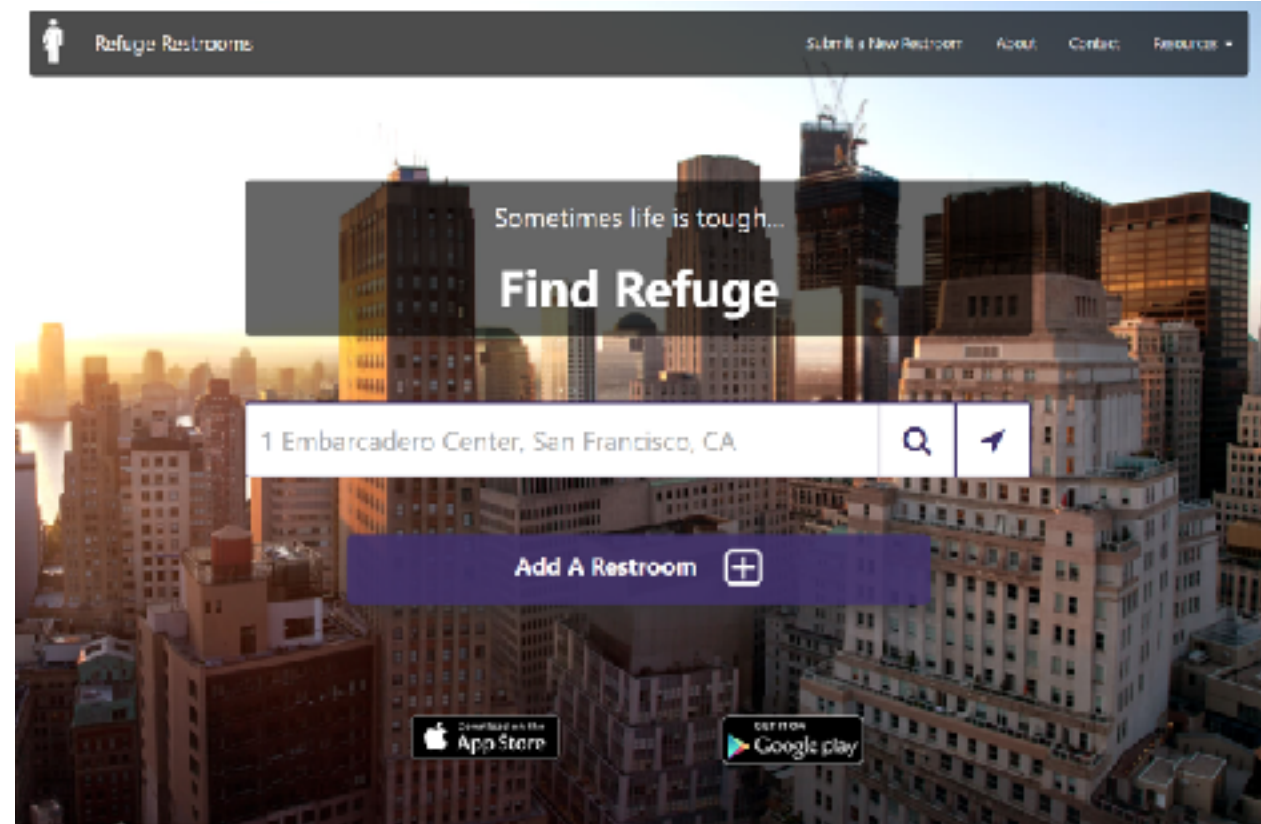
DEVELOPERS USING THEIR SKILLS TO HELP OTHERS



OSS FOR SOCIAL GOOD:

Open source software projects where the outcome distinctly targets a community of people to overcome a societal issue.

DEVELOPERS USING THEIR SKILLS TO HELP OTHERS



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GAPS FROM THE SOCIAL SECTOR

Understudied experience of those interested in making a broader impact

Social impact projects are *used to inspire* in CS Ed community. Does the same exist here in OSS?

Building on this GitHub Study, we focus on the experiences of *contributors*

How to characterize the OSS4SG community?
How can we support them?



APPROACH



Sequential Mixed-Methods Study

21 Semi-structured Interviews



517 survey respondents

Qualitative

Quantitative



Motivations,
Challenges, Project
Selection Strategies

RESULTS: PROJECT SELECTION

Factors to Consider When Selecting a Project	P-OSS4SG (n=226)	P-OSS (n=202)	Delta (P-OSS4SG - P-OSS)
I personally respect/care about the issue this project is trying to solve. (F1)	83.6%	75.7%	7.9%
I like the idea of this project. (F2)	83.2%	78.2%	5.0%
This project is active. (F3)	74.3%	72.3%	2.0%
The goal of this project meets some form of needs I care about. (F4)	73.0%	67.3%	5.7%
This project is welcoming. (F5)	67.7%	64.3%	3.4%
I fully understand the goal and value of this project. (F6)	65.9%	65.3%	0.6%
I trust the owner/organizer of this project. (F7)	63.5%	42.1%	21.4% ***
I feel confident in my skills to help with this project. (F8)	62.4%	65.8%	-3.4%
This project is well-maintained. (F9)	57.5%	64.8%	-7.3%
I can learn some new skills or enhance my skills in this project. (F10)	43.8%	62.4%	-18.6% ***
This project targets a lot of users. (F11)	24.8%	27.7%	-2.9%
This project has a diverse contributor team (e.g., gender, race, geography). (F12)	16.4%	18.3%	-1.9%
Someone else in my community is also working on this project. (F13)	15.9%	16.3%	-0.4%
This project is popular in the community. (F14)	15.5%	27.2%	-11.7% *

