Find the Bug(s)!

```
BlockingQueue queue = …

while (!queue.isEmpty() && ...) {
     CheaterFutureTask Task =
               queue.remove();
     incompleteTasks.add(Task);
     taskValues.add(
          Task.getRawCallable().
               call());
}
```

BatchCommitLogExecutorService.java using BlockingQueue in Cassandra, one bug injected

Foundations of Software Engineering

Part 15: Inspections and Reviews

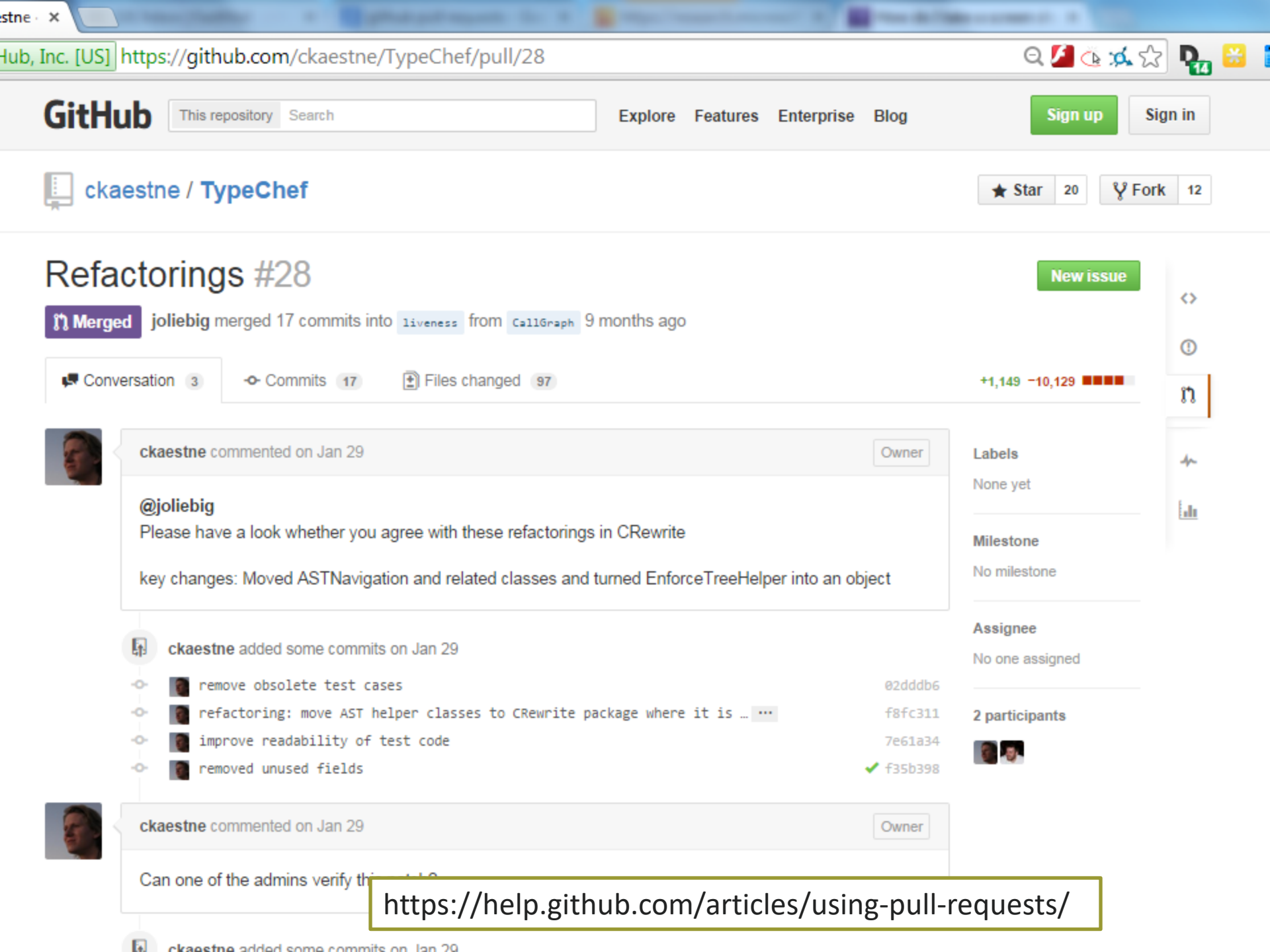
Michael Hilton

Administrivia

- Midterm on Thursday
- 1 page of notes allowed
- Exam review in recitation tomorrow

Software Peer Reviews

What are Code Reviews?


https://github.com/ckaestne/TypeChef/pull/28
GitHub
This repository
Search
Explore
Features
Enterprise
Blog
Sign up
Sign in
ckaestne / TypeChef
Star 20
Fork 12
Refactorings #28
New issue
Merged
joliebig merged 17 commits into liveness from CallGraph 9 months ago
Conversation 3
Commits 17
Files changed 97
+1,149 −10,129
ckaestne commented on Jan 29
Owner
@joliebig
Please have a look whether you agree with these refactorings in CRewrite
key changes: Moved ASTNavigation and related classes and turned EnforceTreeHelper into an object
ckaestne added some commits on Jan 29
remove obsolete test cases
02dddb6
refactoring: move AST helper classes to CRewrite package where it is …
f8fc311
improve readability of test code
7e61a34
removed unused fields
f35b398
ckaestne commented on Jan 29
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Labels
None yet
Milestone
No milestone
Assignee
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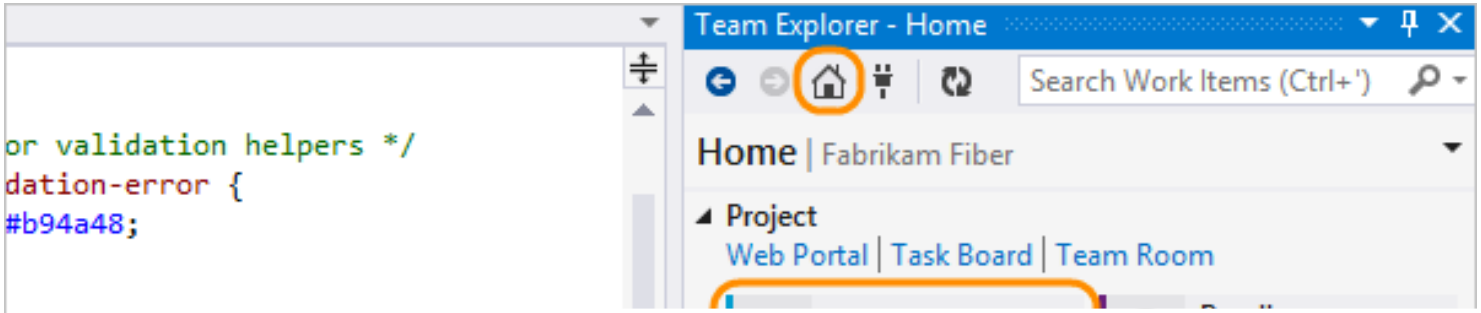


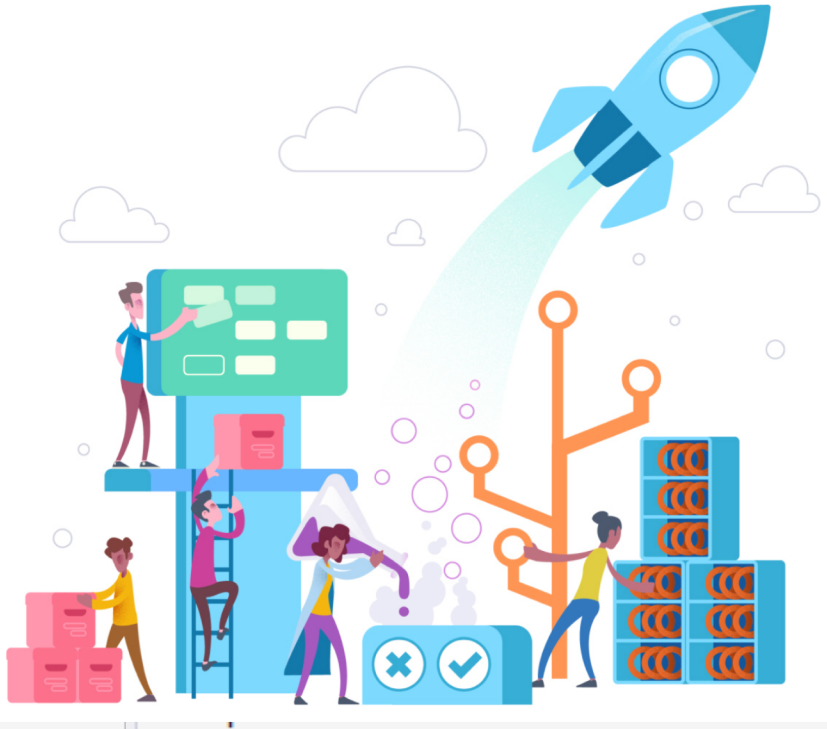
Azure DevOps

Plan smarter, collaborate better, and ship faster with a set of modern dev services.

