

The GitHub Graph: Characterizing Open-Source Collaboration Patterns

Emilie Ma

(<https://emilie.ma> + hello@emilie.ma)

In collaboration with Professors Cleidson de Souza (Universidade Federal do Pará), Dongwook Yoon (UBC), & Ivan Beschastnikh (UBC)

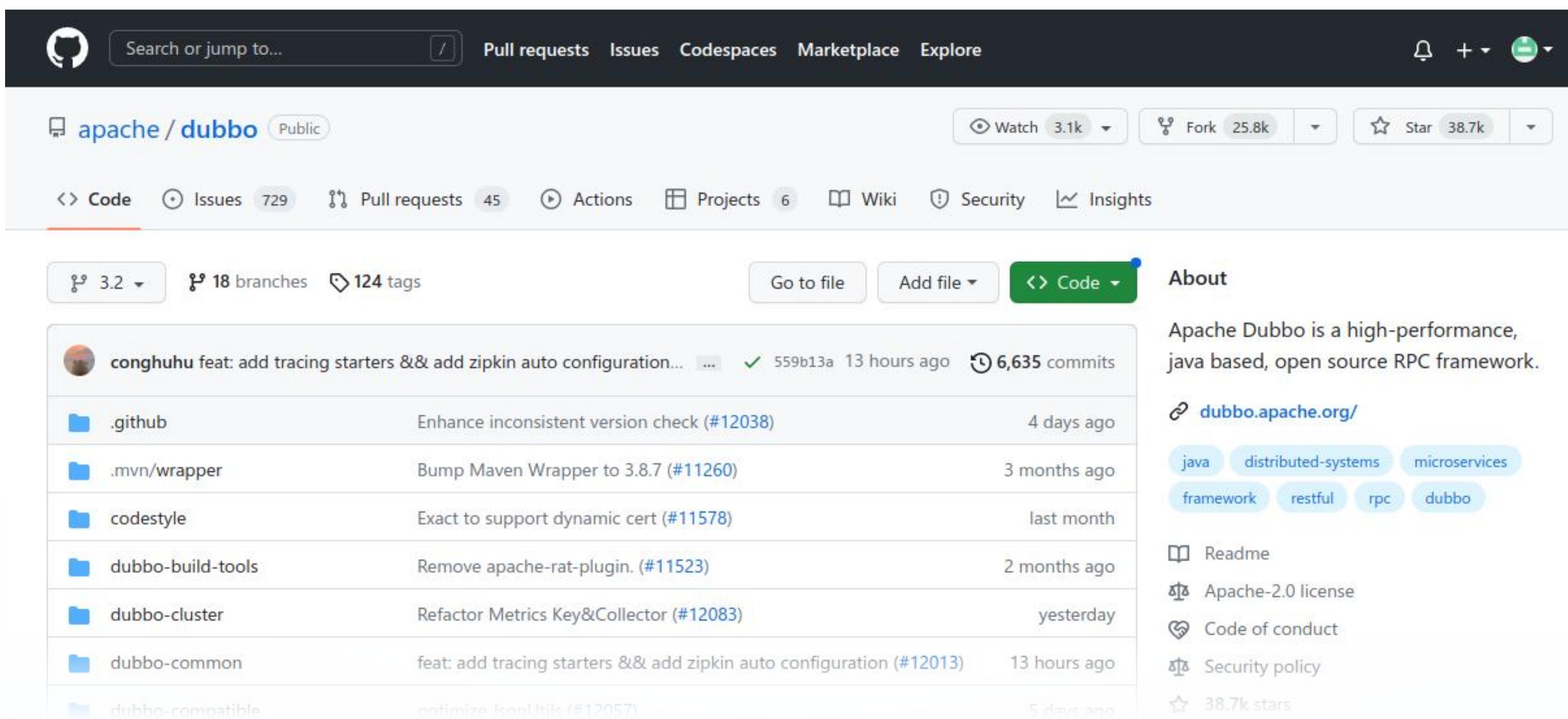
Follow along at emilie.ma/ossna2024

In this talk:

- novel collaboration patterns we observed in OSS
- PR-Issue Graph attributes + implications
- **takeaway:** new outlook on managing OSS, know how to identify workflow types and their implications

Follow along at emilie.ma/ossna2024

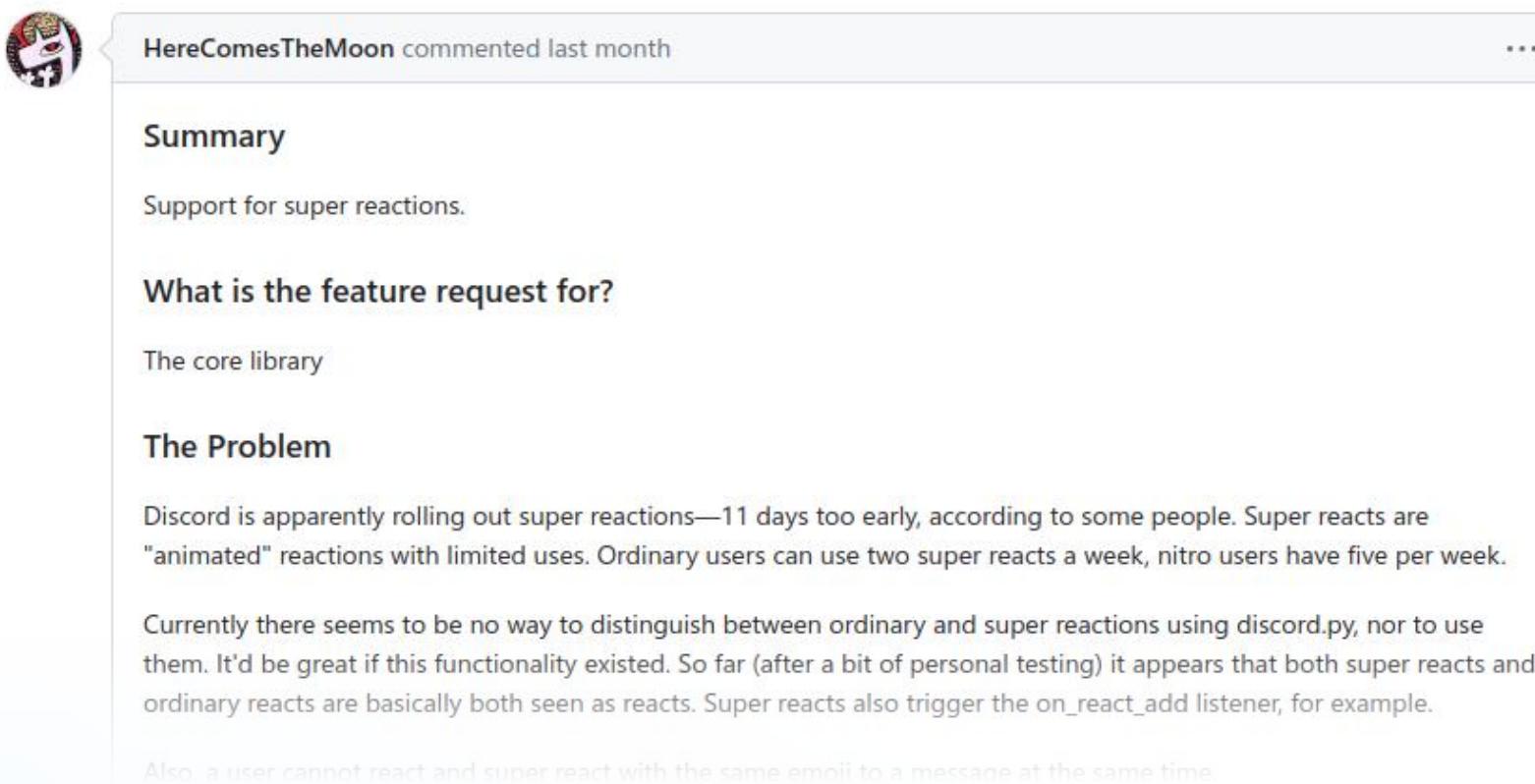
GitHub: “Where the world builds software”



Issues: bug reports, feature requests

Support for super reacts #9309

 Open HereComesTheMoon opened this issue last month · 1 comment



HereComesTheMoon commented last month

Summary
Support for super reactions.

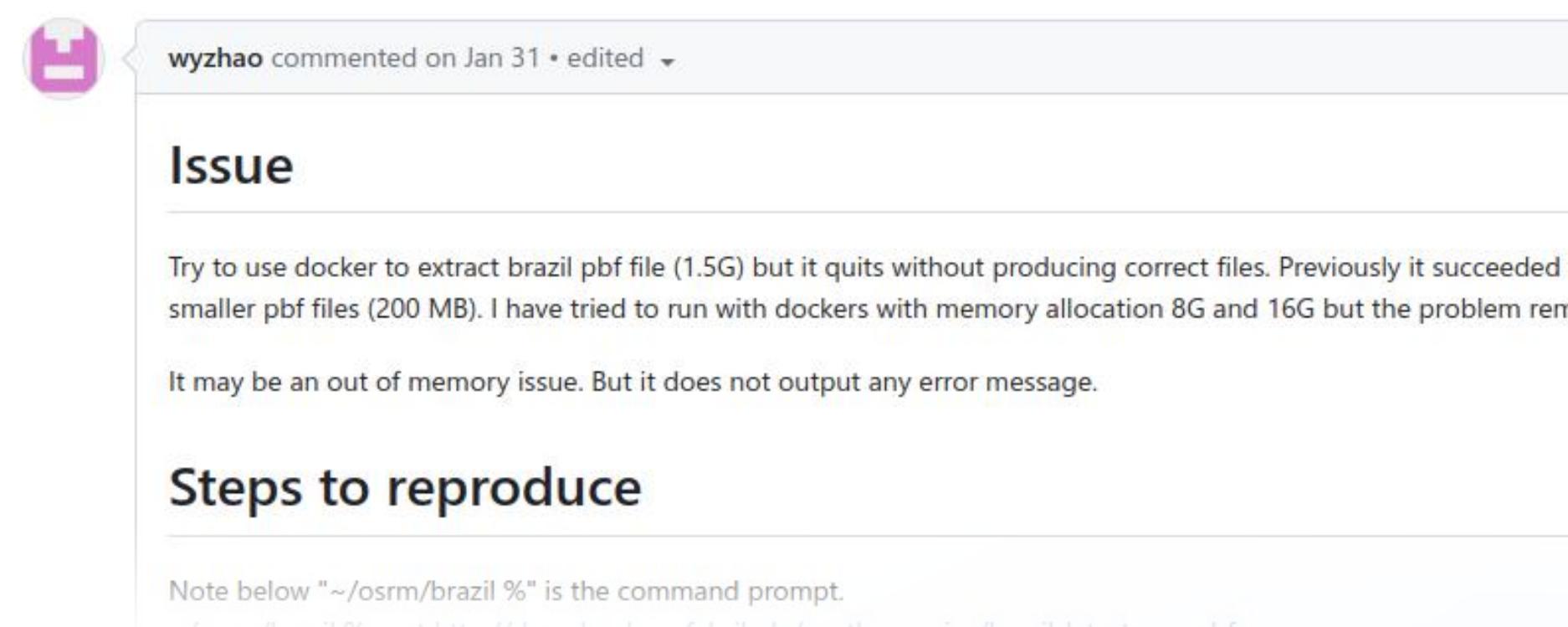
What is the feature request for?
The core library

The Problem
Discord is apparently rolling out super reactions—11 days too early, according to some people. Super reacts are "animated" reactions with limited uses. Ordinary users can use two super reacts a week, nitro users have five per week.
Currently there seems to be no way to distinguish between ordinary and super reactions using discord.py, nor to use them. It'd be great if this functionality existed. So far (after a bit of personal testing) it appears that both super reacts and ordinary reacts are basically both seen as reacts. Super reacts also trigger the on_react_add listener, for example.
Also, a user cannot react and super react with the same emoji to a message at the same time.

Rapptz/discord.py

osrm-extract failed to extract a large pbf file #6533

 Closed wyzhao opened this issue on Jan 31 · 8 comments



wyzhao commented on Jan 31 · edited

Issue
Try to use docker to extract brazil pbf file (1.5G) but it quits without producing correct files. Previously it succeeded for smaller pbf files (200 MB). I have tried to run with dockers with memory allocation 8G and 16G but the problem remains.
It may be an out of memory issue. But it does not output any error message.

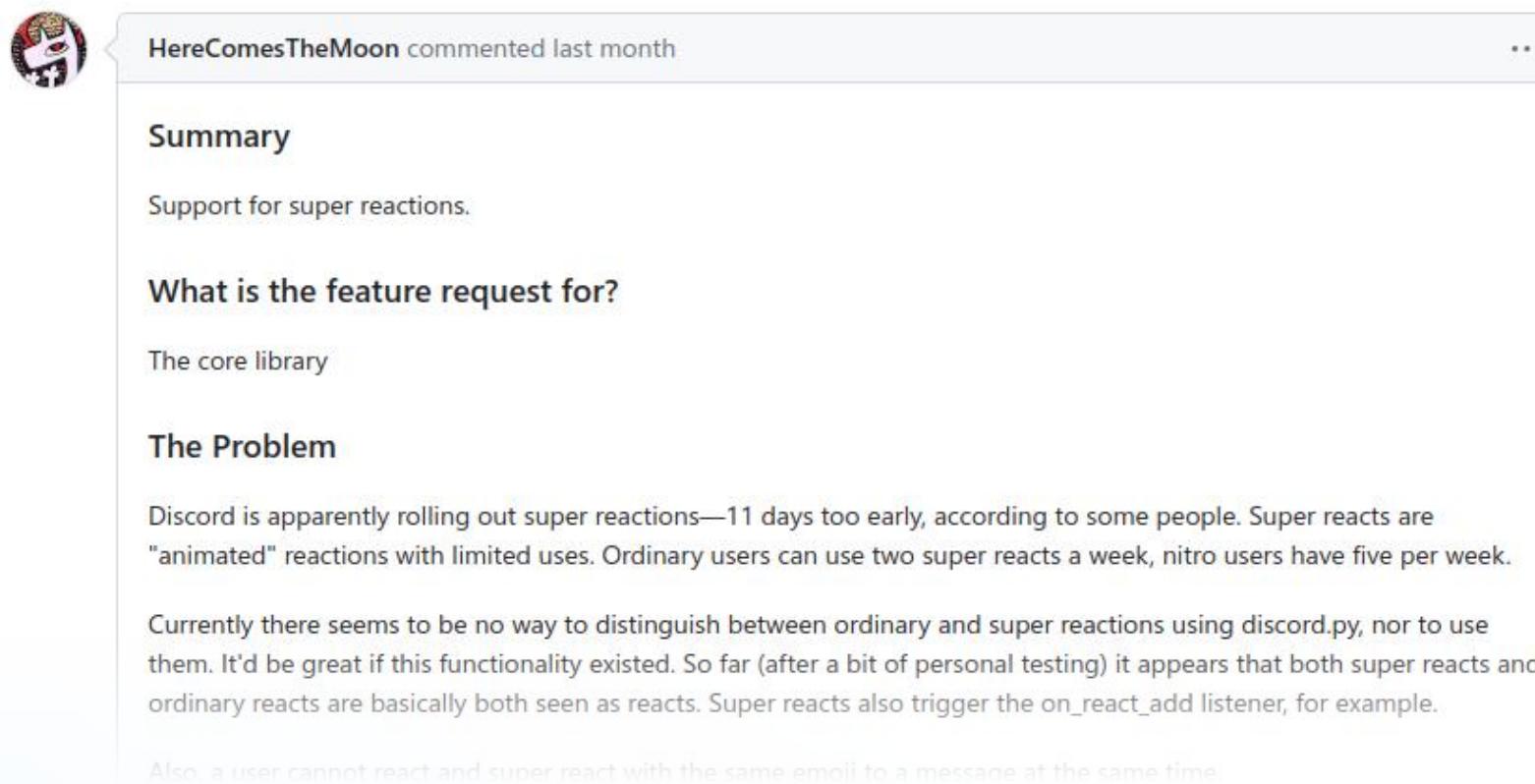
Steps to reproduce

Note below "~/osrm/brazil %" is the command prompt.
~/osrm/brazil % wget http://download.geofabrik.de/south-america/brazil-latest.osm.pbf

Project-OSRM/osrm-backend

Issues: bug reports, feature requests

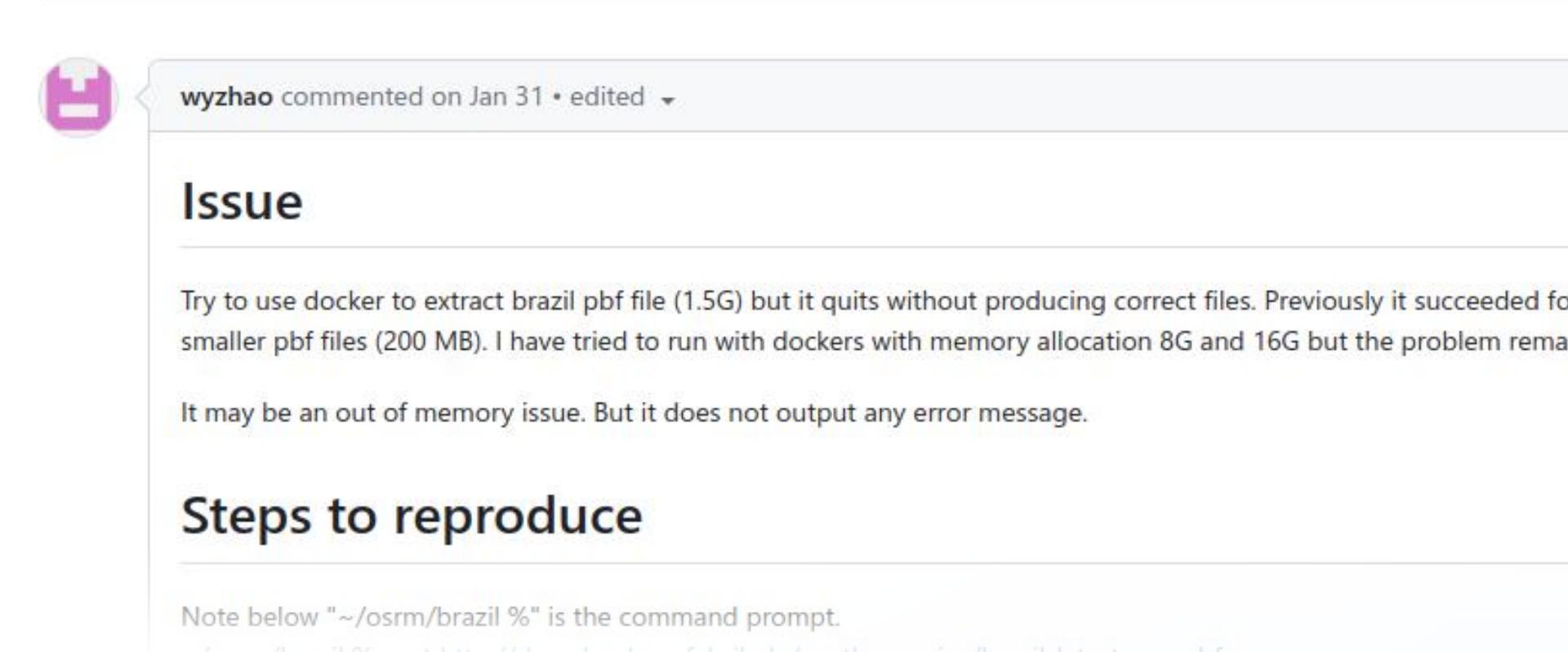
Support for super reacts #9309
unfixed →  HereComesTheMoon opened this issue last month · 1 comment



The screenshot shows a GitHub issue page for pull request #9309. The title is "Support for super reacts". The status is "unfixed" with a green "Open" button. A comment from "HereComesTheMoon" is visible, dated "last month". The comment text includes sections for "Summary", "What is the feature request for?", and "The Problem", detailing the issue with Discord's implementation of super reactions.

Rapptz/discord.py

osrm-extract failed to extract a large pbf file #6533
addressed →  wyzhao opened this issue on Jan 31 · 8 comments



The screenshot shows a GitHub issue page for pull request #6533. The title is "osrm-extract failed to extract a large pbf file". The status is "closed" with a purple "Closed" button. A comment from "wyzhao" is visible, dated "on Jan 31". The comment text includes sections for "Issue" and "Steps to reproduce", detailing the problem with extracting large OSM files using osrm-extract.

Project-OSRM/osrm-backend

Pull Requests: work addressing an Issue

Fix: "Source Run" field in Model Version UI page points to wrong run model artifact in Run UI page #8156

Merged WeichenXu123 merged 10 commits into mlflow:master from WeichenXu123:bug-8150 3 days ago

Conversation 36 Commits 10 Checks 24 Files changed 4 +61 -3

WeichenXu123 commented 2 weeks ago • edited

Related Issues/PRs

#8150

What changes are proposed in this pull request?

Fix: "Source Run" field in Model Version UI page points to wrong run model artifact in Run UI page

Closes #8150

How is this patch tested?