Wilcoxon rank sum test significance codes: '***' $p < 0.001$, '**' $p < 0.01$, '*' $p < 0.05$

RESULTS: CHALLENGES AND OPPORTUNITIES

Challenges	P-OSS4SG+ (n=153)	P-OSS+ (n=228)	Delta (P-OSS4SG+ - P-OSS+)
It is hard for newcomers to understand how to contribute to the project. (C1)	69.9%	64.5%	4.5%
It is hard to understand what features my users need. (C2)	53.6%	49.1%	4.5%
Not knowing where to find good projects to work on. (C3)	49.7%	36.8%	12.9%
Needing more money to work on a project. (C4)	49.0%	43.0%	6.0%
Not understanding the direction of a project. (C5)	41.8%	34.2%	7.6%
Other contributors losing sight of direction of a project. (C6)	32.0%	35.5%	-3.5%
Working with people who do not understand open source. (C7)	32.0%	33.8%	-1.8%
The project is over-engineered. (C8)	24.8%	24.6%	0.2%
Stakeholders are unreasonable on feature requests. (C9)	22.2%	29.4%	-7.2% **
Too much time is spent on documentation in this project. (C10)	14.4%	21.1%	-6.7% *

Wilcoxon rank sum test significance codes: ‘***’ $p < 0.001$, ‘**’ $p < 0.01$, ‘*’ $p < 0.05$



OPPORTUNITIES

DPG Alliance Nomination →
Automated Project Badging

Certified Social Impact

v2.0 adopted

Are there opportunities to highlight Social Impact Projects in open source?

How can we provide safety training for high-risk projects?

OPPORTUNITIES

UAFONOG.PL

Support us on: [Social Media Icons]

Help for Ukraine

In solidarity with Ukraine. Every help counts

This is a grassroots website for those who want to help and for those who are looking for help. It's a place where people of good heart will find the resources they need to help Ukraine in any way they can. It's a place where everyone can find the help they need to help Ukraine in any way they can.

Financial support
• donate money
• buy gift cards

Technical support
• help with translations
• help with translations

Legal advice
• help with translations
• help with translations

Refugee Issues
• help with translations
• help with translations

Journalists
• help with translations
• help with translations

Black lists
• help with translations
• help with translations


Help Parents
• help with translations
• help with translations

DPG A
Auton

2.0 ad

Social I

README.md



An open letter from IT industry specialists to protect Ukraine from information warfare

LOCALIZATION

- English
- Українська (українською)
- Русский (русский)

Important!

- Ban GitHub for russian developers [Petition](#)
- Ban Cloudflare for russian sites [Petition](#)
- Ukrainians and the whole world send Putin to Jupiter.
- Real ways you can help Ukraine

On February 24, 2022, the Russian Federation cowardly attacked independent Ukraine. They are waging a dirty information war against the whole world and direct armed warfare on the territory of Ukraine.

The publicly available IT projects, packages, managers, forums, CDNs, and other resources created for the benefit and convenience of IT professionals are now used to wage war and destroy innocent civilians. We also believe that these resources (like source code, software, and other digital information) help disseminate false information in Russia and can be used to conduct military operations. These resources also make it possible to finance and continue the war in Ukraine with the help of the Russian IT sector.

<https://github.com/cetuspro/help4ua.org-frontend>

<https://github.com/stop-war-in-ukraine/stop-russia-it>

How can we provide safety training for high-risk projects?

ONGOING WORK

Project Owners

Help them find the **OSS Skills** necessary for their projects to succeed

Maintainers

Help them encourage the existing growth and activity in their projects

Contributors

Help them find the best projects for their individual areas of growth

FUTURE: Pairing contributors based on skills and project recommendations to help contributors find the projects they want and the project organizers gets what they need to be successful

IMPACT OF IMPROVING PATHWAYS TO SUSTAINABLE COMMUNITIES

The screenshot shows the 'Maintainer Dashboard' with several key sections:

- Community Growth:** Includes sections for Newcomers, Contributors, Maintainers, and Project Growth.
- Rising Contributors Recommendation:** A highlighted box containing a recommendation to recognize contributors with a 'Rising Contributor' badge. It notes that the project is attracting newcomers, some of whom have been active for at least 3 out of the last 6 months.
- Line Graph:** A chart titled '01/01/2021 - 06/30/2021 (Last 6 months)' showing activity for 'All Contributors', 'Rising Contributors', and 'Other Contributors' from Jan 2021 to Jun 2021.
- Contributor Profiles:** Profiles for 'aponeer-2020' and 'masheynr' are shown, including their activity (Active months, Joined), issues (Created, Closed, Open), and a 'Rising Contributor' recommendation.
- Issue List:** A section titled 'Issue List' showing the state of open issues (e.g., 50% Newcomers friendly issues) and recommendations like 'first-timers-only' and 'good first issue'.
- OSS45G tags:** A section showing tags like 'Environment & Nature' and 'Affordable and Clear Energy'.