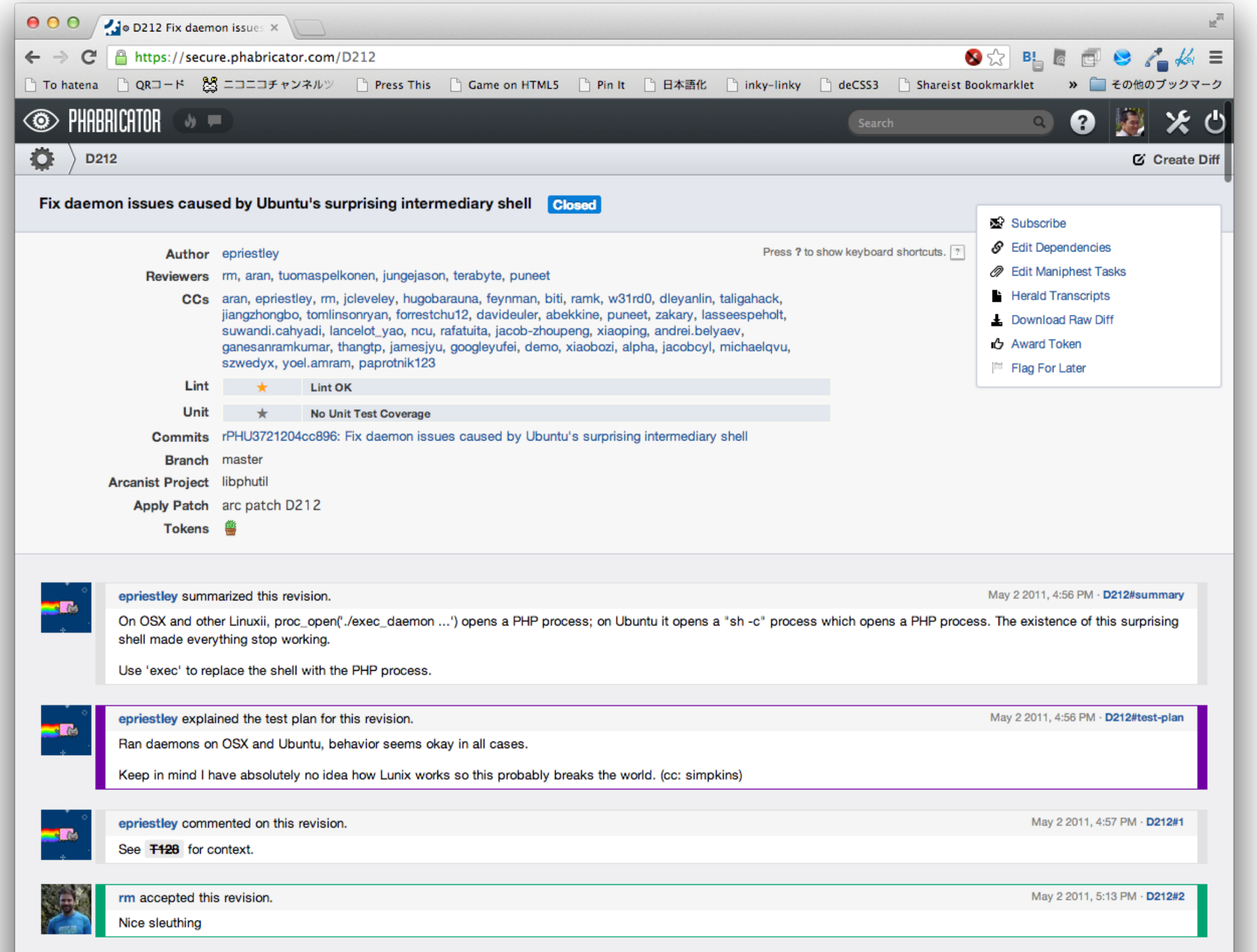
Start free

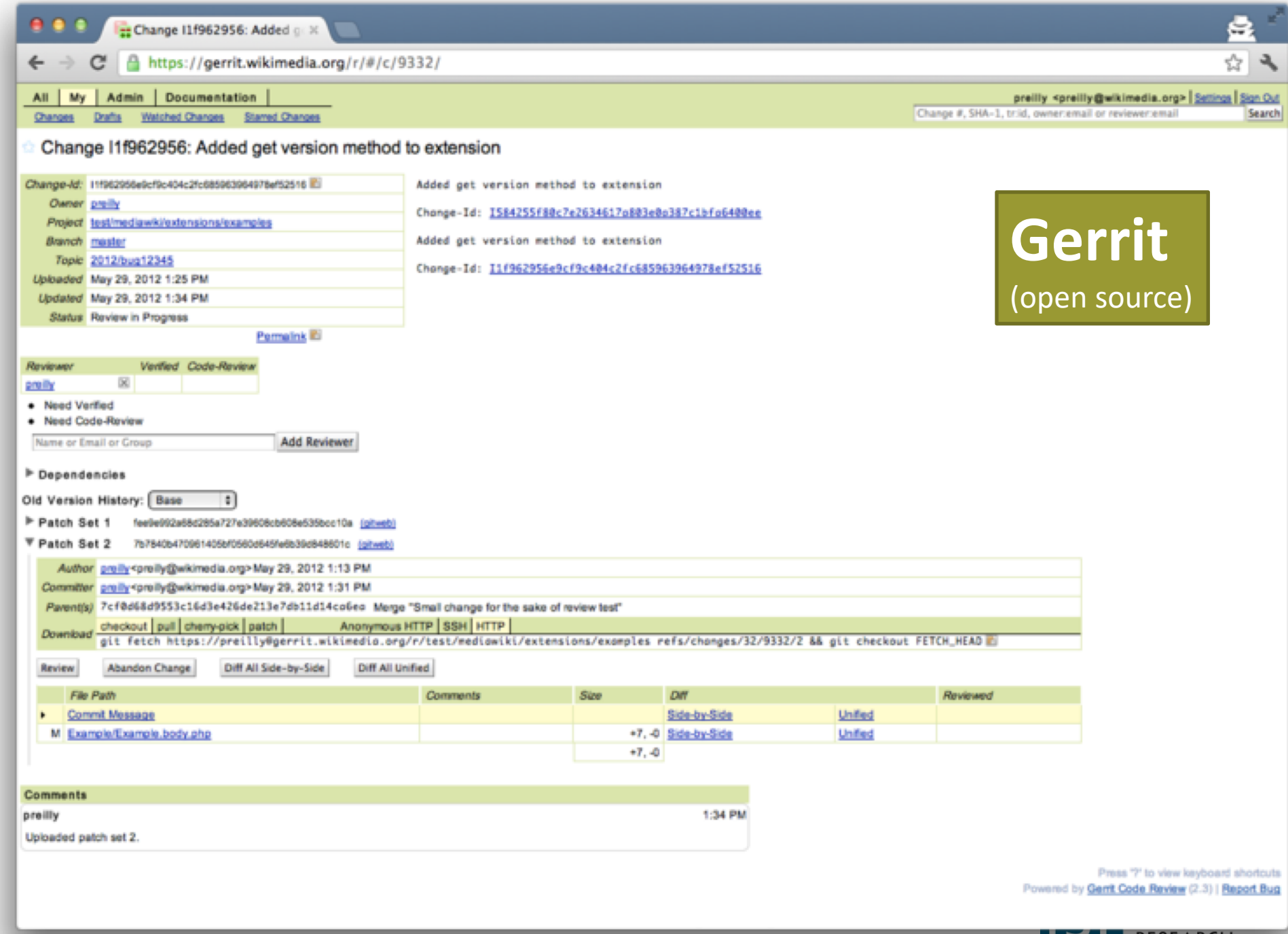
Already have an account?

Sign in to Azure DevOps >

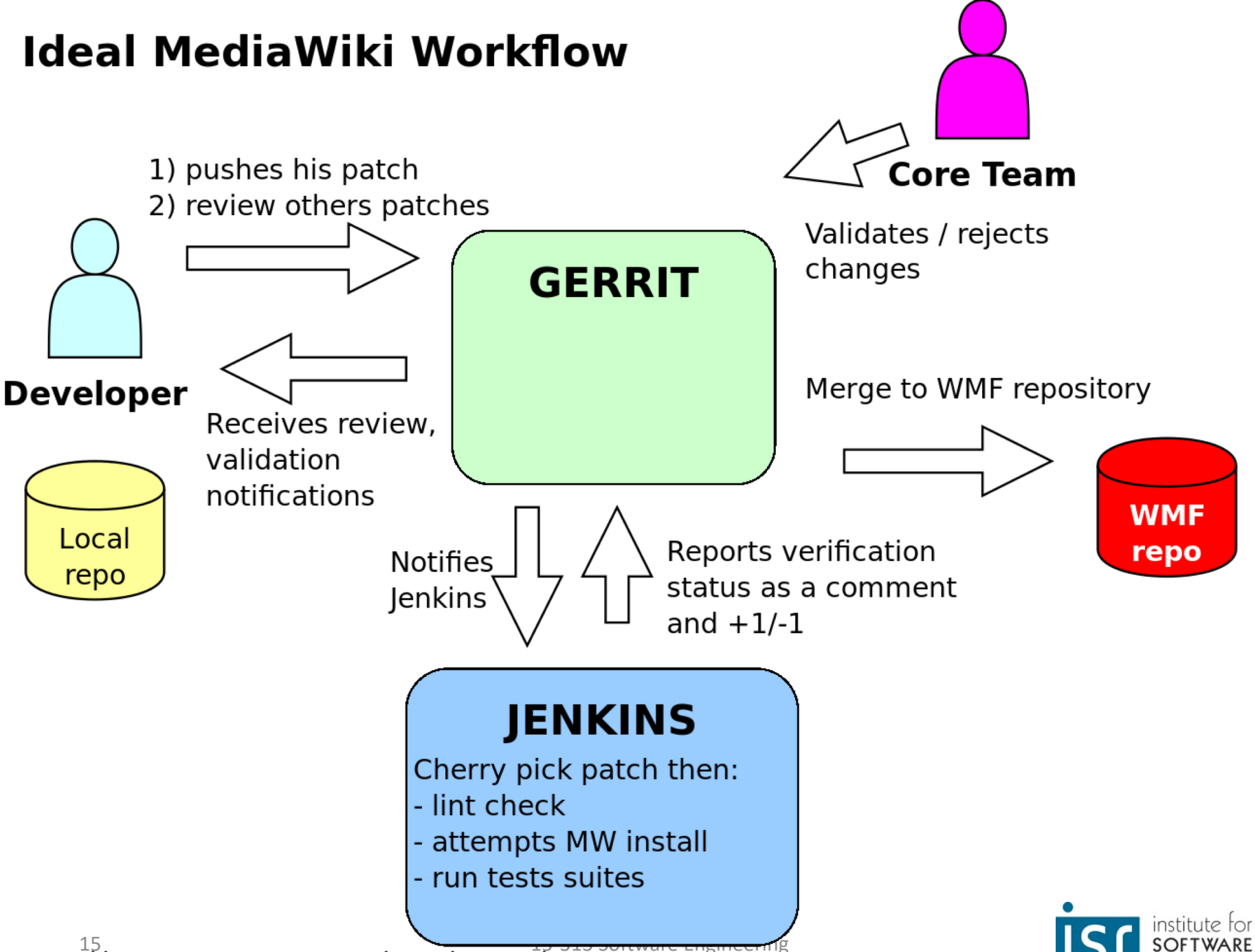


institute for SOFTWARE RESEARCH


D212 Fix daemon issues
https://secure.phabricator.com/D212
PHABRICATOR
Search
D212
Create Diff
Fix daemon issues caused by Ubuntu's surprising intermediary shell
Closed
Author epriestley
Reviewers rm, aran, tuomaspelkonen, jungejason, terabyte, puneet
CCs aran, epriestley, rm, jcleveley, hugobarauna, feynman, biti, ramk, w31rd0, dleyanlin, taligahack, jiangzhongbo, tomlinsonryan, forrestchu12, davideuler, abekkine, puneet, zakary, lasseespeholt, suwandi.cahyadi, lancelot_yao, ncu, rafatuita, jacob-zhoupeng, xiaoping, andrei.belyaev, ganesanramkumar, thangtp, jamesjyu, googleyufei, demo, xiaobozi, alpha, jacobcyl, michaelqvu, szwedyx, yoel.amram, paprotnik123
Lint Lint OK
Unit No Unit Test Coverage
Commits rPHU3721204cc896: Fix daemon issues caused by Ubuntu's surprising intermediary shell
Branch master
Arcanist Project libphutil
Apply Patch arc patch D212
Tokens
Press ? to show keyboard shortcuts.
Subscribe
Edit Dependencies
Edit Maniphest Tasks
Herald Transcripts
Download Raw Diff
Award Token
Flag For Later
epriestley summarized this revision.
May 2 2011, 4:56 PM · D212#summary
On OSX and other Linuxii, proc_open('./exec_daemon ...') opens a PHP process; on Ubuntu it opens a "sh -c" process which opens a PHP process. The existence of this surprising shell made everything stop working.
Use 'exec' to replace the shell with the PHP process.
epriestley explained the test plan for this revision.
May 2 2011, 4:56 PM · D212#test-plan
Ran daemons on OSX and Ubuntu, behavior seems okay in all cases.
Keep in mind I have absolutely no idea how Lunix works so this probably breaks the world. (cc: simpkins)
epriestley commented on this revision.
May 2 2011, 4:57 PM · D212#1
See T128 for context.
rm accepted this revision.
May 2 2011, 5:13 PM · D212#2
Nice sleuthing