Existing unit/integration tests
 New unit/integration tests
 Manual tests (describe details, including test results, below)

Reviewers

- harupy ✓
- dbczumar
- hubertzub-db ✓

Assignees

No one assigned

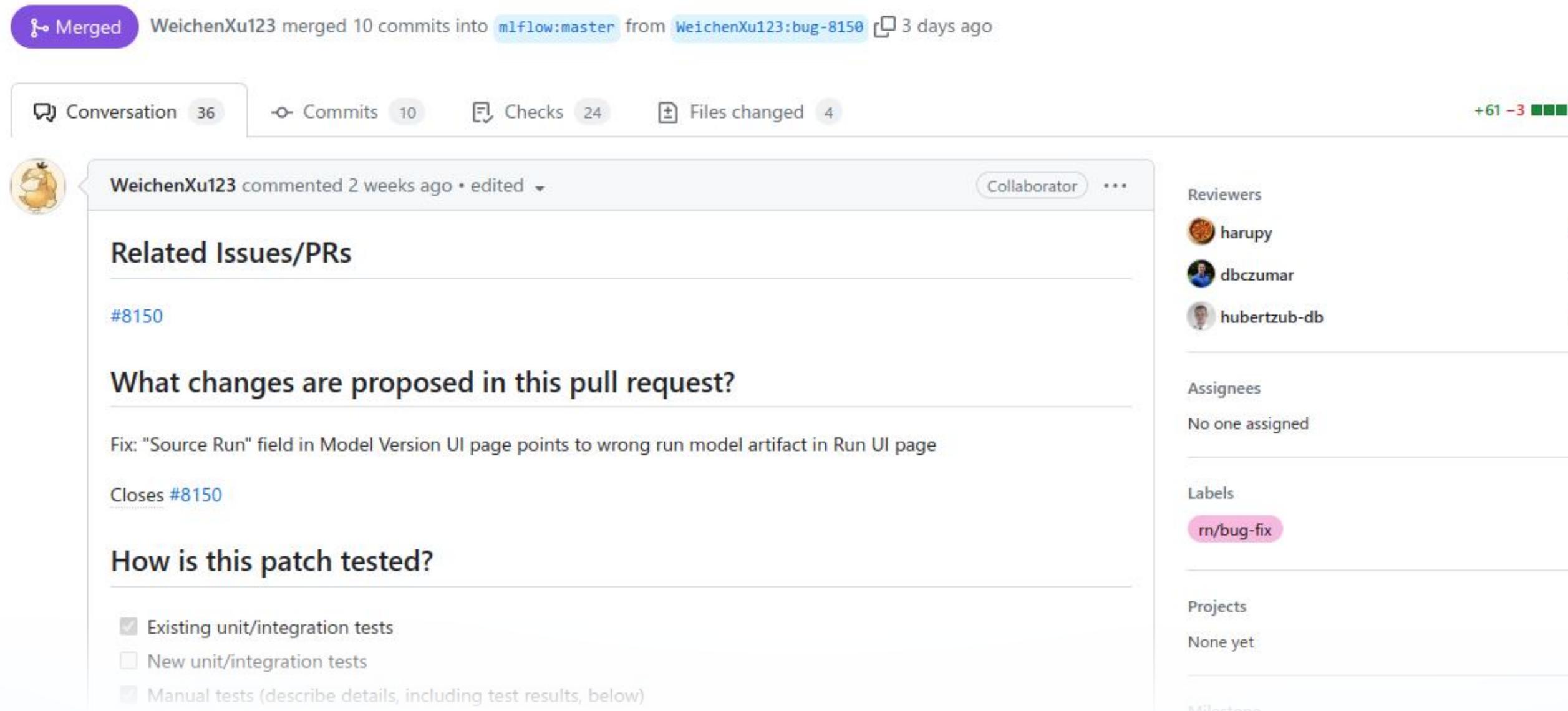
Labels

m/bug-fix

Projects

None yet

Milestone



mlflow/mlflow

Pull Requests: work addressing an Issue

work was accepted →
possible statuses:
open, closed, merged

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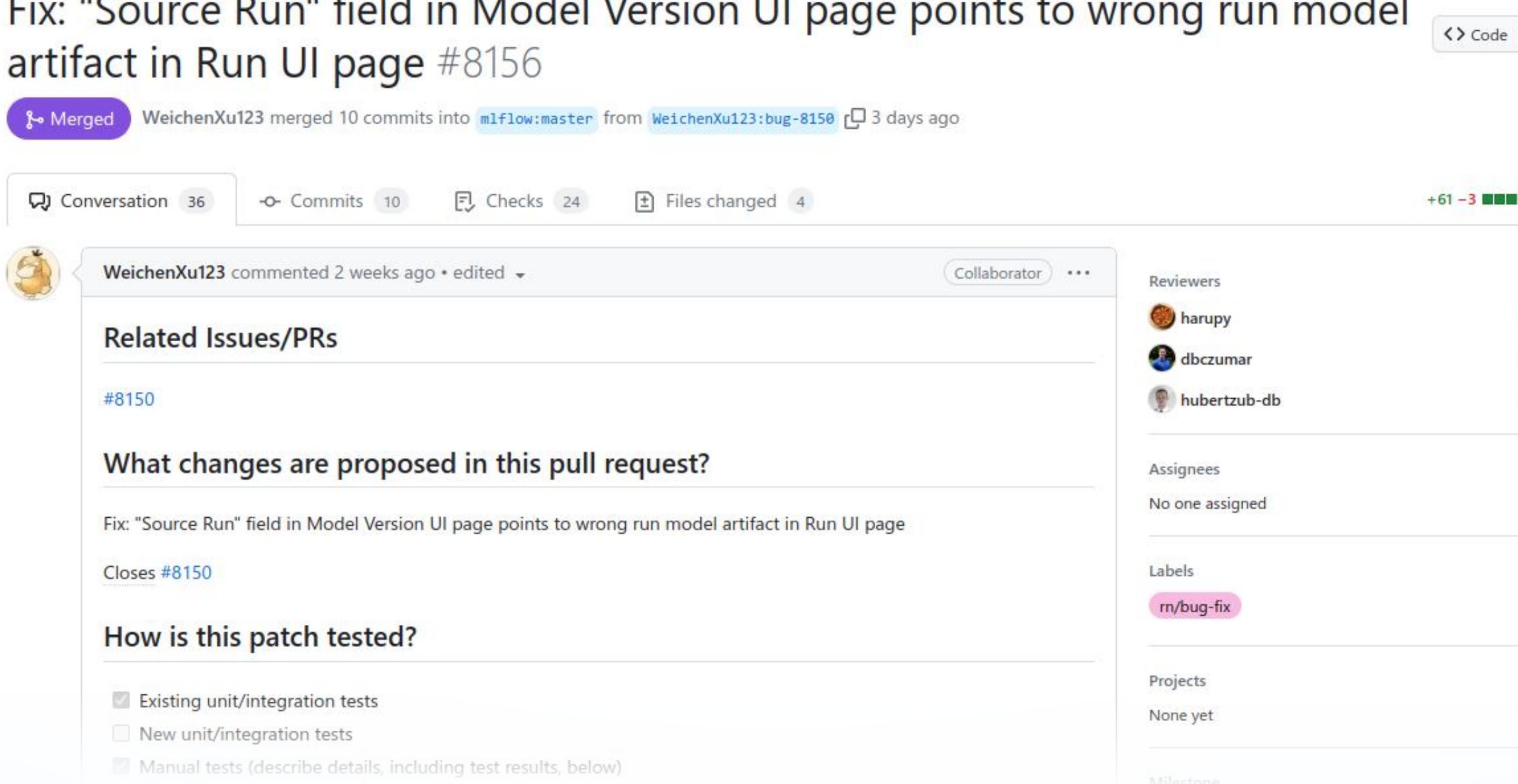
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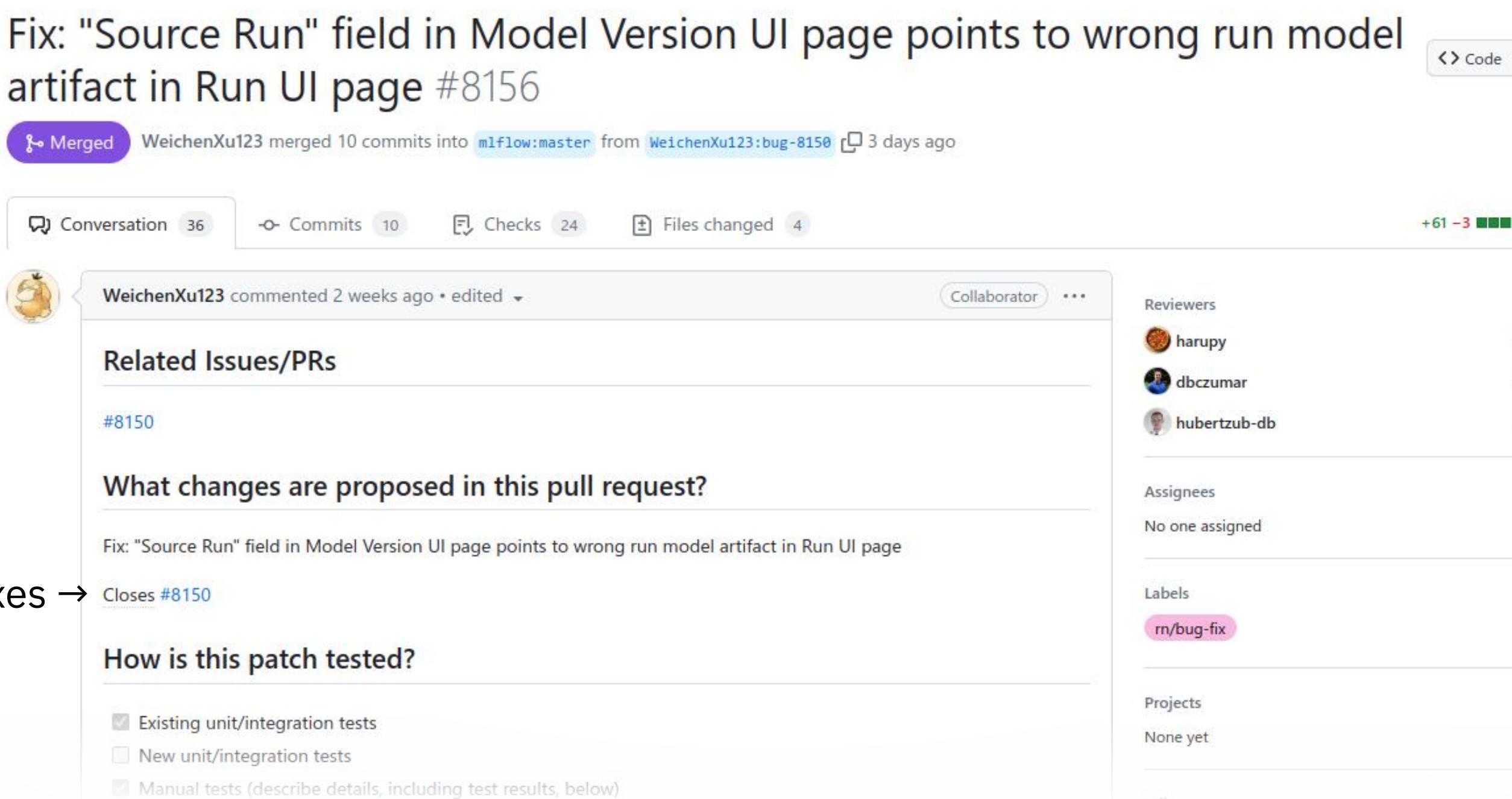
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Projects
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mlflow/mlflow

Issue ↔ PR = A link!

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Closed amesar opened this issue 2 weeks ago • 4 comments • Fixed by #8156

amesar commented 2 weeks ago

Willingness to contribute

No. I cannot contribute a bug fix at this time.

MLflow version

2.2.2

System information

- OS Platform and Distribution (e.g., Linux Ubuntu 16.04):
- Python version:
- yarn version, if running the dev UI:

Describe the problem

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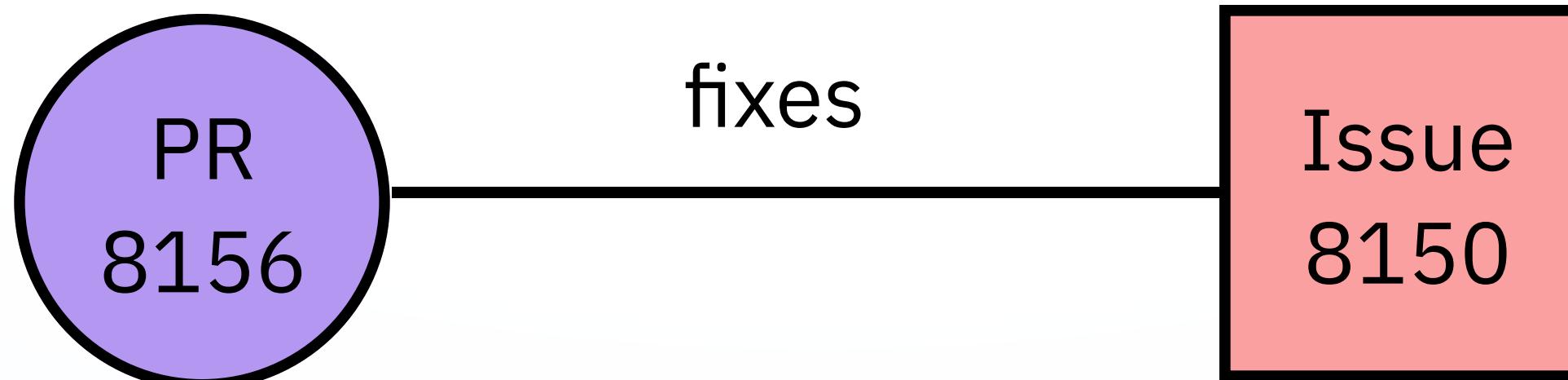
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Node Status



Merged



Open

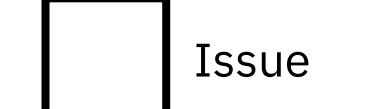


Closed

Node Type



Pull Request



Issue

Another explicit link: “duplicate”

message.stickers always return empty list #7186

 Closed  3 tasks done Poloin34 opened this issue on Jul 7, 2021 · 2 comments



Poloin34 commented on Jul 7, 2021

Summary

as title, stickers not listed and no way to get them (even just if there's one)



Rapptz commented on Jul 7, 2021

Duplicate of #7140. It's literally a few below this one. Search before opening an issue.



Missing Message.stickers #7140

 Closed  3 tasks done attendeeany opened this issue on Jun 30, 2021 · 6 comments



attendeeany commented on Jun 30, 2021

Summary

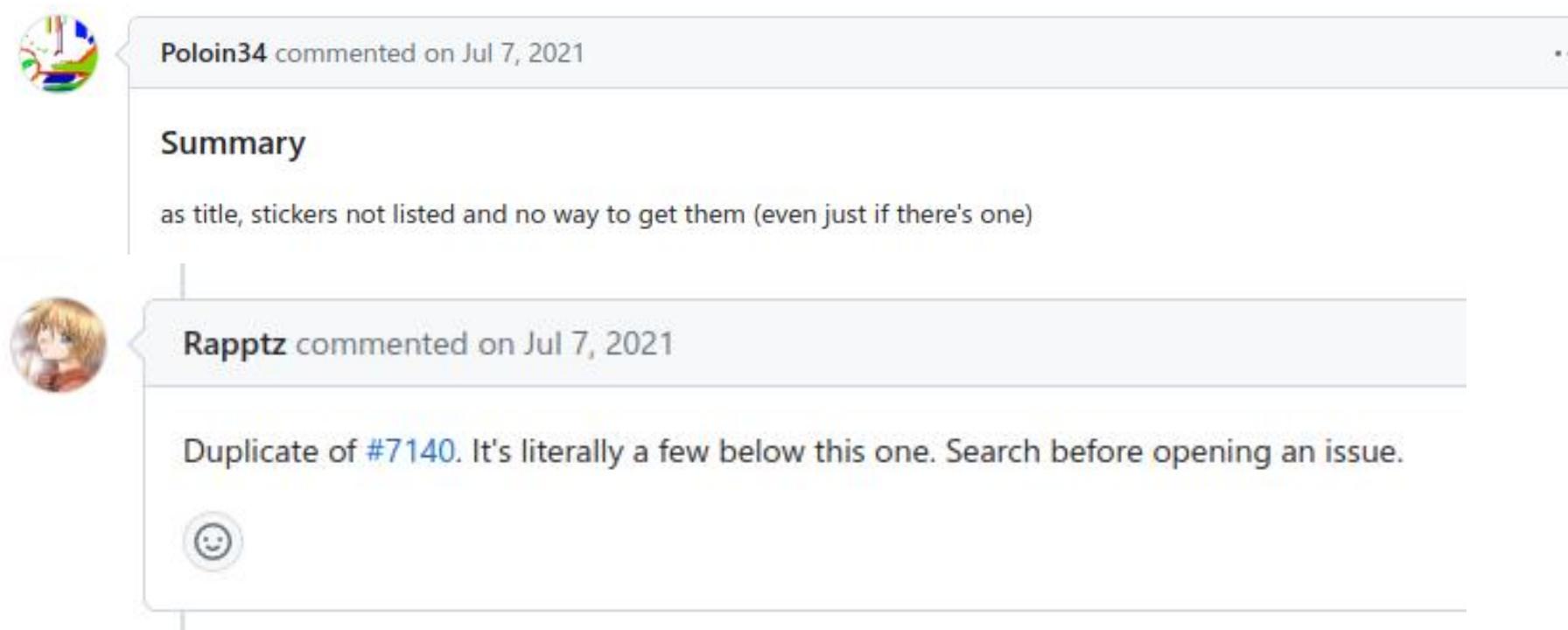
discord.Message.stickers is always empty

Rapptz/discord.py

Another explicit link: “duplicate”

message.stickers always return empty list #7186

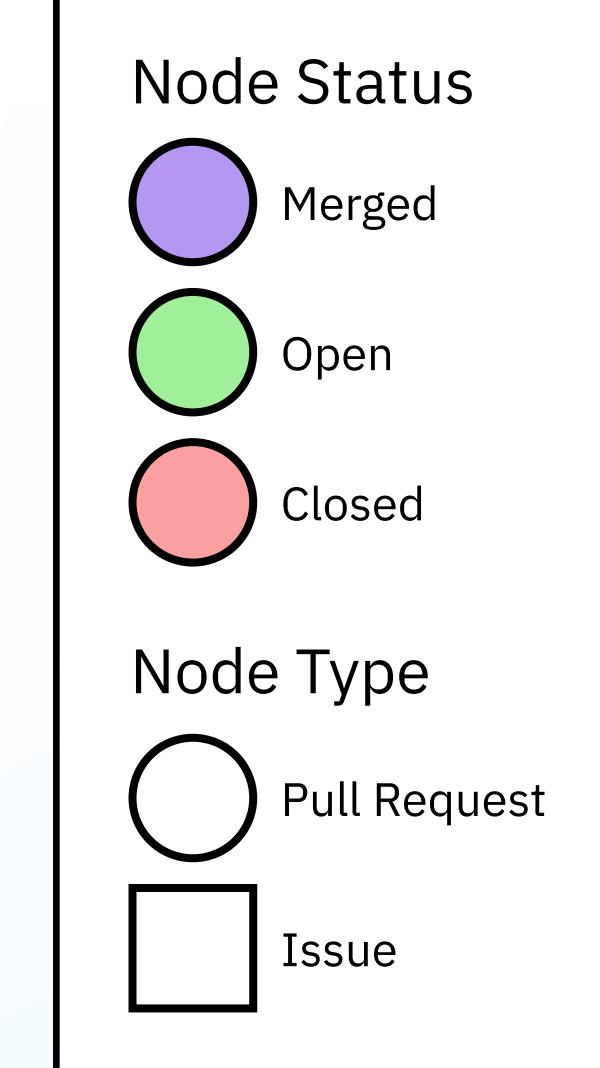
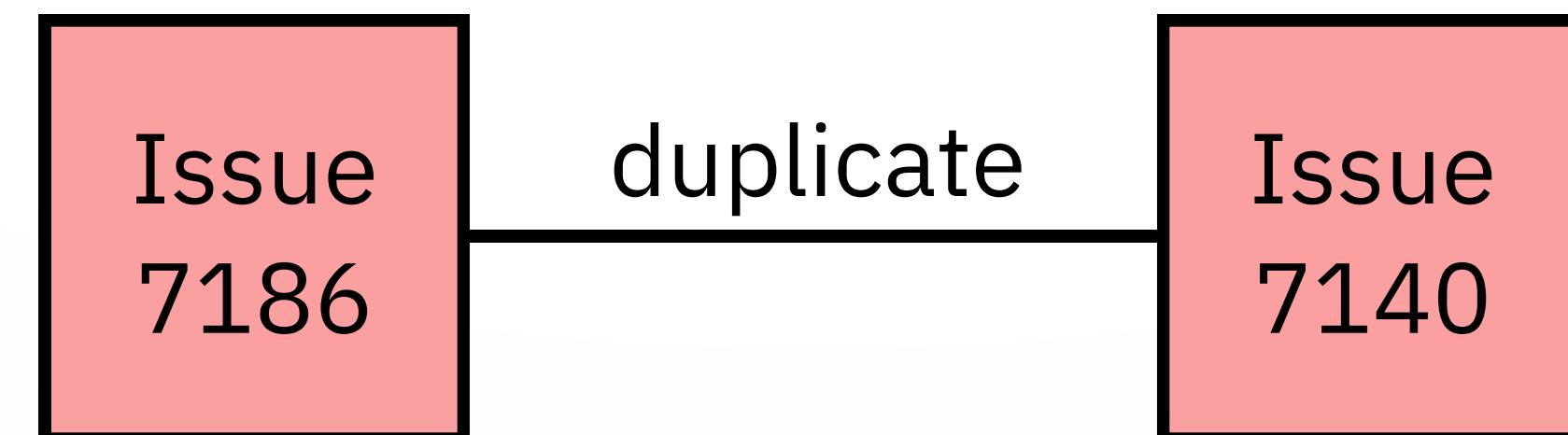
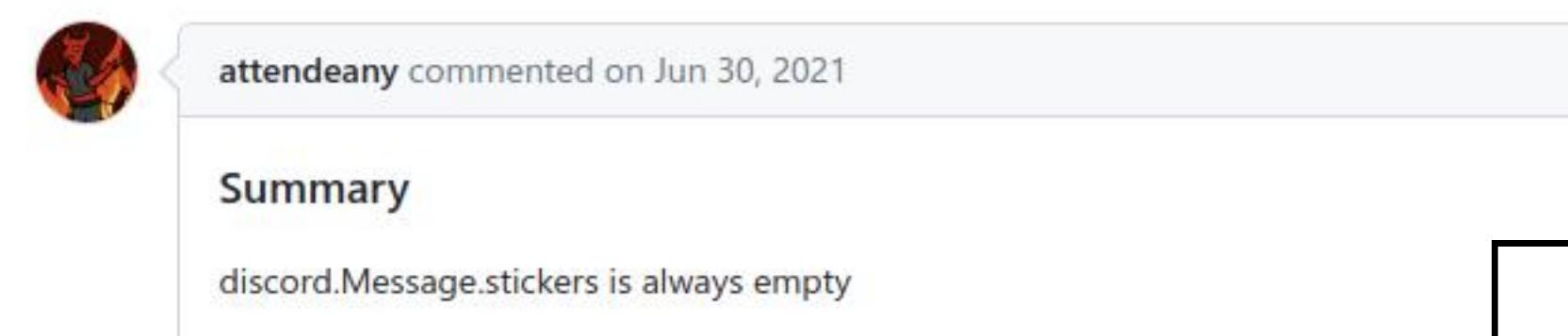
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Rapptz/discord.py

