Guide to exploring the SStuBs dataset

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Single statement bugs (***S***imple ***St***upid ***B***ug***s***)

Source:

- top 100 Java Maven Projects
  - SStuBs: 10,231
  - Bugs: 25,539
- top 1000 Java Projects
  - SStuBs: 63,923
  - Bugs: 153,698

Lots of effort in bug fixing by developers

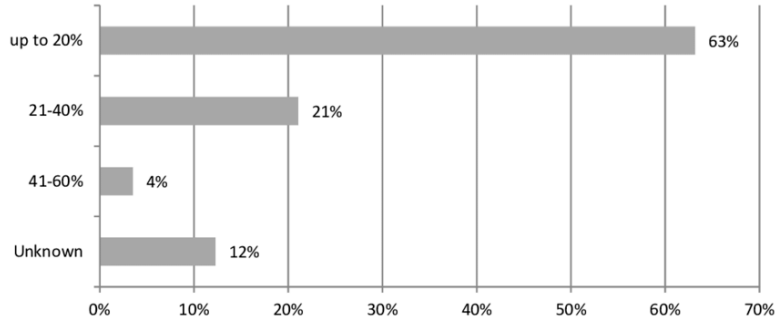


Figure 1: Ratio of total project effort spent on bug fixing by developers.[1]

[1]Software Quality Assurance During Implementation: Results of a Survey in Software Houses from Germany, Austria and Switzerland ICSQ 17

For auto program repair

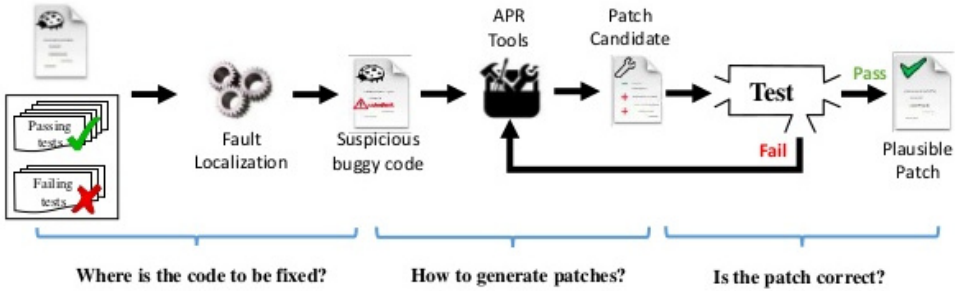


Figure 2: Basic process of automated program repair(APR) [2]

[2] LSRepair: Live Search of Fix Ingredients for Automated Program Repair APSEC 18

Existing dataset size

Table 1: Stats on selected datasets for APR[3]

Name	Domain	Size
DroixBench	Android	24
Codeflaws	C/C++	3,902
BugsJS	JavaScript	453
QuixBugs	Multiple	40
Refactory	Python	1,783
SStubBs	***Java***	***10k+/10k+***

[3] https://program-repair.org/benchmarks.html

The creation of the dataset

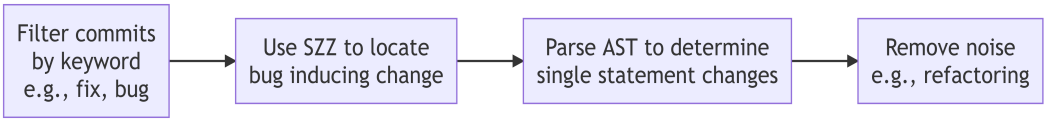
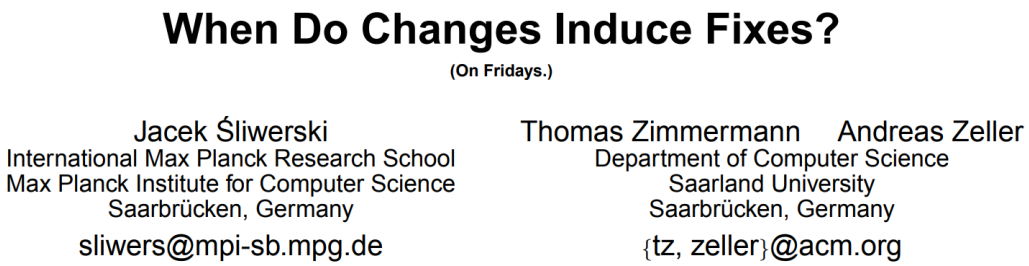


Figure 3: Bug collection process

SZZ algorithm



When Do Changes Induce Fixes?

(On Fridays.)