Change I1f962956: Added g
https://gerrit.wikimedia.org/r/#/c/9332/
All My Admin Documentation
Changes Drafts Watched Changes Starred Changes
preilly <preilly@wikimedia.org> Settings Sign Out
Change #, SHA-1, tr:id, owner:email or reviewer:email Search
Change I1f962956: Added get version method to extension
Change-Id: I1f962956e9cf9c404c2fc685963964978ef52516
Owner preilly
Project test/mediawiki/extensions/examples
Branch master
Topic 2012/bug12345
Uploaded May 29, 2012 1:25 PM
Updated May 29, 2012 1:34 PM
Status Review in Progress
Permalink
Added get version method to extension
Change-Id: I584255f80c7e2634617a803e0a387c1bfa6480ee
Added get version method to extension
Change-Id: I1f962956e9cf9c404c2fc685963964978ef52516
Gerrit
(open source)
Reviewer Verified Code-Review
preilly
Need Verified
Need Code-Review
Name or Email or Group
Add Reviewer
Dependencies
Old Version History: Base
Patch Set 1 fee0e992a68d285a727e39608cb608e535bcc10a (gitweb)
Patch Set 2 7b7840b47096145bf0560d645fe8b39d848601c (gitweb)
Author preilly <preilly@wikimedia.org> May 29, 2012 1:13 PM
Committer preilly <preilly@wikimedia.org> May 29, 2012 1:31 PM
Parent(s) 7cf0d68d9553c16d3e426de213e7db11d14ca6ea Merge "Small change for the sake of review test"
Download checkout pull cherry-pick patch Anonymous HTTP SSH HTTP
git fetch https://preilly@gerrit.wikimedia.org/r/test/mediawiki/extensions/examples refs/changes/32/9332/2 && git checkout FETCH_HEAD
Review
Abandon Change
Diff All Side-by-Side
Diff All Unified
File Path Comments Size Diff Reviewed
Commit Message Side-by-Side Unified
M Example/Example.body.php +7, -0 Side-by-Side Unified
+7, -0
Comments
preilly 1:34 PM
Uploaded patch set 2.
Press "?" to view keyboard shortcuts
Powered by Gerrit Code Review (2.3) | Report Bug

Ideal MediaWiki Workflow



http://www.mediawiki.org/wiki/Gerrit/Advanced_usage

Date Thu, 16 Oct 2014 14:47:41 +0200
From Greg Kroah-Hartman <>
Subject [PATCH] staging: android: binder: move to the "real" part of the kernel

From: Greg Kroah-Hartman <gregkh@linuxfoundation.org>

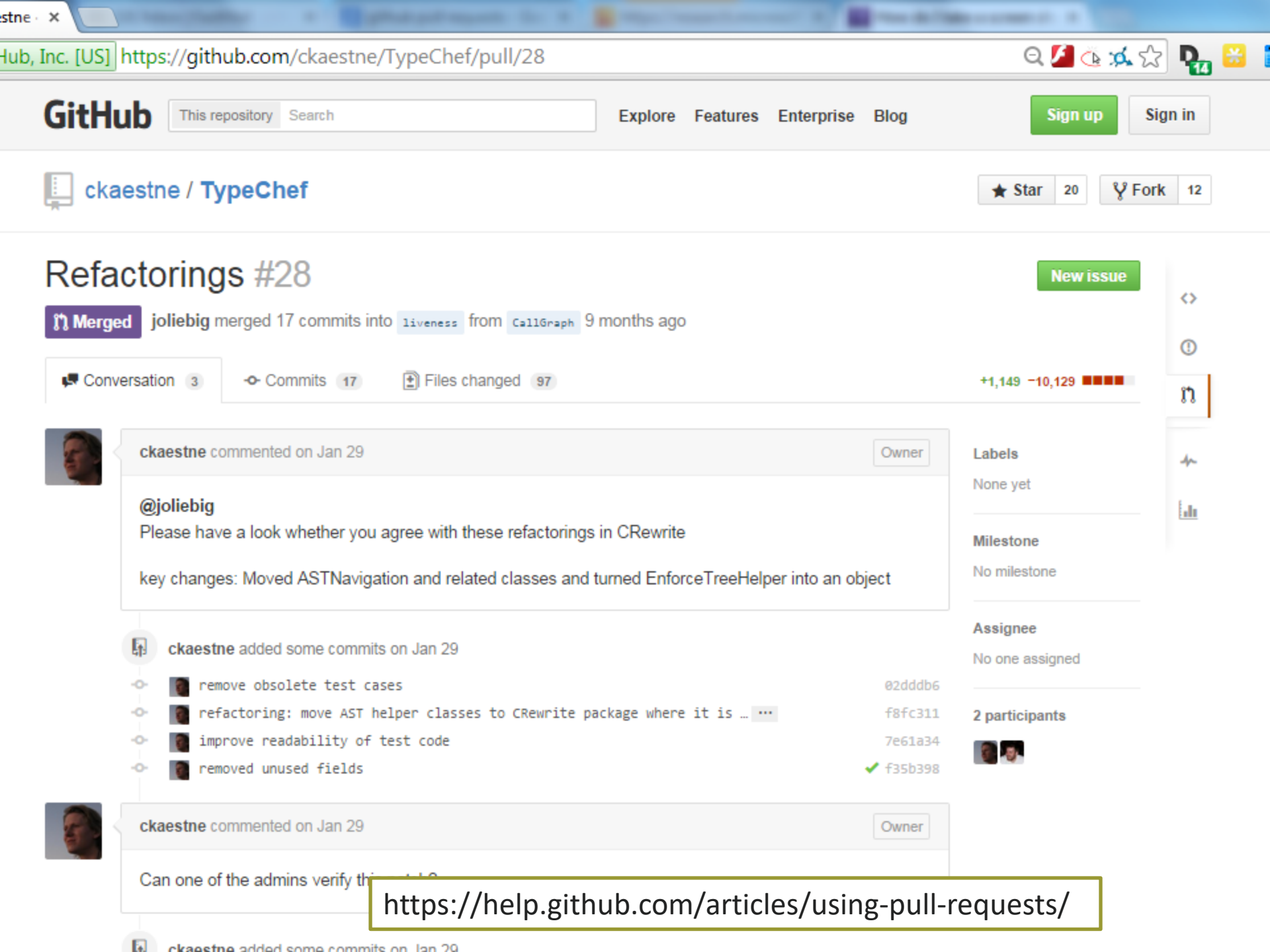
The Android binder code has been "stable" for many years now. No matter
what comes in the future, we are going to have to support this API, so
might as well move it to the "real" part of the kernel as there's no
real work that needs to be done to the existing code.

Signed-off-by: Greg Kroah-Hartman <gregkh@linuxfoundation.org>

This was discussed in the Android miniconf at the Plumbers conference.
If anyone has any objections to this, please let me know, otherwise I'm
queueing this up for 3.19-rc1

```
 drivers/Kconfig                                    |  2 ++
 drivers/Makefile                                   |  1 +
 drivers/android/Kconfig                            | 37 ++++++++++++++++++++++++
 drivers/android/Makefile                           |  3 ++
 drivers/{staging => }/android/binder.c             |  0
 drivers/{staging => }/android/binder.h             |  2 +-
 drivers/{staging => }/android/binder_trace.h       |  0
 drivers/staging/android/Kconfig                    | 30 ----------------------
 drivers/staging/android/Makefile                   |  1 -
 include/uapi/linux/Kbuild                          |  1 +
 include/uapi/linux/android/Kbuild                  |  2 ++
 .../uapi => include/uapi/linux/android}/binder.h   |  0
 12 files changed, 47 insertions(+), 32 deletions(-)
 create mode 100644 drivers/android/Kconfig
 create mode 100644 drivers/android/Makefile
 rename drivers/{staging => }/android/binder.c (100%)
 rename drivers
 rename drivers
 create mode 100644 include/uapi/linux/android/Kbuild
 rename {drivers/staging/android/uapi => include/uapi/linux/android}/binder.h (100%)
```

https://www.kernel.org/doc/Documentation/SubmittingPatches


https://github.com/ckaestne/TypeChef/pull/28
GitHub
This repository
Search
Explore
Features
Enterprise
Blog
Sign up
Sign in
ckaestne / TypeChef
Star 20
Fork 12
Refactorings #28
New issue
Merged
joliebig merged 17 commits into liveness from CallGraph 9 months ago
Conversation 3
Commits 17
Files changed 97
+1,149 −10,129
ckaestne commented on Jan 29
Owner
@joliebig
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Labels
None yet
Milestone
No milestone
Assignee
No one assigned
2 participants
https://help.github.com/articles/using-pull-requests/

“Many eyes make all bugs shallow”

Standard Refrain in Open Source

“Have peers, rather than customers, find defects”

Karl Wiegers

Isn’t testing sufficient?

- Errors can mask other errors
- Only completed implementations can be tested (esp. scalability, performance)
- Design documents cannot be tested
- Tests don’t check code quality
- Many quality attributes (eg., security, compliance, scalability) are difficult to test

A second pair of eyes

- Different background, different experience
- No preconceived idea of correctness
- Not biased by “what was intended”

Checklists!

https://en.wikipedia.org/wiki/File:B17_-_Chino_Airshow_2014_(framed).jpg

OFFICIAL A.A.F. PILOT'S CHECK LIST

B-17F AND B-17G

For detailed instructions see Pilot's Handbook AN 01-20EF-I or AN 01-20EG-I in data case

PILOT

BEFORE STARTING

1. Pilot's Pre-flight — Complete.
2. Form 1A, Form F, Weight and Balance — Checked.
3. Controls and Seats — Checked — Checked.
4. Fuel Transfer Valves and Switch — Off.
5. Intercoolers — Cold.
6. Gyros — Uncaged.
7. Fuel Shut-off Switches — Open.
8. Gear Switch — Neutral.
9. Cowl Flaps — Open Right — Open Left — Locked.
10. Turbos — Off.
11. Idle cut-off — Checked.
12. Throttles — Closed.
13. High RPM — Checked.
14. Auto Pilot — Off.
15. De-icers and Anti-icers Wing and Prop. — Off.
16. Cabin heat — Off.
17. Generators — Off.

STARTING ENGINES

1. Fire Guard and Call Clear — Left-Right.
2. Master Switches — On.
3. Battery Switches and Inverters — On and Checked.
4. Parking Brakes — Hydraulic Check-On — Checked.
5. Booster Pumps — Pressure — On and Checked.
6. Carburetor Filters — Open.
7. Fuel Quantity — Gallons per tank.
8. Start Engines
   a. Fire Extinguisher Engine Selector — Checked.
   b. Prime — As Necessary.