Maintainer Insights Dashboard
Built by Mariam Guizani, Denae Ford, and Tom Zimmermann
(Completed & Presented Aug 2021)

THE DASHBOARD WE BUILT DIRECTLY LED TO GITHUB'S INSIGHTS DASHBOARD



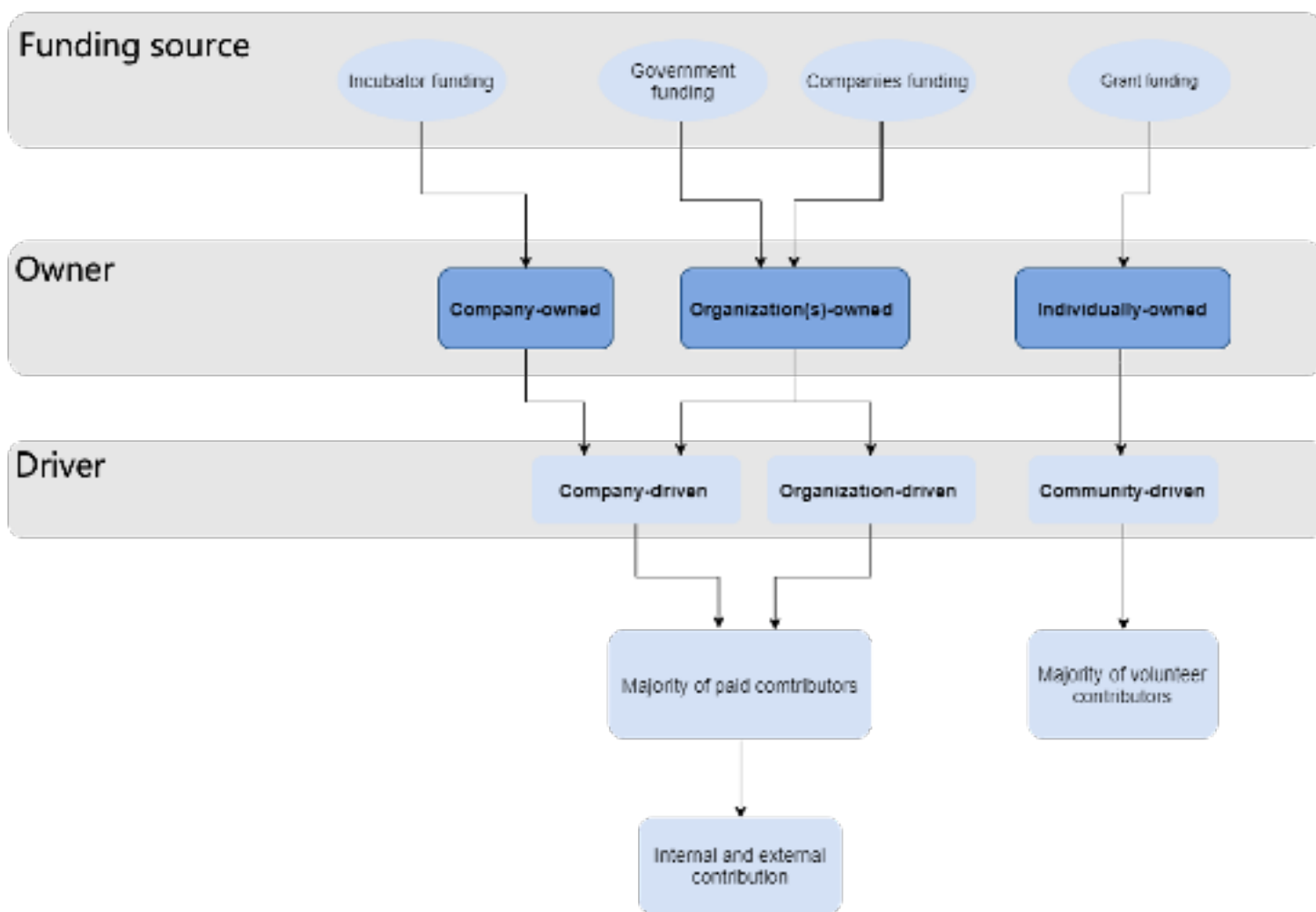
The screenshot shows the 'Community insights' dashboard on GitHub, featuring several charts and metrics:

- Contribution activity:** A line chart showing the count of new contributions over time.
- Discussion page views:** A bar chart showing the number of page views for discussions.
- Maintainer activity:** A line chart showing the count of issues created by maintainers.
- Maintainer issue contributions:** A line chart showing the count of issues created by maintainers.

