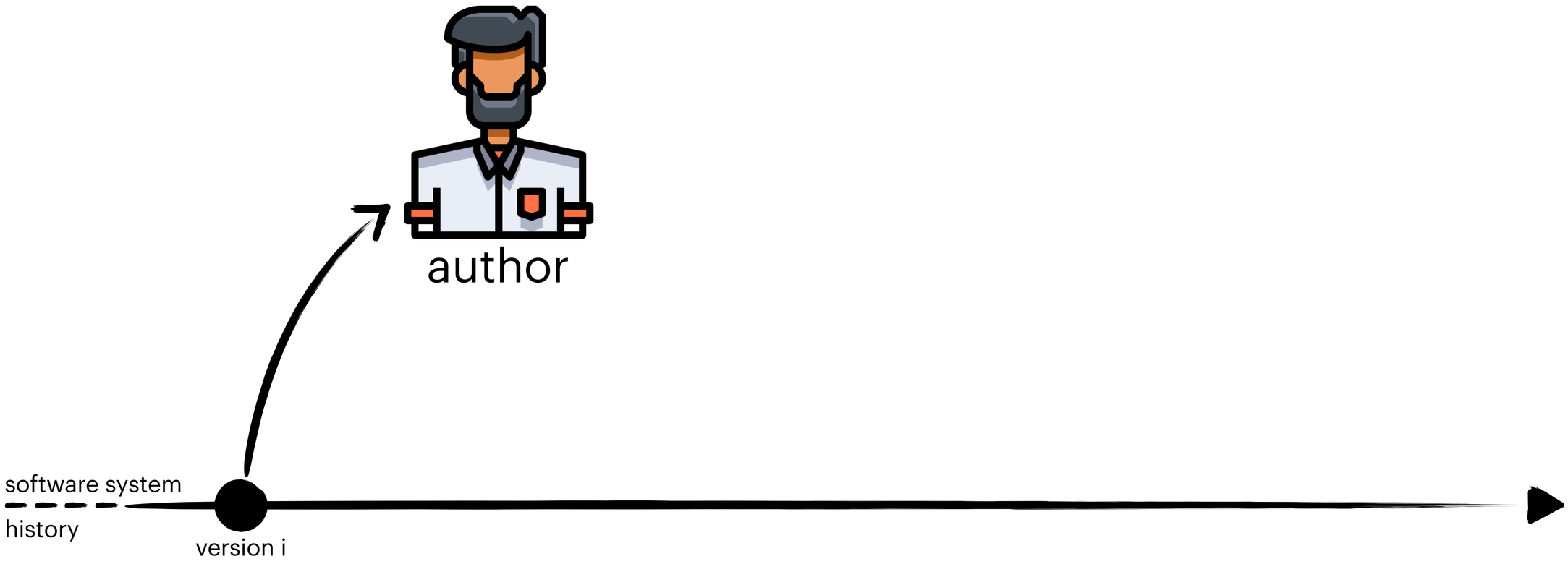
Code review effectiveness

How code review works (and doesn't) in the real world.