CO-PILOT

BEFORE TAKE OFF

1. Tail Wheel — Locked.
2. Gyro — Set.
3. Generators — On.

AFTER TAKE OFF

1. Wheels — Pilot's Signal.
2. Power Reduction.
3. Cowl Flaps.
4. Wheel Check — OK Right. OK Left.

BEFORE LANDING

1. Radio Call Altimeter — Set.
2. Crew Positions — OK.
3. Auto Pilot — Off.
4. Booster Pumps — On.
5. Mixture Controls — Auto Rich.
6. Intercooler — Set.
7. Carburetor Filters — Open.
8. Wing De-icers — Off.
9. Landing Gear
   a. Visual — Down right
      Down left
      Tail wheel
      Down,
      Antenna In
   b. Light — OK.
   c. Switch Off — Neutral.
10. Hydraulic Pressure — OK. Valve closed.
11. RPM 2100 — Set.
12. Turbos — Set.
13. Flaps $1/3$ — $1/3$ Down

FINAL APPROACH

14. Flaps — Pilot's Signal.
15. High RPM — Pilot's Signal.

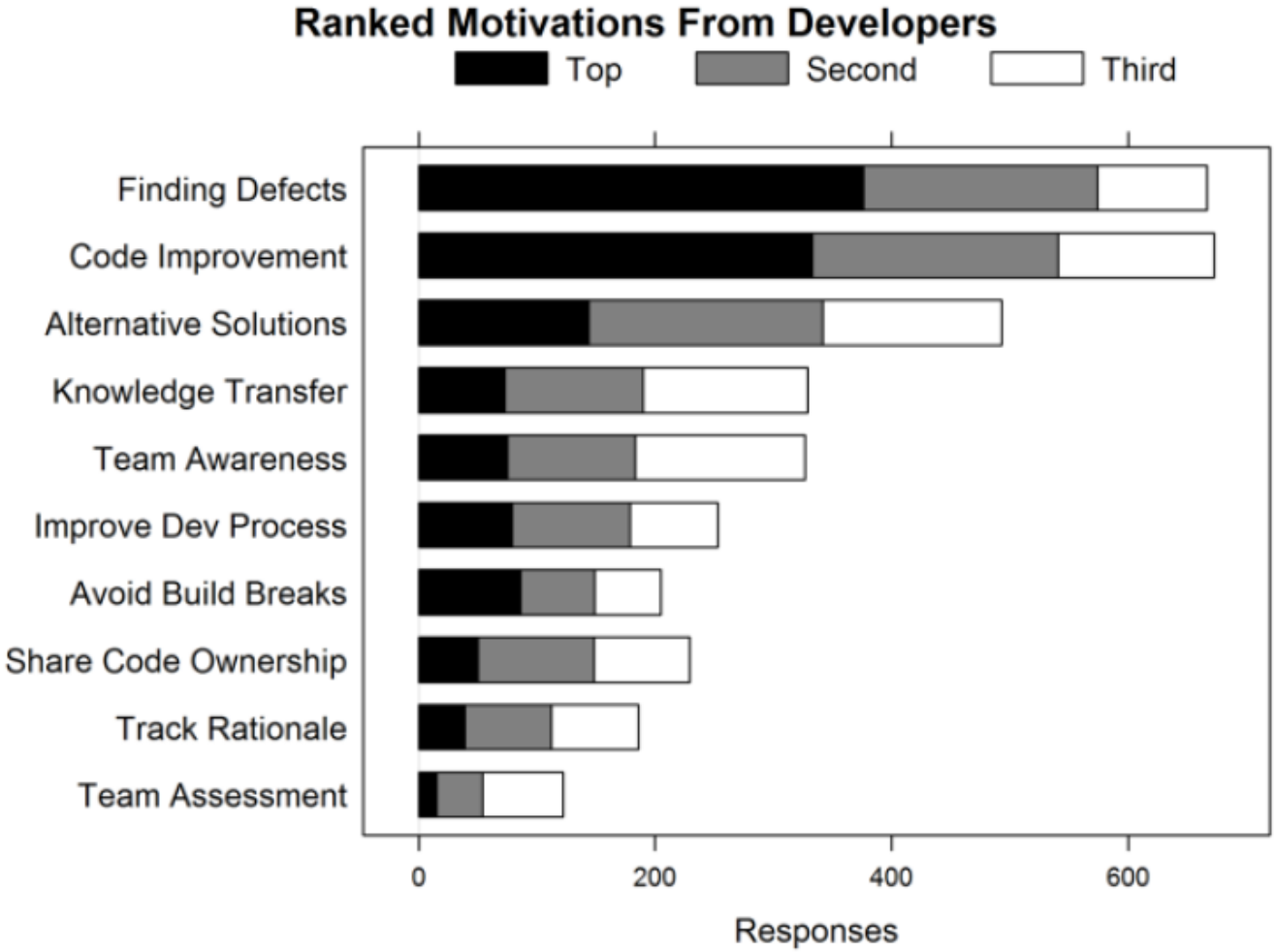
The Checklist: https://www.newyorker.com/magazine/2007/12/10/the-checklist

Activity

Develop checklist for Code Review

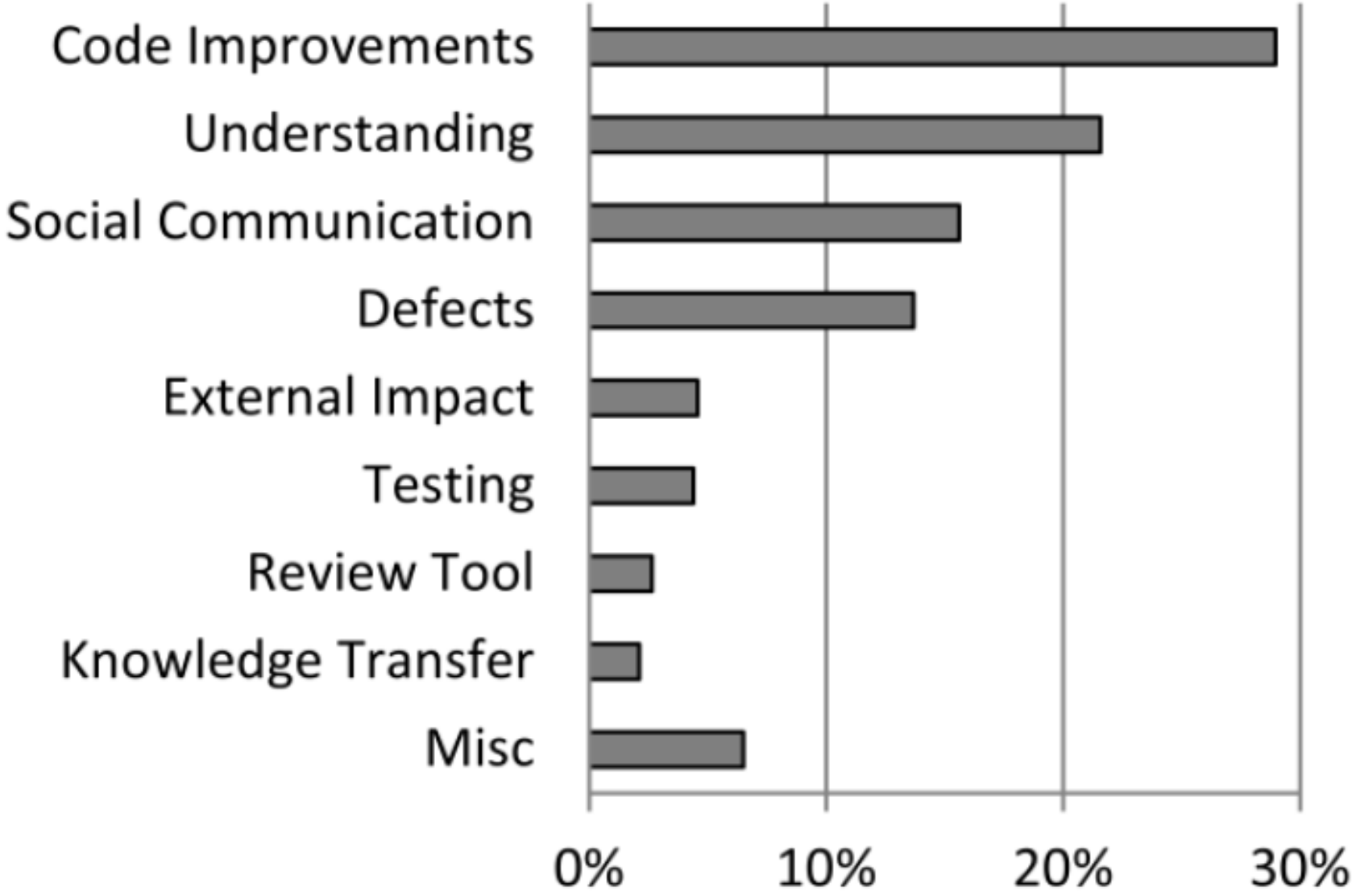
Expectations and Outcomes of Modern Code Reviews

Code Review at Microsoft



Bacchelli, Alberto, and Christian Bird. "Expectations, outcomes, and challenges of modern code review." *Proceedings of the 2013 International Conference on Software Engineering*. IEEE Press, 2013.

Outcomes (Analyzing Reviews)



Bacchelli, Alberto, and Christian Bird. "Expectations, outcomes, and challenges of modern code review." *Proceedings of the 2013 International Conference on Software Engineering*. IEEE Press, 2013.

Mismatch of Expectations and Outcomes

- Low quality of code reviews
  - Reviewers look for easy errors, as formatting issues
  - Miss serious errors
- Understanding is the main challenge
  - Understanding the reason for a change
  - Understanding the code and its context
  - Feedback channels to ask questions often needed
- No quality assurance on the outcome

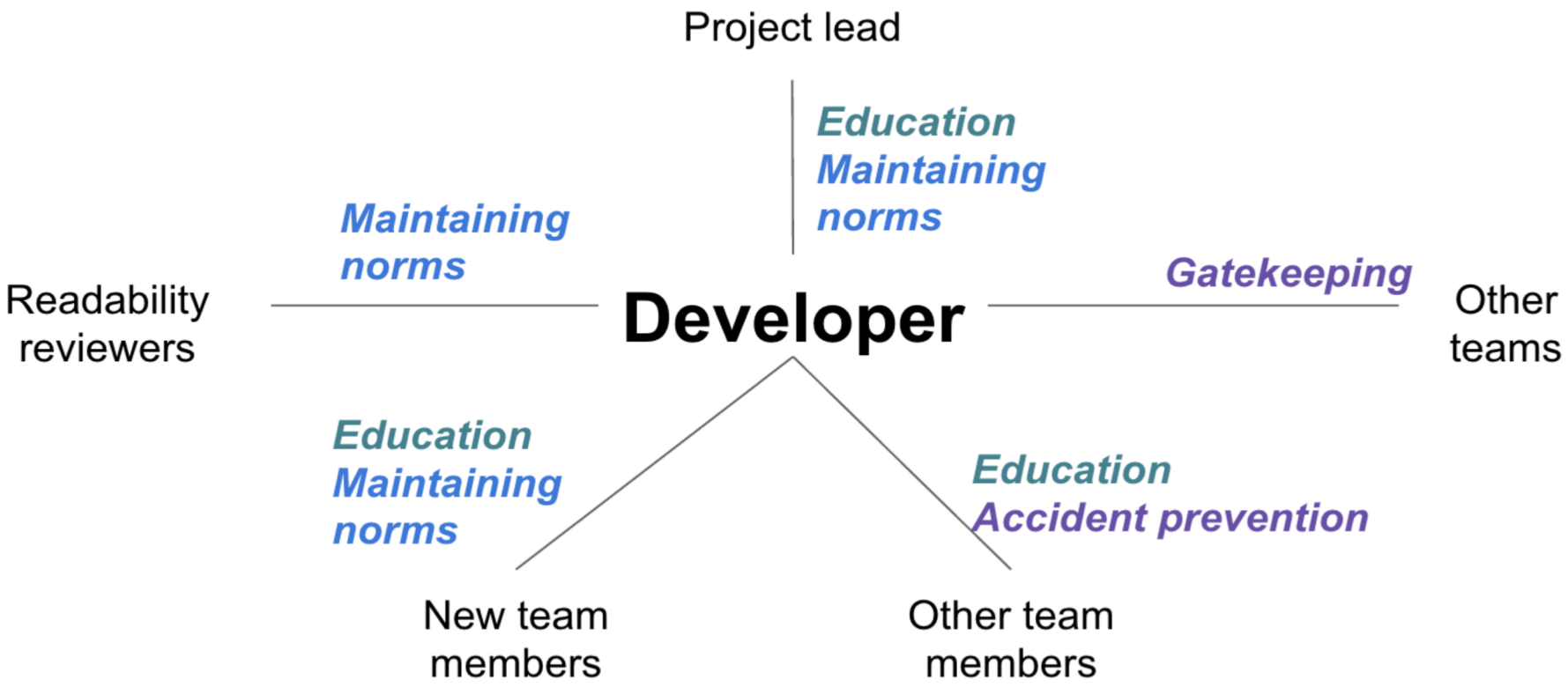
Bacchelli, Alberto, and Christian Bird. "Expectations, outcomes, and challenges of modern code review." *Proceedings of the 2013 International Conference on Software Engineering*. IEEE Press, 2013.