GitHub's Community Insights Dashboard
(Announced Jan 2022)

Mariam Guizani, Thomas Zimmermann, Anita Sarma, Denae Ford. Attracting and Retaining OSS Contributors with a Maintainer Dashboard. To appear in the proceedings of the *IEEE/ACM International Conferences on Software Engineering - Software Engineering in Society (ICSE SEIS) 2022*. May 2022. [\[pre-print\]](#)

GOVERNANCE MODELS IN OSS4SG COMMUNITIES



- Interns looking at how to make these communities sustainable
- Recent Paper on how did this through a Community Maintainer Dashboard: <https://arxiv.org/abs/2202.07740>
- External partner, CHAOSS, also considering how the governance of a project will dictate how and who feels comfortable participating.
 - <https://chaoss.community/>



NEXT GENERATION OF DEVELOPERS



**SOCIAL
TRANSPARENCY**



**SOCIETAL
IMPACT**



HYBRID WORK

LEARNINGS FROM PANDEMIC REMOTE WORK



PRE COVID REMOTE WORK



The Remote Work Report by GitLab: The Future of Work is Remote

March 2020



Attitudes on remote working

90% I would recommend working remotely to a friend

87% I am satisfied with tools and processes that enable remote team communication

86% My leadership team gives me agency and autonomy while working remotely

86% Remote work is the future of work

84% I am able to accomplish all of my tasks remotely

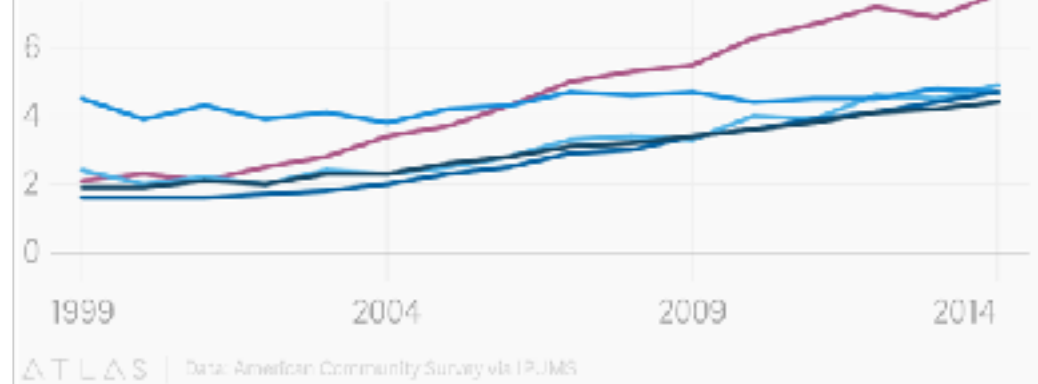
84% My leadership team understands what it takes to operate a team remotely

62% I would consider leaving my co-located company for a remote role

Programmers are most likely to work from home

Computer science Art, design, and media Personal care
Business and finance Management

8% of all full-time employees



Advantages include:

- Control over how this identity was shared
- Flexibility of economically stable work
- Autonomy to disengage and re-engage

1 [GitLab 2020 | The Remote Work Report] —pre pandemic report

2 Denae Ford, Reed Milewicz, Alexander Serebrenik. How Remote Work Can Foster a More Inclusive Environment for Transgender Developers. <https://dl.acm.org/doi/10.1109/GE.2019.00011>

3 [Groskopf 2017 | Data: American Community Survey via IPUMS]

PANDEMIC REMOTE WORK STUDIES



**PANDEMIC
WORK**

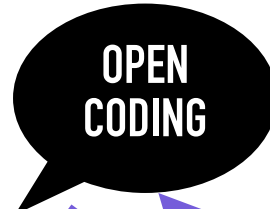
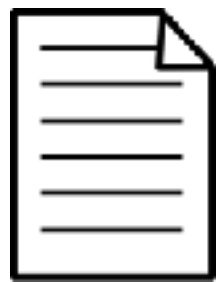


**REMOTE
ONBOARDING**



**TEAM
PRODUCTIVITY**

APPROACHES



**267 responses
(26.7% response rate)**

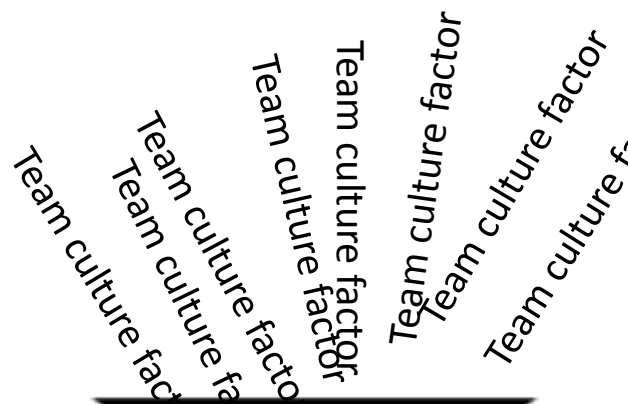
REMOTE ONBOARDING



**608 responses
(18% response rate)**

Model with All Factors
AIC Backwards Stepwise Regression

TEAM PRODUCTIVITY



Team culture factor
Team culture factor
Team culture factor

Final Reduced Model



SELECTED FINDINGS

Challenges Faced

- Not comfortable asking for help
- Can't find someone to help them
- Hard time forming & sustaining team connections
- Can't find correct documentation
- Hardware and Permissions