Alberto Bacchelli
zest
University of Zurich[UZH]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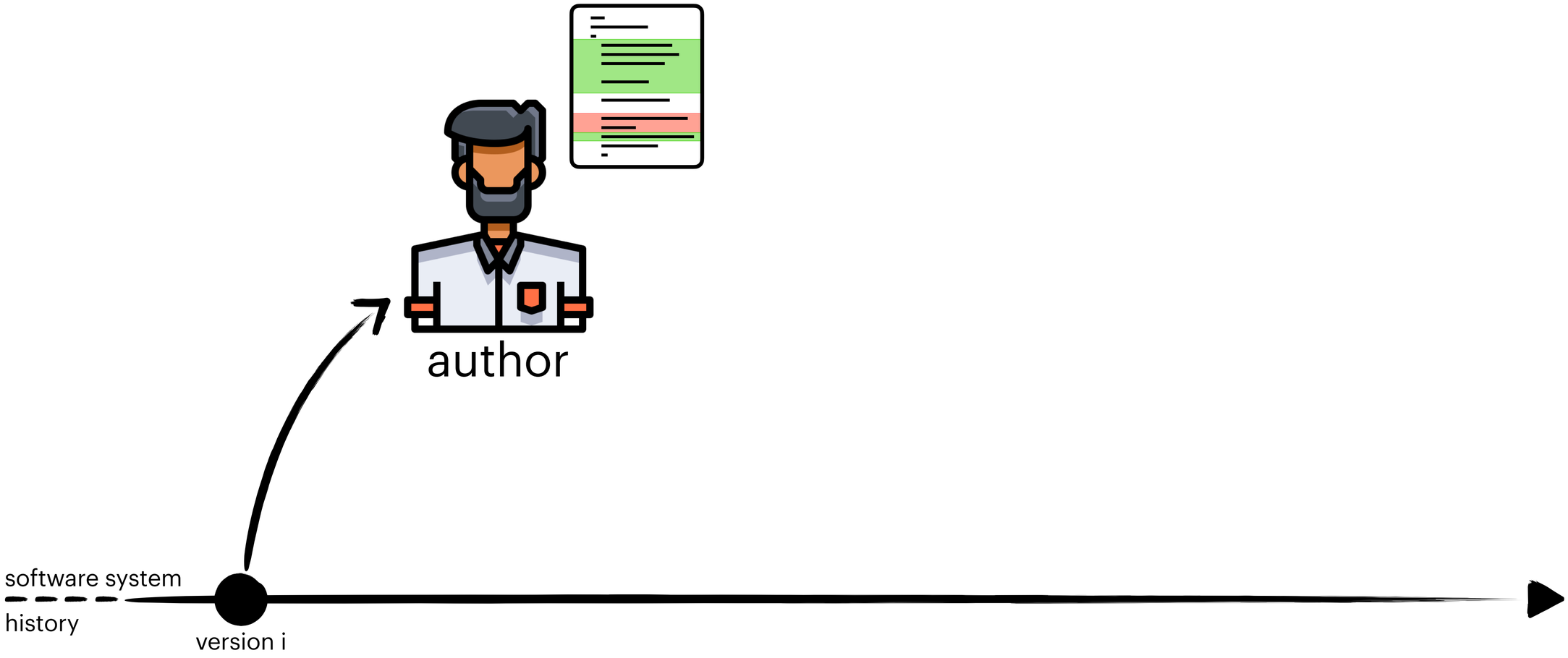
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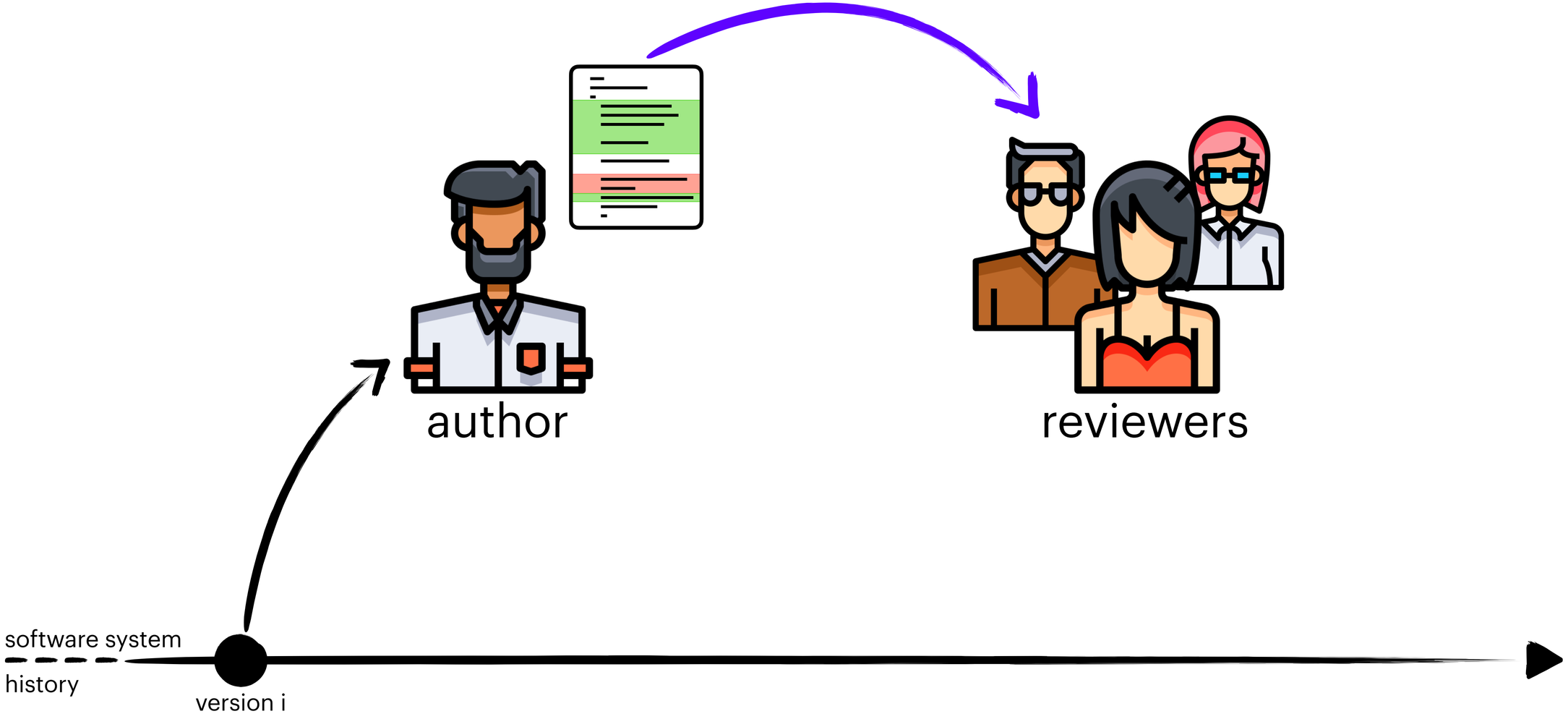
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33 src/System.Collections.Immutable/tests/ImmutableListTest.cs

```diff
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 164 164         [Fact]
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     169 +           var random = new Random(randSeed);
     170 +
     171 +           int expectedTotalSize = 0;
     172 +
 167 173             var list = ImmutableList<int>.Empty;
 168 174
 169     -           // Add batches of 32, 128 times, giving 4096 items
 170     -           int batchSize = 32;
     175 +           // Add some small batches, verifying balance after each
 171 176             for (int i = 0; i < 128; i++)
 172 177             {
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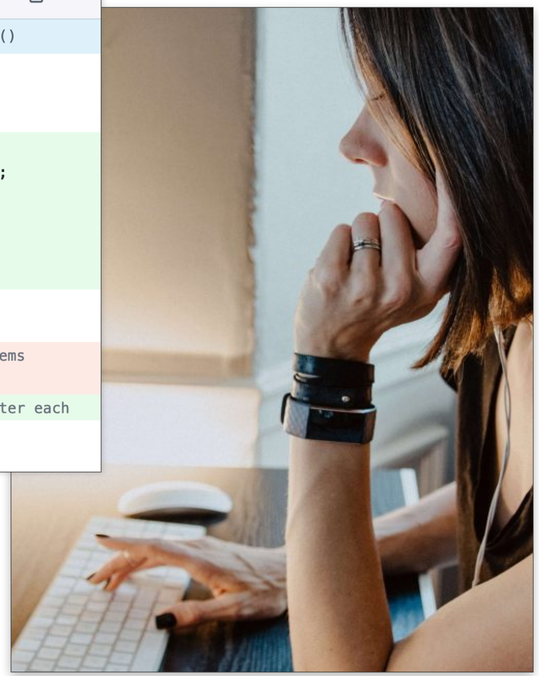

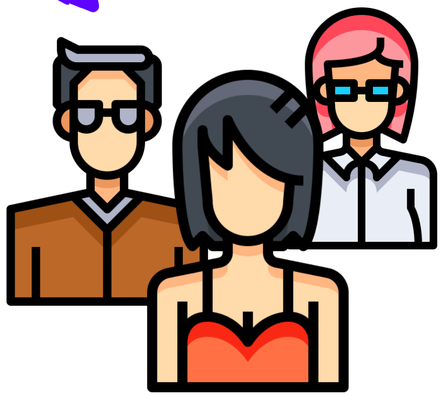

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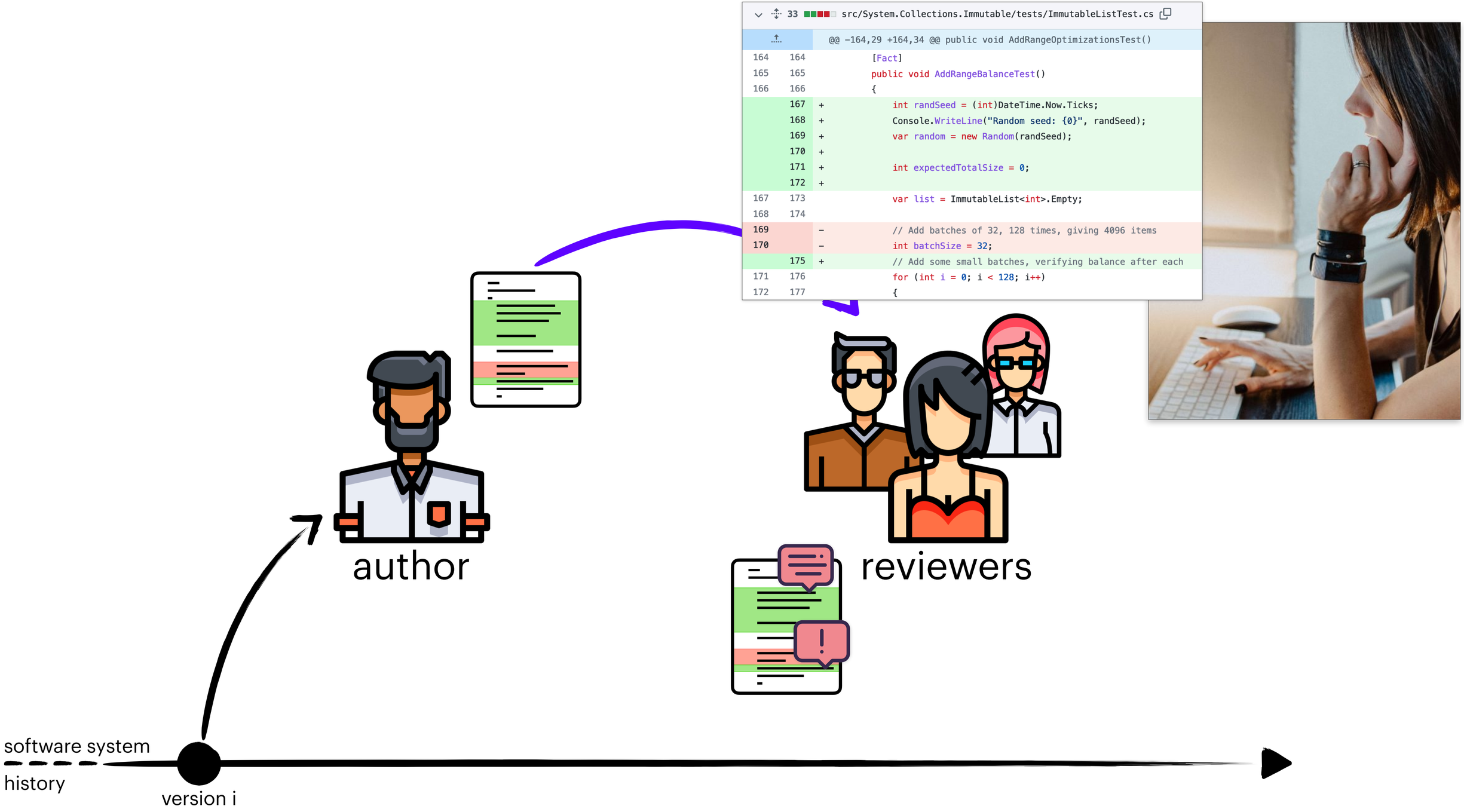
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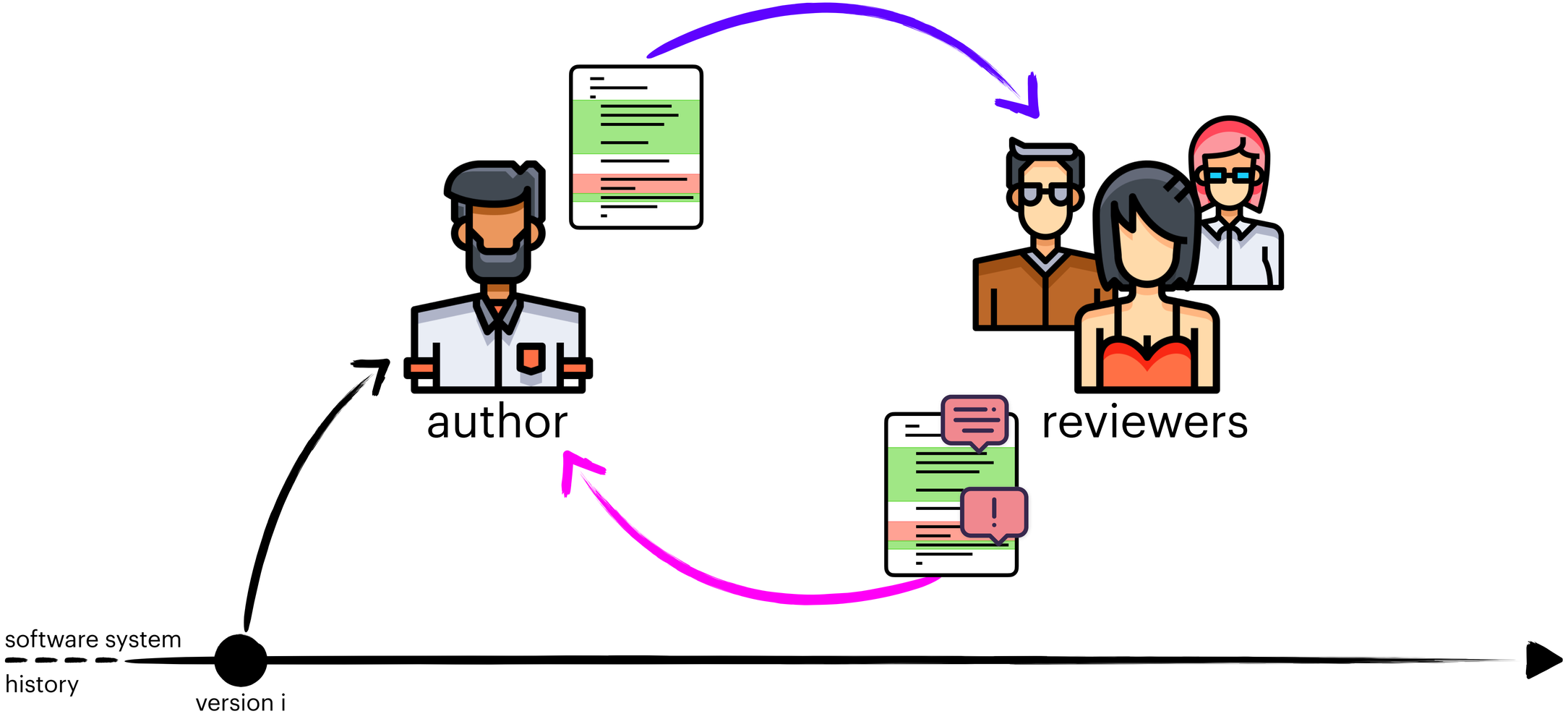
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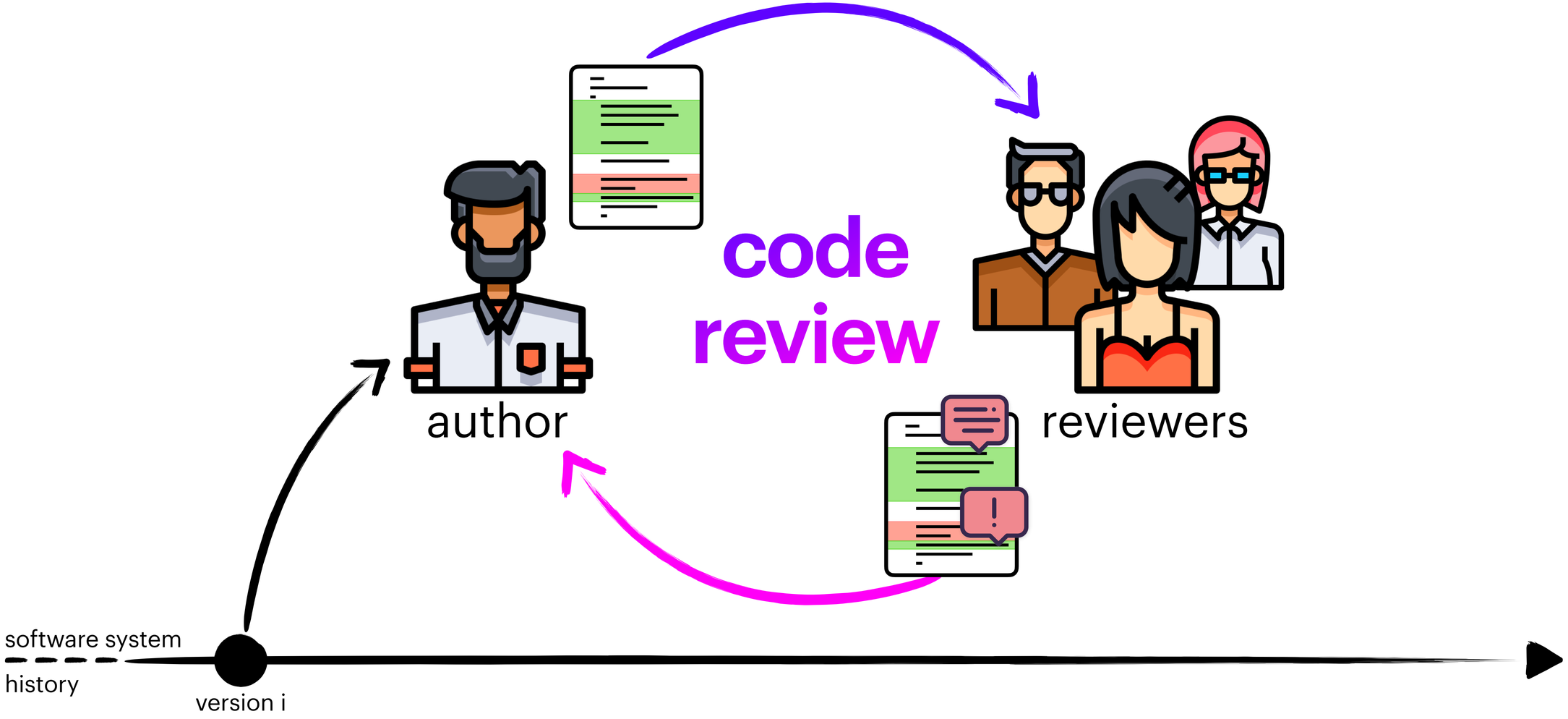
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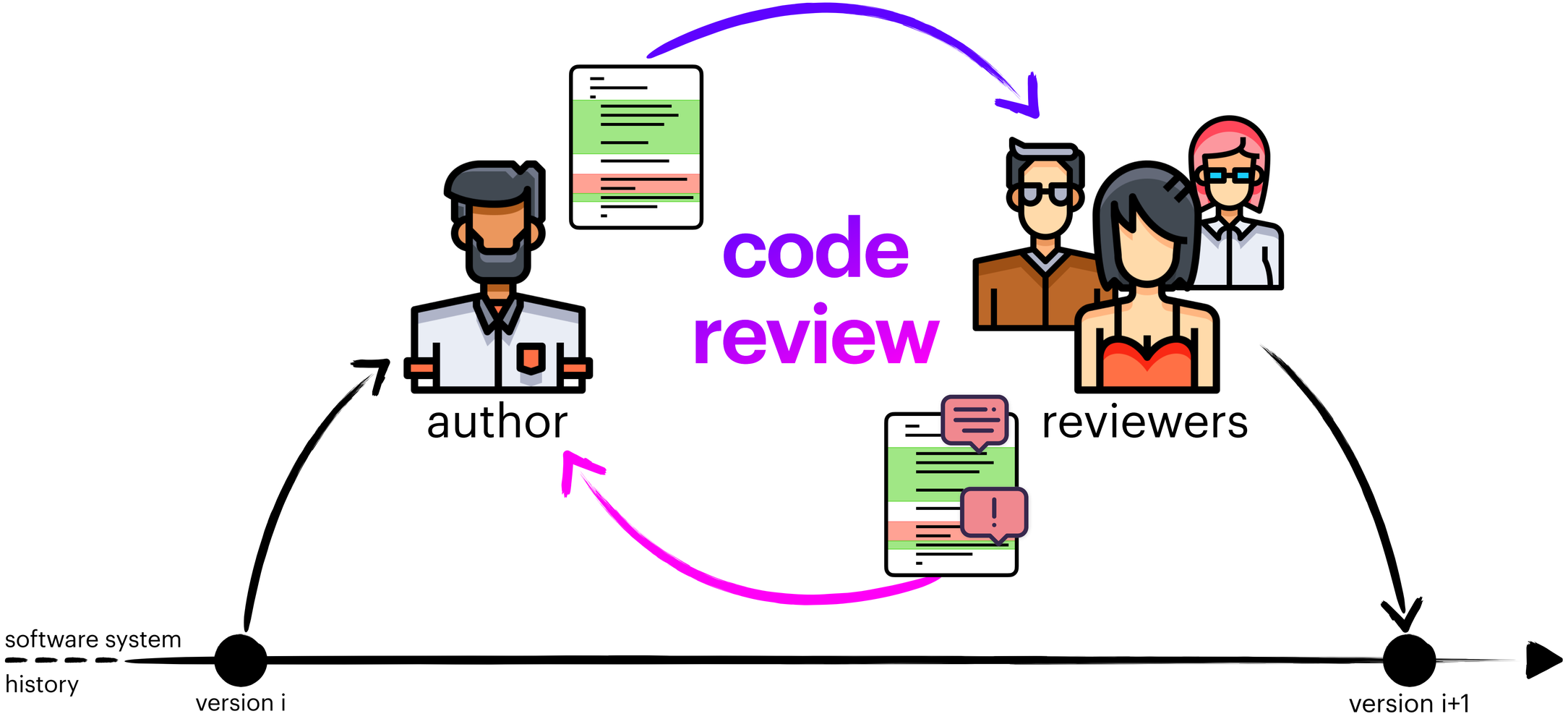
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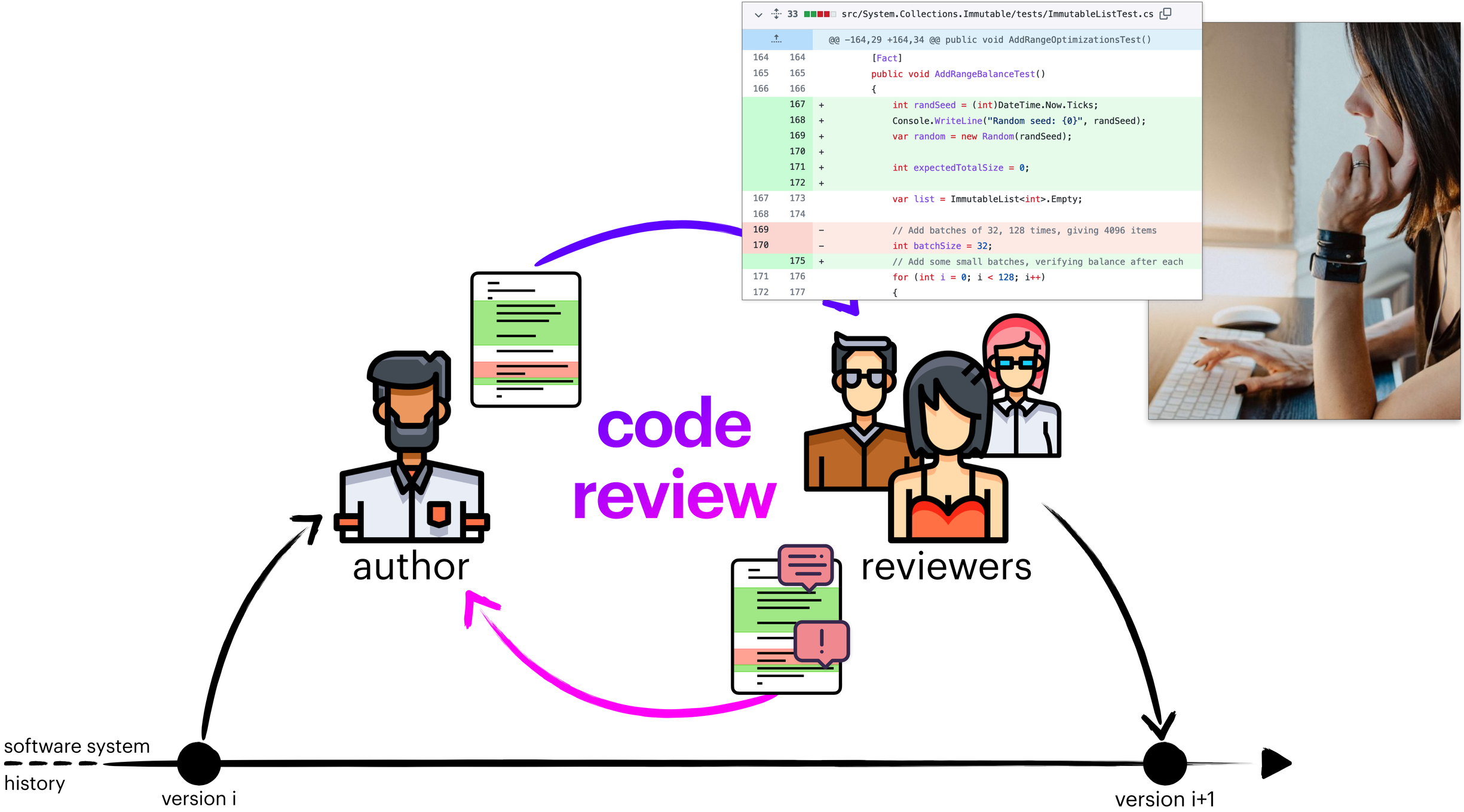
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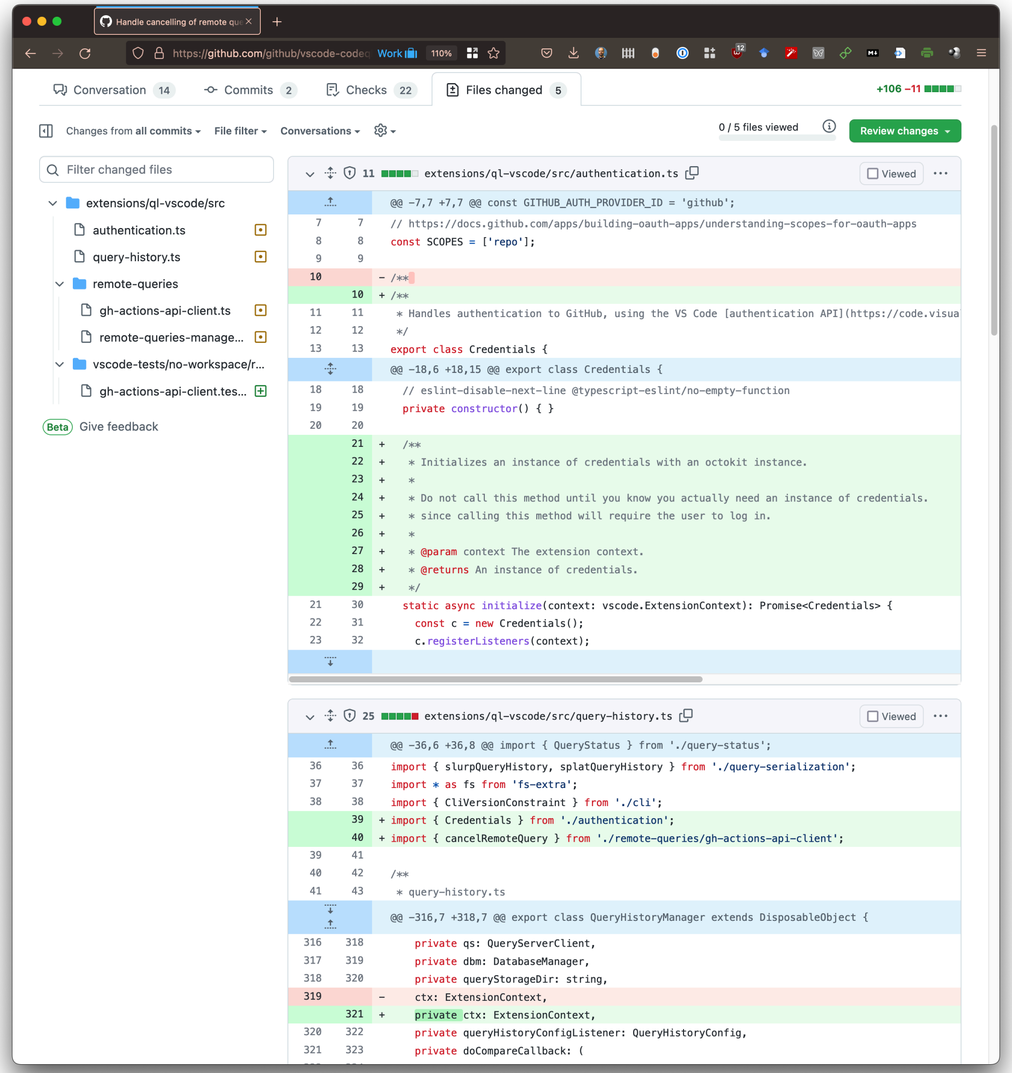
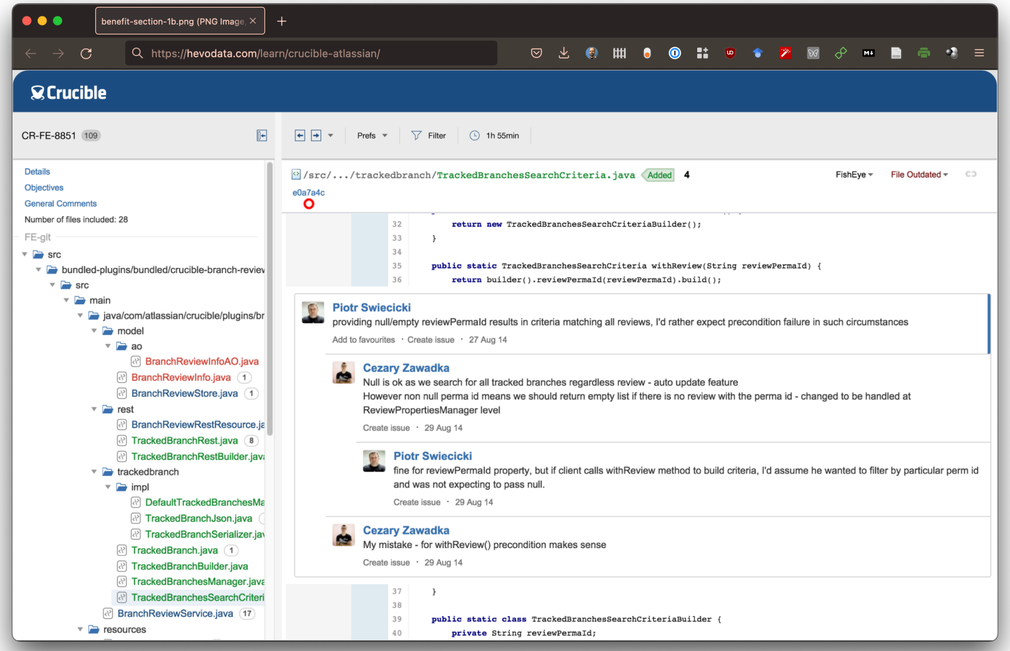
code review
some facts

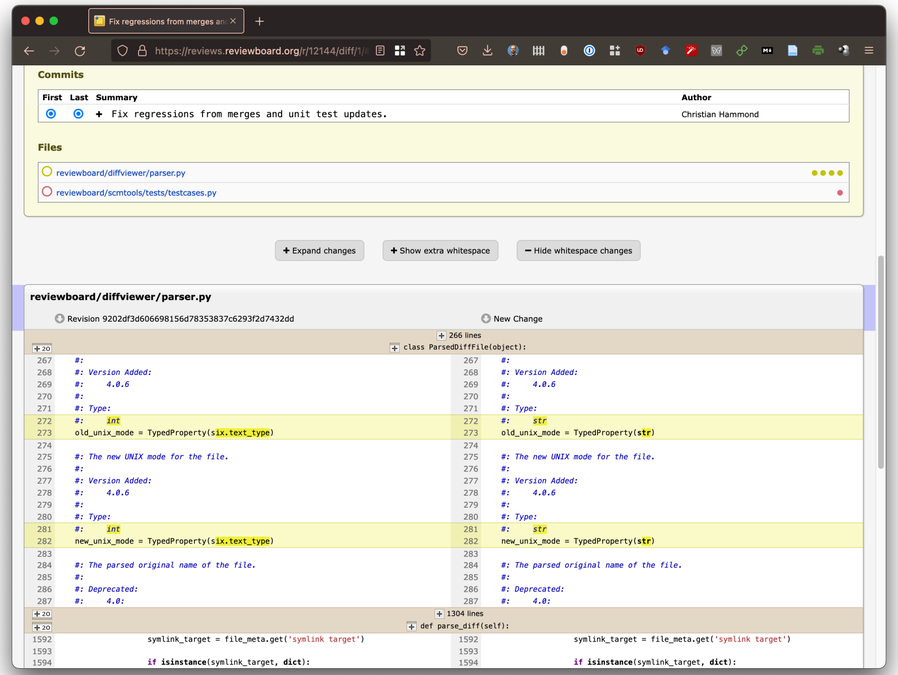
- About 70% of developers spend 2 to 8 hours a week reviewing code.
  [Stack Overflow Dev Survey 2019]
- In 2021, 170M pull requests have been merged in GitHub.
  [The 2021 State of the Octoverse]
- Most code changes at Microsoft and Google are reviewed.

code review

tools







code review

Handle cancelling of remote que

https://github.com/github/vscode-codeq