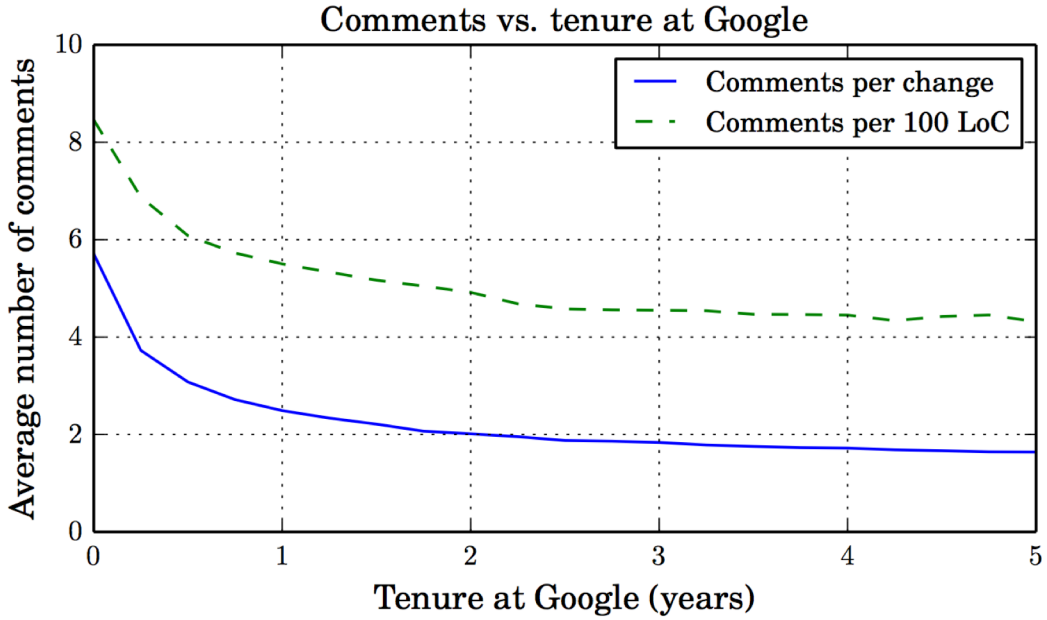
Code Review at Google

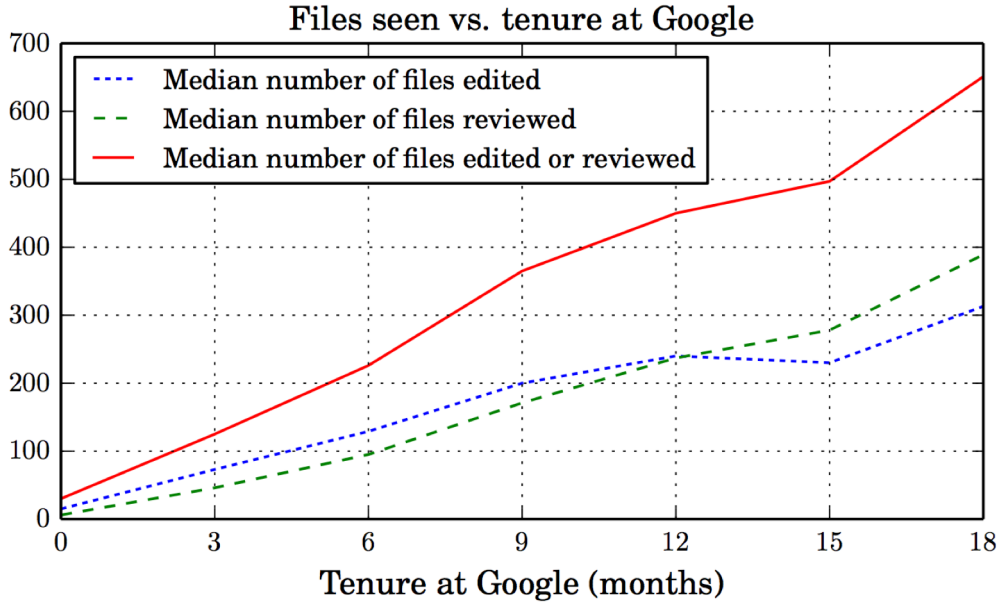
- Introduced to "*force developers to write code that other developers could understand*"
- 3 Found benefits:
  - checking the consistency of style and design
  - ensuring adequate tests
  - improving security by making sure no single developer can commit arbitrary code without oversight

Caitlin Sadowski, Emma Söderberg, Luke Church, Michal Sipko and Alberto Bacchelli. 2018. Modern Code Review: A Case Study at Google. International Conference on Software Engineering

Reviewing relationships




Comments vs. tenure at Google
Comments per change
Comments per 100 LoC
Average number of comments
Tenure at Google (years)
0
2
4
6
8
10
0
1
2
3
4
5


Files seen vs. tenure at Google
Median number of files edited
Median number of files reviewed
Median number of files edited or reviewed
Tenure at Google (months)
0
100
200
300
400
500
600
700
0
3
6
9
12
15
18

Formal Inspections

Formal Inspections

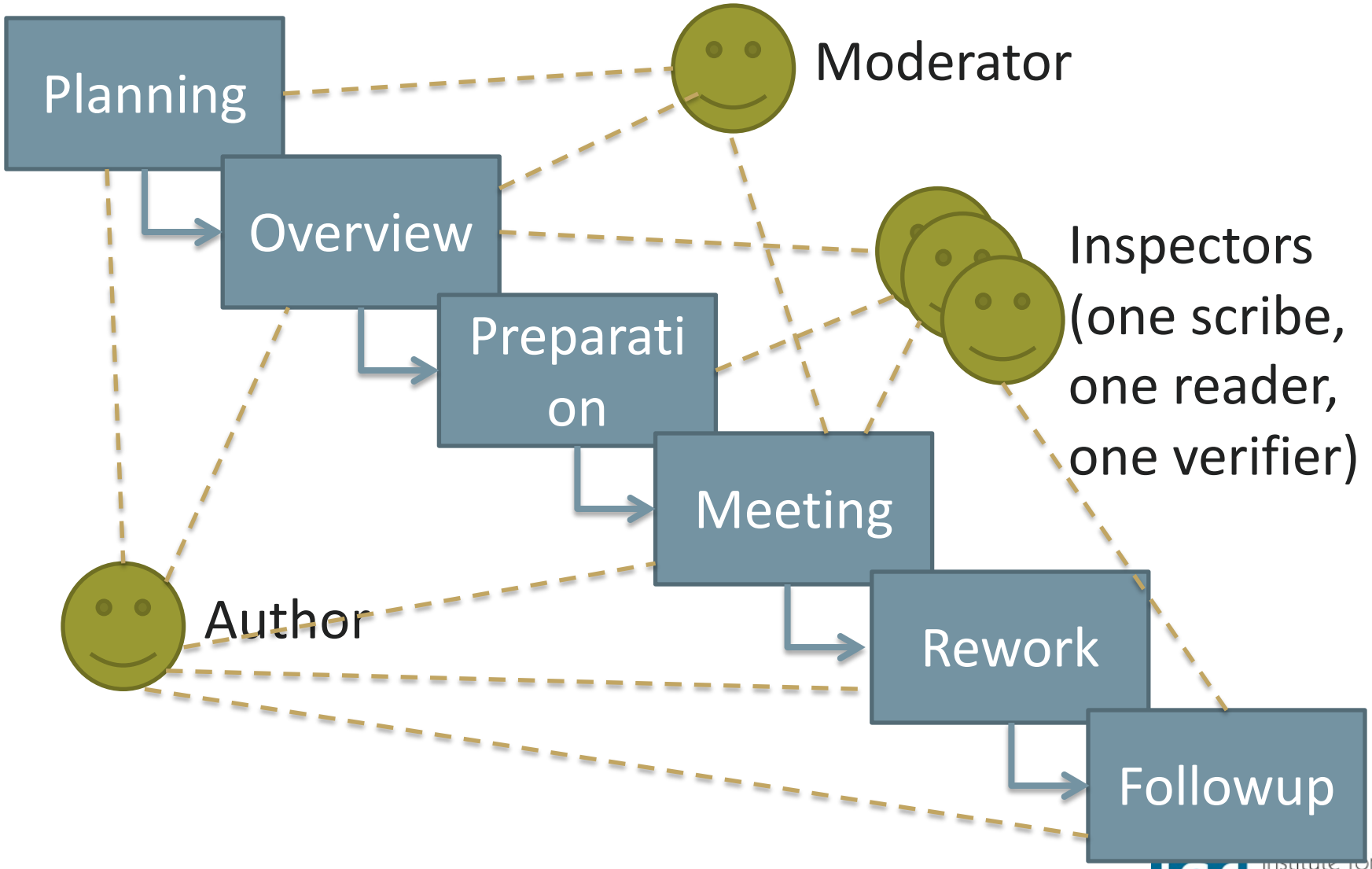
- Idea popularized in 70s at IBM
- Broadly adopted in 80s, much research
  - Sometimes replacing component testing
- Group of developers meets to formally review code or other artifacts
- Most effective approach to find bugs
  - Typically 60-90% of bugs found with inspections
- Expensive and labor-intensive

(see textbook Chapter 22.2)

Inspection Team and Roles

- Typically 4-5 people (min 3)
- Author
- Inspector(s)
  - Find faults and broader issues
- Reader
  - Presents the code or document at inspection meeting
- Scribe
  - Records results
- Moderator
  - Manages process, facilitates, reports

Inspection Process



Checklists

- Reminder what to look for
- Include issues detected in the past
- Preferably focus on few important items
- Examples:
  - Are all variables initialized before use?
  - Are all variables used?
  - Is the condition of each if/while statement correct?
  - Does each loop terminate?
  - Do function parameters have the right types and appear in the right order?
  - Are linked lists efficiently traversed?
  - Is dynamically allocated memory released?
  - Can unexpected inputs cause corruption?
  - Have all possible error conditions been handled?
  - Are strings correctly sanitized?