Helpful Workarounds

- Have active communication channels
- Group-determined communication standards
- Assign Onboarding Buddy
- Assign a Tech Mentor AND Org Mentor
- Include social activities as part of 'work'

SELECTED FINDINGS

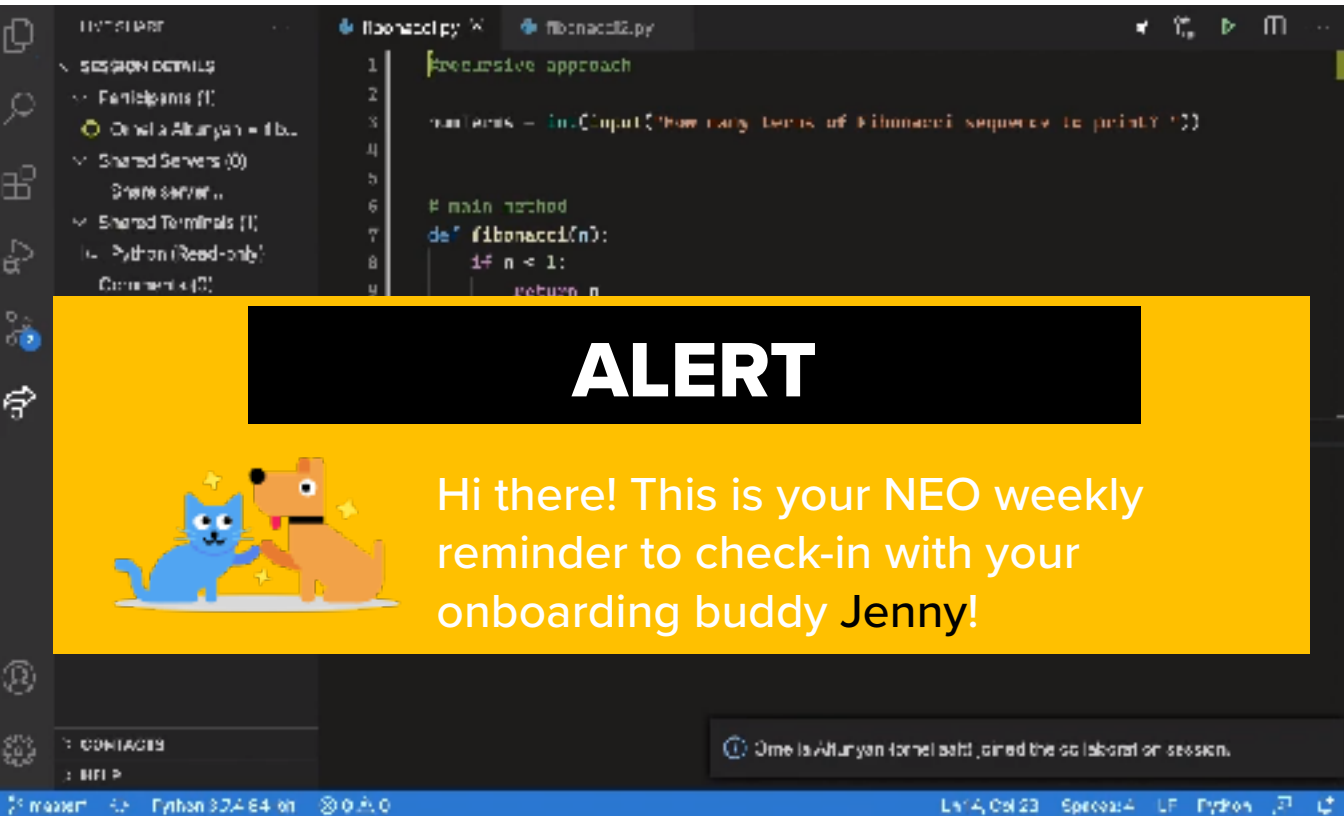
Challenges Faced

Helpful Workarounds

How can we scale these workarounds?