Conversation 14 | Commits 2 | Checks 22 | Files changed 5

Changes from all commits | File filter | Conversations | 0 / 5 files

Filter changed files

- extensions/ql-vscode/src
  - authentication.ts
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Beta Give feedback

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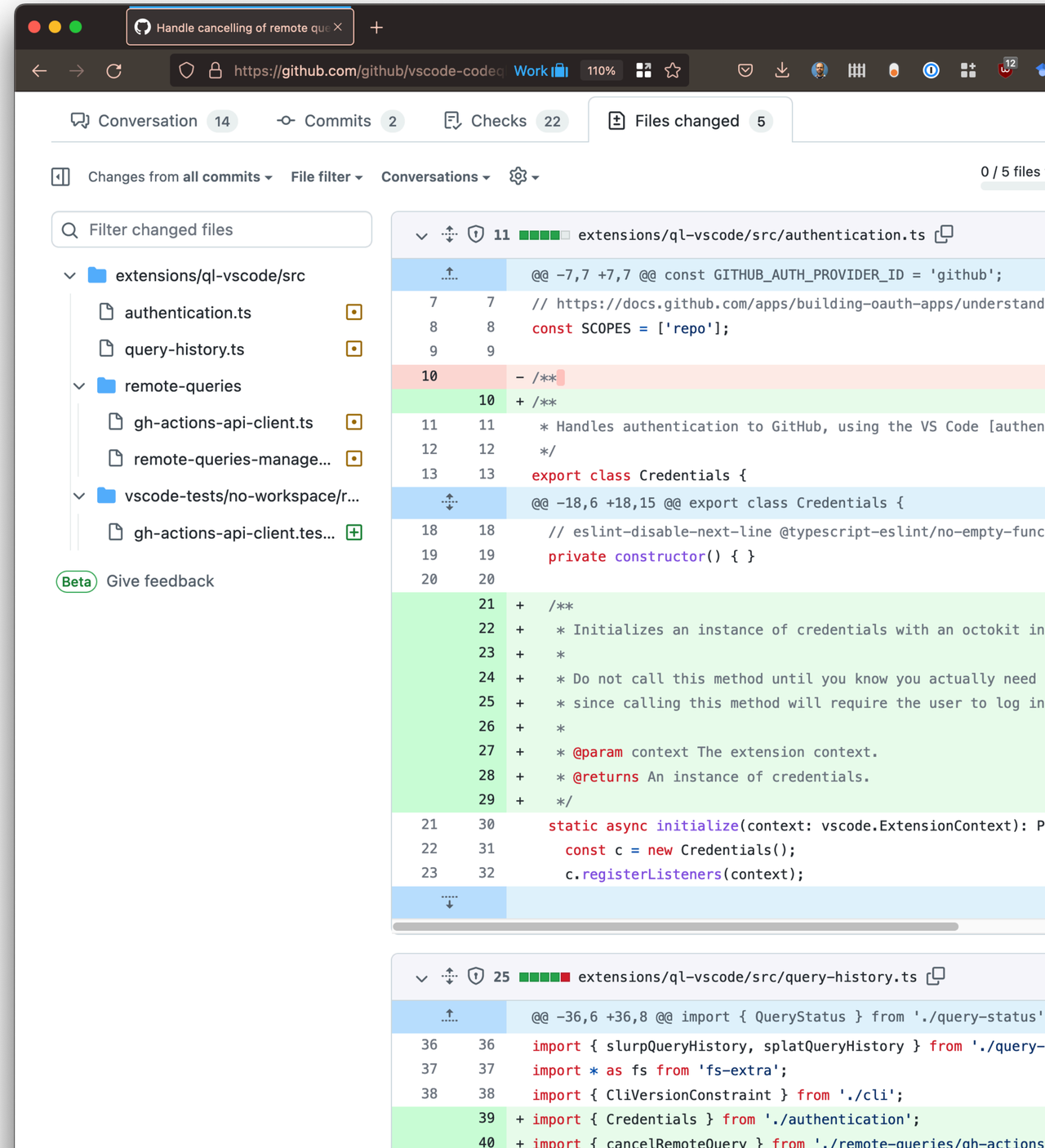
code review

reviewers' behavior

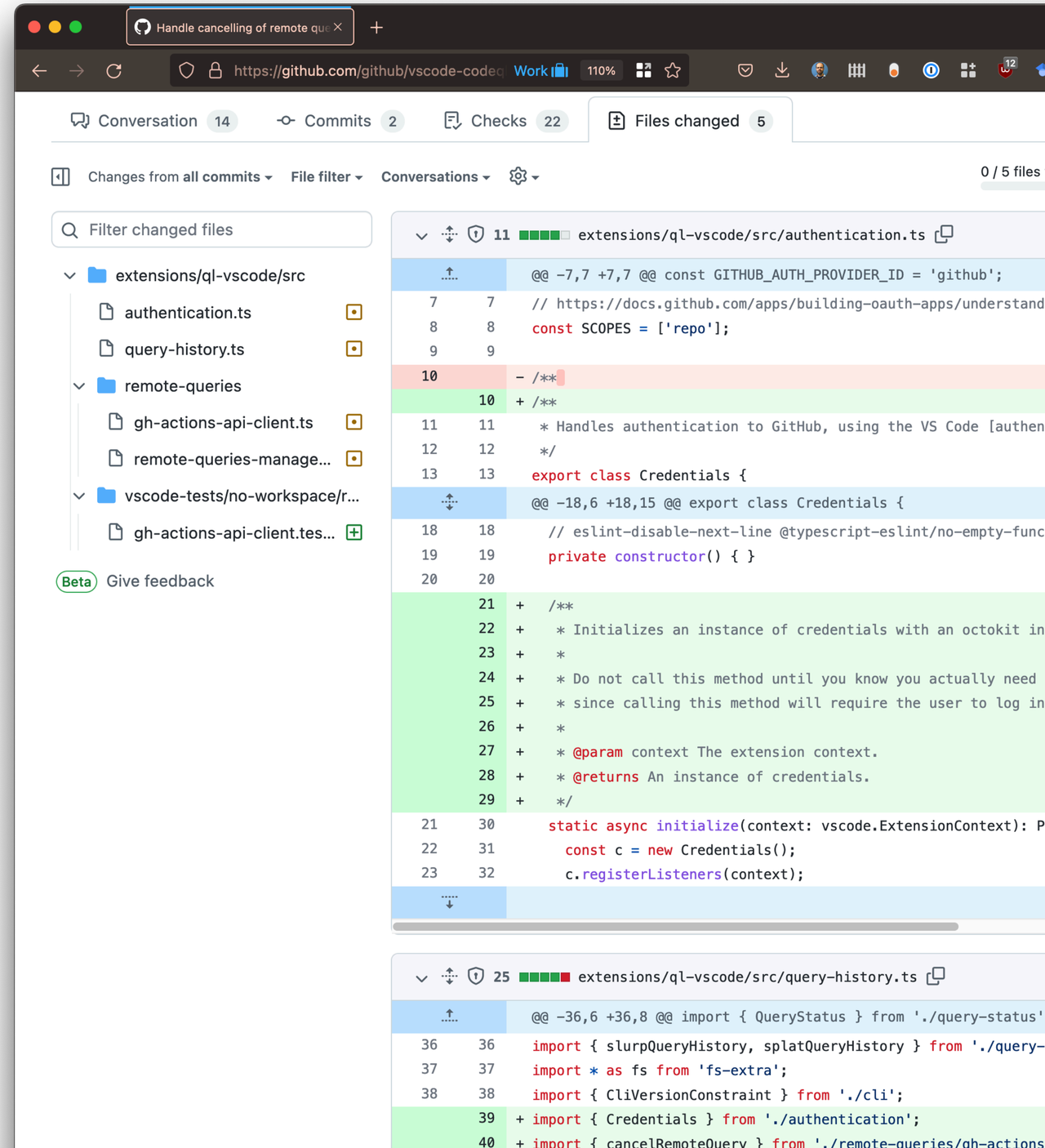


code review

reviewers' behavior

- In more than 50% of the reviews, the reviewer started with the file presented first.
- In almost 40% of the navigations, the reviewer went to the next file in order.

[Baum, Schneider, Bacchelli - ICSME 2017]



code review

test files

Handle cancelling of remote que

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code review

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- Developers see test code as less important than production code.

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code review

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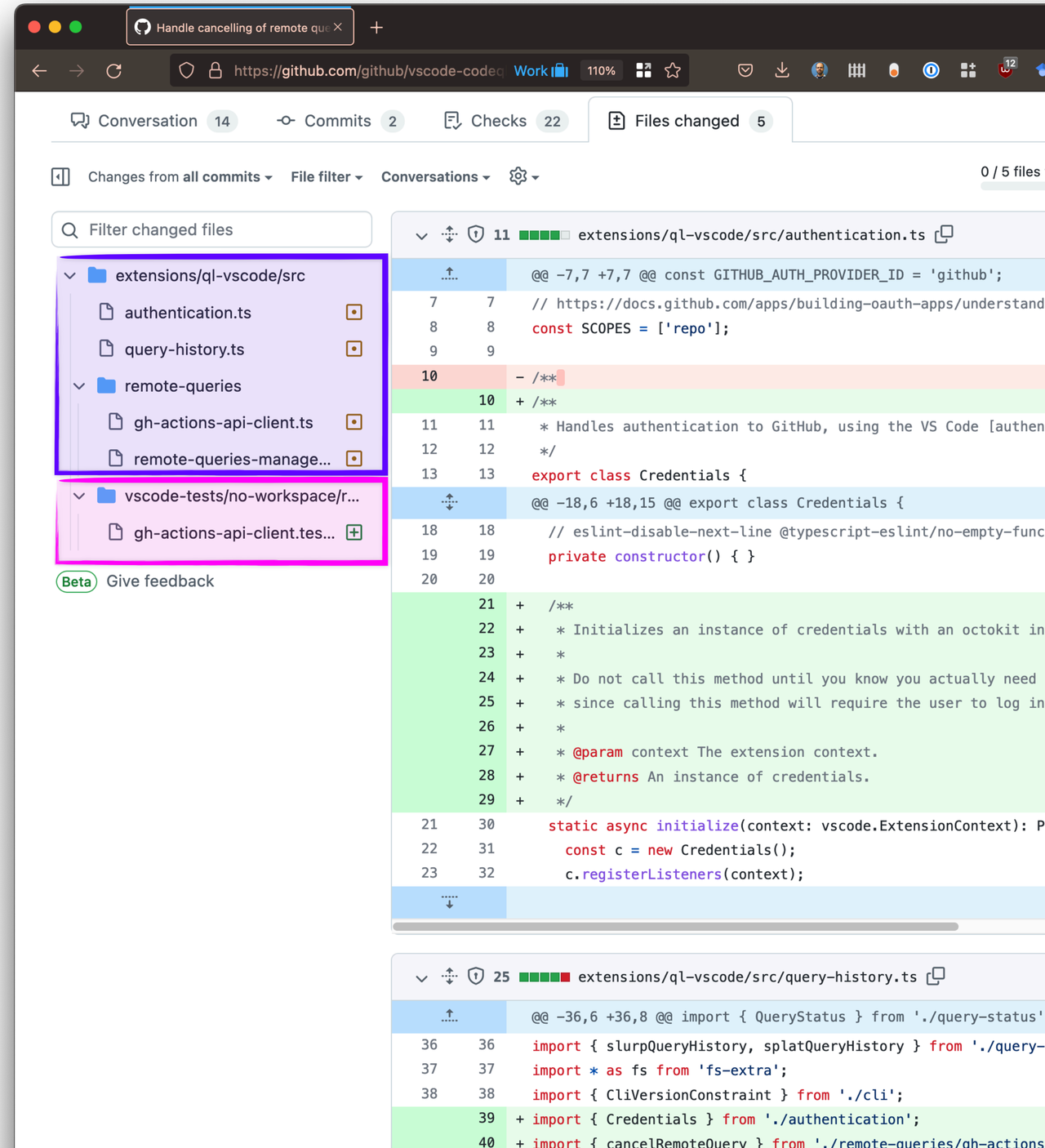
- Developers see test code as less important than production code.
- Test files are almost twice less likely to be discussed during code review when together with production files.



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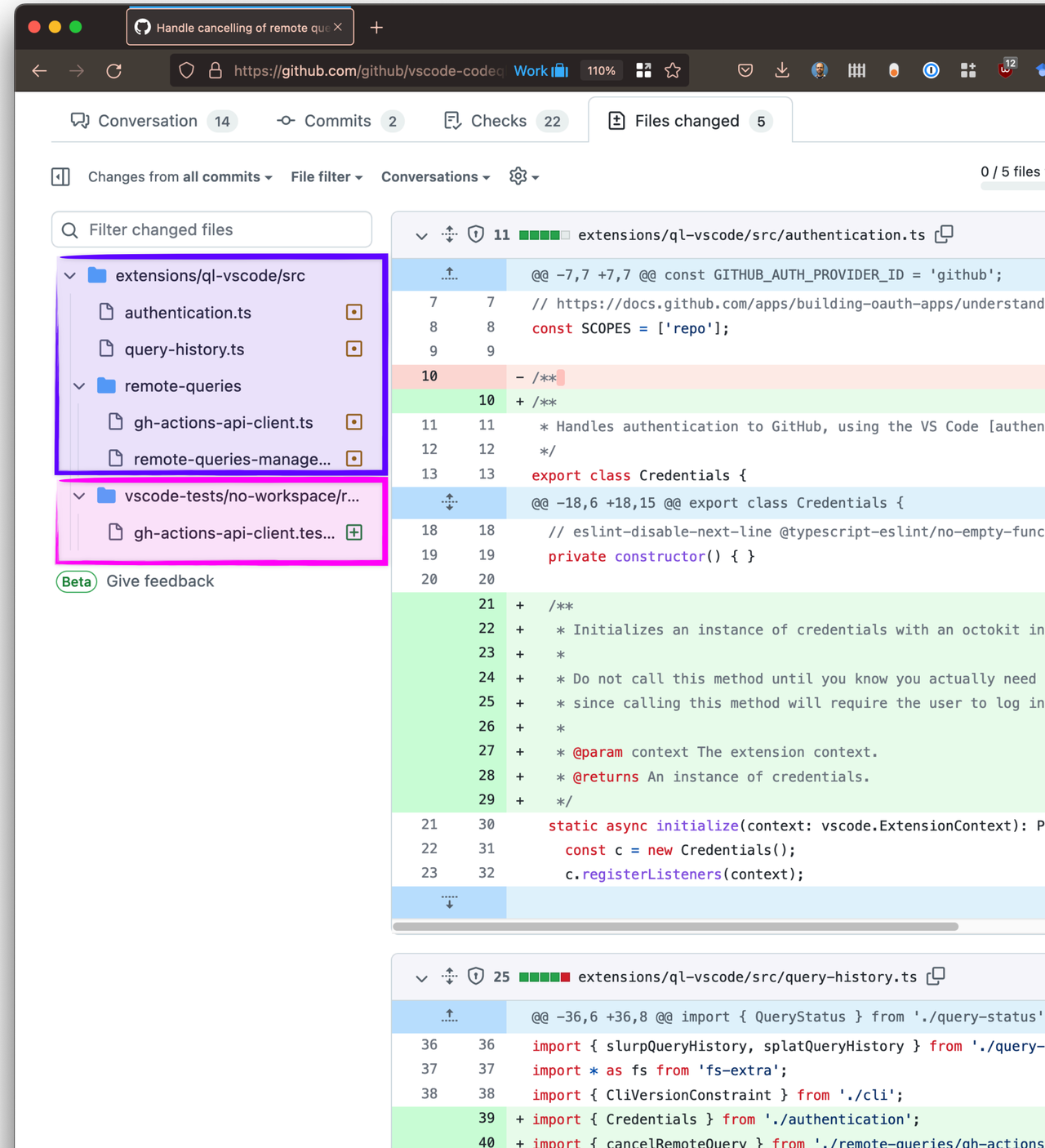
[Spadini, Aniche, Storey, Bruntink, Bacchelli - ICSE 2018]



code review

test order experiment

code review

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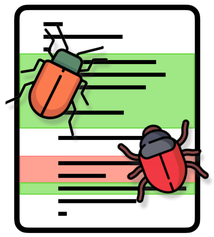

production.java

code review

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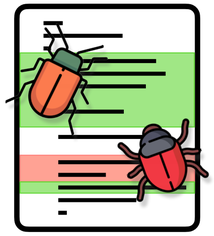

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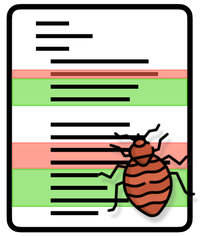

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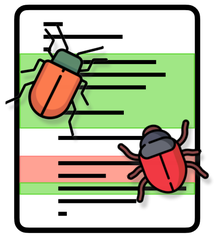

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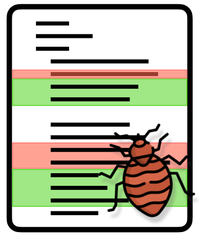

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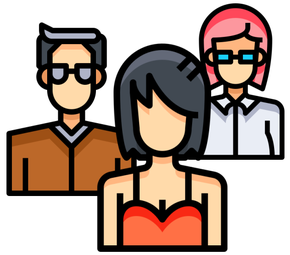

participants