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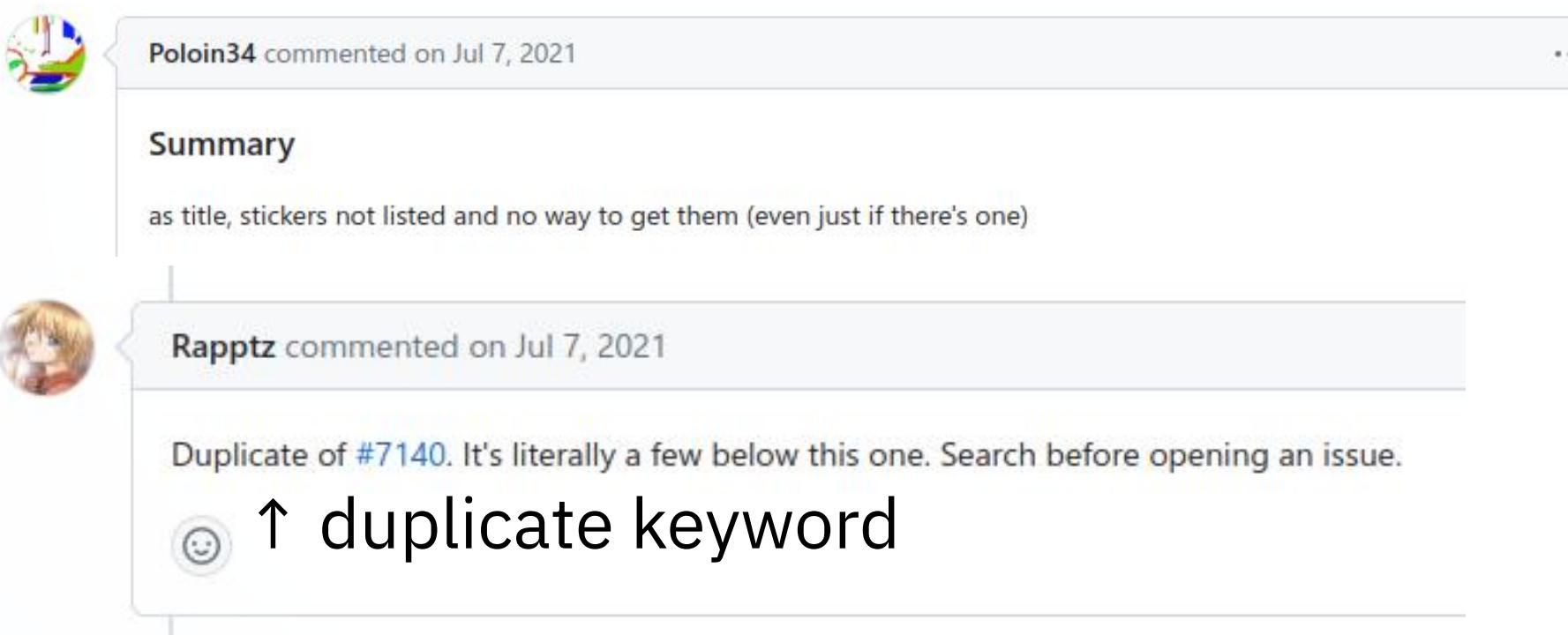


Another explicit link: “duplicate”

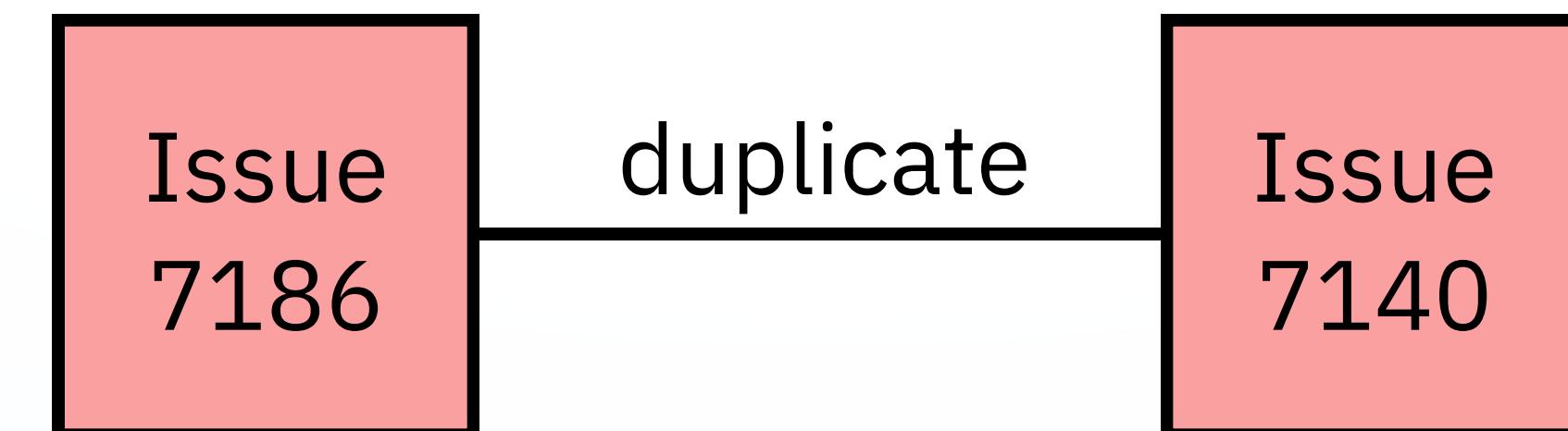
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↑ created later



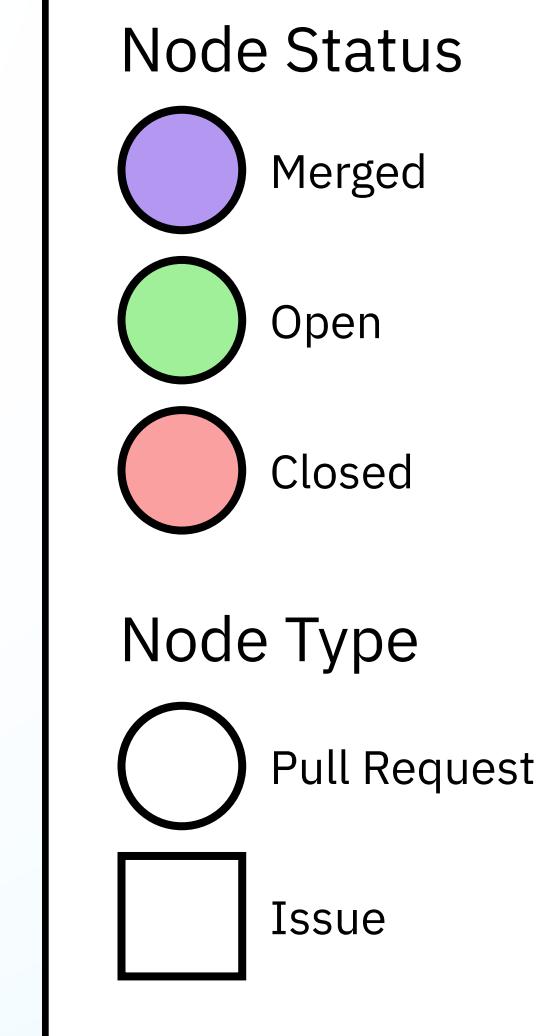
Rapptz/discord.py



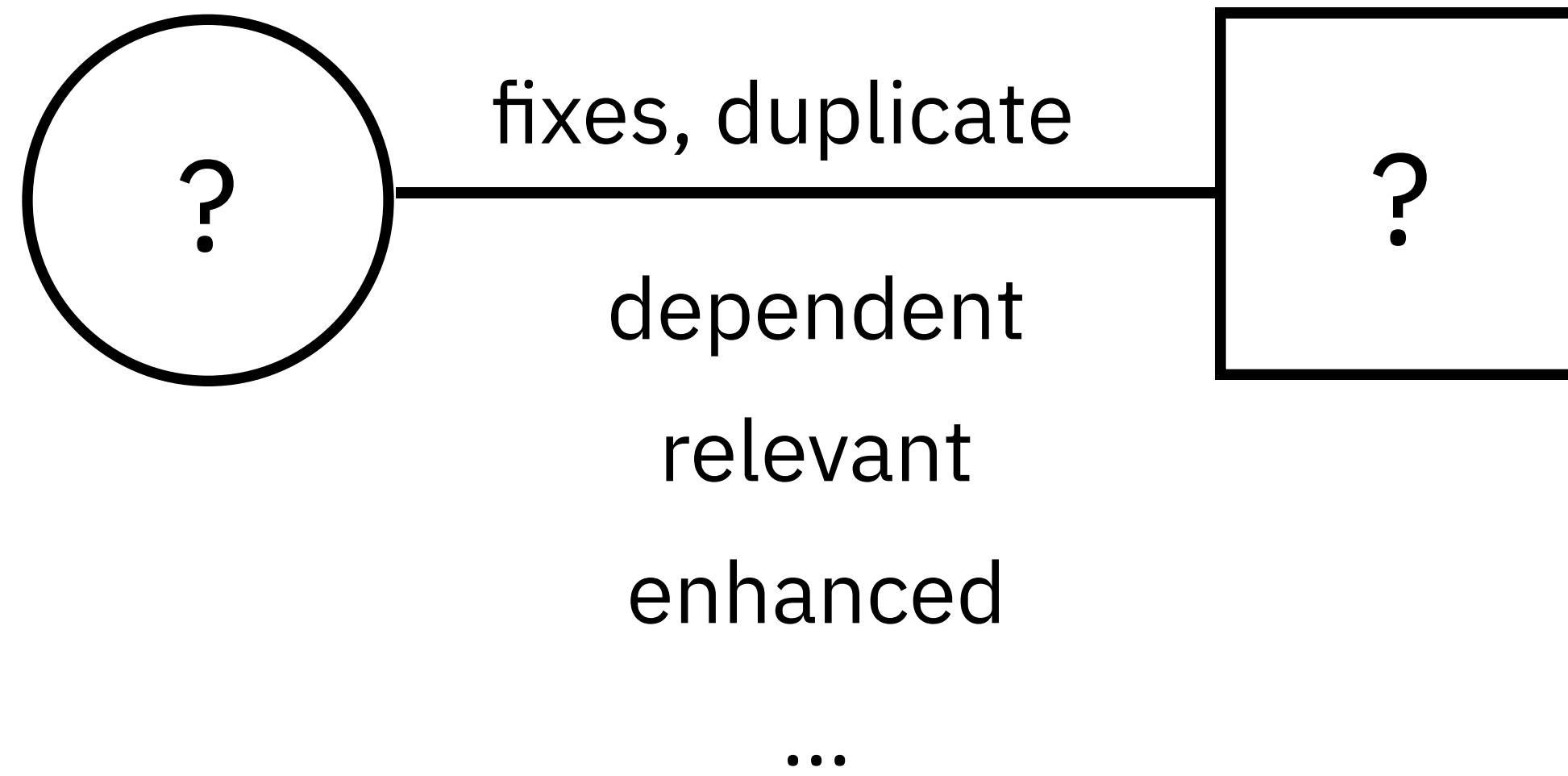
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↑ created earlier

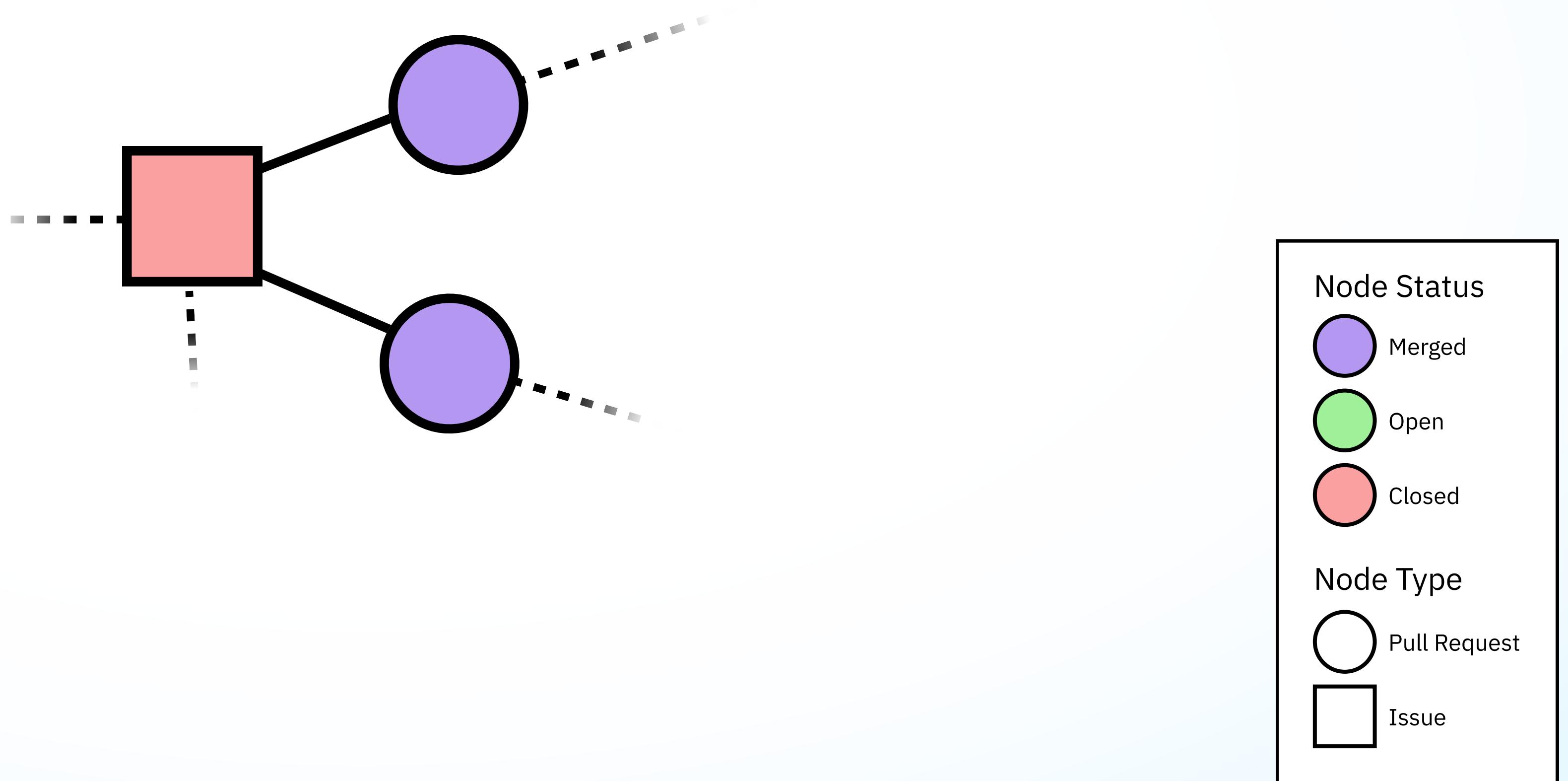


Prior work has focused on these links.

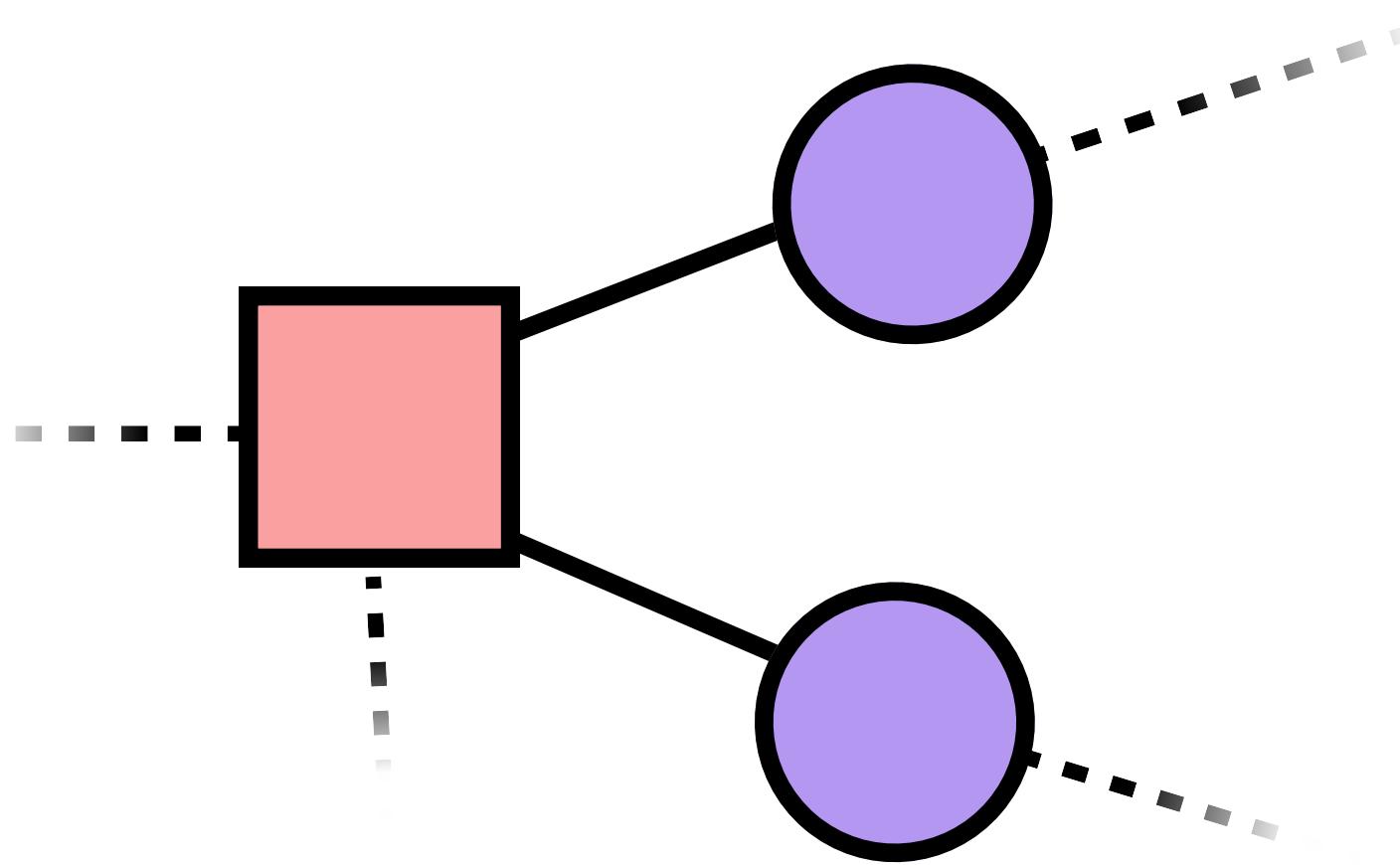


(“@alex, this fixes #9...”, Chopra et al., CSCW 2021;
“How Are Issue Units Linked?...”, Li et al., APSEC 2018;
“Understanding shared links and their intentions...”, Wang et al., ESE 2021;
“The review linkage graph for code review analytics...”, Hirao et al., ESEC/FSE 2019;
“Traceability Network Analysis...” Nicholson et al., AIRE 2020)

Going beyond links: Graph Perspective



Going beyond links: Graph Perspective

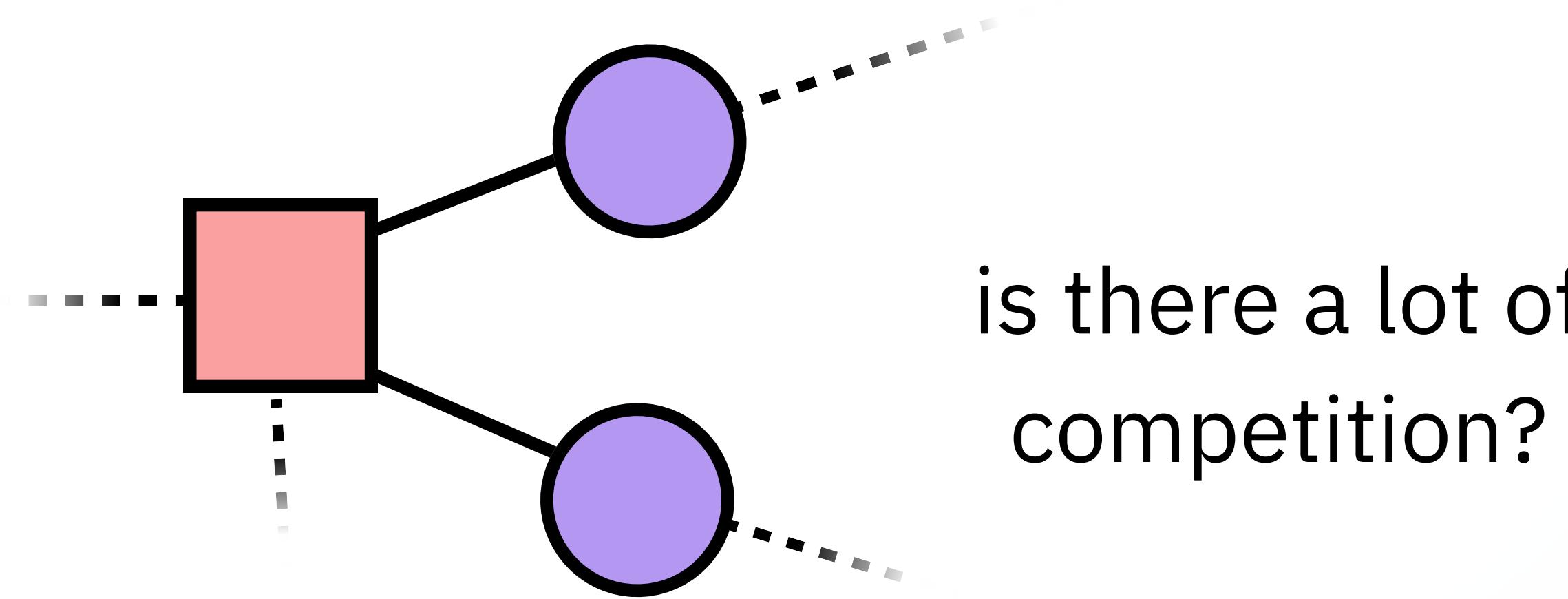


graph perspective = more context = richer
understanding of work practices

Node Status	
●	Merged
●	Open
●	Closed
Node Type	
	Pull Request
	Issue

Going beyond links: Graph Perspective

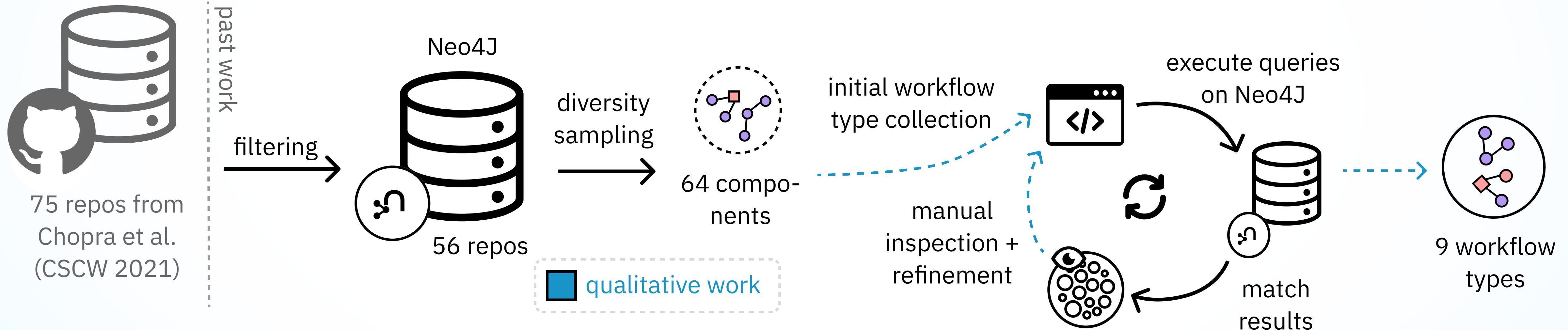
do developers break
their work up?