- Hard time forming & sustaining team connections
- Can't find correct documentation
- Hardware and Permissions
- Assign Onboarding Buddy
- Assign a Tech Mentor AND Org Mentor
- Include social activities as part of 'work'

OPPORTUNITIES TO SCALE SUPPORT



Helpful Workarounds

- ❑ Have active communication channels

- ❑ Group-determined communication standards

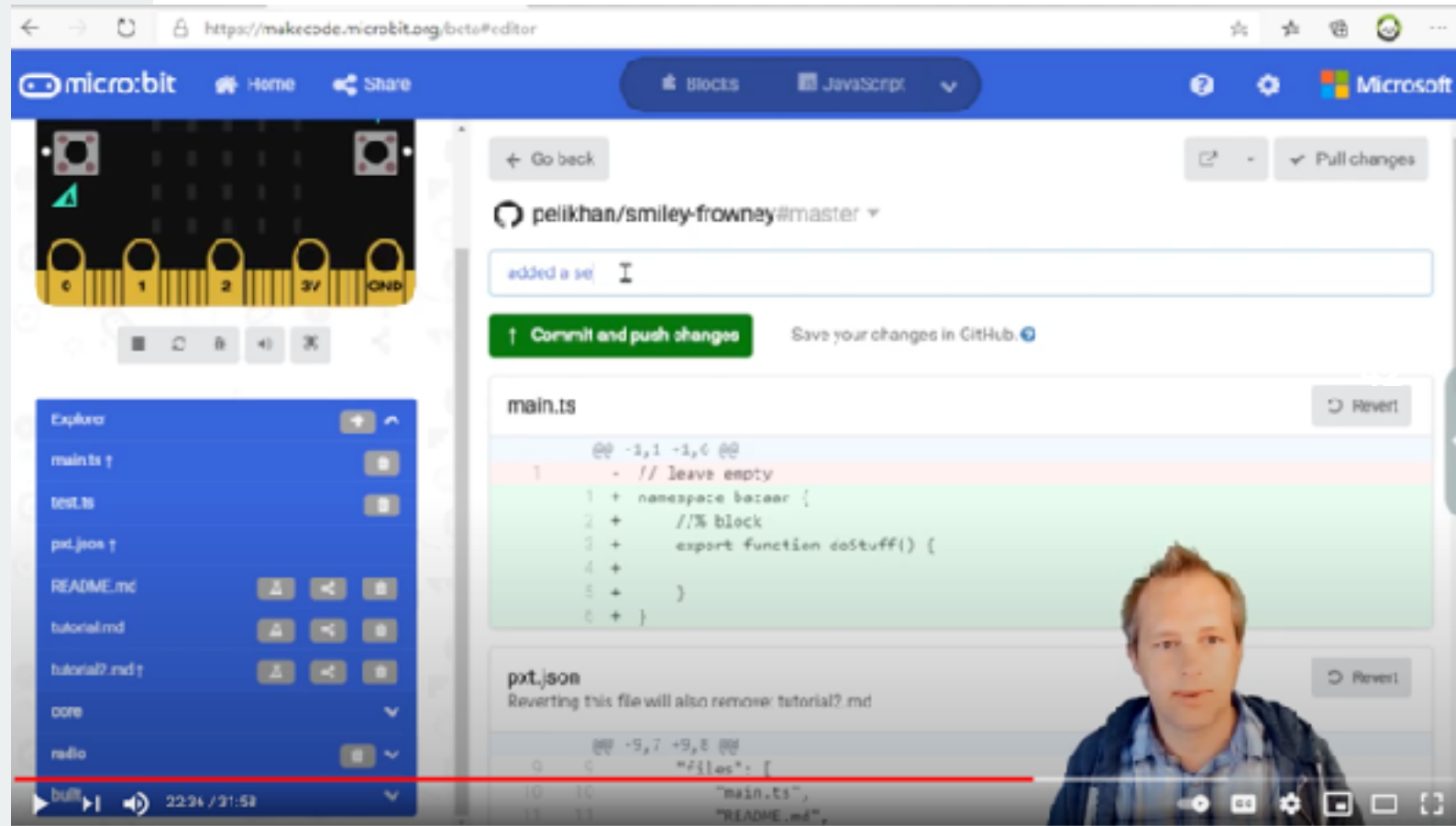
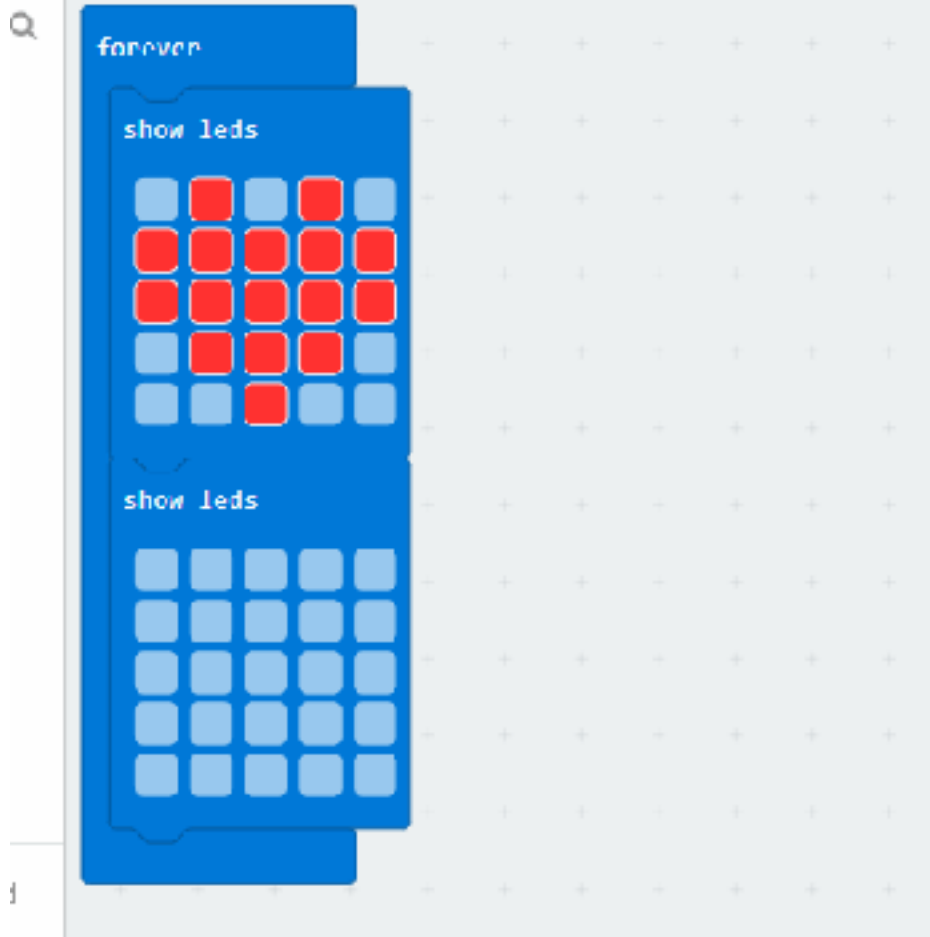
- ❑ Assign Onboarding Buddy