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code review

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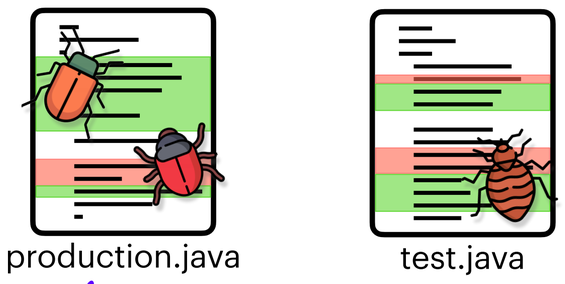

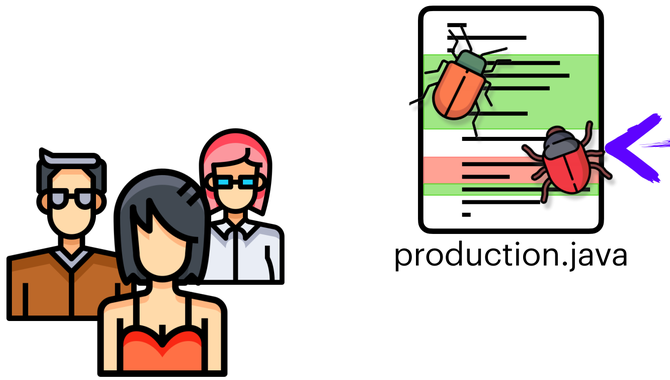

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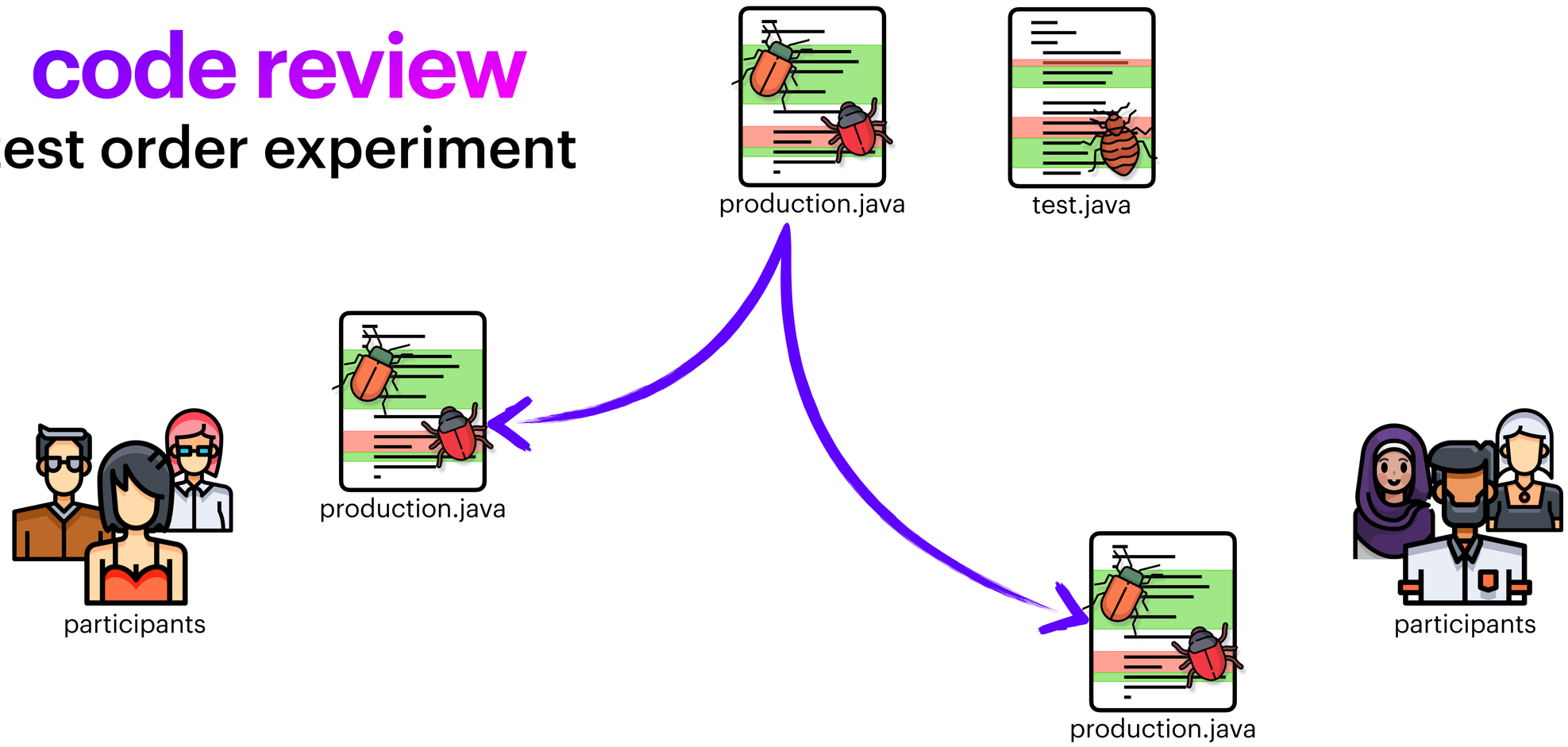

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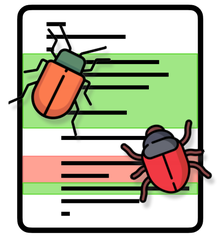
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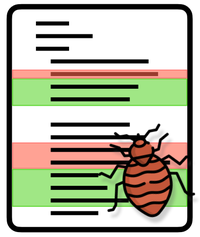
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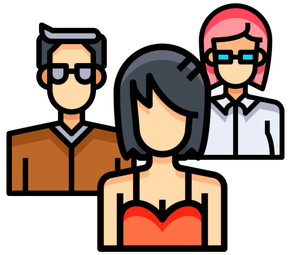
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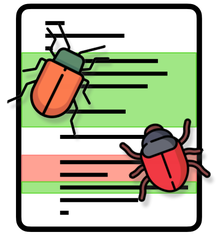
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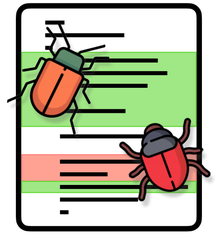
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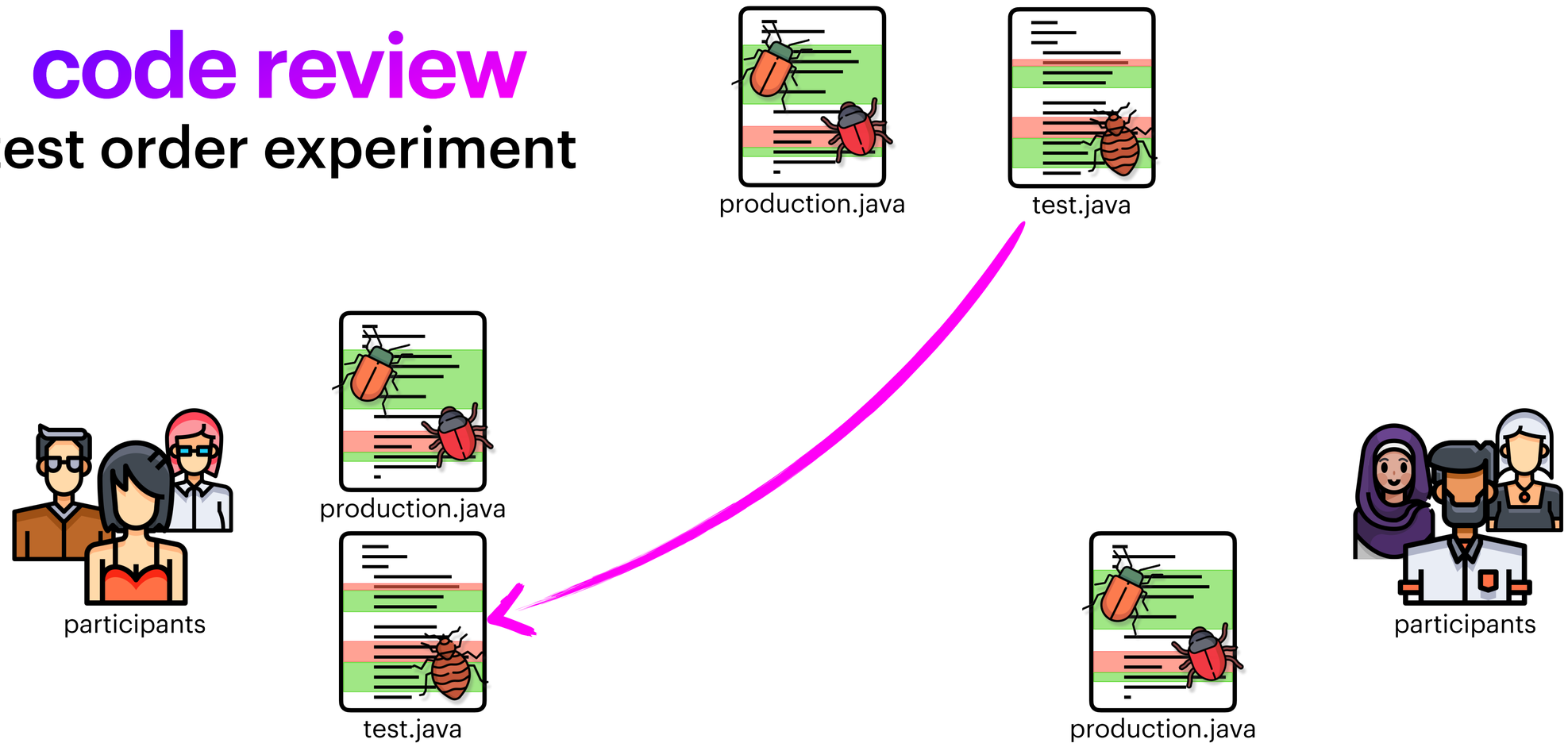
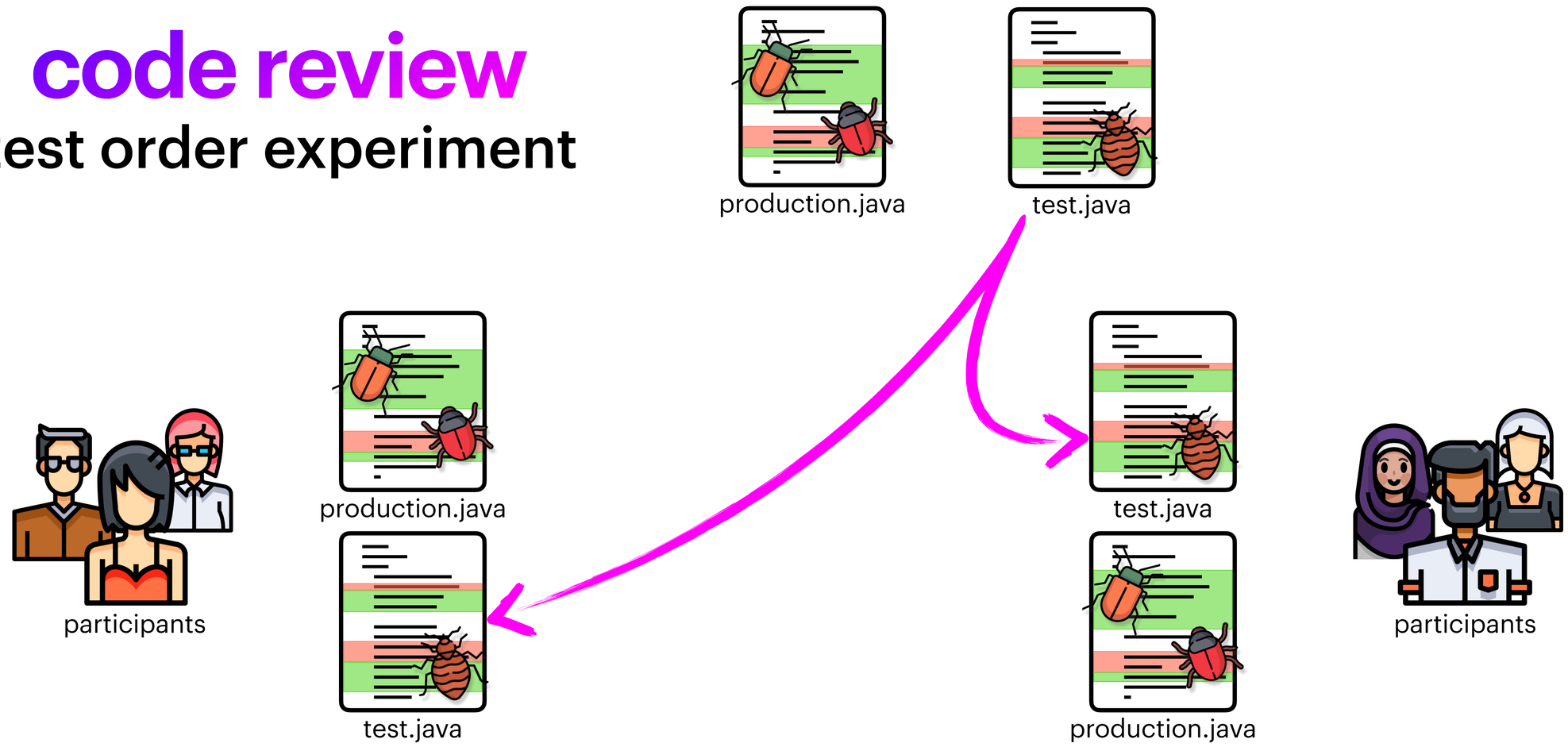


code review

test order experiment



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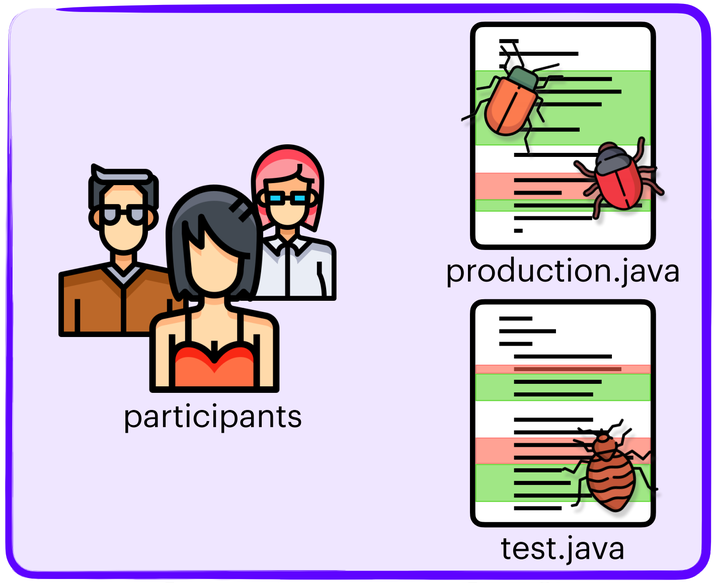
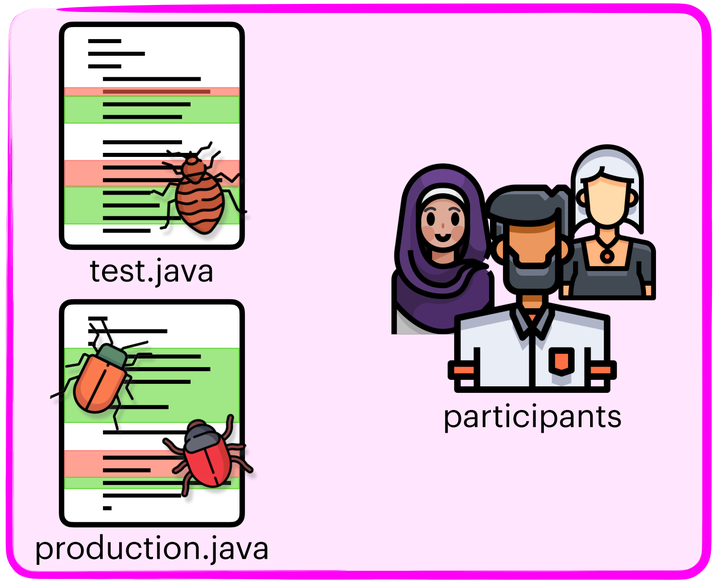


production code first order



test code first order

code review

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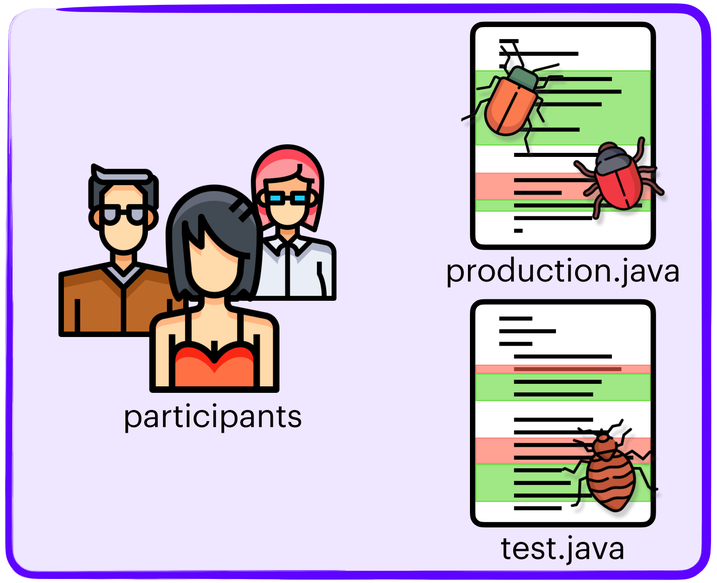
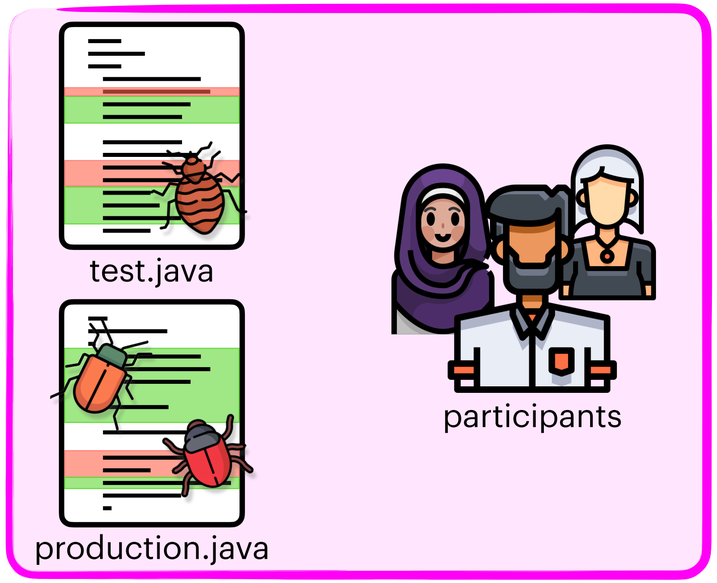


same likelihood of finding the production bugs



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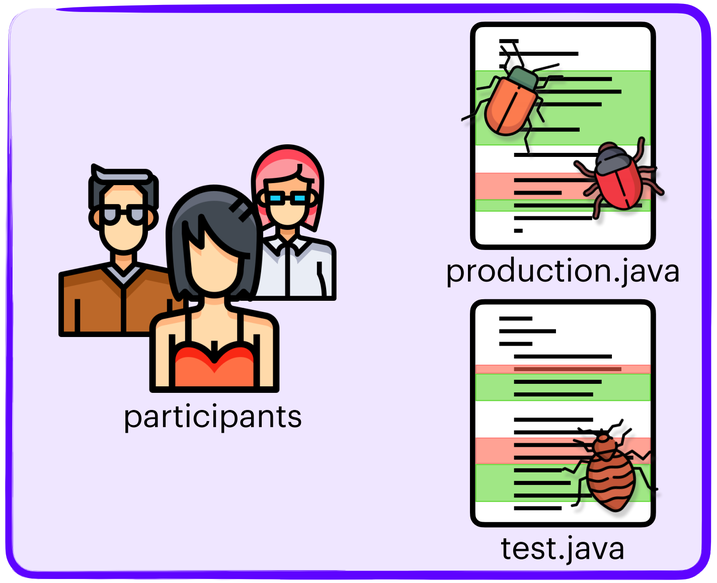
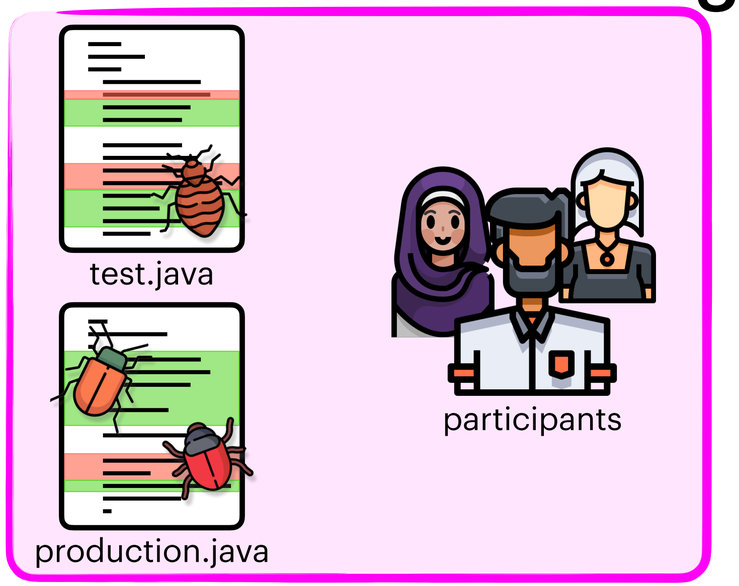


same likelihood of finding the production bugs

250% more likely to find the test bug



code review

test files

Handle cancelling of remote que

https://github.com/github/vscode-codeq Work 110%

Conversation 14 | Commits 2 | Checks 22 | Files changed 5

Changes from all commits | File filter | Conversations | 0 / 5 files

Filter changed files

- extensions/ql-vscode/src
  - authentication.ts
  - query-history.ts
  - remote-queries
    - gh-actions-api-client.ts
    - remote-queries-manage...
- vscode-tests/no-workspace/r...
  - gh-actions-api-client.tes...

Beta Give feedback

11 extensions/ql-vscode/src/authentication.ts