Perspective-based Inspections

- Have inspectors with different specialties or different focuses/checklists
  - Encourages alternative thinking patterns
- Have reviewers start in different places in the document
  - Avoid loosing focus at the same location
- Especially in preparation phase
- Little published data, but considered an effective practice

Process details

- Authors do not explain or defend the code – not objective
  - Author != moderator, != scribe, !=reader
  - Author should still join the meeting to observe questions and misunderstandings and clarify issues if necessary
- Reader (optional) walks through the code line by line, explaining it
  - Reading the code aloud requires deeper understanding
  - Verbalizes interpretations, thus observing differences in interpretation

Social issues: Egos in Inspections

- Author's self-worth in artifacts
- Identify defects, not alternatives; do not criticize authors
  - "you didn't initialize variable a" -> "I don't see where variable a is initialized"
- Avoid defending code; avoid discussions of solutions/alternatives
- Reviewers should not "show off" that they are better/smarter
- Avoid style discussions if there are no guidelines
- Author decides how to resolve fault

Social issues 2

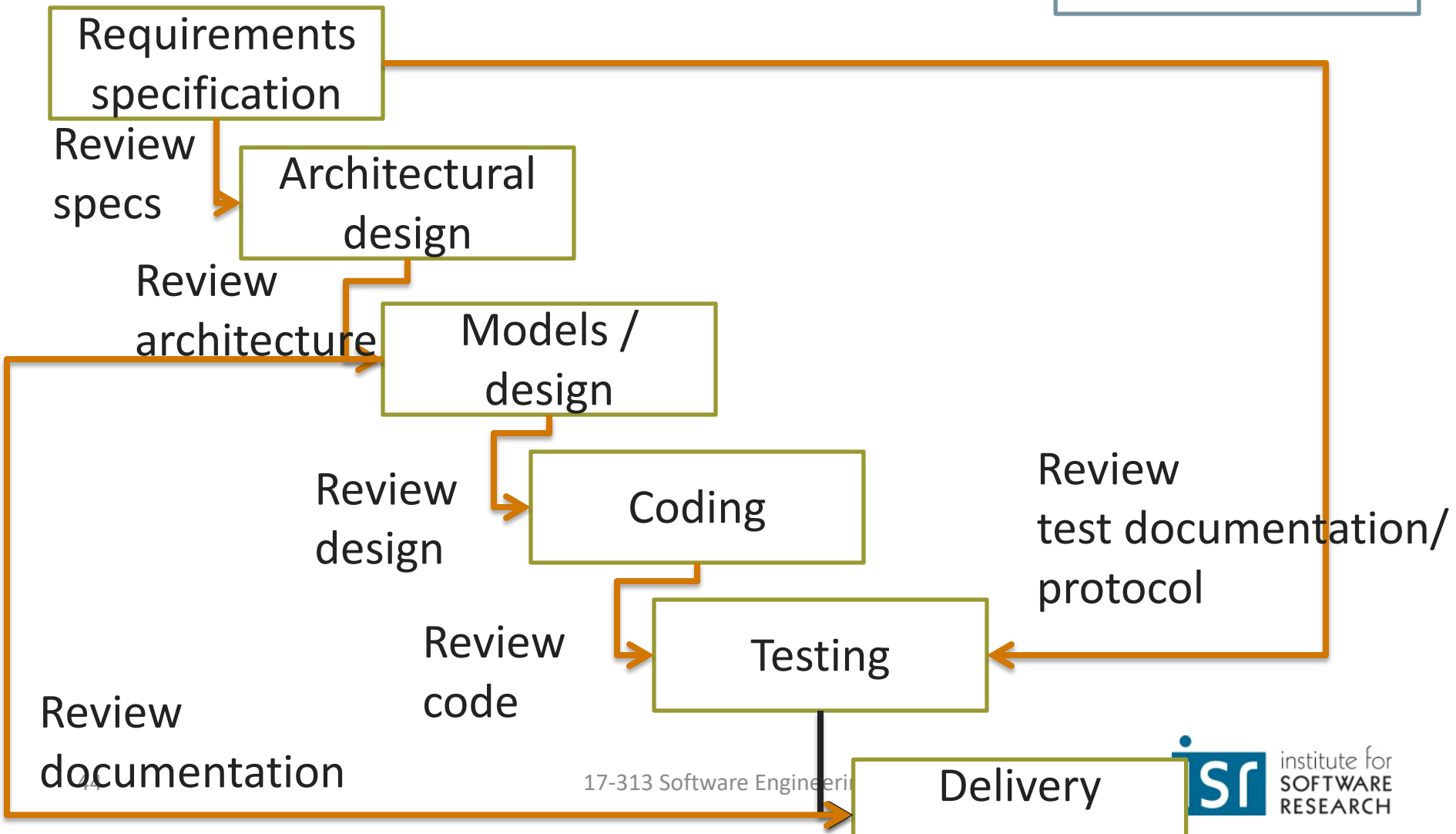
- Moderator must move discussion along, resolve conflicts
- Meetings should not include management
- Do not use for HR evaluation
  - "finding more than 5 bugs during inspection counts against the author"
  - Leads to avoidance, fragmented submission, not pointing out defects, holding pre-reviews
- Responsibility for quality with authors, not reviewers
  - "why fix this, reviewers will find it"

Root Cause Analysis

- Beyond the immediate puzzle
- How to improve the development process to avoid this problem
  - Restructure development process
  - New policies
  - New development tools, new languages, new analysis tools

Review Checkpoints during Lifecycle

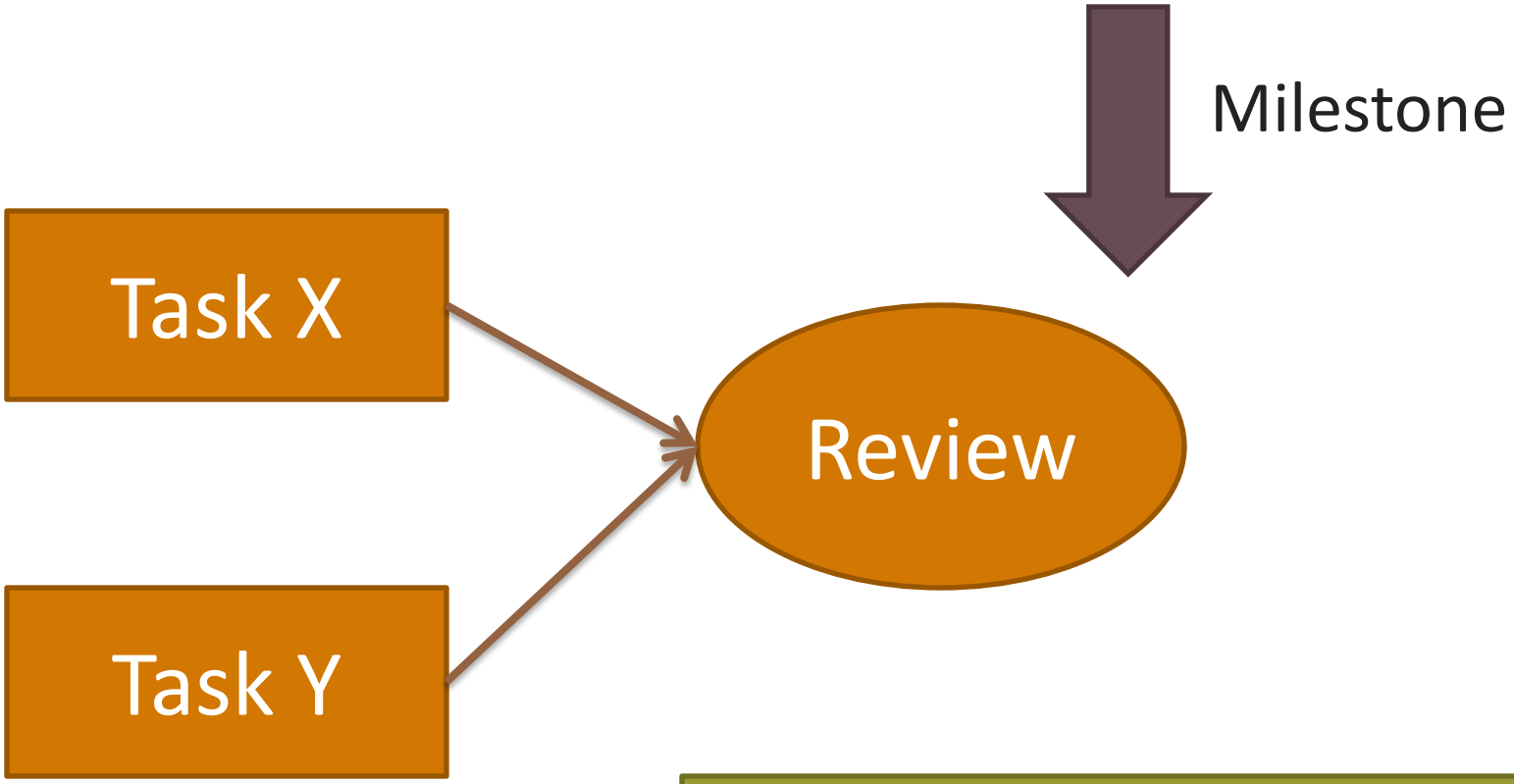
Also reviewable:
Business plan
Marketing documents
Project plans
Documentation



When to inspect

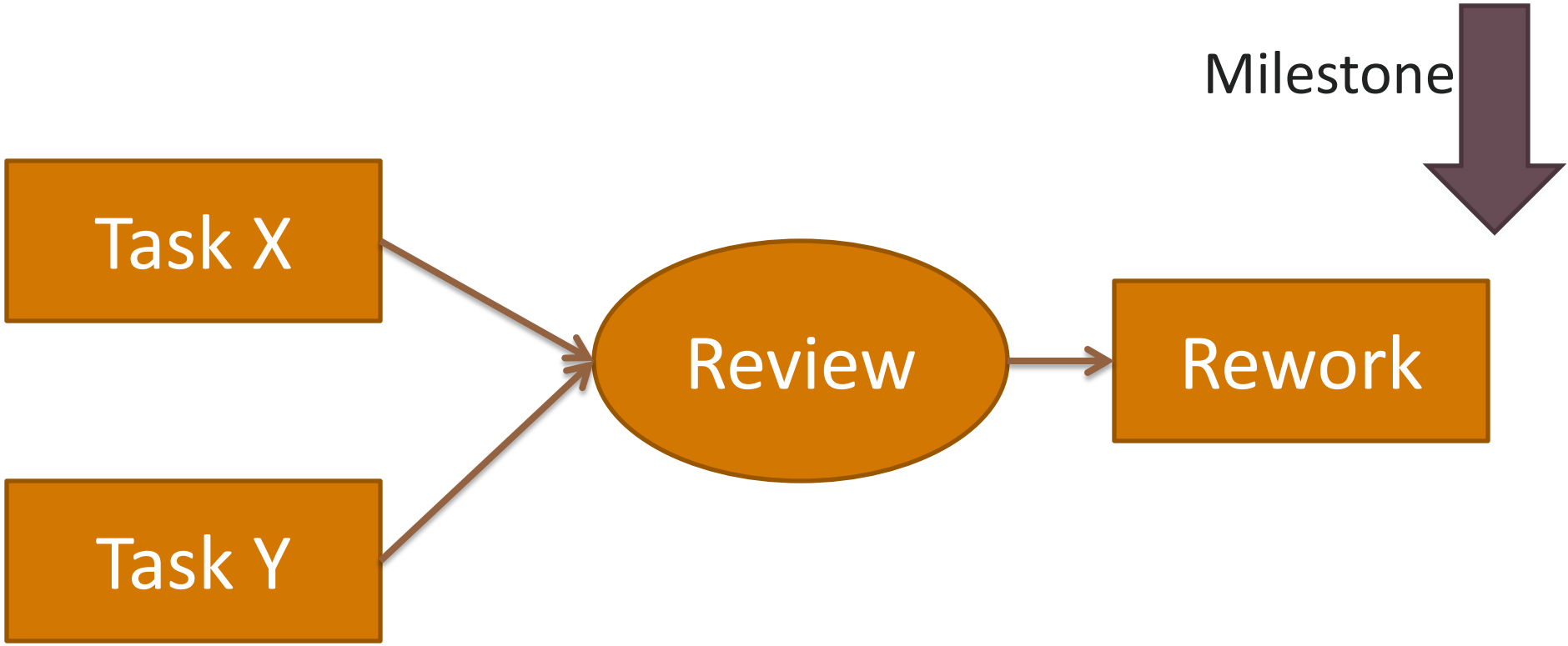
- Before milestones
- Incremental inspections during development
  - Earlier often better than later: smaller fragments, chance to influence further development
  - Large code bases can be expensive and frustrating to review
    - Break down, divide and conquer
    - Focus on critical components
    - Identify defect density in first sessions to guide further need of inspections