- ❑ Assign a Tech Mentor AND Org Mentor

- ❑ Include social activities as part of 'work'

PROJECTS TO KEEP ON THE RADAR

LOW CODE V. NO CODE W/ MAKE CODE



BRINGING DEVELOPMENT TO WHERE THE NEXT GENERATION IS NOW

The image shows a VS Code editor window with two tabs: `fibonacci.py` and `fibonacci2.py`. The code in `fibonacci.py` is as follows:

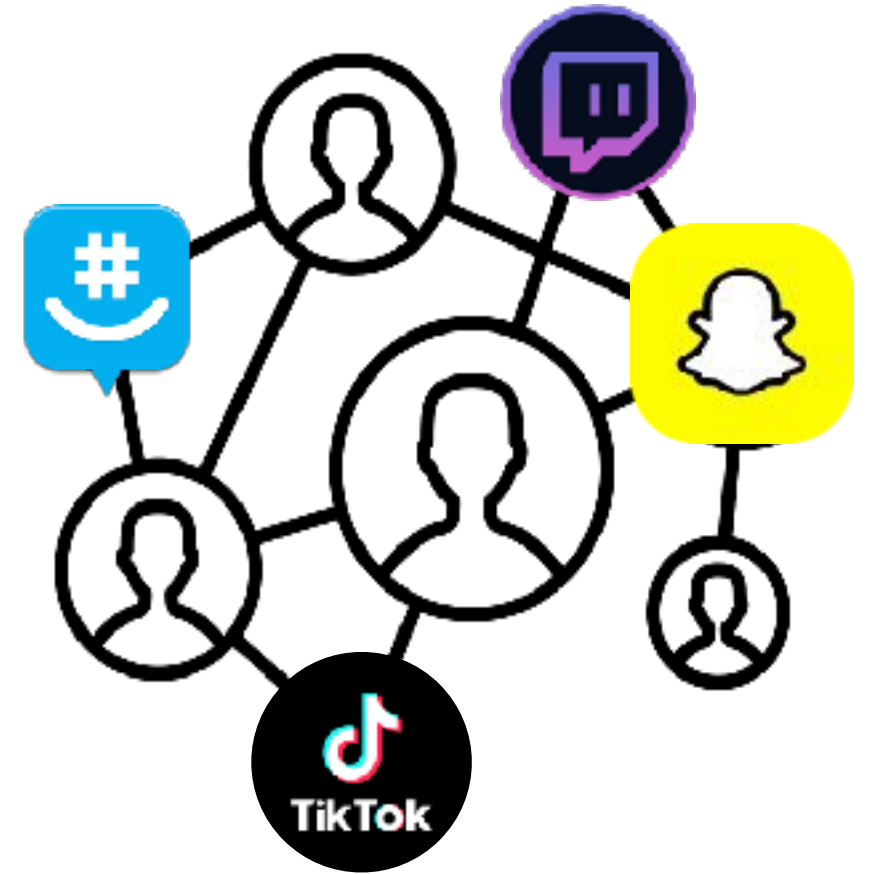
```
1  #recursive approach
2
3  numTerms = int(input("How many terms of Fibonacci sequence to print? "))
4
5
6
```

A collaboration overlay is shown in the center, displaying a notification: "Ornella Altunyan (ornellaalt) joined the collaboration session." Below the notification, the status bar shows "Ln 14, Col 23 Spaces: 4 LF Python".