```
@@ -7,7 +7,7 @@ const GITHUB_AUTH_PROVIDER_ID = 'github';
7  7   // https://docs.github.com/apps/building-oauth-apps/understand
8  8   const SCOPES = ['repo'];
9  9
10     - /**
   10  + /**
11 11   * Handles authentication to GitHub, using the VS Code [authen
12 12   */
13 13  export class Credentials {
@@ -18,6 +18,15 @@ export class Credentials {
18 18    // eslint-disable-next-line @typescript-eslint/no-empty-func
19 19    private constructor() { }
20 20
   21  +  /**
   22  +   * Initializes an instance of credentials with an octokit in
   23  +   *
   24  +   * Do not call this method until you know you actually need
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   26  +   *
   27  +   * @param context The extension context.
   28  +   * @returns An instance of credentials.
   29  +   */
21 30    static async initialize(context: vscode.ExtensionContext): P
22 31      const c = new Credentials();
23 32      c.registerListeners(context);
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25 extensions/ql-vscode/src/query-history.ts

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36 36  import { slurpQueryHistory, splatQueryHistory } from './query-
37 37  import * as fs from 'fs-extra';
38 38  import { CliVersionConstraint } from './cli';
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code review

production files

Handle cancelling of remote que

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code review

production files

code review

production files

- We analyzed review comments for 200k pull requests from some 140 popular projects in GitHub...

code review

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- ... and found something remarkable.