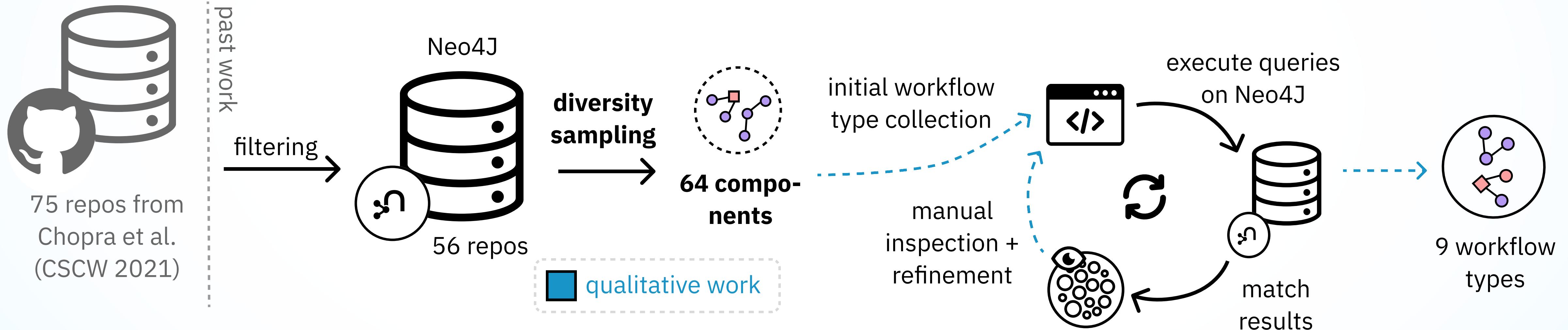
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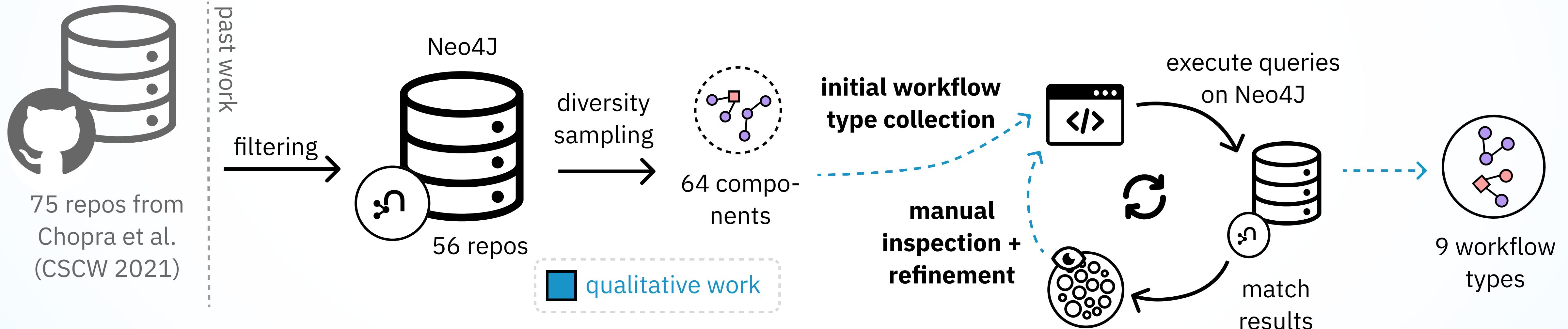
Analyzing 90K+ Issues and PRs with Neo4j



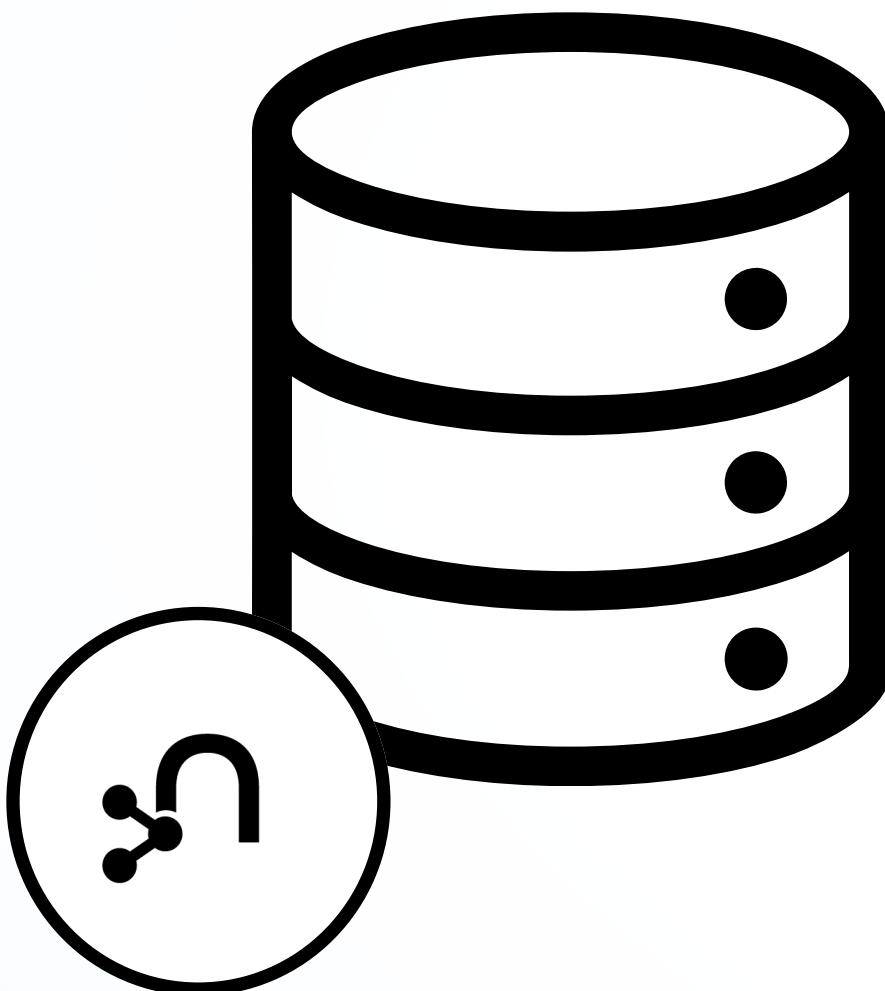
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Analyzing 90K+ Issues and PRs with Neo4j



Neo4j + Cypher Queries



Neo4j =
graph DBMS

The screenshot shows the Neo4j browser interface. On the left, there is a code editor window containing a Cypher query:

```
1 //Competition
2 match (i:issue)-[r {labels:"fixes"}]-(pr:pull_request)
3 where i.status = "closed"
4 with i, collect(distinct pr) as pull_requests, collect (distinct pr.user) as users
5 where size([p_r in pull_requests where p_r.status="merged"]) = 1 and size([p_r in pull_requests where p_r.status="closed"]) >= 1 and size(pull_requests) >= 2 and
size(users) > 1
6 return i, pull_requests
```

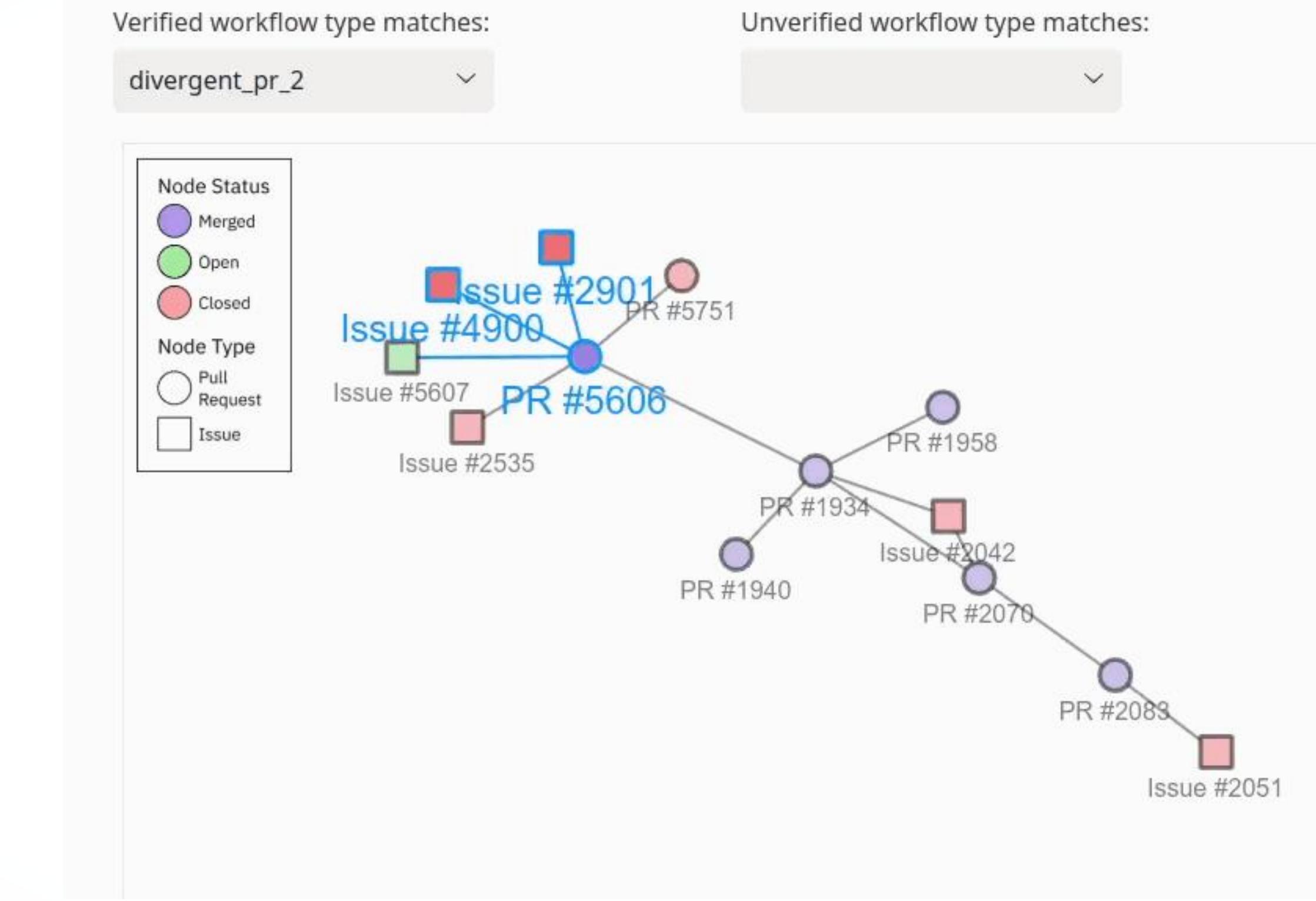
To the right of the code editor is a graph visualization area showing a complex network of nodes and relationships. The nodes are colored green and purple, and the relationships are shown as dashed lines. Below the graph is an "Overview" panel displaying statistics:

- Node labels:
 - * (111)
 - Issue (36)
 - pull_request (75)
- Relationship types:
 - * (103)
 - RELATED (103)
- Displaying 111 nodes, 0 relationships.

↑ used for qualitative coding and iteration

Workflows Explorer

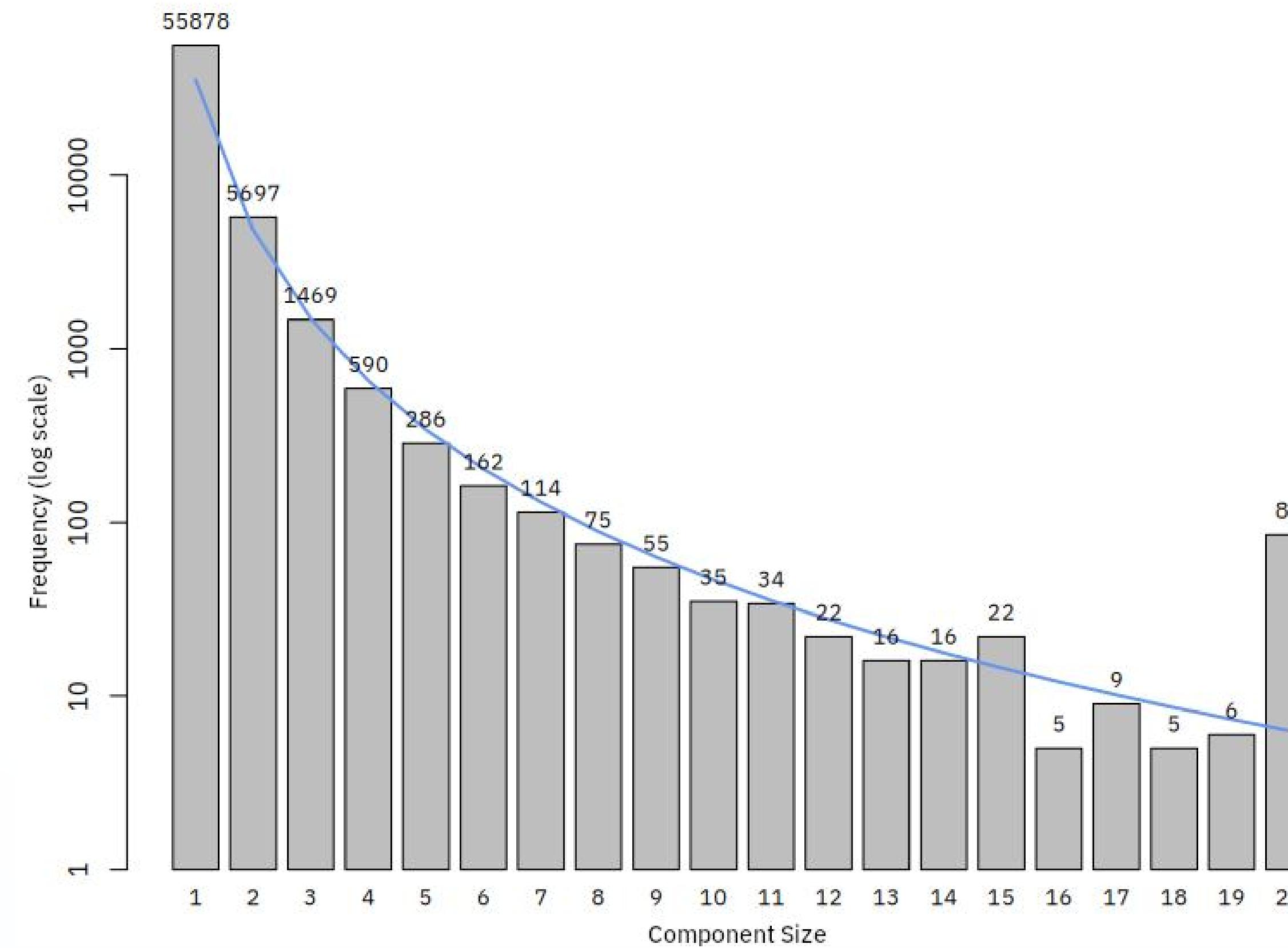
mlflow/mlflow Workflow Type Matches



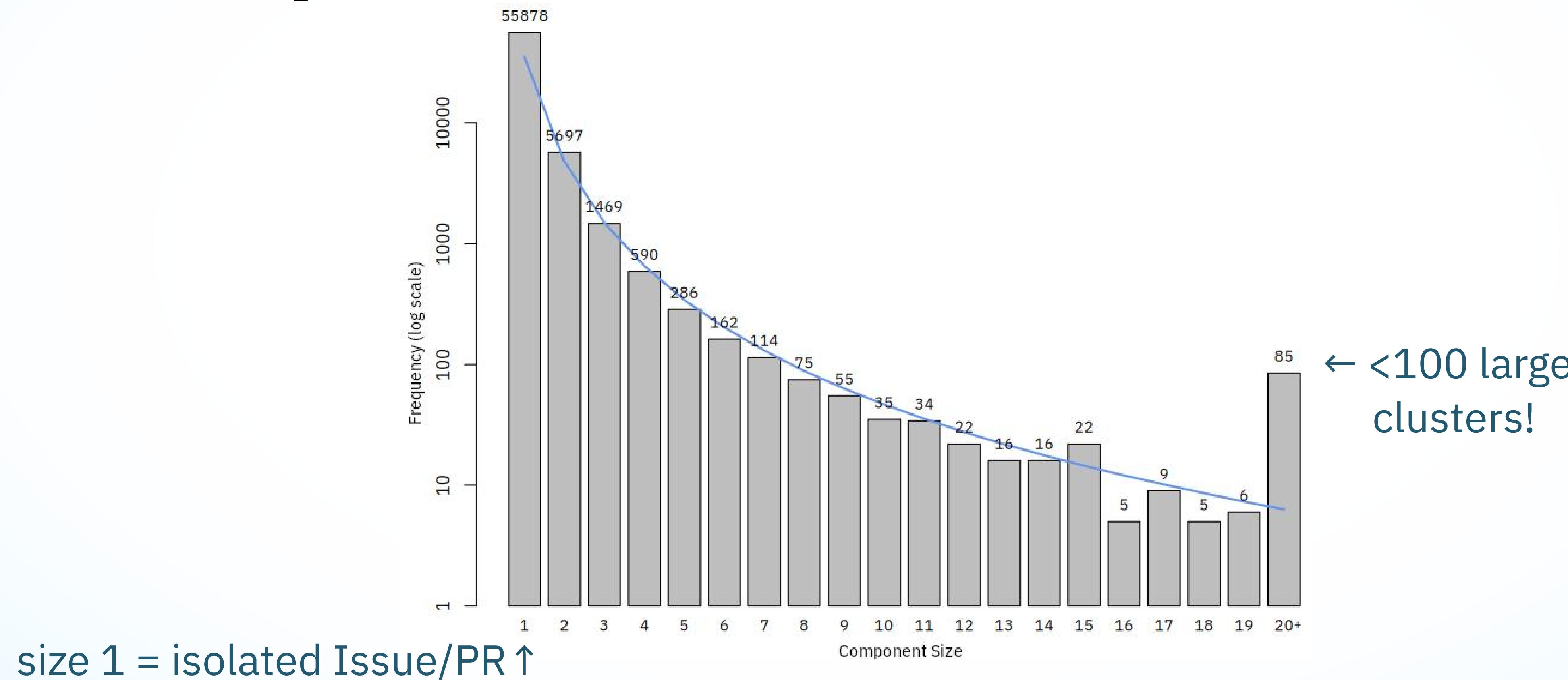
ubcdllab.github.io/pr-issue-topology-project/

↑ our project + workflow type match visualization tool,
used for conducting interviews

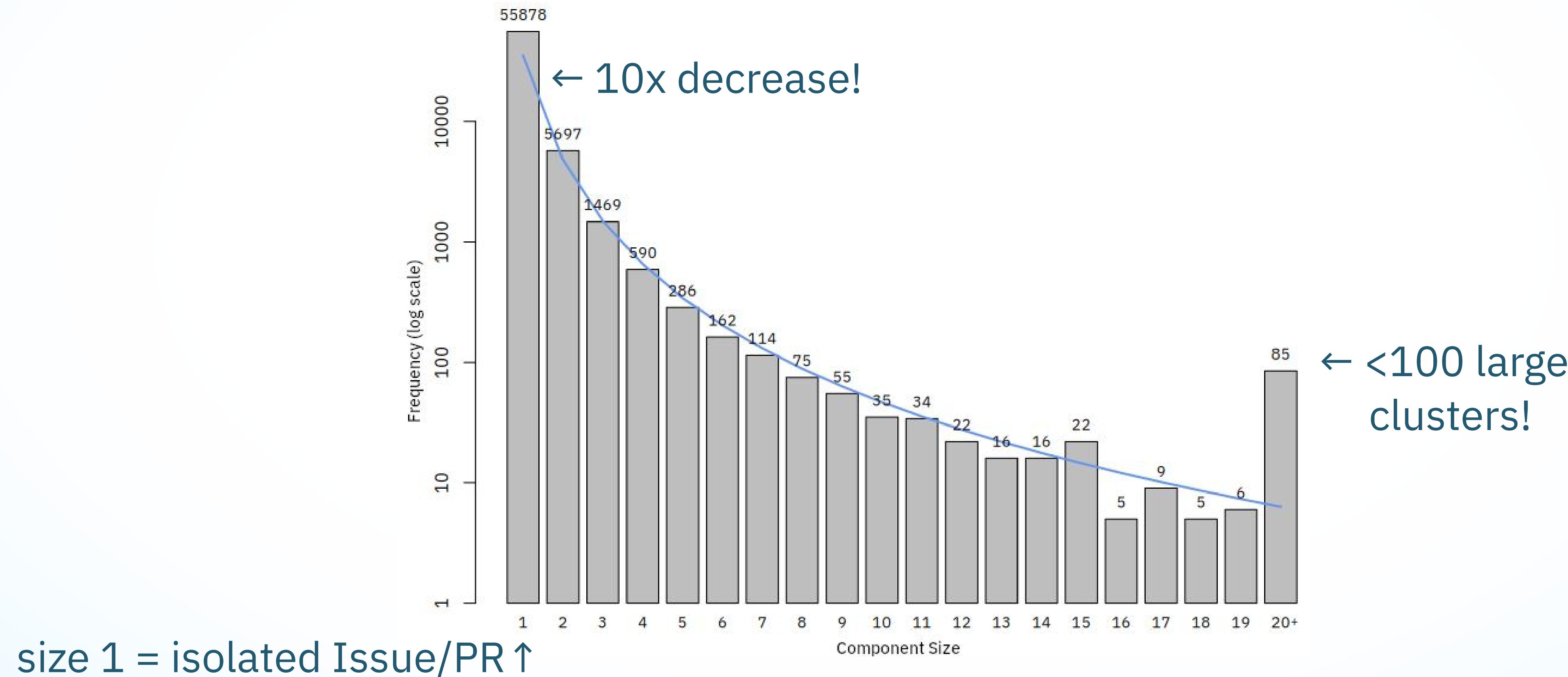
Cluster sizes follow a power-law distribution.