Reviews as part of a Milestone



Suitable milestone?

Reviews as part of a Milestone

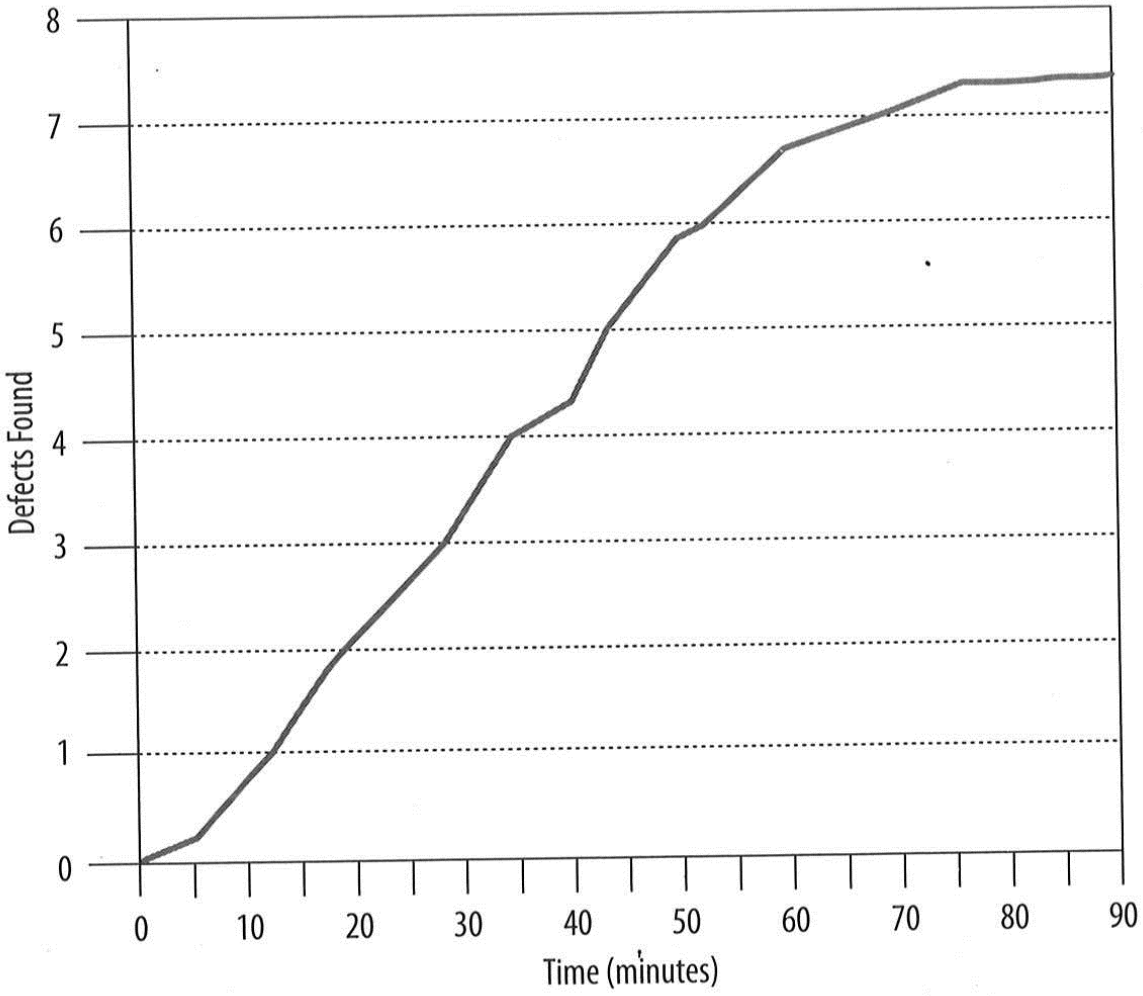


Guidelines for Inspections

- Collected over many companies in many projects and experiments
- Several metrics easily measureable (effort, issues found, lines of code inspected) …

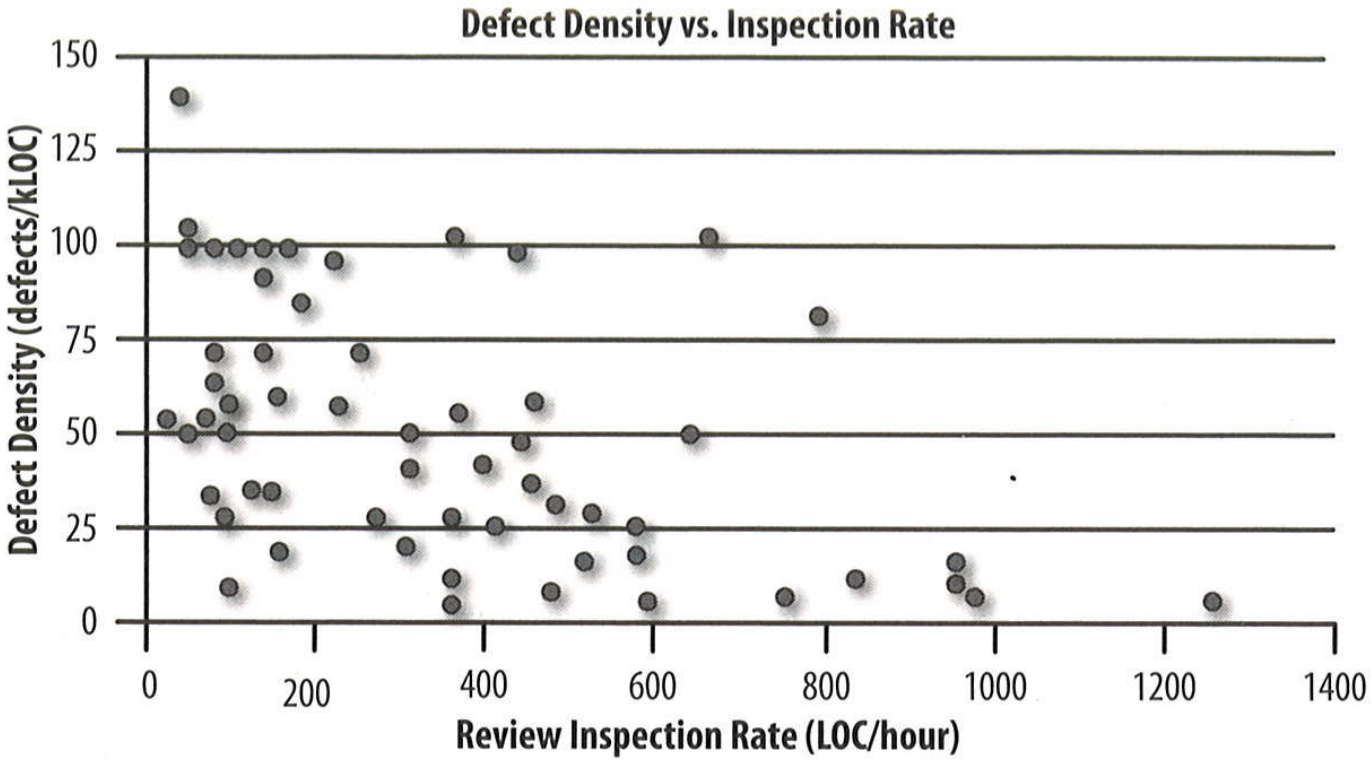
Source: Oram and Wilson (ed.). Making Software. O'Reilly 2010. Chapter 18 and papers reviewed therein

Focus Fatigue



Recommendation:
Do not exceed
60 minute session

Inspection speed



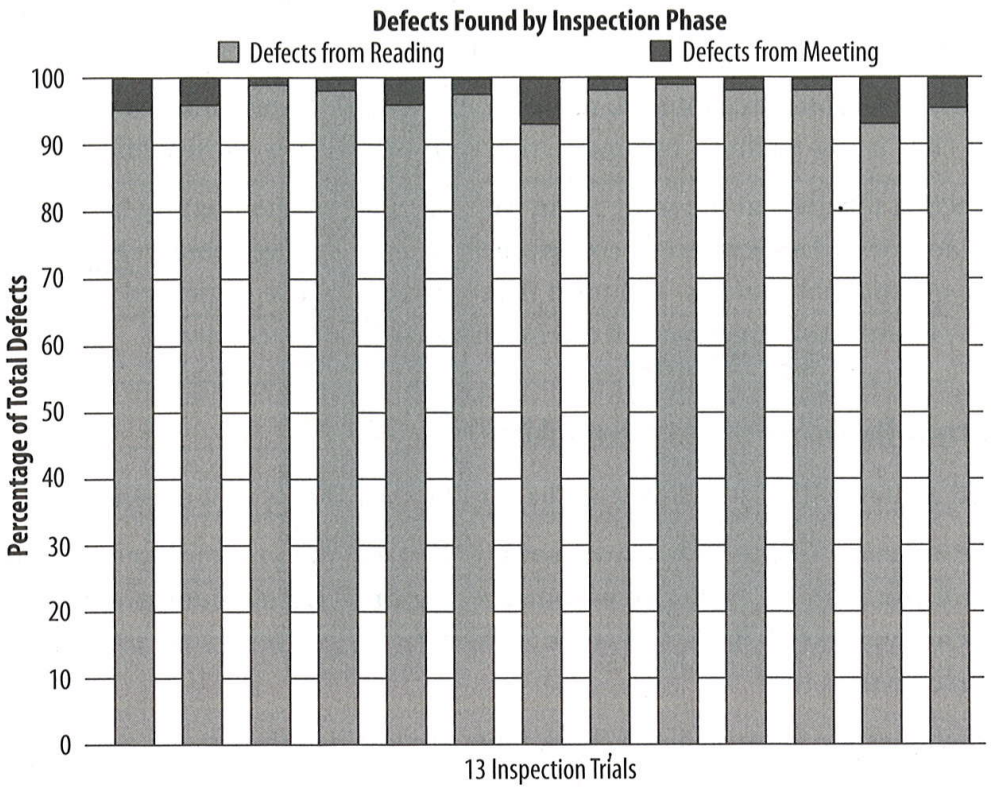
Above 400 LOC/h reviews get shallow

Recommendation: Schedule less than 400 LOC for a 1h review session

Importance of Context

- Code with fewer context dependencies is easier to review
- Reviewers need to look at related files
- -> Modularity (small interfaces, high cohesion, low coupling, …)

Are meetings required?