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Figure 4: Initial publication of the SZZ algorithm at MSR 05'[4]

[4]For reference the initial release of Git was in Apr. 07, 2005

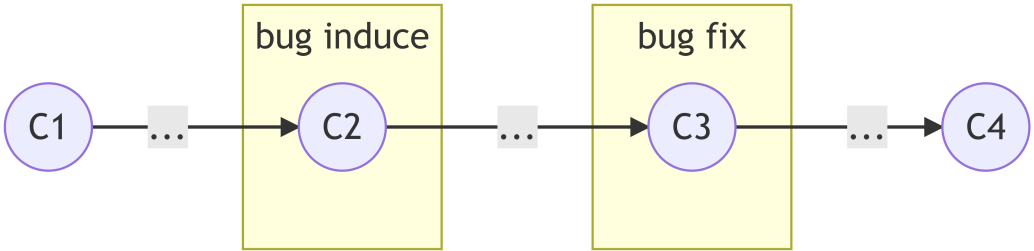


Figure 5: SZZ algorithm

1. We start with a bug report in the bug database, indicating a *fixed problem*.
2. We extract the associated change from the version archive, thus giving us the *location* of the fix.
3. We determine the *earlier change* at this location that was applied before the bug was reported

git blame

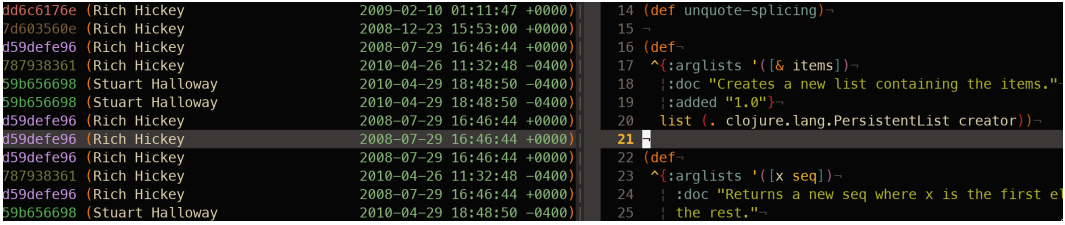


Figure 6: Example with `git blame`[5]

[5] https://github.com/clojure/clojure/blob/master/src/clj/clojure/core.clj at commit 0df3d8e2e27fb06fa53398754cac2be4878b12d1

SStuBs and general bugs

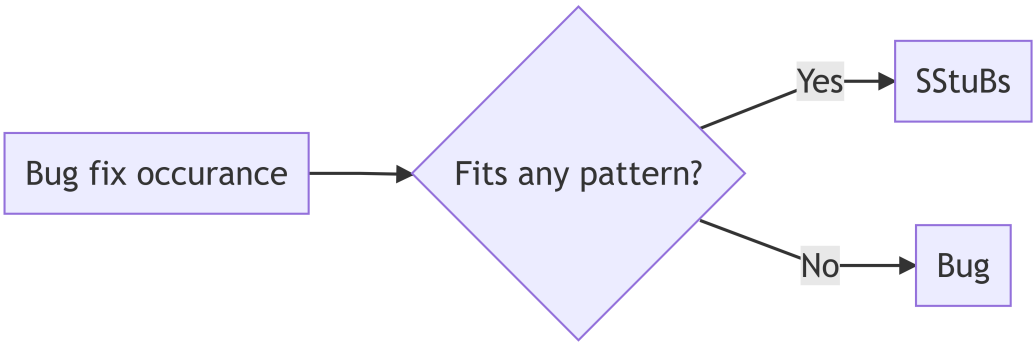


Figure 7: SStuBs or Bugs

Example pattern matched

Change Numeric Literal: `3.14` to `3.1415926`

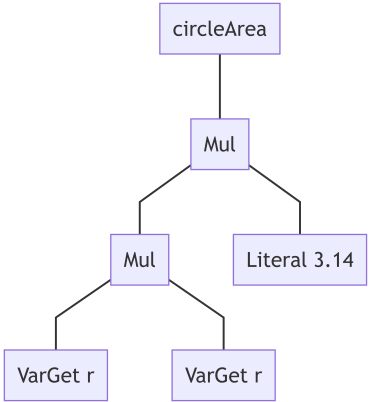


Figure 8: AST pre bug fix

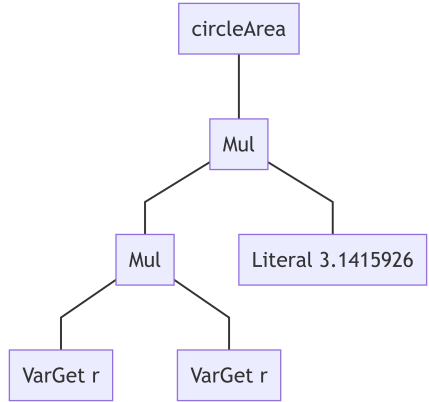


Figure 9: AST post bug fix

```
circleArea = r*r*3.14
```

```
circleArea = r*r*3.1415926
```