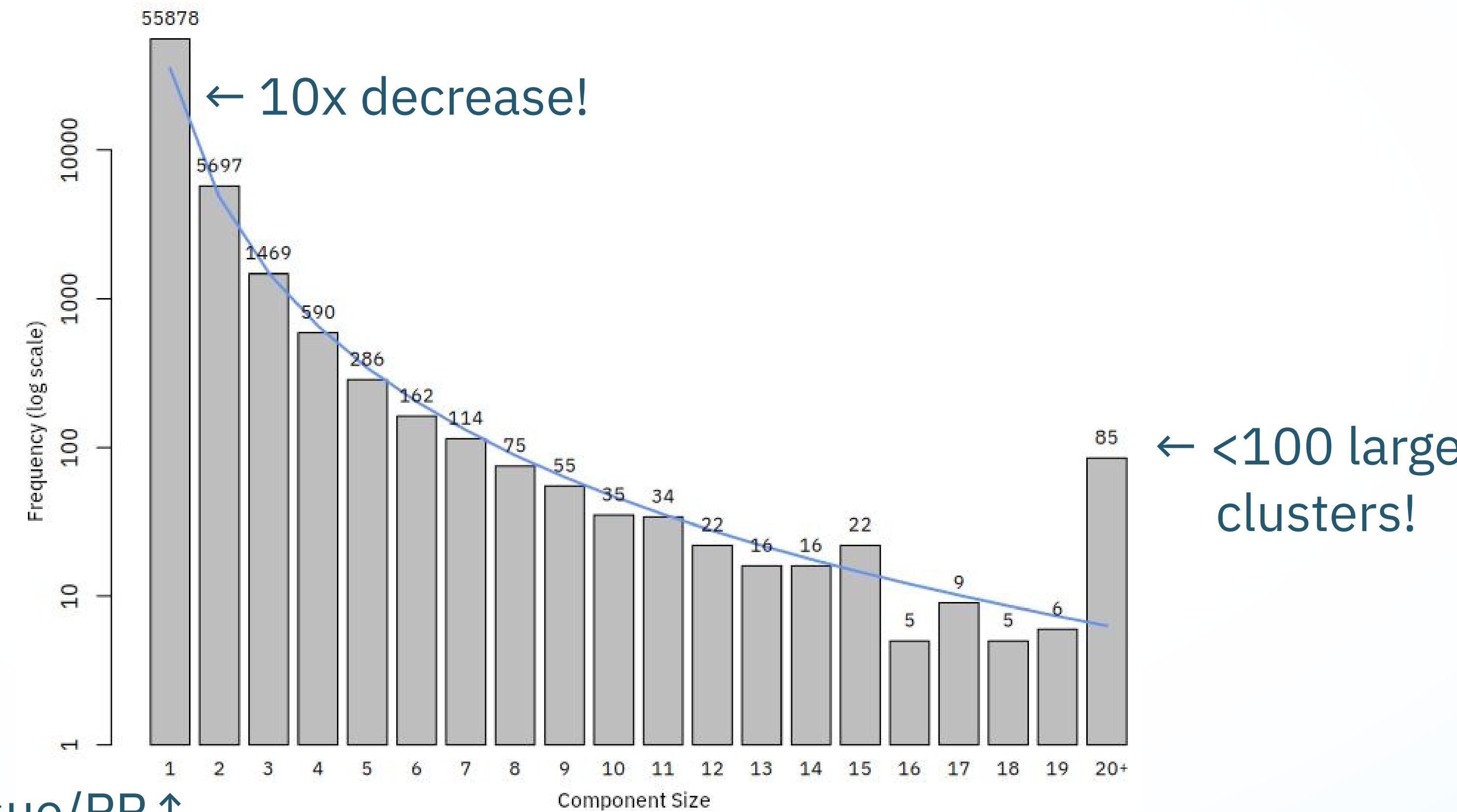
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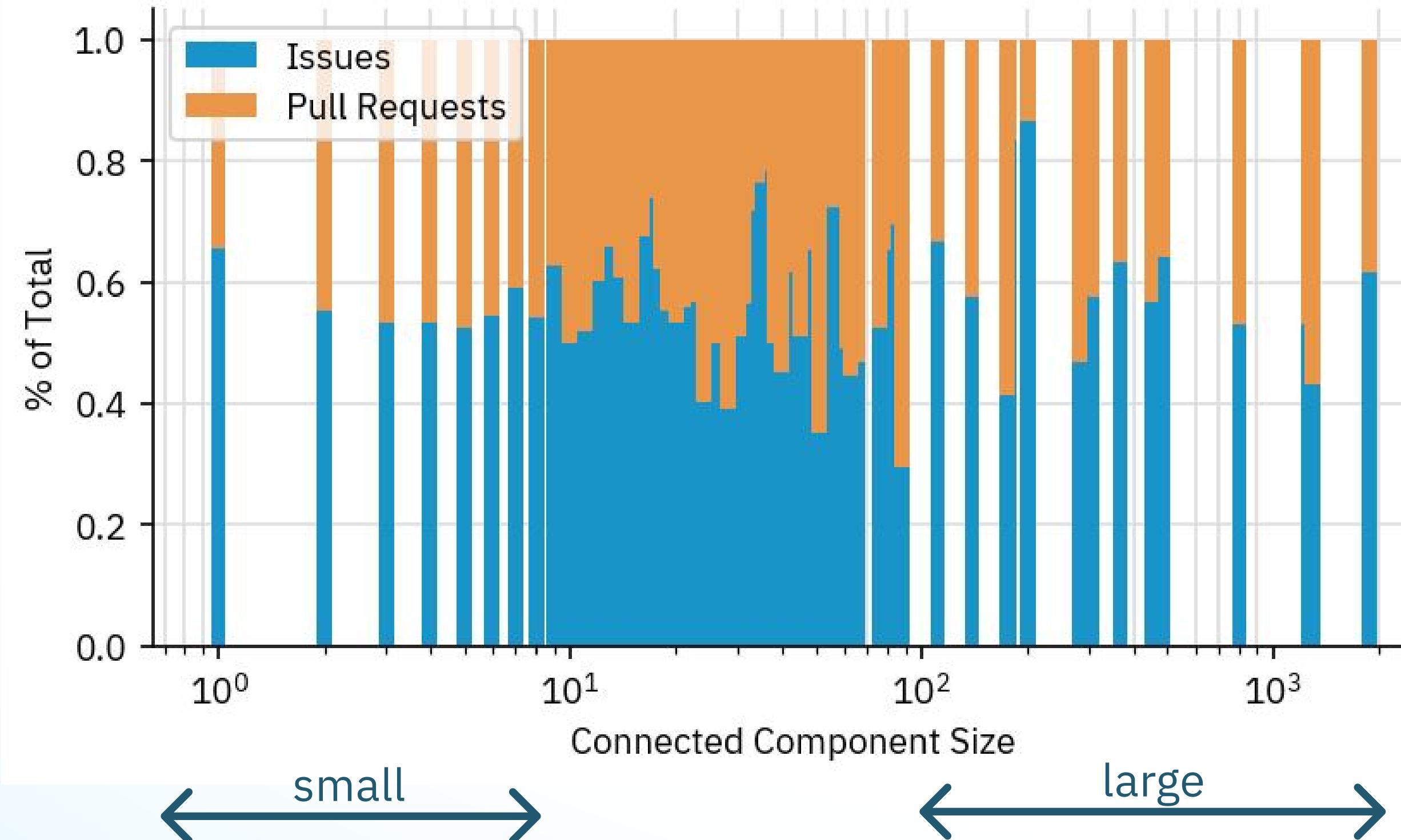


Cluster sizes follow a power-law distribution.



Can help identify work to prioritize.

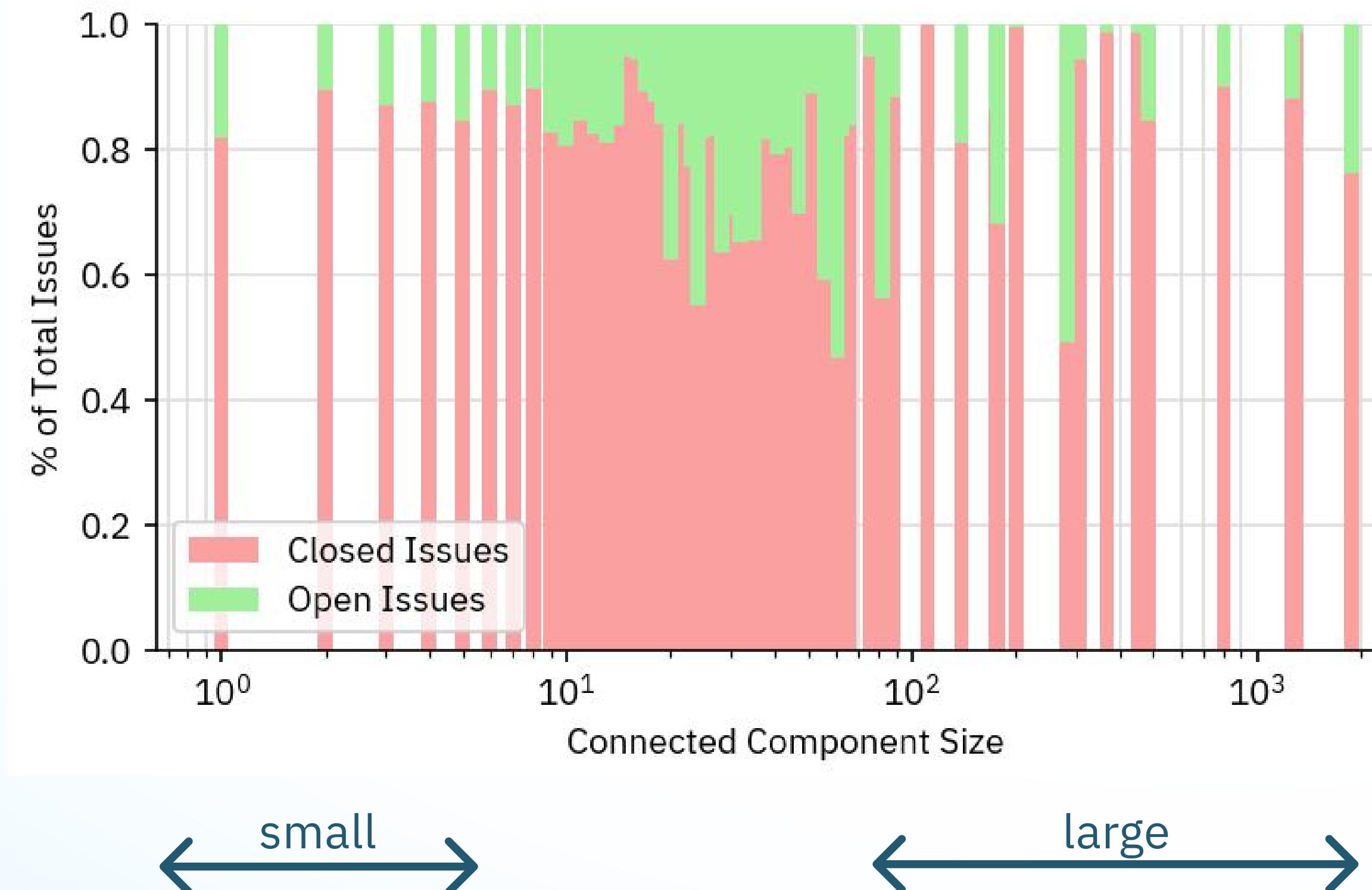
Different cluster sizes, different types of work.



Small clusters have:

- More **Issues (blue)**

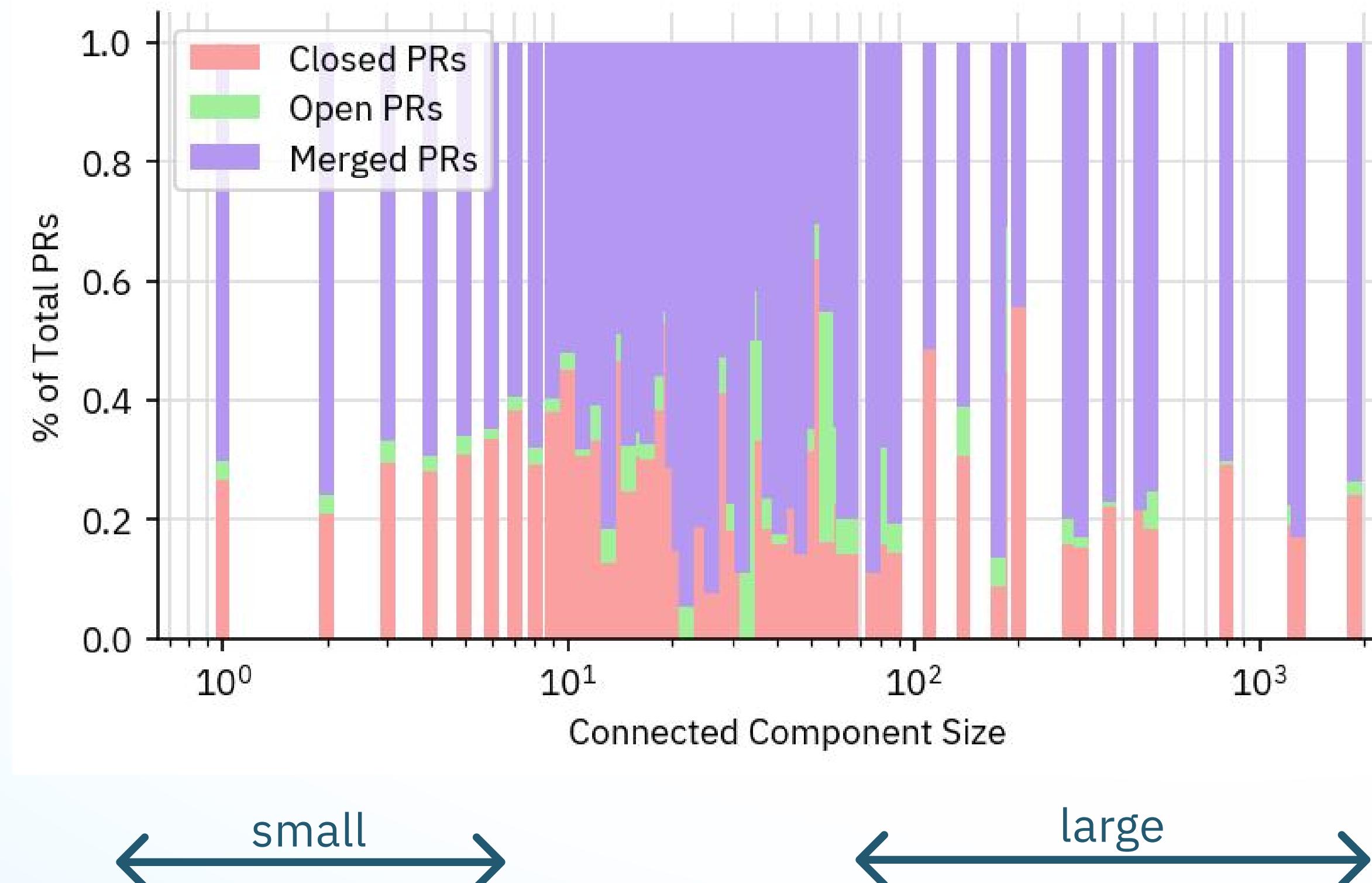
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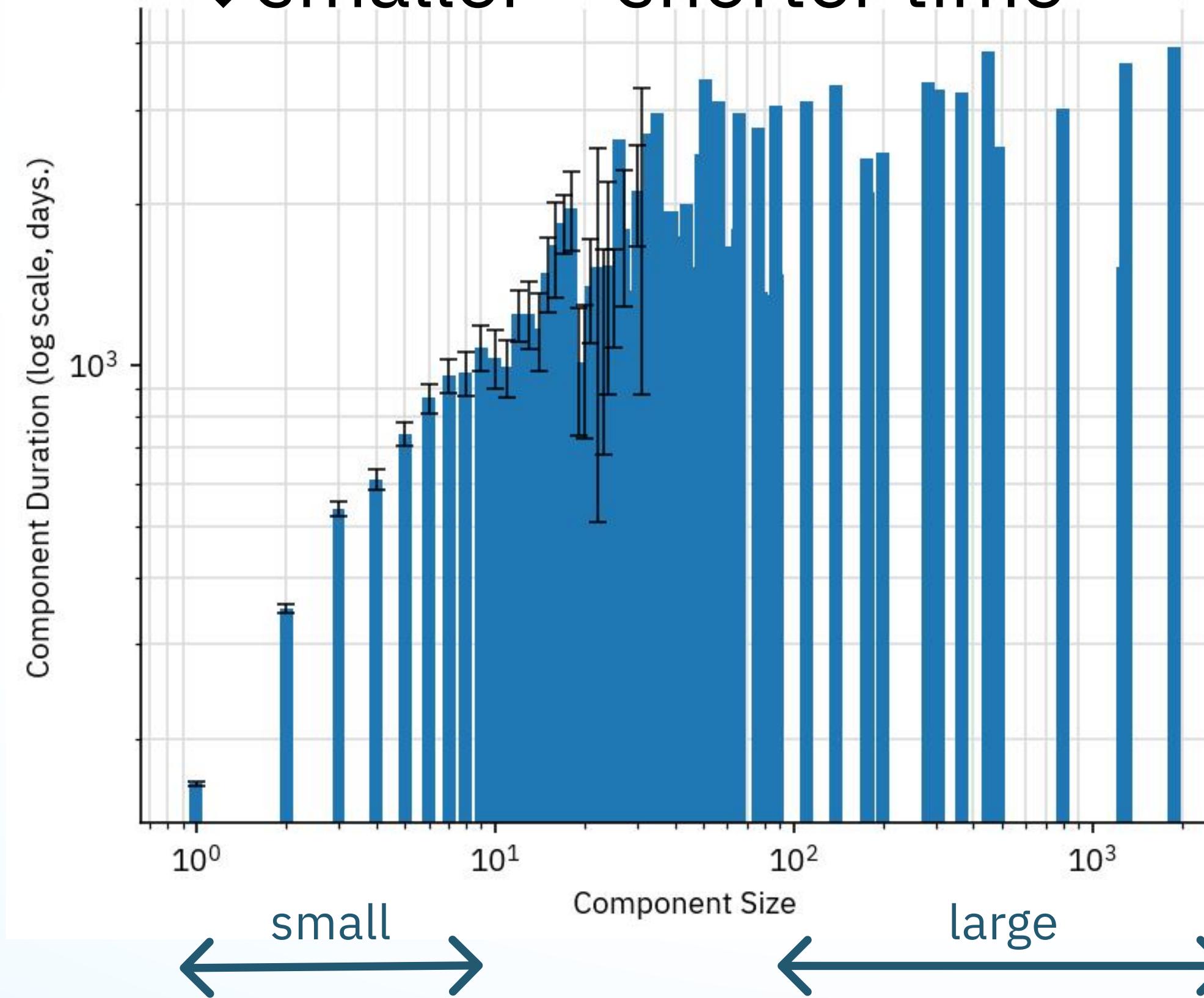
- More Issues
- Fewer **closed** Issues (red)

Different cluster sizes, different types of work.



Different cluster sizes, different types of work.

↓ smaller = shorter time



Small clusters have:

- More Issues
- Fewer closed Issues
- Fewer merged PRs
- Shorter timespan between first/last update

Different cluster sizes, different types of work.

Big (>100 node) clusters have: Small (<10 node) clusters have:

- Fewer Issues
 - More closed Issues
 - More merged PRs
 - Longer timespan between first/last update
 - = **long-term, mature work**
- More Issues
 - Fewer closed Issues
 - Fewer merged PRs
 - Shorter timespan between first/last update
 - = **one-off contribution, WIPs**

Examining a cluster

From Rapptz/discord.py:

Rewrite: please add a `invoked_parent` feature. #1874

Closed

ribosomerocker opened this issue on Feb 4, 2019 · 4 comments · Fixed by #6462

Adds an `invoked_parents` to context #6453

Closed

sudosnok wants to merge 3 commits into `Rapptz:master` from `sudosnok:patch/invoked-parents`



sudosnok commented on Feb 21, 2021

Summary

This adds an `invoked_parents` property allowing easy access to the aliases of the parent
(Group : str)

Closes #1874



Rapptz commented on Feb 21, 2021

I'm definitely not a fan of the way this implementation was done.

The way I imagined this attribute was similar to how `invoked_with` and `parents` are done
attribute within the context. As it stands right now this walks over the view a second time!



Rapptz closed this on Feb 21, 2021

[commands] Add Context.`invoked_parents` #6462

Merged

Rapptz merged 2 commits into `Rapptz:master` from `SebbyLaw:feature/invoked-parents` on Feb 23, 2021



SebbyLaw commented on Feb 22, 2021

Summary

Adds `Context.invoked_parents`, resolves #1874

Also resolves #6461 which I found during testing, and including the commit here because it's easier to merge.

This PR can be merged without squashing.