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cumulative number of review comments by file position

code review
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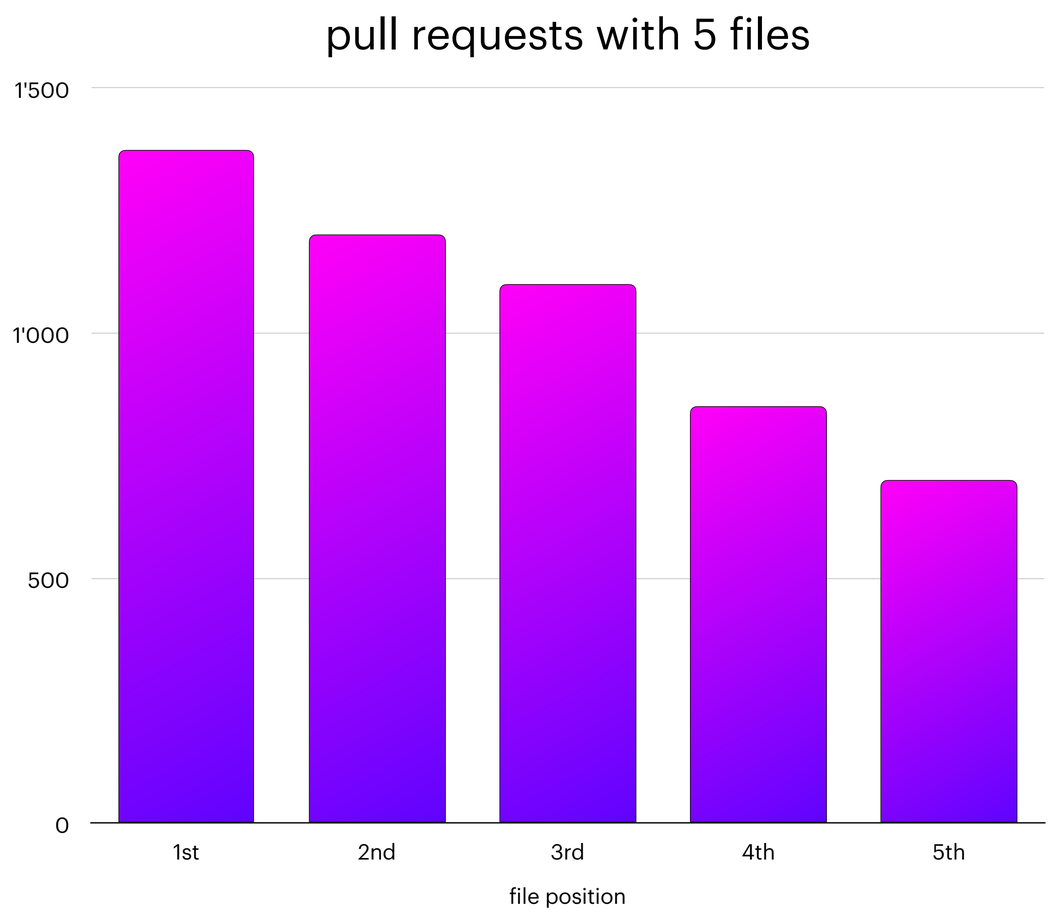

code review
production files

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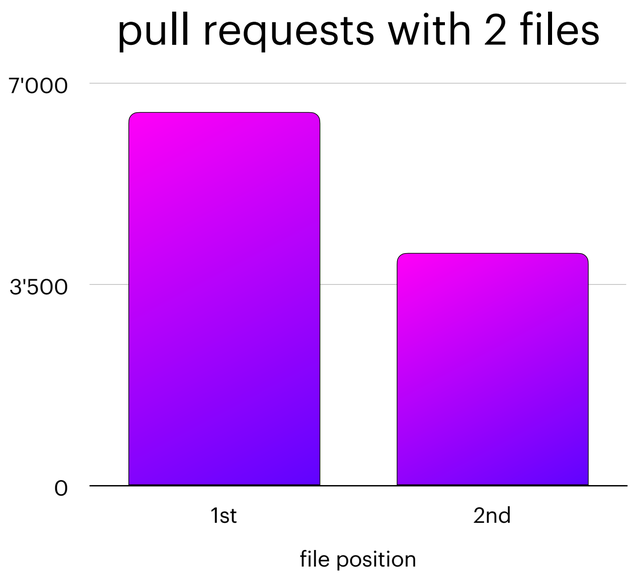

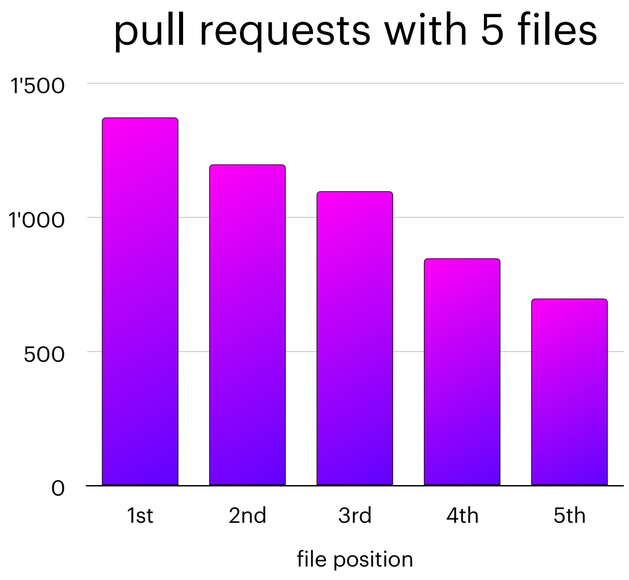

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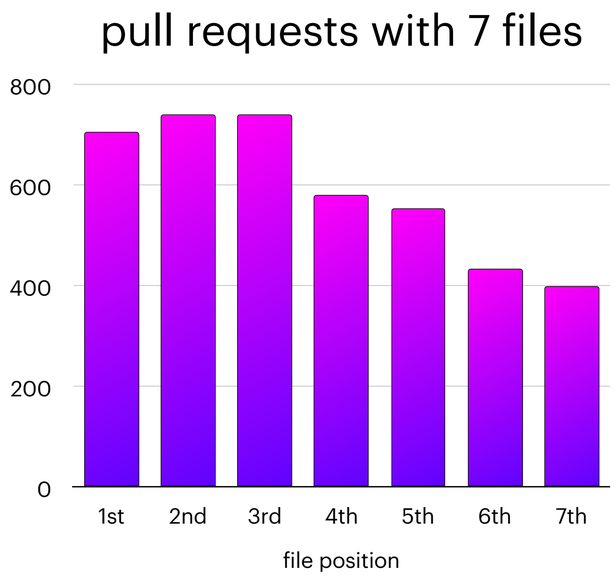

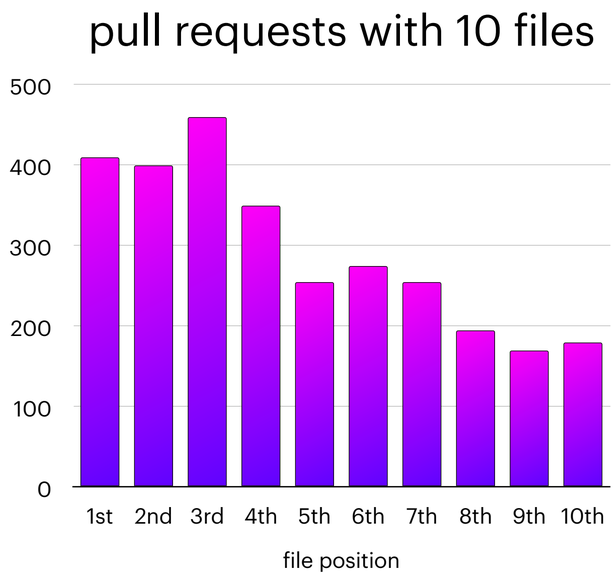

code review

production files experiment

code review

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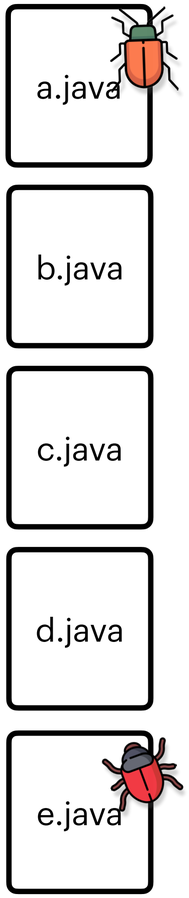

code review

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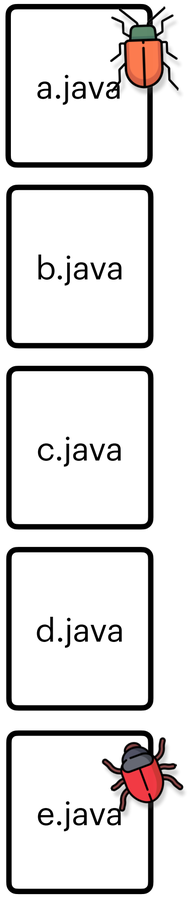

code review

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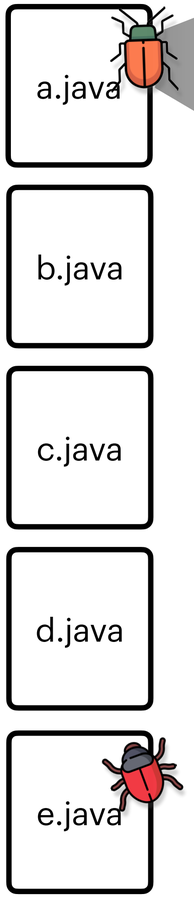


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38              default:
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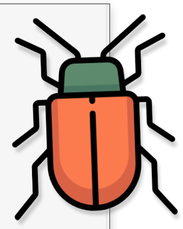

code review

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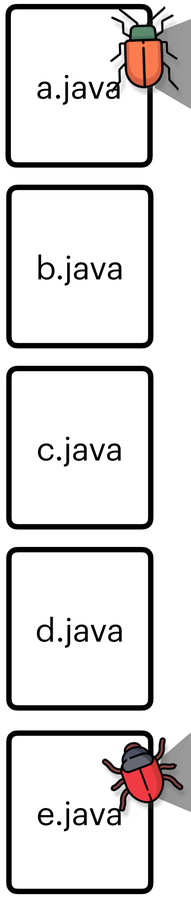


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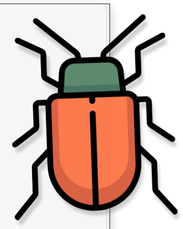

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code review

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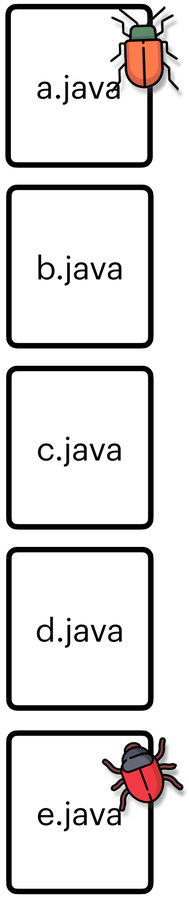

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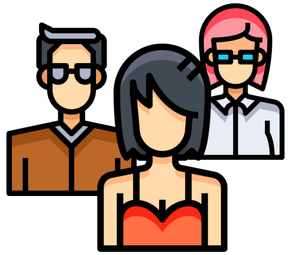


participants

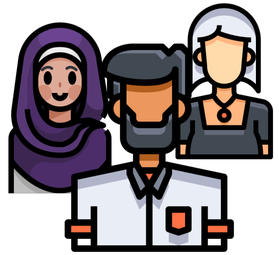
a.java

b.java

c.java

d.java

e.java



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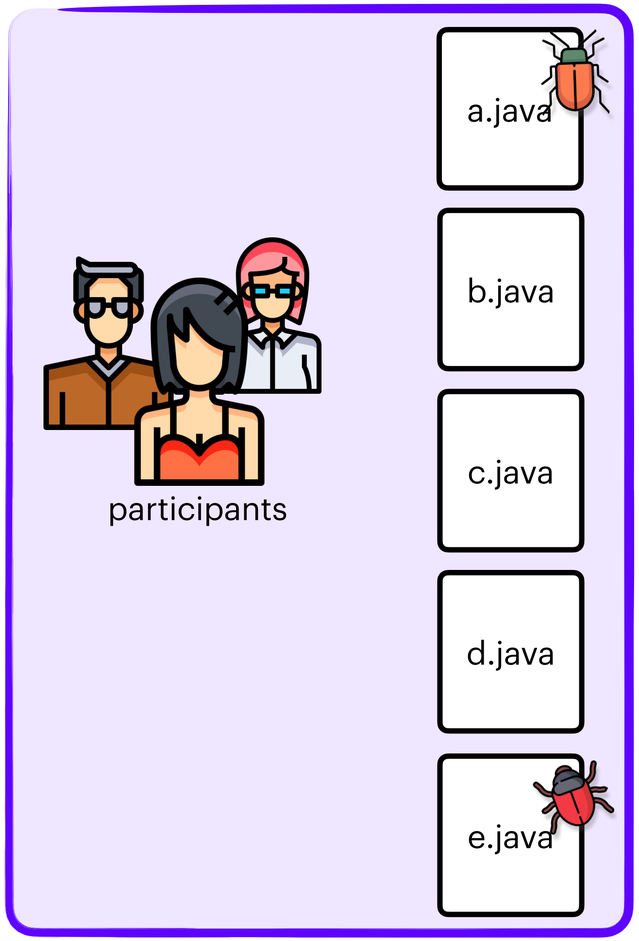