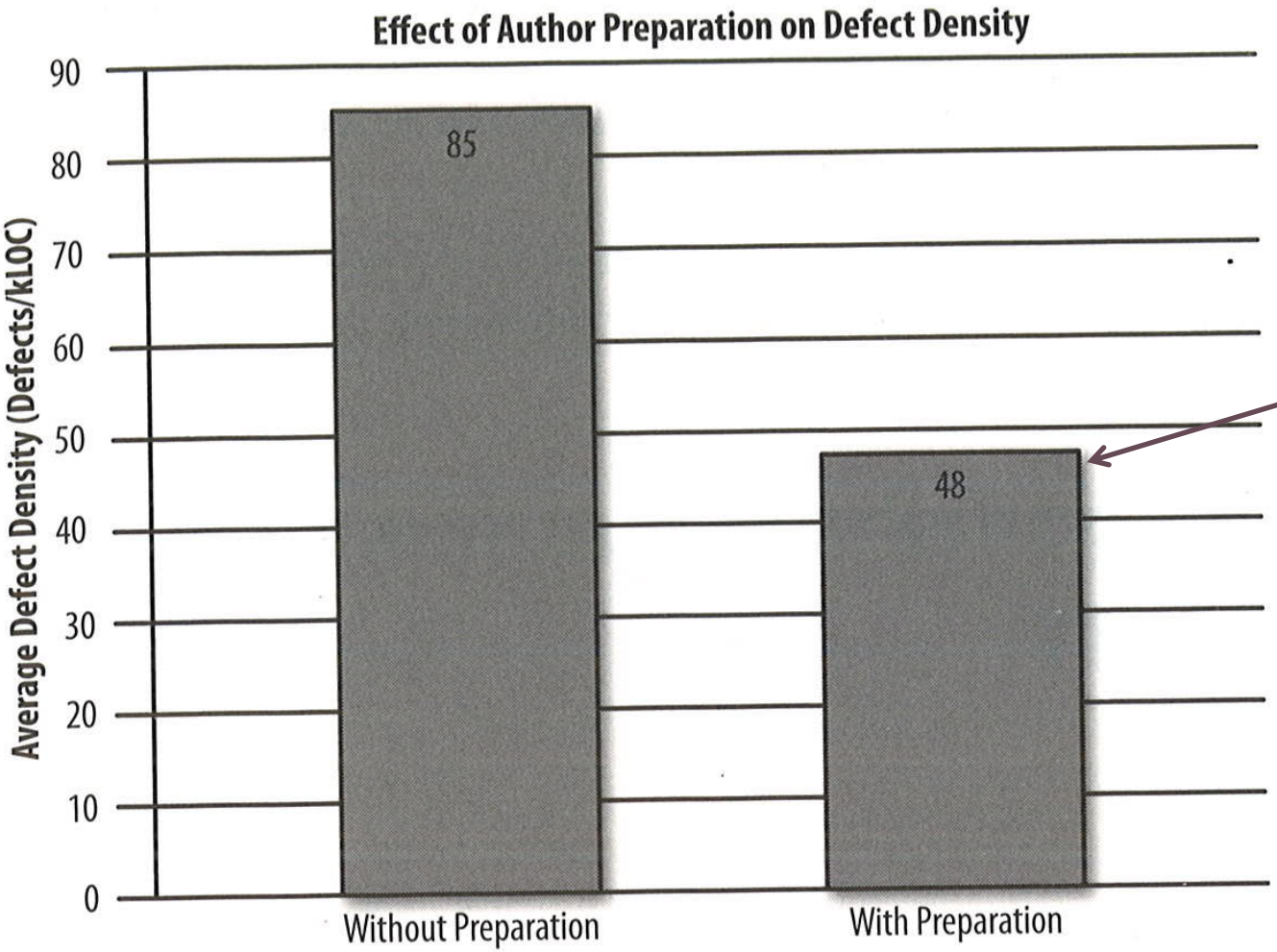


Most issues found during preparation, not in meeting.
Suggested synergy seems to have only low impact
Claim: Defects found in meetings often more subtle

False positives

- About 25% of found issues are false positives
- Avoid discussing during meeting
- Confusion during meeting is indicator that document could be clearer

Self-checks can find half the issues



Authors have self-checked their document before inspection

Arguments against Reviews?

Cost Discussion in Context

- Formal inspections vs modern code reviews
  - Formal inspections very expensive (about one developer-day per session)
  - Passaround distributed, asynchronous
- Code reviews vs testing
  - Code reviews claimed more cost effective
- Code reviews vs not finding the bug

Types of Code Reviews by Formality

- Ad hoc review
- Passaround ("modern code reviews")
- Pair programming
- Walkthrough
- Inspection

More formal

Source: Wiegers. Peer Reviews in Software. Addison-Wesley 2002

Types of Code Reviews by Formality

- Ad hoc review
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- Wa
- Insp

When to use reviews?
Which formality?

More formal

Source: Wiegers. Peer Reviews in Software. Addison-Wesley 2002

Differences among peer review types

Review Type	Planning	Preparation	Meeting	Correction	Verification
Formal Inspection	Yes	Yes	Yes	Yes	Yes
Walkthrough	Yes	Yes	Yes	Yes	No
Pair Programming	Yes	No	Continuous	Yes	Yes
Passaround	No	Yes	Rarely	Yes	No
Ad Hoc Review	No	No	Yes	Yes	No

Source: Wiegers. Peer Reviews in Software. Addison-Wesley 2002

Experience (studies/claims)

- Raytheon
  - Reduced “rework” from 41% of costs to 20%
  - Reduced integration effort by 80%
- Paulk et al. : costs to fix a space shuttle software
  - 1$ if found in inspection
  - 13$ during system test
  - 92$ after delivery
- IBM
  - 1h of inspection saves 20h of testing
- R. Grady, efficiency data from HP
  - System use 0.21 defects/h
  - Black box testing 0.28 defects/h
  - White box testing 0.32 defects/h
  - Reading/inspection 1.06 defects/h

Security Audits

IsTrueCryptAuditedYet?
Yes!

Update Apr 2, 2015: Phase II complete. TrueCrypt has been audited.

Update Feb 18, 2015: Matthew posted an update on the Phase II cryptanalysis today. The Phase I audit report is available on the Open Crypto Audit Project site, and a verified source and download archive for TrueCrypt v. 7.1a can be found on our GitHub mirror. We'll be posting further news @opencryptoaudit on Twitter in the months ahead.

TrueCrypt (TC) is an open source file and disk encryption software package used by people all over the world, but a complete cryptanalysis has not been performed on the software, and questions remain about differences between Windows, Linux and Mac OS X versions. In addition, there has been no legal review on the current TrueCrypt v. 3.0 open source license - preventing inclusion in most of the free operating systems, including Ubuntu, Debian, RedHat, CentOS and Fedora. We want to be able to trust it, but a fully audited, independently verified repository and software distribution would make us feel better about trusting our security to this software. We're pledging this money to sponsor a comprehensive public audit of TrueCrypt.

Support the Project

You can help support the Project on our FundFill site, or our new IndieGoGo site *(note: both funds accept credit cards; FundFill also accepts Bitcoin, while IndieGoGo also takes PayPal & eChecks)*.

Goals

- Resolve license status on the current (v. 7.1a) TrueCrypt source code (license v. 3.0) copyright & distribution, in order to create a verified, independent version control history repository (signed source and binary)
- Perform and document repeatable, deterministic builds of TC 7.1a from source code for current major operating systems:
  - Windows 7
  - Mac OS X (Lion 10.7 and Mountain Lion 10.8)
  - Ubuntu 12.04 LTS and 13.04, RedHat 6.4, CentOS 6.4, Debian 7.1, Fedora 19
- Conduct a public cryptanalysis and security audit of the TC 7.1a

Rules

“Many eyes make all bugs shallow”

Standard Refrain in Open Source

Firefox

src/usr.bin/head/head.c - view - 1.18

cvsweb.openbsd.org/cgi-bin/cvsweb/src/usr.bin/head/head.c?rev=1.18&content-type=text/x-cvsweb-markup

37 year old bug

Return to head.c CVS log

File: [local] / src / usr.bin / head / head.c (**download**)

Revision **1.18**, *Wed Oct 8 08:31:53 2014 UTC* (13 days, 4 hours ago) by *schwarze*
Branch: **MAIN**
CVS Tags: **HEAD**
Changes since **1.17**: **+7 -5 lines**

```
Fix a 37 year old bug introduced by Bill Joy on August 24, 1977
that was already present in the 1BSD release on March 9, 1978
by merging Keith Bostic's 22 year old fix from 4.4BSD (not kidding).

Original CSRG SCCS commit message:

  ^As 00009/00006/00145
  ^Ad D 5.7 92/03/04 14:35:42 bostic 9 8
  ^Ac can't use freopen; example is "date | head file1 /dev/stdin"

ok deraadt@ tedu@, also checked by Martin <Natano dot net>
```

```
/*      $OpenBSD: head.c,v 1.18 2014/10/08 08:31:53 schwarze Exp $      */

/*
 * Copyright (c) 1980, 1987 Regents of the University of California.
 * All rights reserved.
 *
 * Redistribution and use in source and binary forms, with or without
 * modification, are permitted provided that the following conditions
 * are met:
 * 1. Redistributions of source code must retain the above copyright
 *    notice, this list of conditions and the following disclaimer.
 * 2. Redistributions in binary form must reproduce the above copyright
```

The Shellshock vulnerabilities affect **Bash**, a program that various Unix-based systems use to execute command lines and command scripts. Bash is free software, developed collaboratively and overseen since 1992 on a volunteer basis by Chet Ramey, a professional software architect.

Analysis of the source code history of Bash shows the vulnerabilities **had existed undiscovered since version 1.03 in 1989.**

Further Reading

- Sommerville. Software Engineering. 8th Edition. Addison-Wesley 2007. Chapter 22.2
  - Overview of formal inspections
- Wiegers. Peer Reviews in Software. Addison-Wesley 2002
  - Entire book on formal inspections, how to run them and how to introduce them
- Bacchelli and Bird. "Expectations, outcomes, and challenges of modern code review." *Proceedings of the 2013 International Conference on Software Engineering*. IEEE Press, 2013.
  - Detailed studies of modern code reviews at Microsoft
- Oram and Wilson (ed.). Making Software. O'Reilly 2010. Chapter 18
  - Overview of empirical research on formal inspections

Our plan is to gather a list of interested parties, then send out a simple, informal form for you to fill out, and then we will present the projects to the students, and let them choose. I will add you to the list of interested customers.