Below the overlay, the VS Code editor shows the following code:

```
18  print("Fibonacci sequence:")
19  for i in range(numTerms):
20      print(fibonacci(i))
21
```

A yellow arrow points from the notification area to the code. The bottom status bar shows "Ln 14, Col 23 Spaces: 4 LF Python".



WHAT DOES THIS MEAN FOR AI-ASSISTED PROGRAMMING ENVIRONMENTS?



GitHub
Copilot

 tabnine

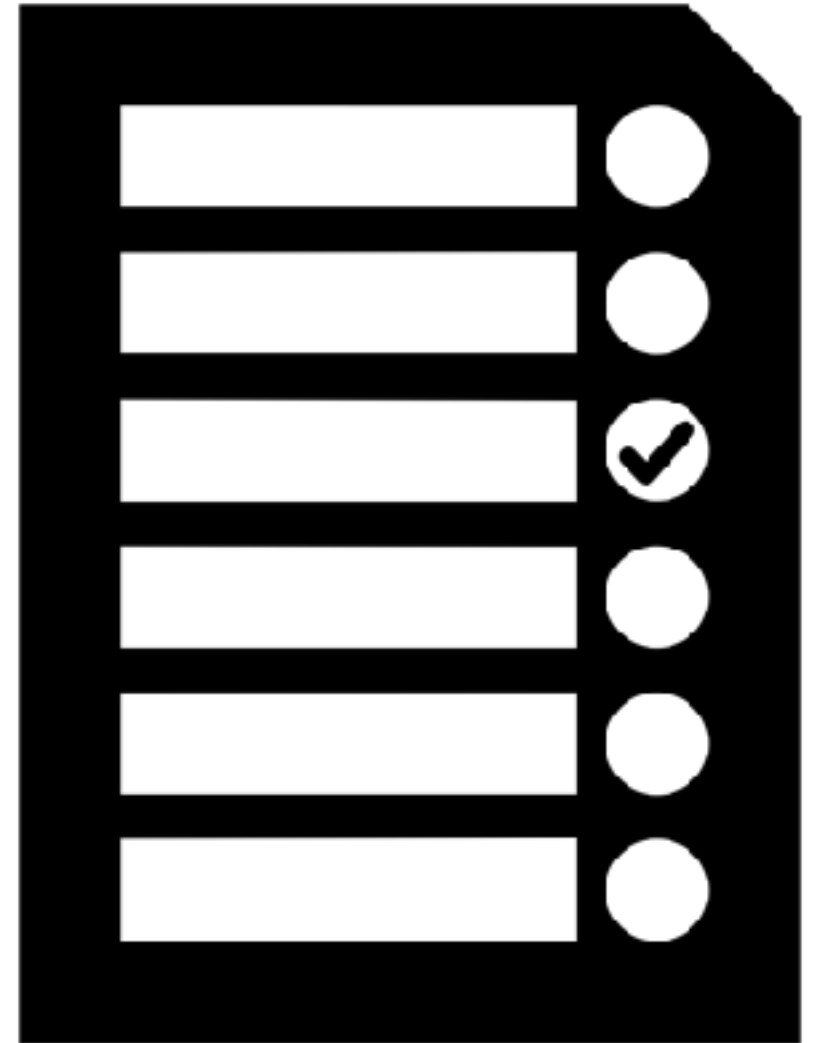
Code faster with AI code completions

```
parse_expenses.py write_sol.go sentiment.py addresses.rb  
1 cl  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17
```

**WHAT WILL IT TAKE TO BE READY FOR THE NEXT
GENERATION?**

IT WILL TAKE...

- ❑ **Help newcomers overcome barriers.** No sustainable way for online communities to attract new contributors.
- ❑ Identify successful **retention techniques**.
- ❑ **Protect maintainers and contributors from burnout.** Community maintainers and moderators are overworked will eventually depart communities.
- ❑ **Reduce bad actors** who are engaging in toxic behavior (e.g., malicious commits).
- ❑ Enable new approaches to **scale community growth**.
- ❑ **Build upon metrics** for understanding healthy communities that can be calculated.



~~How do we empower more people to become software developers?~~

What are we doing **NOW** that prepares us for the next generation of software developers?

THANKS TO MY AMAZING COLLABORATORS



SUMMARY

The next generation of software developers will **broaden the definition of 'who' a software developer can be.**

Online programming communities (OPCs) will be the way this next generation gets ushered in. **It's already happening!**

Vision: How can we **empower and connect** the next generation of software devs through the communities they engage in now?

THANK YOU



The next generation of software developers will **broaden the definition of 'who' a software developer can be.**

Online programming communities (OPCs) will be the way this next generation gets ushered in. **It's already happening!**

Vision: How can we **empower and connect** the next generation of software devs through the communities they engage in now?



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