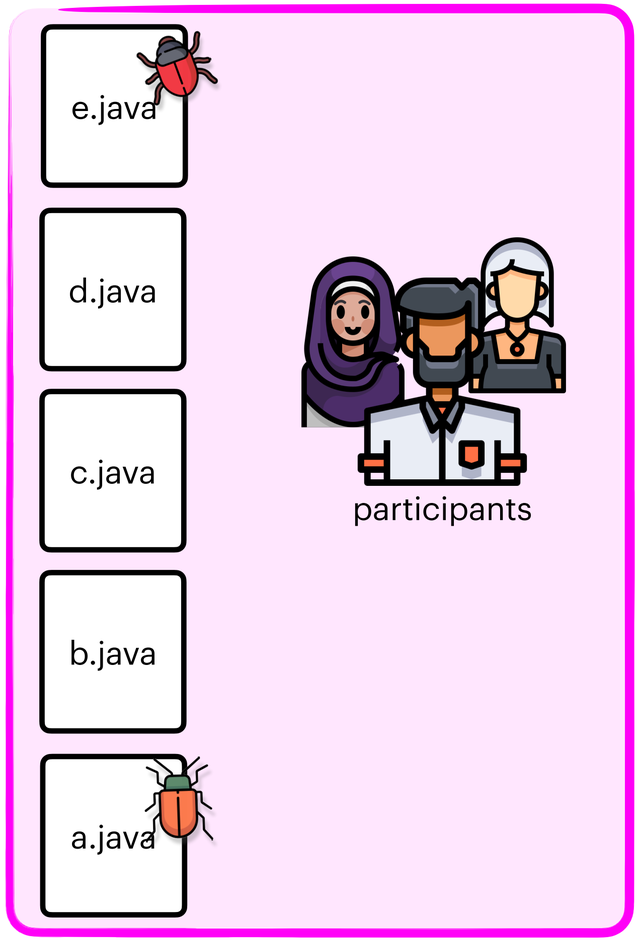

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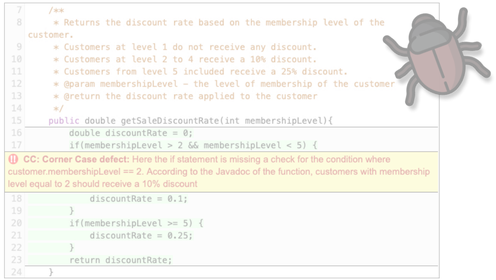


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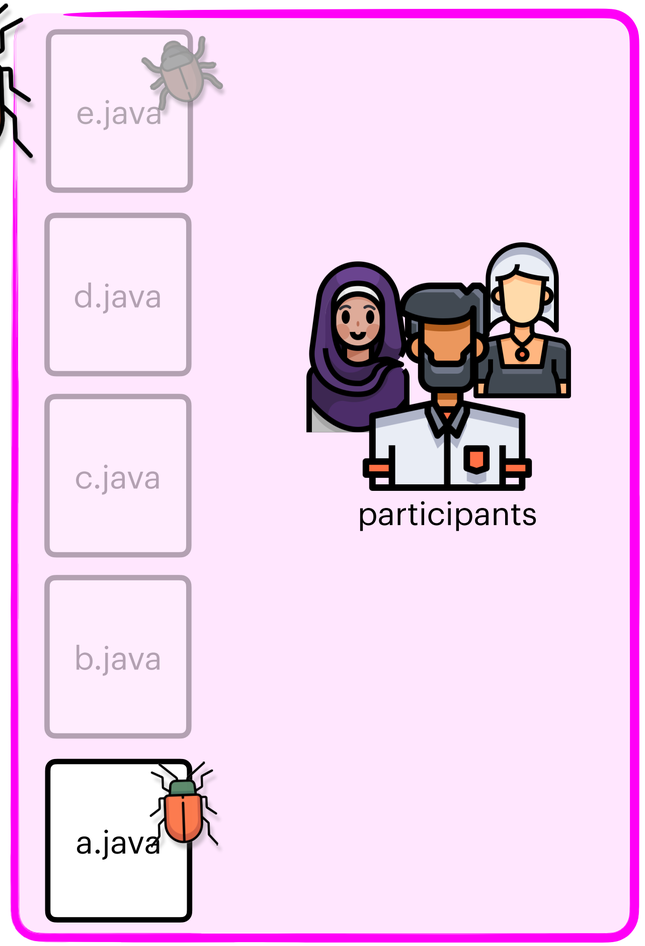

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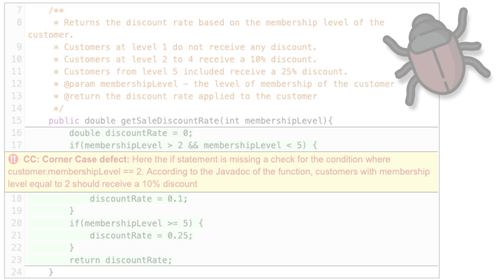


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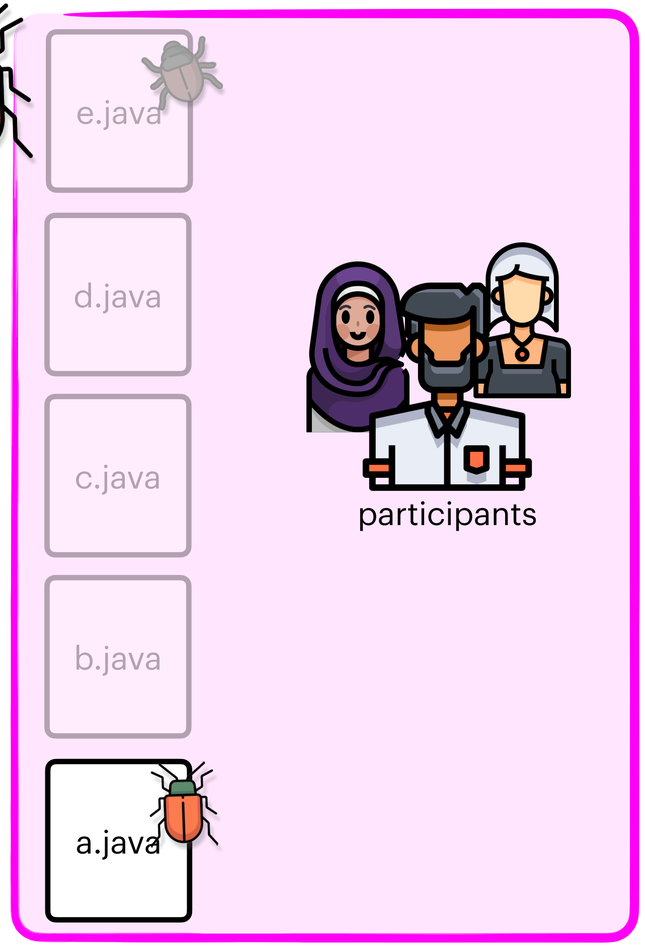
same likelihood of finding the bug



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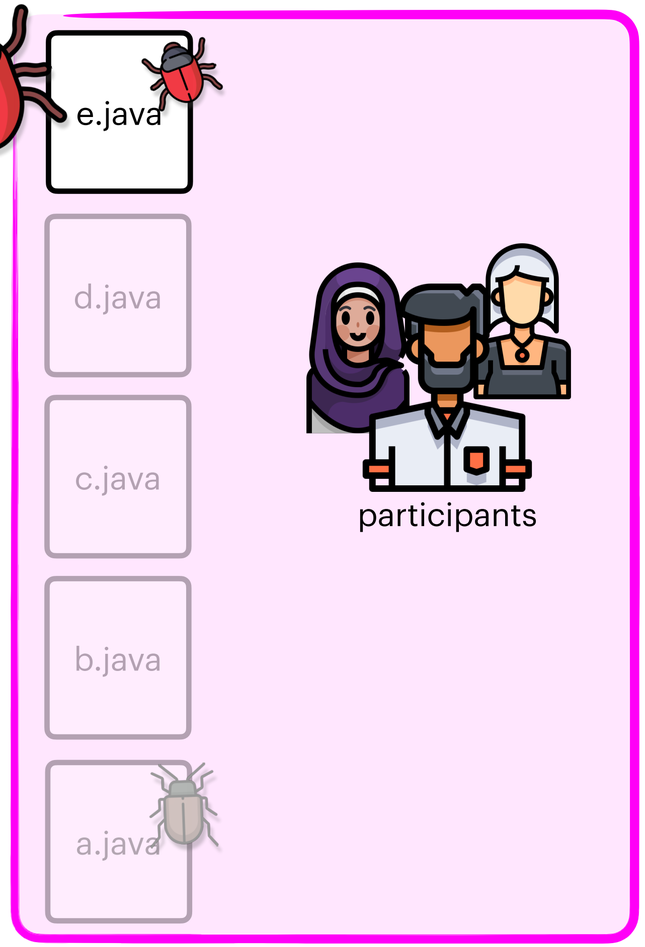
15    public double getSaleDiscountRate(int membershipLevel){
16        double discountRate = 0;
17        if(membershipLevel > 2 && membershipLevel < 5) {
```

CC: Corner Case defect: Here the if statement is missing a check for the condition where customer.membershipLevel == 2. According to the Javadoc of the function, customers with membership level equal to 2 should receive a 10% discount

```
18            discountRate = 0.1;
19        }
20        if(membershipLevel >= 5) {
21            discountRate = 0.25;
22        }
23        return discountRate;
24    }
```



code review

production files experiment

```
26          switch (destinationAddress.getCountry()) {
27              case "USA":
28                  shippingCost = shippingCost * 1.2;
29                  break;
30              case "Canada":
31                  shippingCost = shippingCost * 1.18;
32                  break;
33              case "Mexico":
34                  shippingCost = shippingCost * 1.35;
35                  break;
36              case "UK":
37                  shippingCost = shippingCost * 1.27;
```

MB: Missing Break defect: Here a break statement is missing. In this way, when the country is UK, the execution will fall through the default case and a wrong tax of 1.27 * 2 will be applied.

```
38              default:
39                  shippingCost = shippingCost * 2;
40          }
41          return shippingCost;
```

175% more likely
to find the bug