An example exploration: Commit pattern and bug fix authorship

Tasks

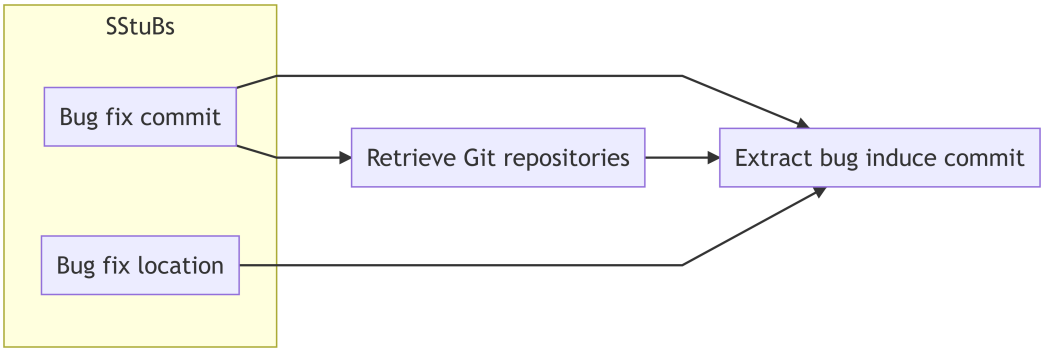


Figure 10: Workflow

Immediate catches in SStuBs dataset

- `b3log/solo` migrated to `88250/solo`
- `dropwizard/metrics` have “ghost” commits

Going beyond the “naive” SZZ algorithm

Integration (e.g., C6) vs Implementation (e.g., C4)

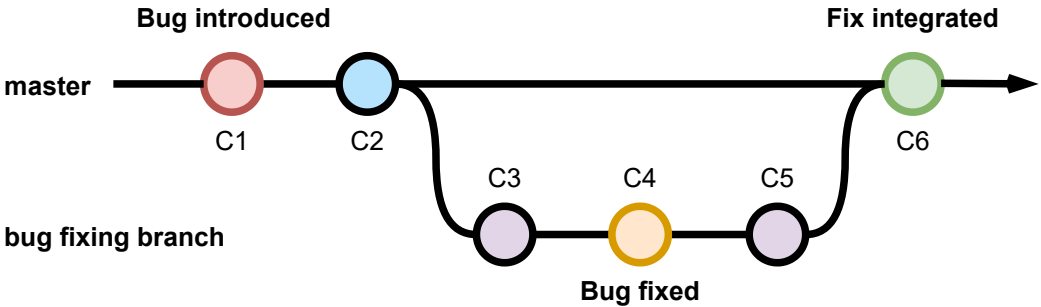


Figure 11: Complex Git history

Incorrect localization of Bug Fix Line number

```
final int oldLineNum = ((CompilationUnit)
 ↪  oldNode.getRoot()).getLineNumber( oldNodeStartChar );
```

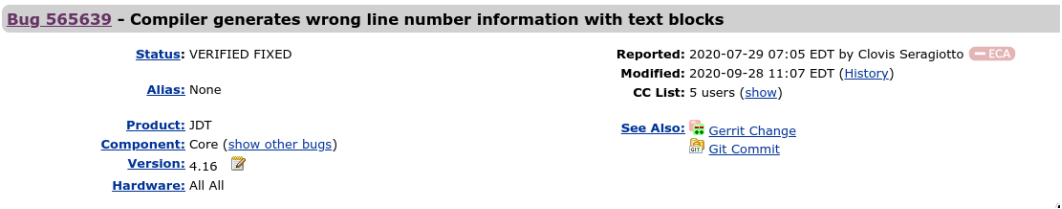


Figure 12: Bug report on Eclipse[6]

[6] https://bugs.eclipse.org/bugs/show_bug.cgi?id=565639

Determine commit attributes

- Authorship
- Commit size (i.e., Churn)
- Bug fixing time

Commit authorship

```
commit 1458db8e86332e0534e64869d452886472031633
Author:     Wenhan Zhu (Cosmos) <zhuwenhan950913@gmail.com>
AuthorDate: Thu Aug 20 00:46:30 2020 +0800
Commit:     Wenhan Zhu (Cosmos) <zhuwenhan950913@gmail.com>
CommitDate: Thu Aug 20 00:46:30 2020 +0800

    Update vim color settings for no numberline underscore and italic
↪   comments

diff --git a/vim/.vimrc b/vim/.vimrc
index d193be3..f8b8d8a 100644
```