Conversation

0



Commits

2



Checks

0



Files changed

2

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← “fixes” link type



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↓ another keyword

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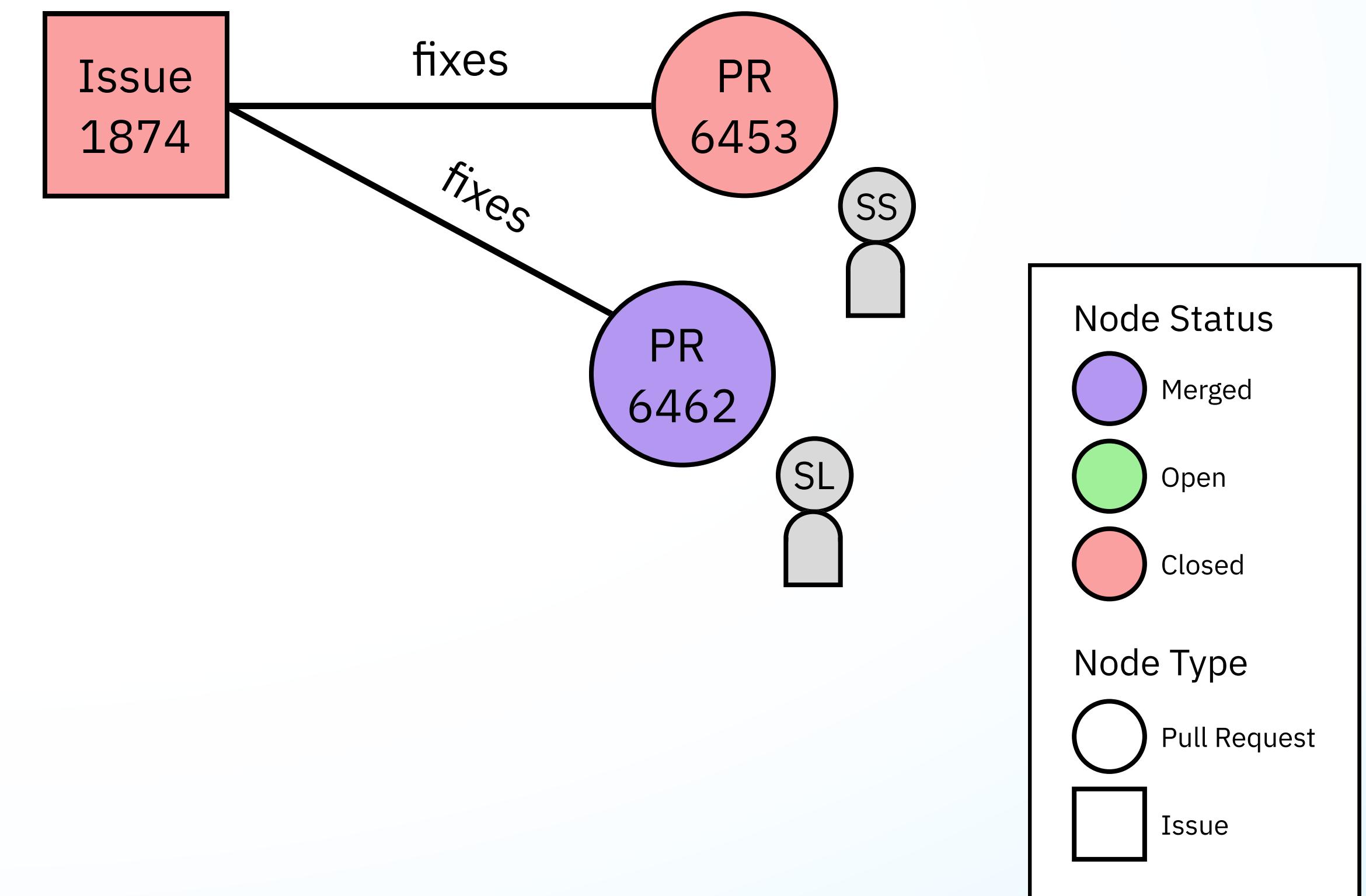
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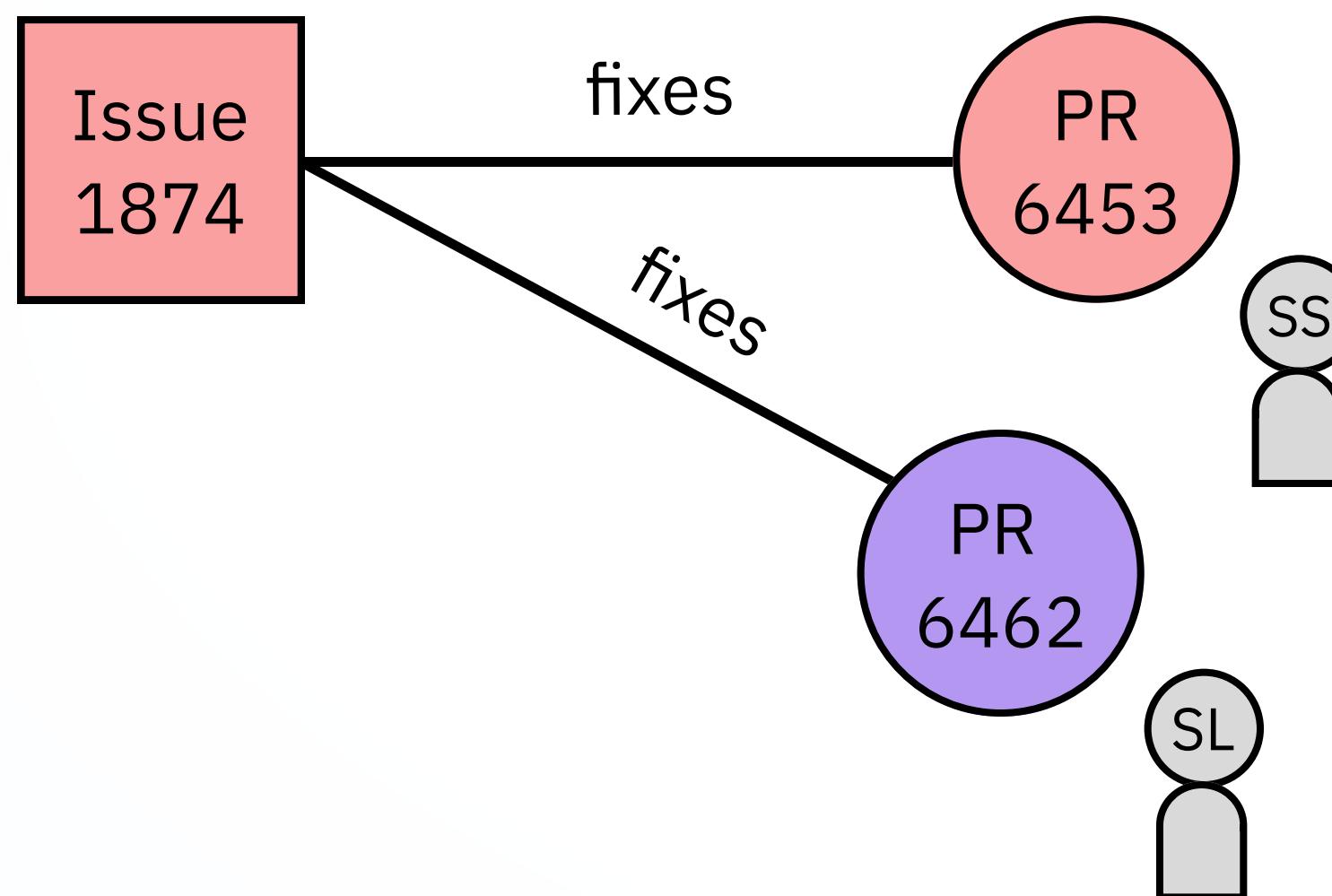
[commands] Add Context.invoked_parents #6462

Merged Rapptz merged 2 commits into `Rapptz:master` from `SebbyLaw:feature/invoked-parents` on Feb 2

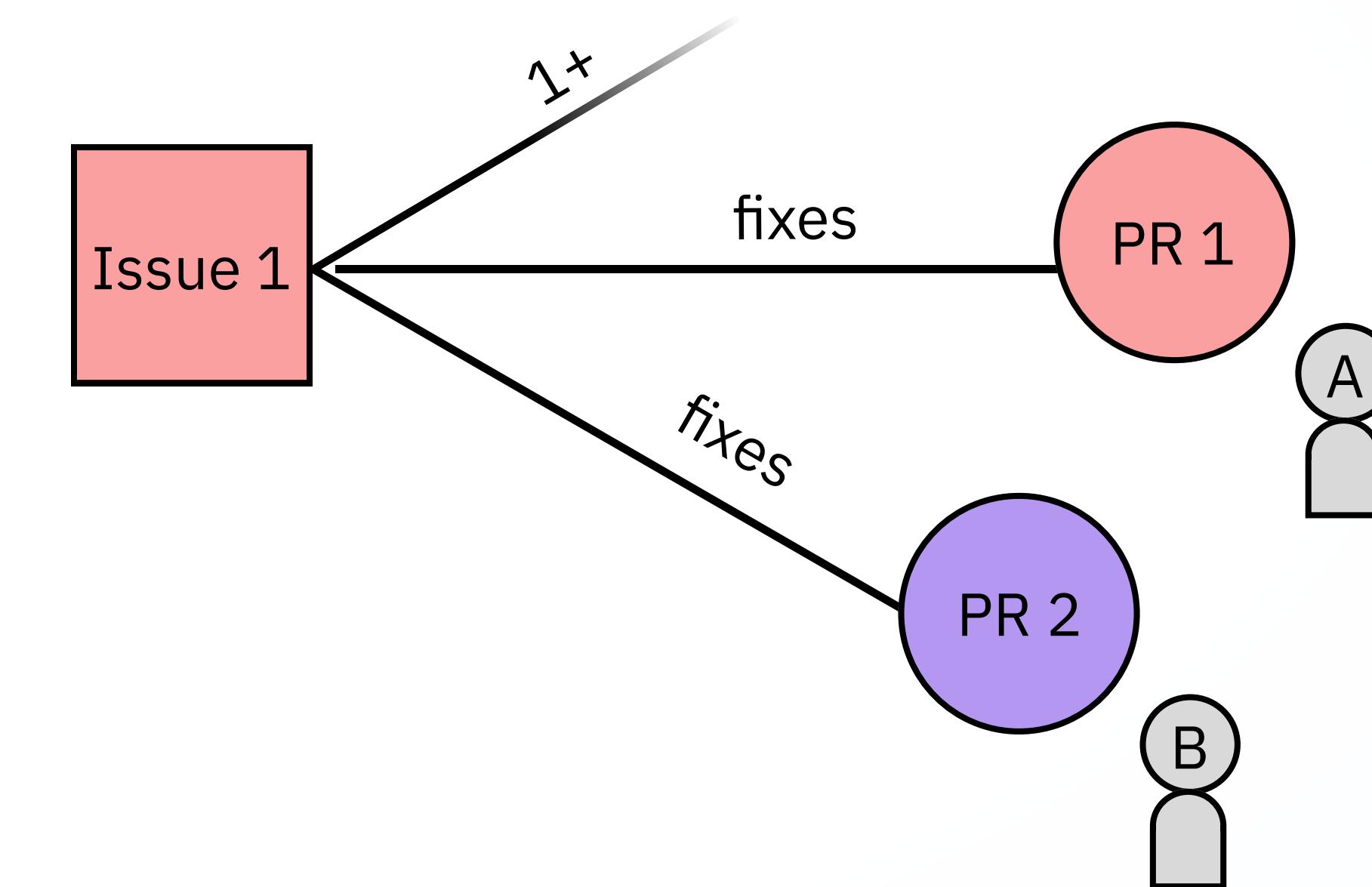


Examining a cluster

From Rapptz/discord.py:

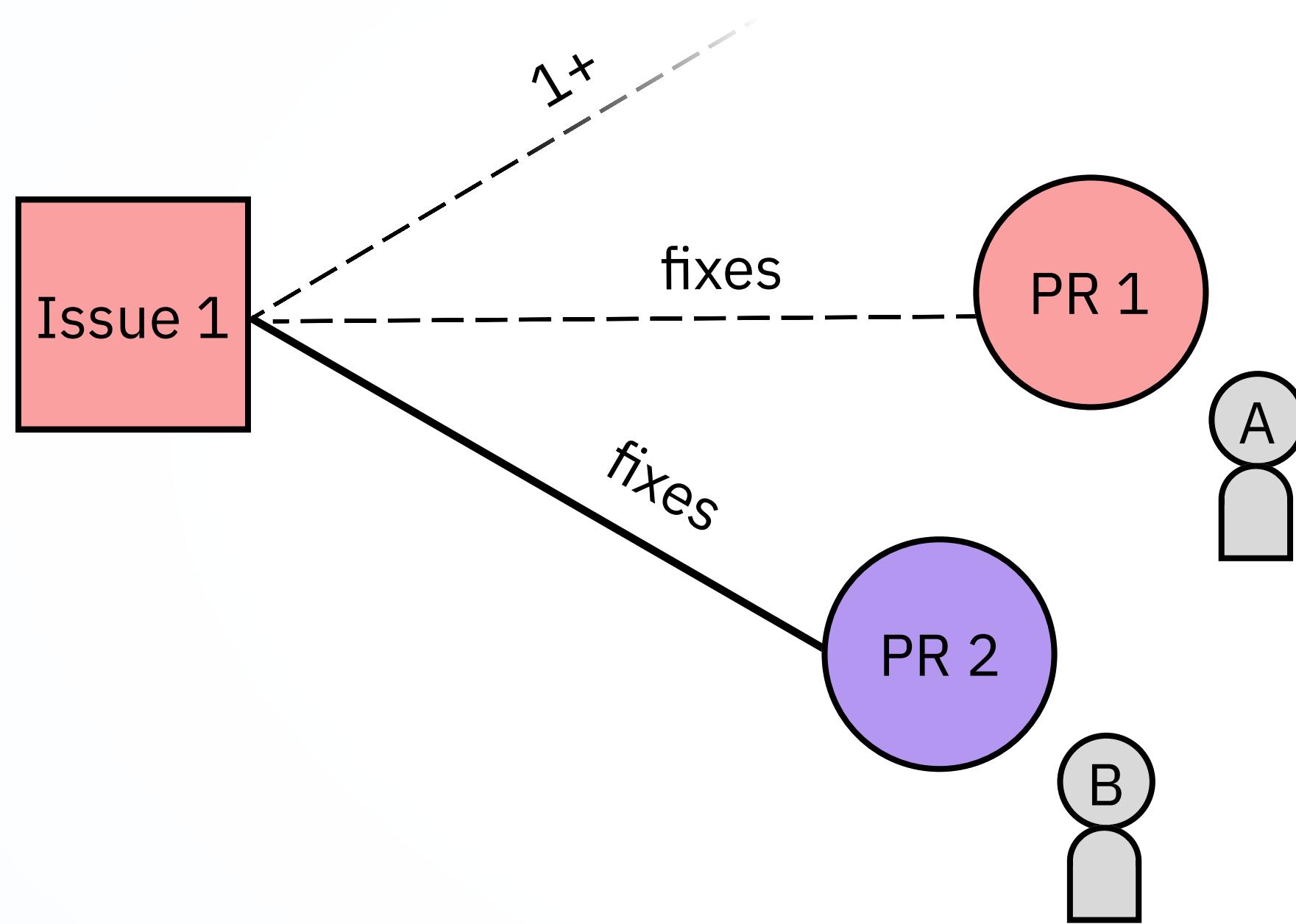


Competing PRs workflow type:



Node Status
Merged
Open
Closed
Node Type
Pull Request
Issue

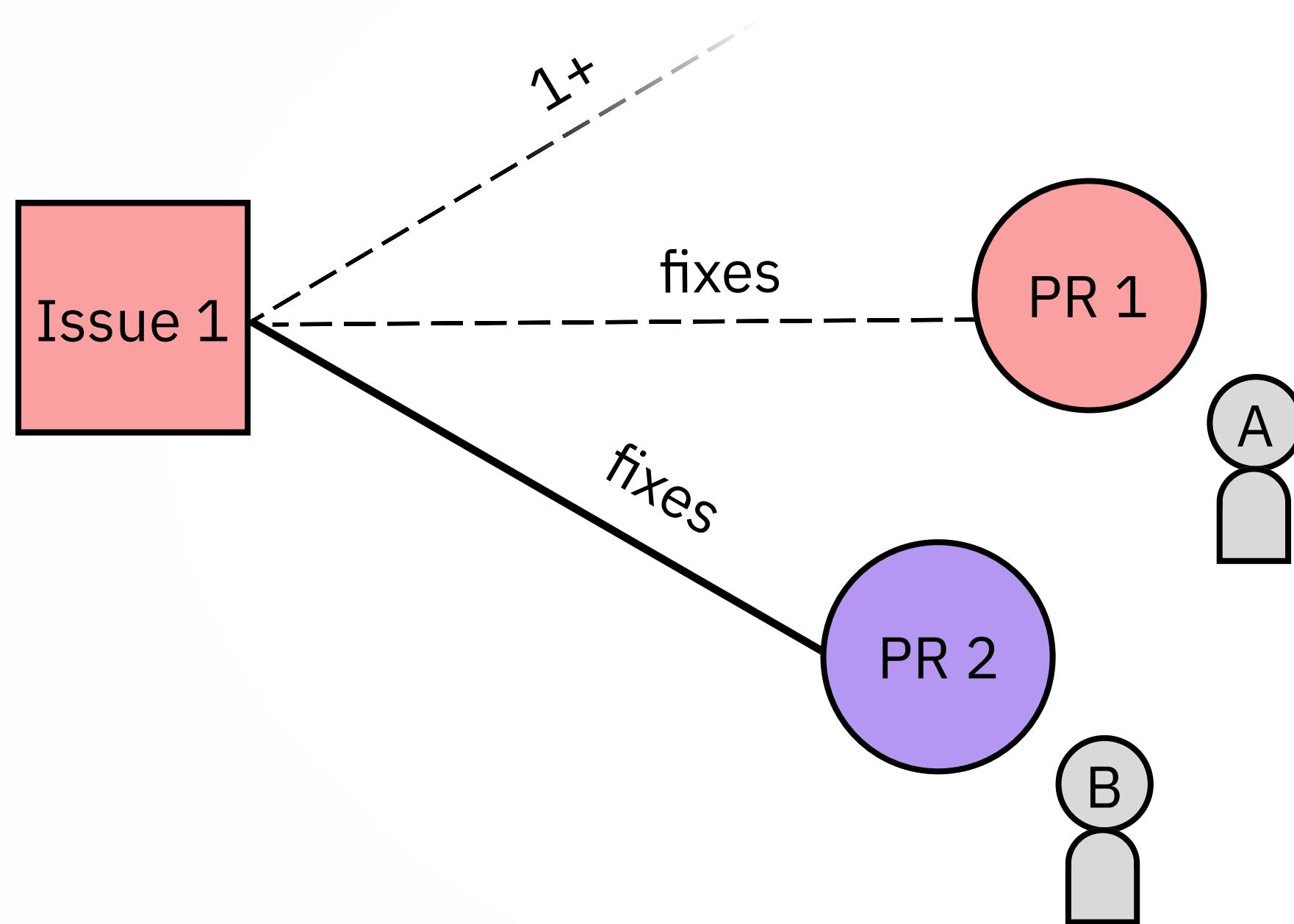
Workflow type definitions



- associated with work practices

Example: Competing PRs

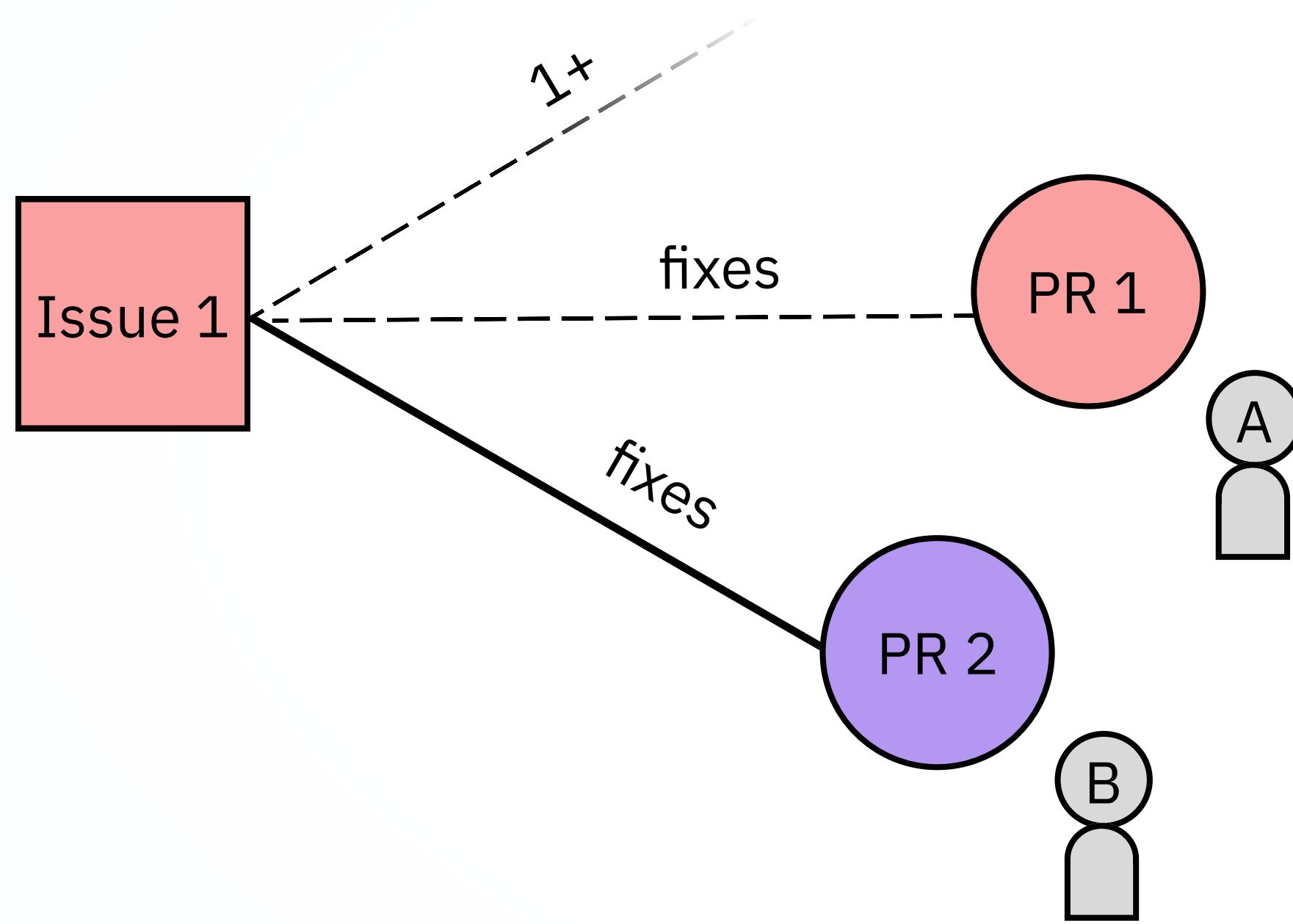
Workflow type definitions



- associated with work practices
- has prototypical graph structure

Example: Competing PRs

Workflow type definitions

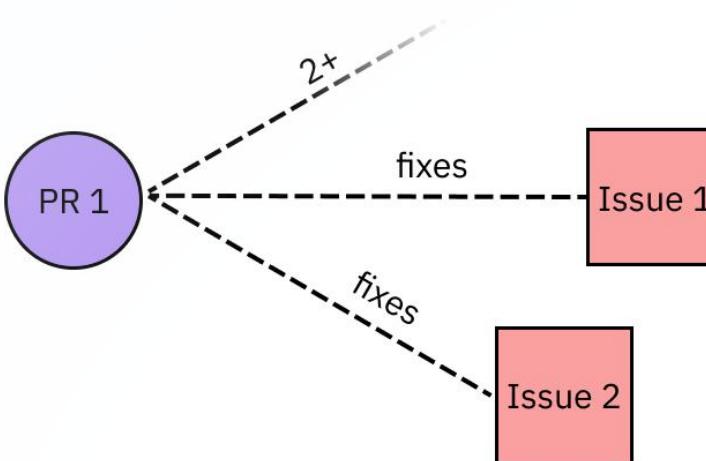


- associated with work practices
- has prototypical graph structure
- described as a combination of some constraints (e.g. an Issue/PR with some given status fixes another Issue/PR)