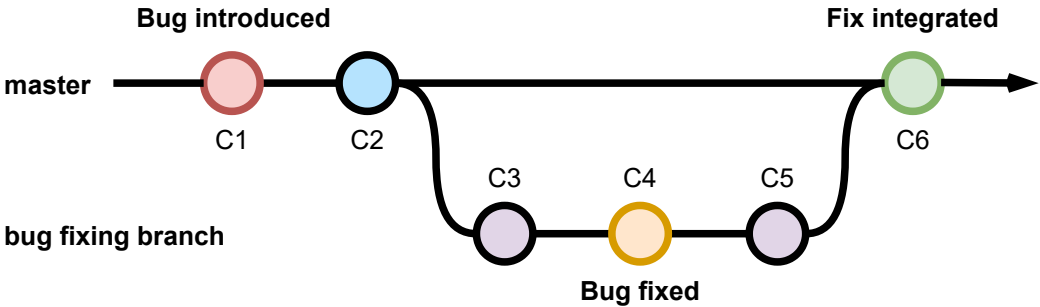
Commit change (Churn)

```
--- a/vim/.vimrc
+++ b/vim/.vimrc
@@ -442,5 +442,10 @@ nnoremap <silent> <space>p
 ↪  :<C-u>CocListResume<CR>

-" Makes vim transparent
+" === Color settngs =====
+" Transparency
 hi Normal guibg=NONE ctermbg=NONE
+" No underline for current line number
+hi CursorLineNr cterm=bold gui=bold
+" Italic comments
+hi Comment cterm=italic gui=italic
```

$$Churn = AddedLines + RemovedLines$$

Measuring fix time



Bug fix time: time difference between C1 and C6 (not C4)

Developers often fix other peoples simple bugs

Table 2: Bug fixes by authorship

Fixed by same author	Fixed by a different author	Total
5,674	4,508	10,182

Bug fix time

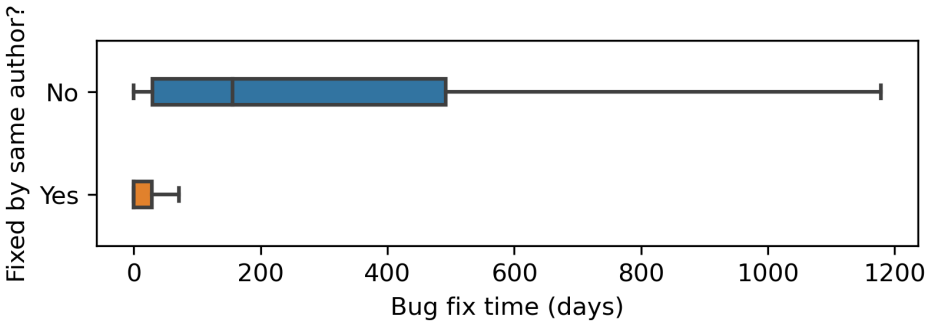


Figure 13: Distribution of bug fix time by authorship

Bug fix size

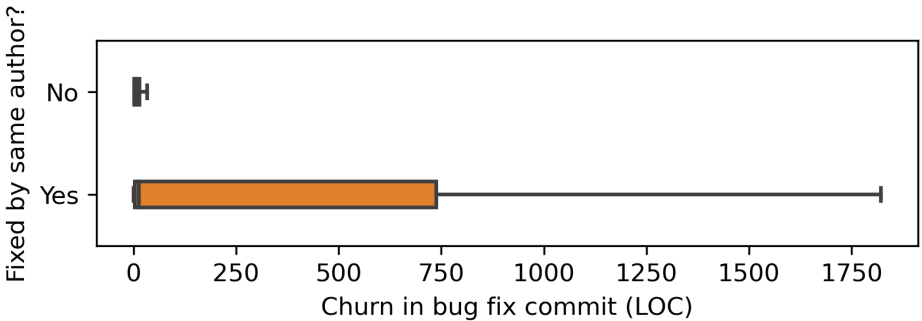


Figure 14: Distribution of bug fix size by authorship

Summary

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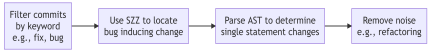

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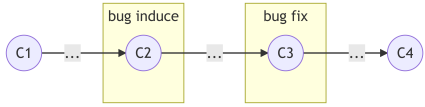

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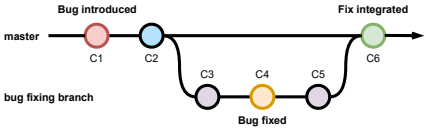

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 hi Normal guibg=NONE ctermbg=NONE
+" No underline for current line number
+hi CursorLineNr cterm=bold gui=bold
+" Italic comments
+hi Comment cterm=italic gui=italic
```

$$Churn = AddedLines + RemovedLines$$