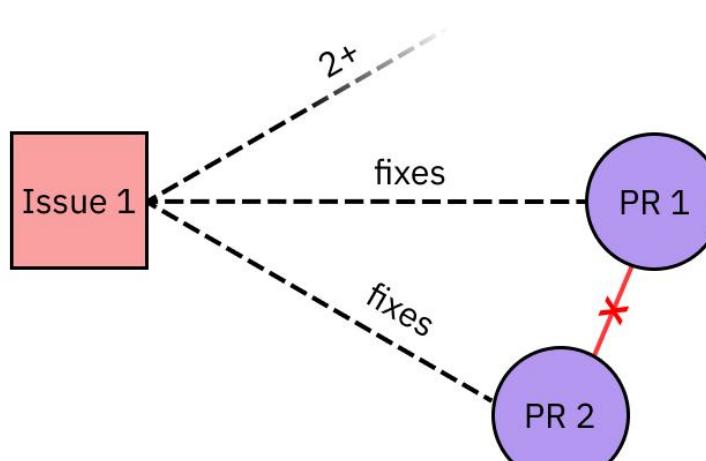
Example: Competing PRs

Workflow type definitions

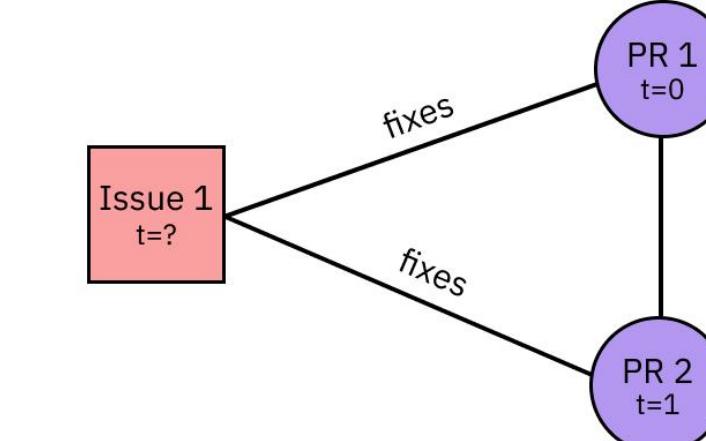
Divergent PR



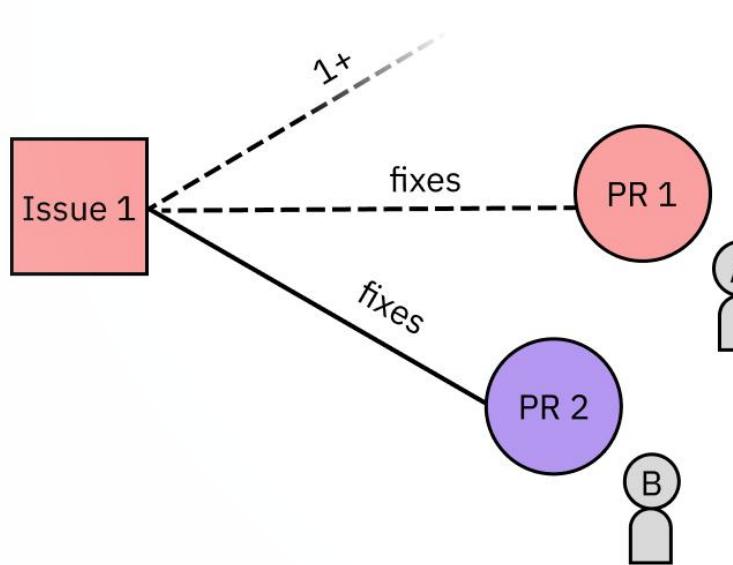
Decomposed Issue



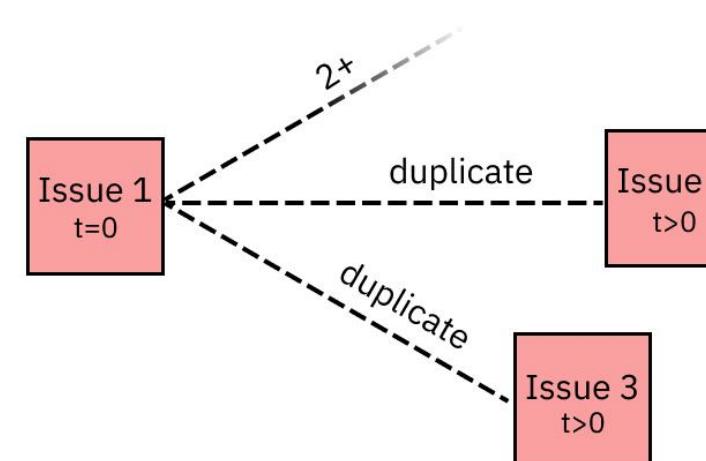
Extended PR



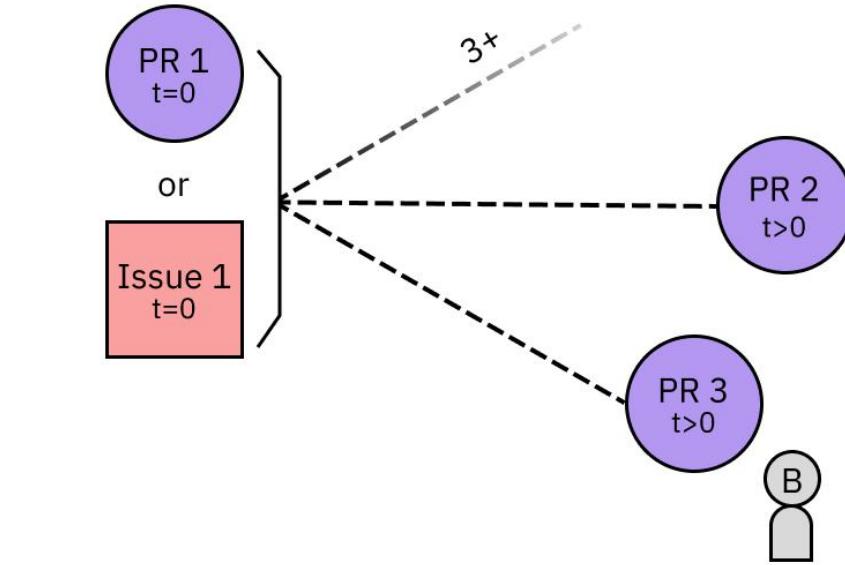
Competing PRs



Duplicate Issue Hub

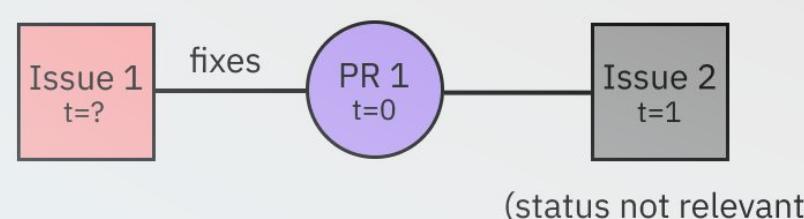


Integrating PR/Issue Hub

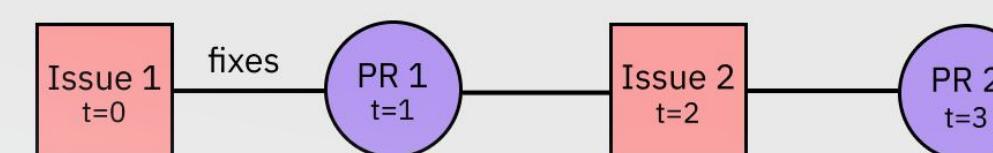


Consequence

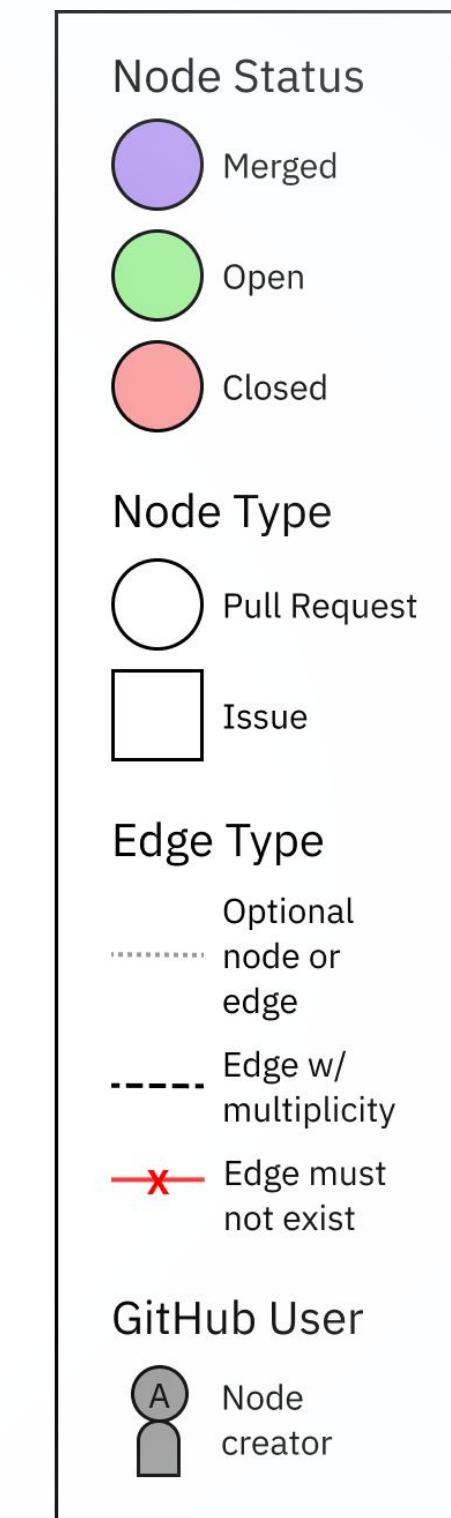
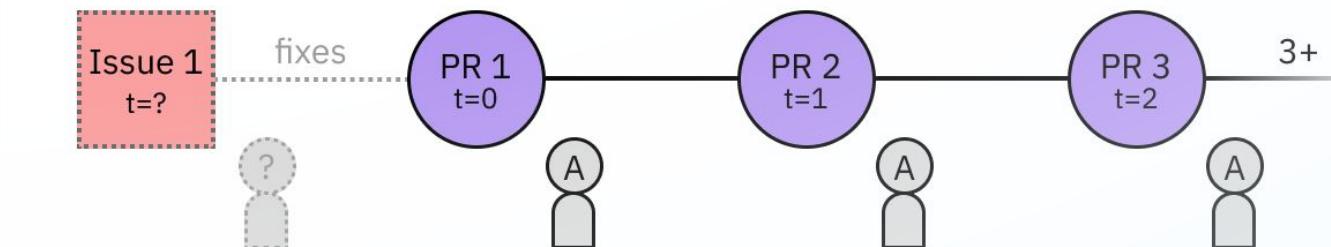
Consequent Issue



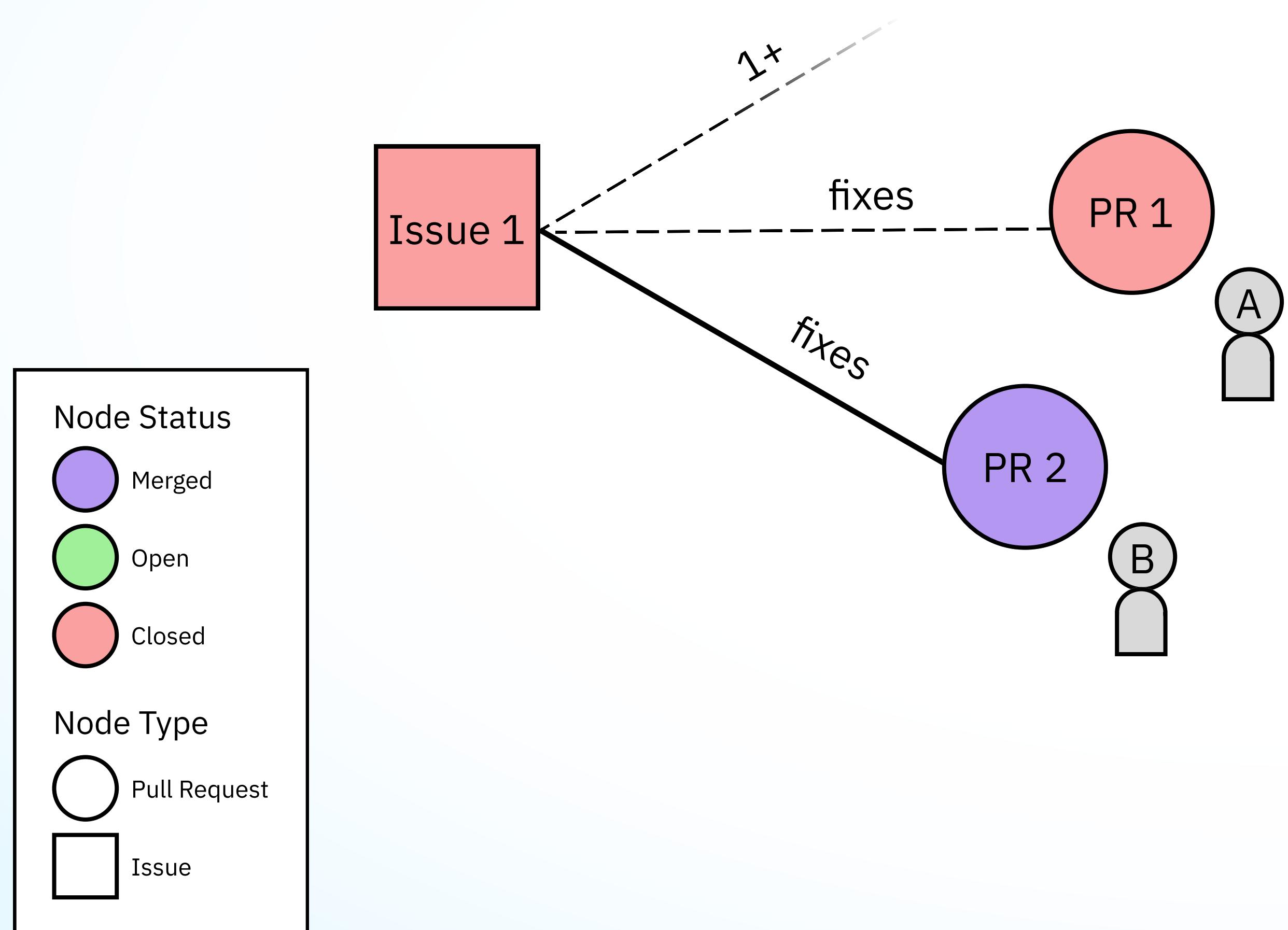
Consequent Issue-PR



Dependent PRs

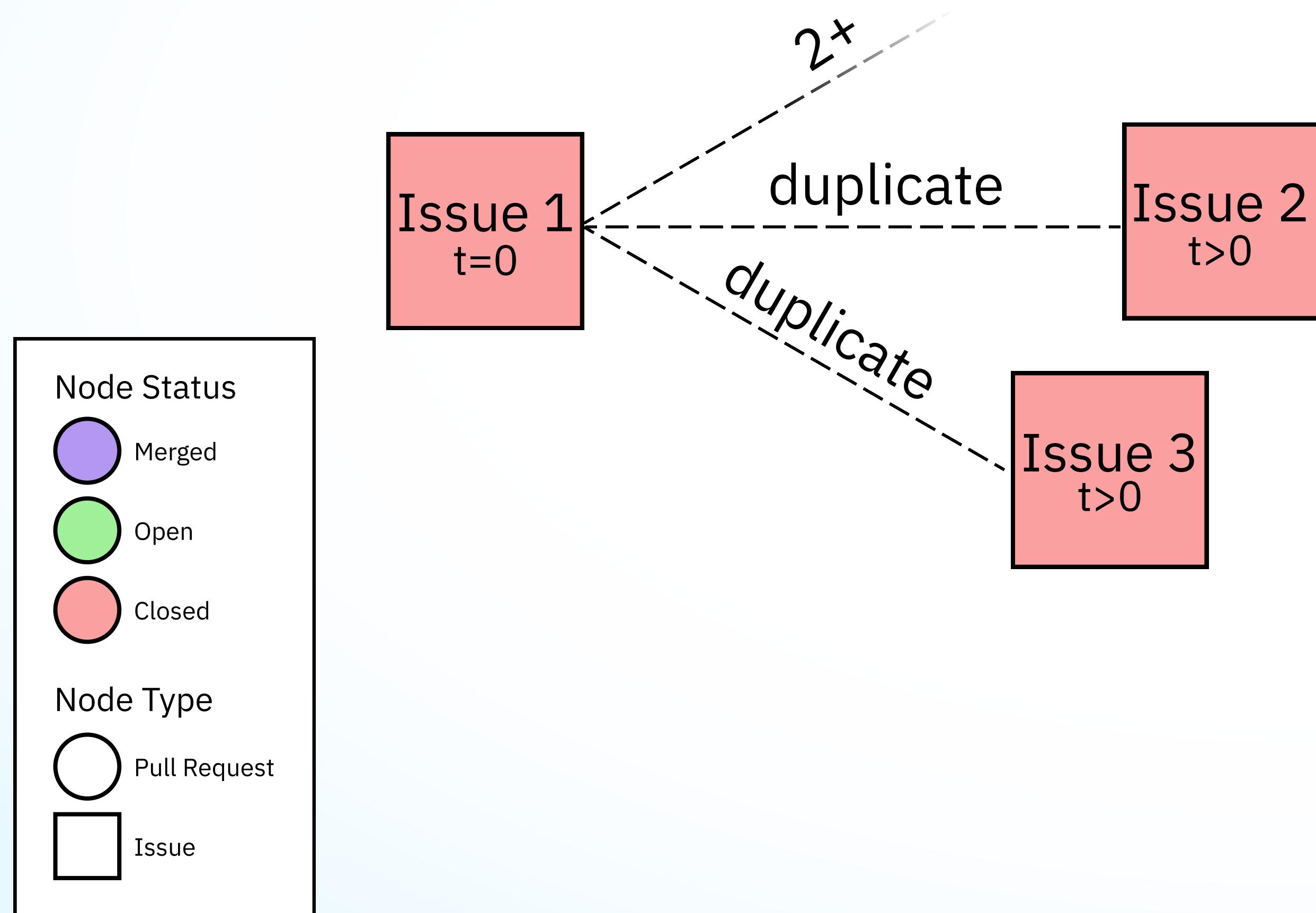


Competing PRs



- one Issue connected to multiple PRs
- only one PR merged
- “wasted” work due to poor communication
- alternatively: finding the “best” solution

Duplicate Issue Hub



- one Issue with multiple outgoing ‘duplicate’ Issue links
- contributors not being aware of other work
- additional maintenance burden
- not as frequent as you’d think!

Duplicate Issue Hub

From Rapptz/discord.py:

Node Status	
	Merged
	Open
	Closed
Node Type	
	Pull Request
	Issue



Integrating PR/Issue Hub

From apache/dubbo:

[WeeklyReport] Weekly report for Dubbo 2019-5-31 to 2019-6-7 #4266

 Closed dubbo-bot opened this issue on Jun 7, 2019 · 0 comments

Repo Overview

Basic data

Basic data shows how the watch, star, fork and contributors count changed in the passed week.

Watch	Star	Fork	Contributors
3217	27013 (1191)	15166 (197)	201 (11)

Issues & PRs

Issues & PRs show the new/closed issues/pull requests count in the passed week.

New Issues	Closed Issues	New PR	Merged PR
20	16	25	24

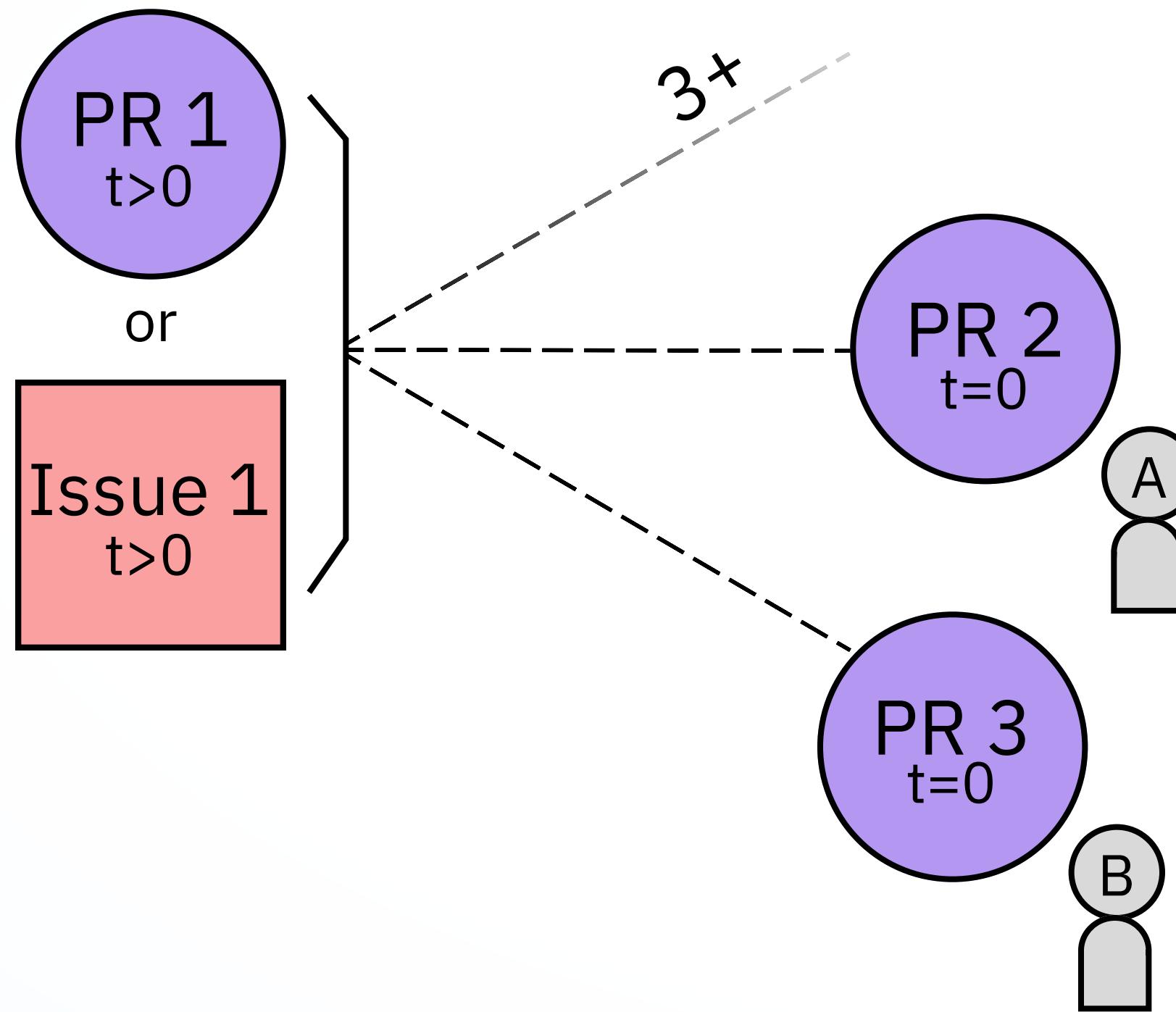
PR Overview

Thanks to contributions from community, Dubbo team merged 24 pull requests.

- 2.7.2 release ([#4259](#))
- Default future from jeff-lv ([#4257](#))
- performance tuning: cache service key ([#4255](#))
- performance tuning: channel connect status ([#4254](#))
- Performance tuning: keep heartbeat updated in io thread to avoid race ([#4249](#))
- Applicationmodel revert ([#4245](#))
- getMethodparameter refactor ([#4244](#))
- delete useless code ([#4242](#))

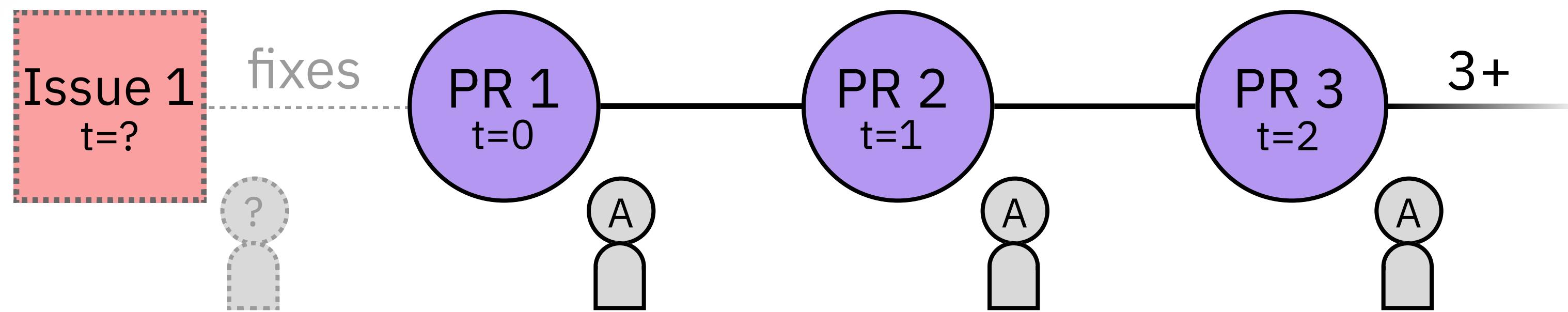
Integrating PR/Issue Hub

Node Status	
Circle	Merged
	Open
	Closed
Node Type	
	Pull Request
	Issue



- Issue or PR connected to many closed PRs
- central Issue/PR created after merged PRs
- release or documentation workflows

Dependent PRs



Node Status



Merged



Open



Closed

Node Type



Pull Request



Issue

- stacked PRs workflow: breaking work up into small, shippable changes
 - series of PRs optionally starting with Issue
 - created by same (few) authors

Divergent PR

From grpc/grpc-web:

Fixes #848: Fixed a bug where we can't pass the interceptors into the client constructor because of a type mismatch.

Fixes #868: Added `MethodDescriptor` to the exported types. Replace the deprecated `MethodInfo` with `MethodDescriptor`.

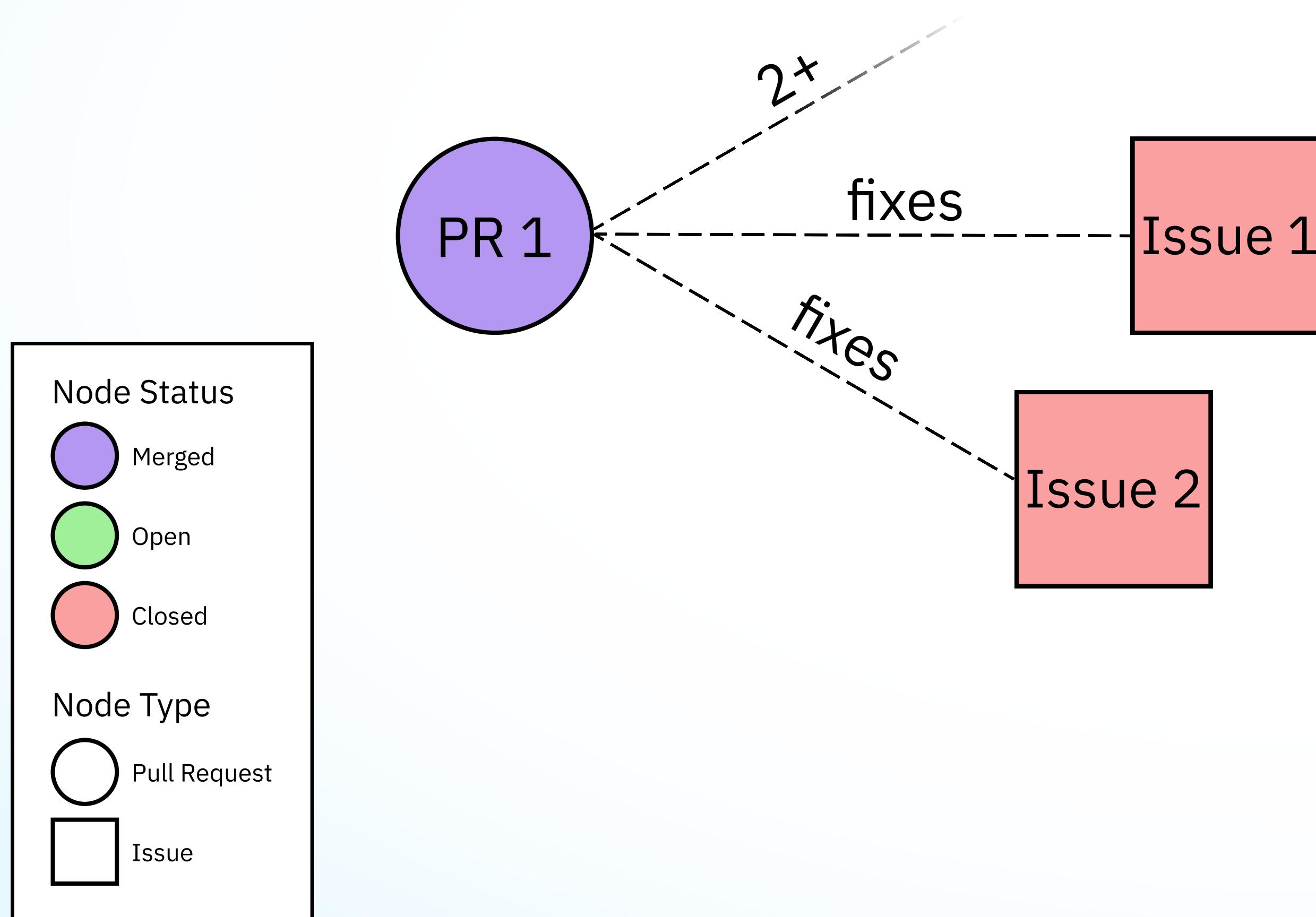
Fixes #877: Fixed issue where `UnaryResponse` symbols are being optimized away.

And in general added some missing classes to the exported types as well.

Added tests for both callback-based `StreamInterceptor` and promise-based `UnaryInterceptor`. And now execute `tsc` with `--strict`.

↑ negative, because unrelated changes in same PR = hard to review

Divergent PR

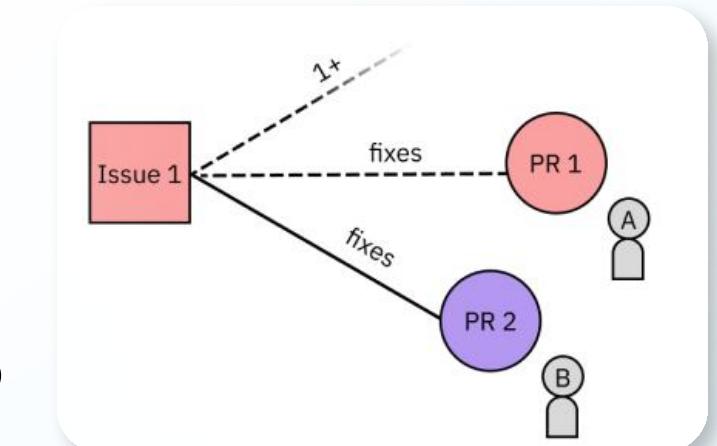
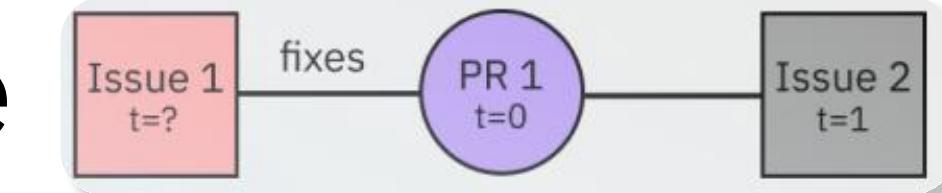


- merged PR fixing multiple Issues
- can be both positive or negative, depending if Issues are related and linked

Some workflow types are more popular than others.

Workflow Type	Num. Matches
Competing PRs	15
Consequent Issue	210
Consequent Issue-PR	471
Decomposed Issue	91
Dependent PRs	52
Divergent PR	118
Duplicate Issue Hub	45
Extended PR	14
Integrating PR/Issue Hub	94

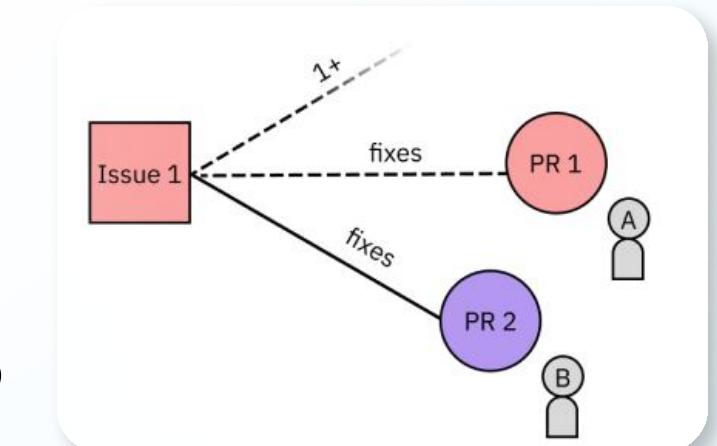
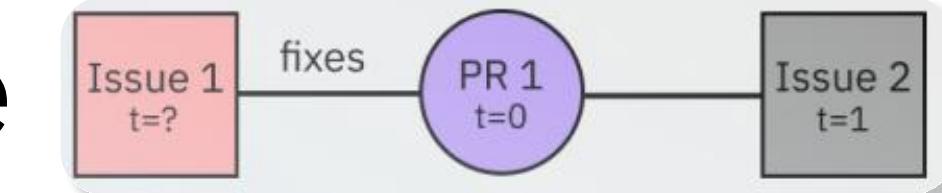
- Consequent Issue-PR most popular, followed by very similar Consequent Issue
- Very few Competing PRs or Extended PR matches → constraints or alternatives



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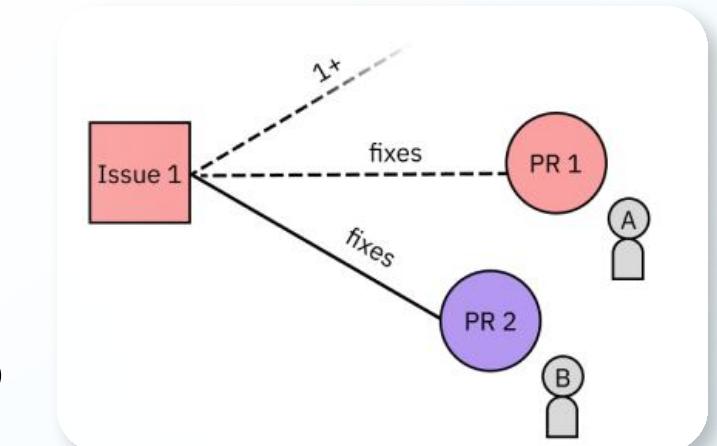
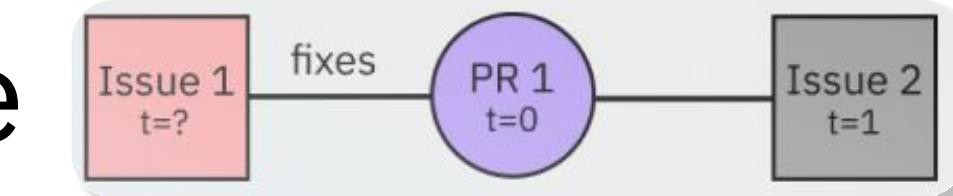
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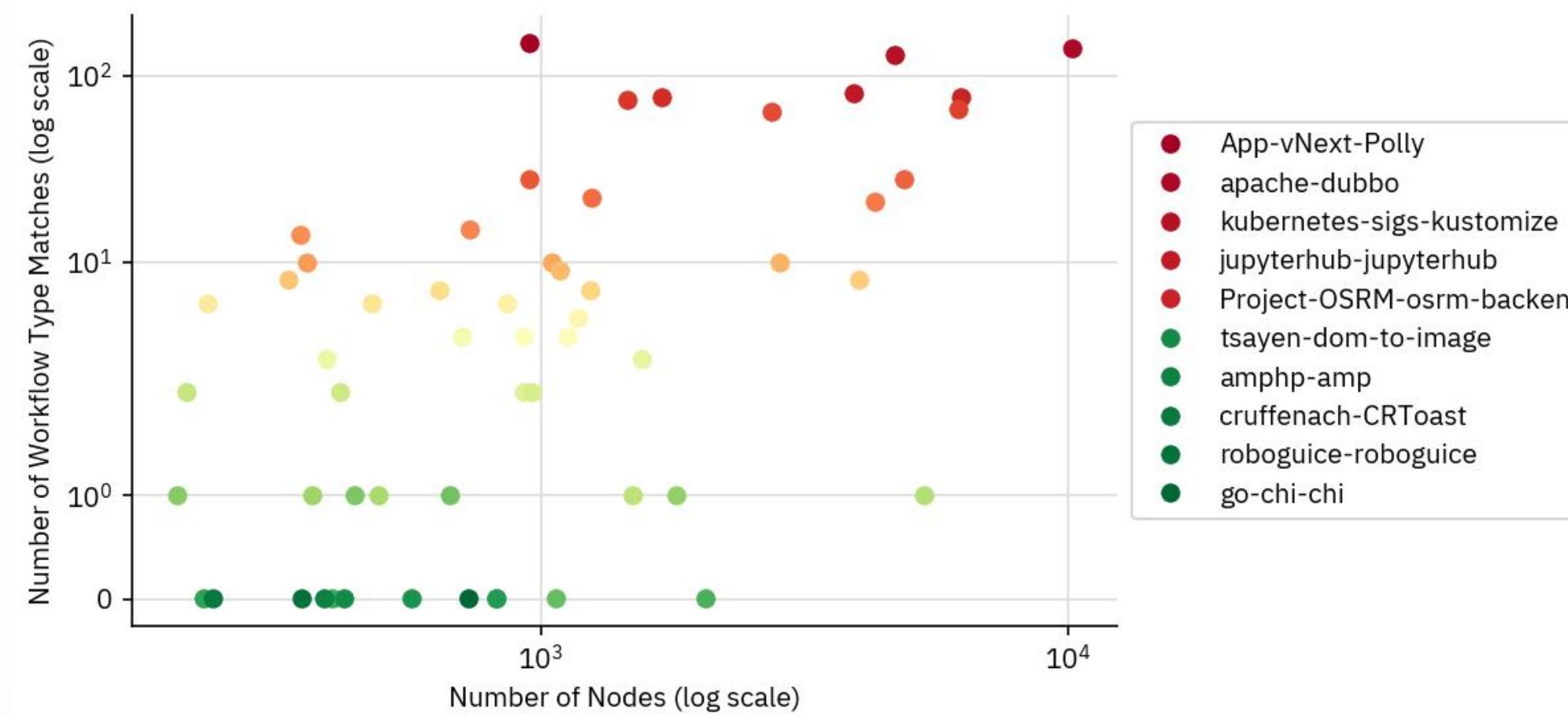
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Workflow types represent projects fairly well.



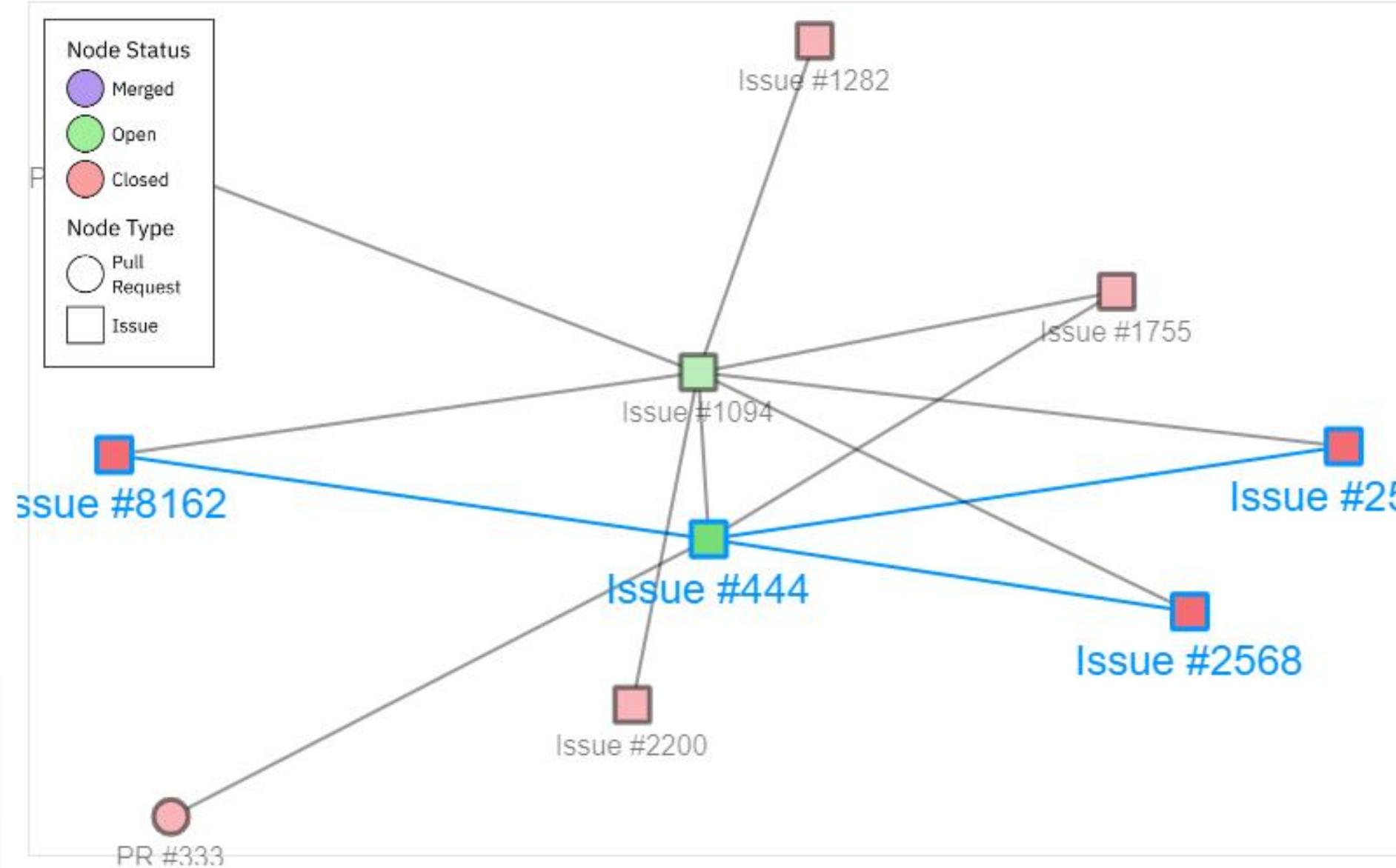
- 52% of nodes meeting basic criteria are in a match
- Most projects contain at least one match, though frequencies differ per repo → maturity
- 12 small projects contain no workflow type matches

What did developers think?

Rapptz/discord.py Workflow Type Matches

Verified workflow type matches:

duplicate_issue_hub_3



- 6 interviews: 3 with open-source maintainers of projects we studied; 3 software engineers using GitHub in a closed-source context
- centred around interactive project explorer customized for their project

What did developers think?

- Help make better decisions in development process
 - Duplicate Issue Hubs → change in documentation or bug reporting process
 - Extended PRs → need for more training, or for computing burndown charts
 - Divergent PR → prioritize review

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 - Divergent PR → prioritize review
- Help understand inter-dependencies visually
- Are limited due to not examining contents of Issue or PR

Implications

- Can inform prioritization

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(“The review linkage graph for code review analytics...”, Hirao et al., ESEC/FSE 2019)

Implications

- Can inform prioritization
- Can improve code review/PM practices
- Can identify areas of wasted work
- Can extend duplicate/first issue detection tools (Hirao et al., 2019)
- Next: talking with more maintainers like you!

(“*The review linkage graph for code review analytics...*”, Hirao et al., ESEC/FSE 2019)

Conclusion

- Novel graph-based perspective
- Workflow type definitions and attributes
- Automatable queries and interactive explorer tools
- Insights into developer collaboration and OSS maintenance

Reach us at cleidson.desouza@acm.org,
reach me at hello@emilie.ma.

Slides available at emilie.ma/ossna2024