```
7       /**
8        * Returns the discount rate based on the membership level of the customer.
9        * Customers at level 1 do not receive any discount.
10       * Customers at level 2 to 4 receive a 10% discount.
11       * Customers from level 5 included receive a 25% discount.
12       * @param membershipLevel - the level of membership of the customer
13       * @return the discount rate applied to the customer
14       */
15      public double getSaleDiscountRate(int membershipLevel){
16          double discountRate = 0;
17          if(membership Level > 2 && membershipLevel < 5) {
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CC: Corner Case defect: Here the if statement is missing a check for the condition where customer.membershipLevel == 2. According to the Javadoc of the function, customers with membership level equal to 2 should receive a 10% discount

```
18              discountRate = 0.1;
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23          return discountRate;
24      }
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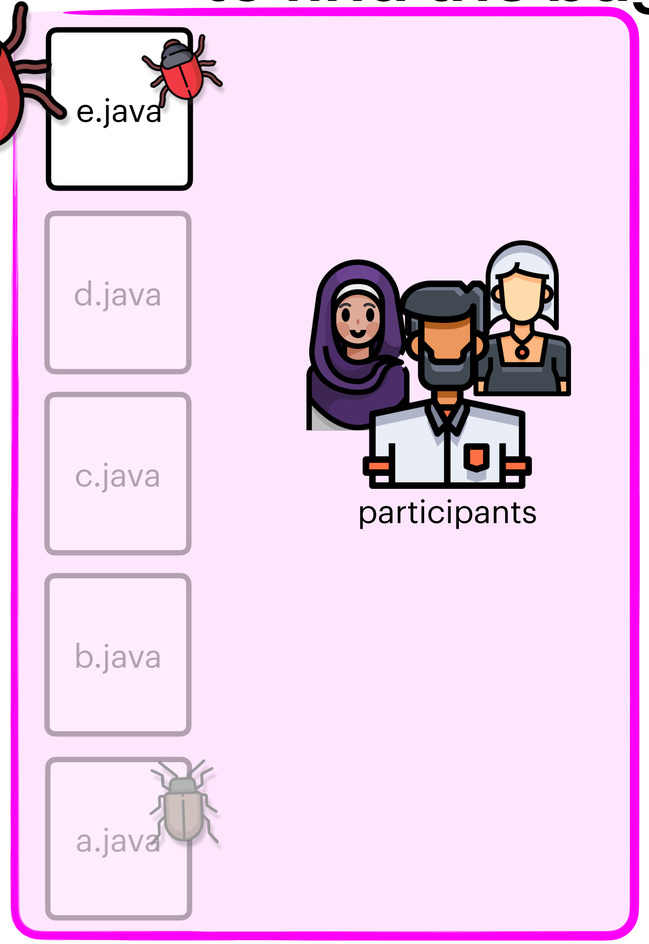
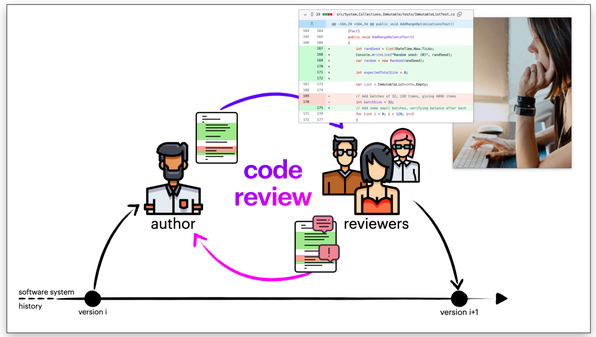
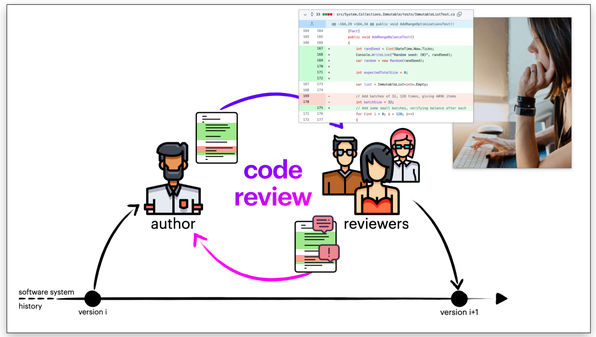


review

review


code
review
author
reviewers
software system
history
version i
version i+1

review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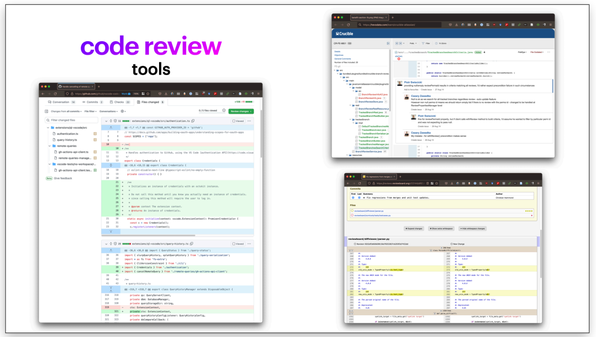
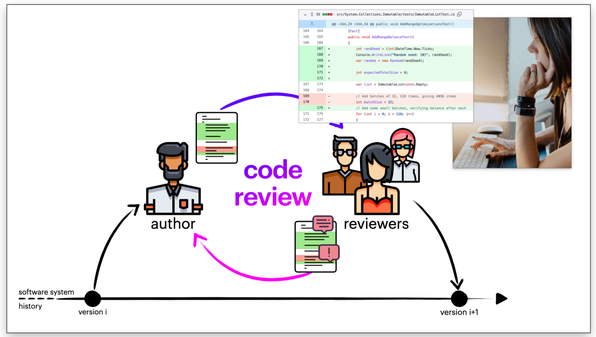
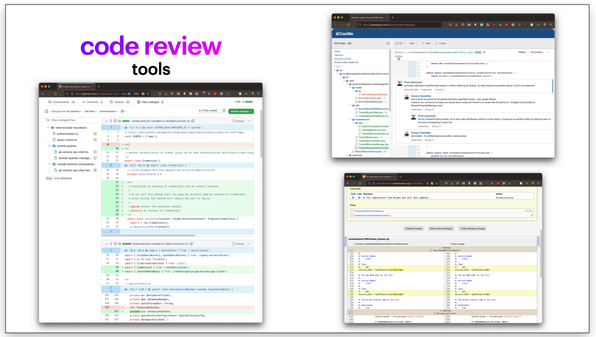

code review
tools

review

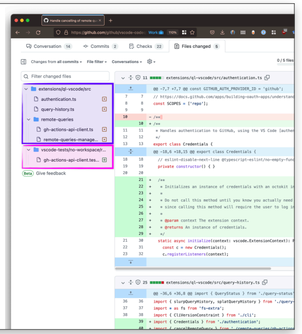




code review
test files

- Developers see test code as less important than production code.
- Test files are almost twice less likely to be discussed during code review when together with production files.

[Spadini, Aniche, Storey, Bruntink, Bacchelli - ICSE 2018]



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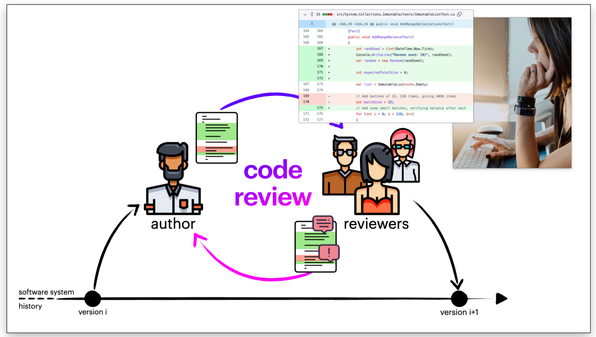
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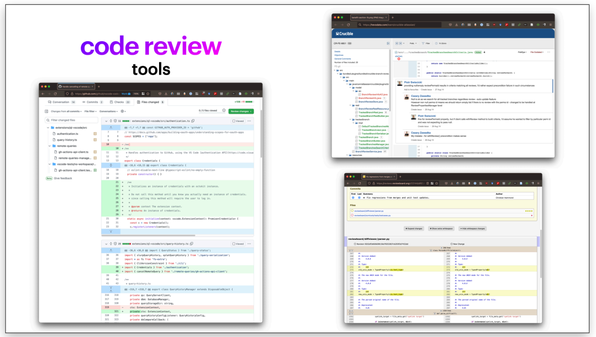
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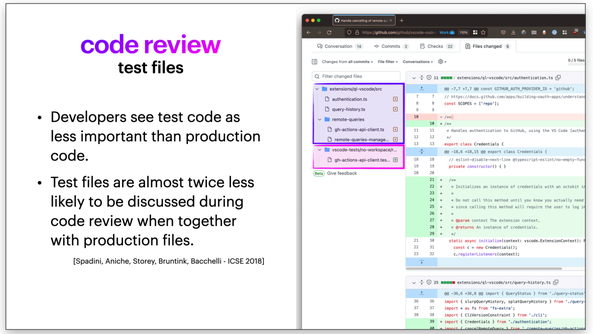
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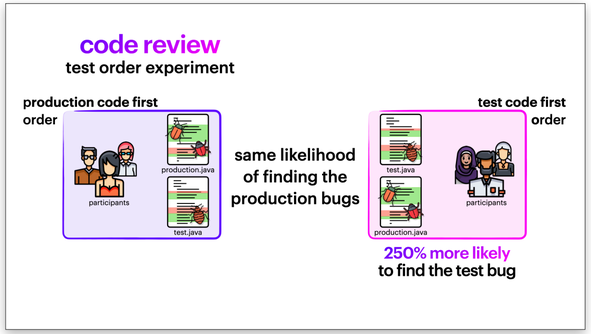
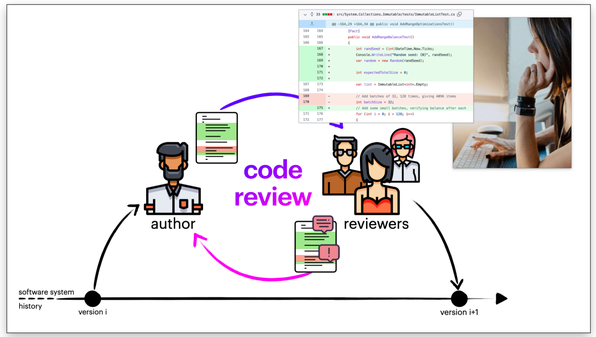

code review
test order experiment
production code first order
participants
production.java
test.java
same likelihood of finding the production bugs
test code first order
test.java
participants
production.java
250% more likely
to find the test bug

review



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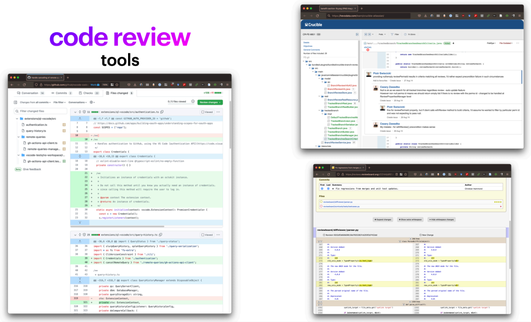

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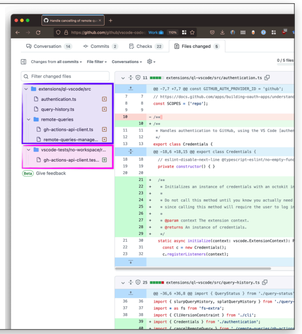

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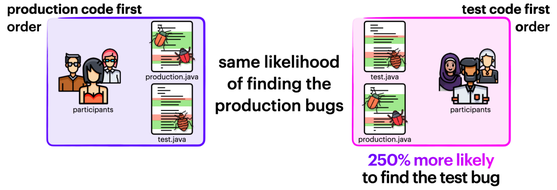

code review
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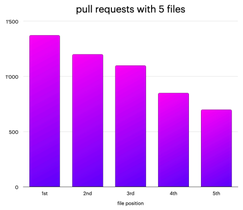
cumulative number of review comments by file position



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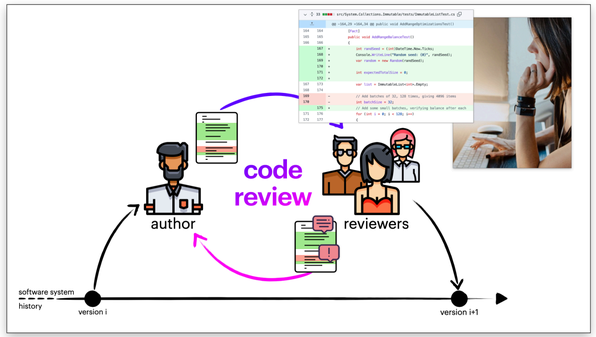
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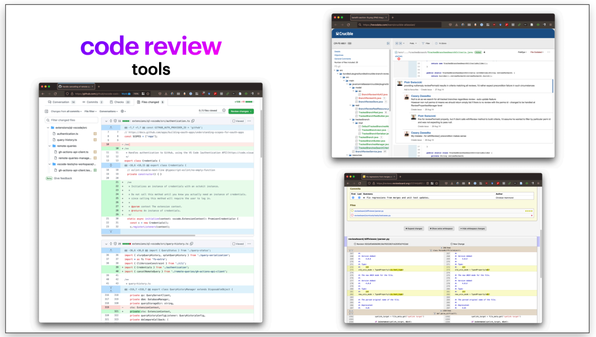
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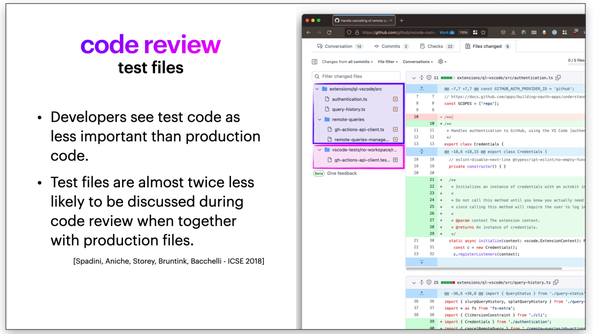
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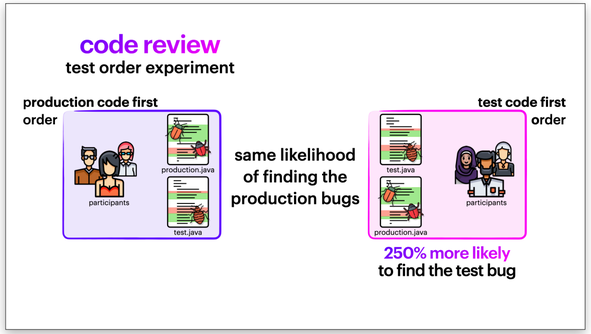
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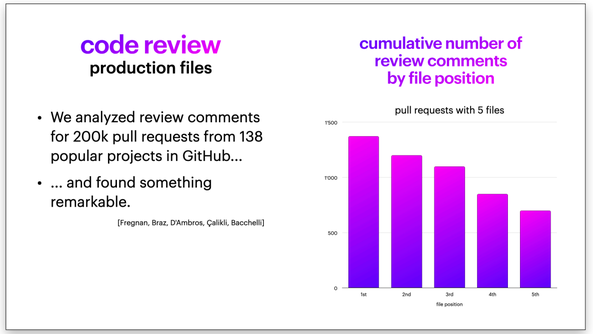
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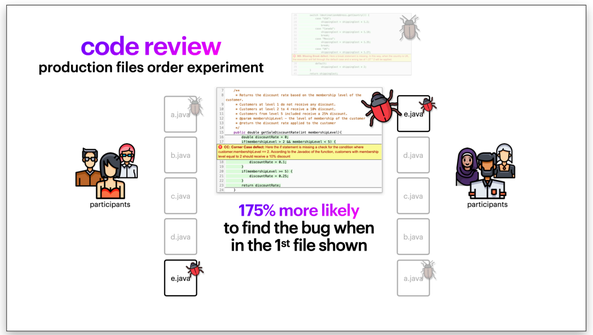
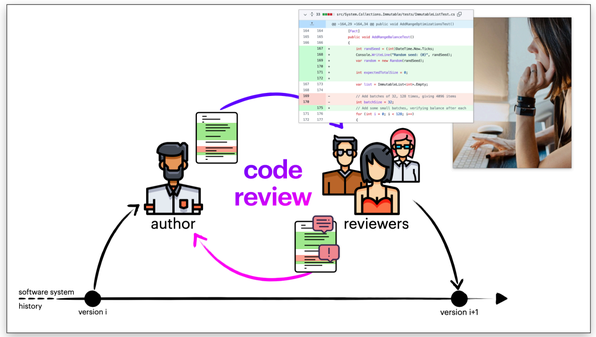
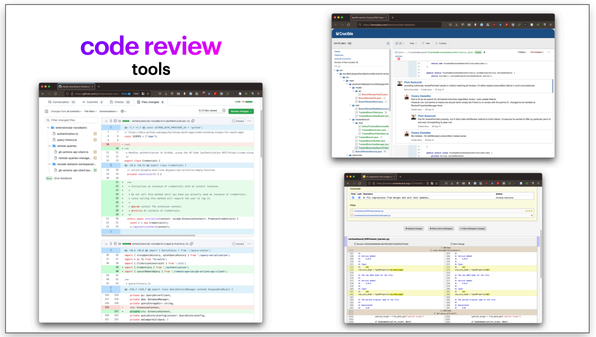
cumulative number of review comments by file position
pull requests with 5 files
1500
1000
500
0
1st
2nd
3rd
4th
5th
file position


code review
production files order experiment
participants
a.java
b.java
c.java
d.java
e.java
175% more likely to find the bug when in the 1st file shown

review





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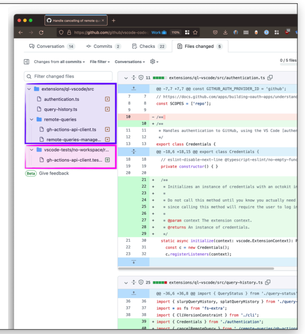

code review
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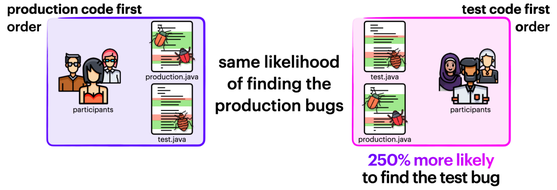

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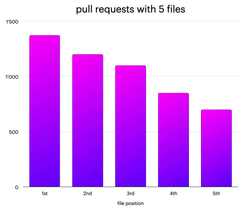
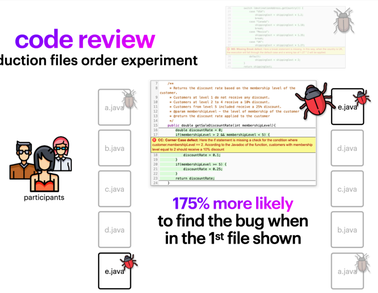
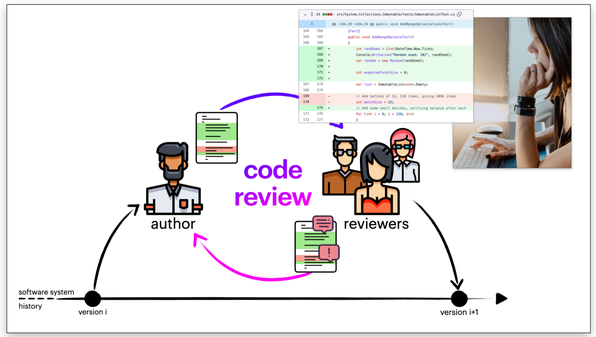


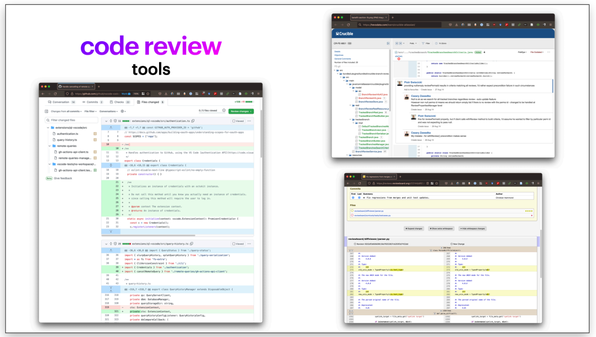
code review
production files order experiment

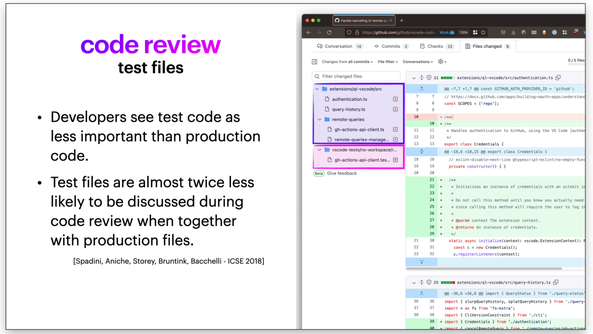


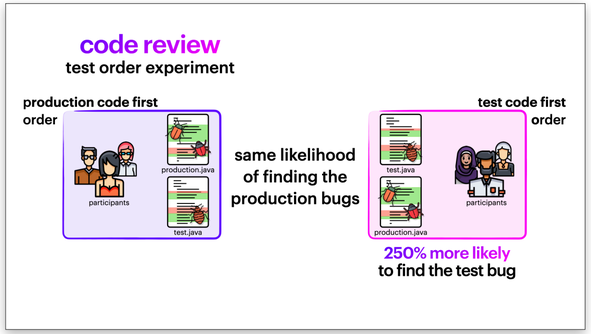
takeaways

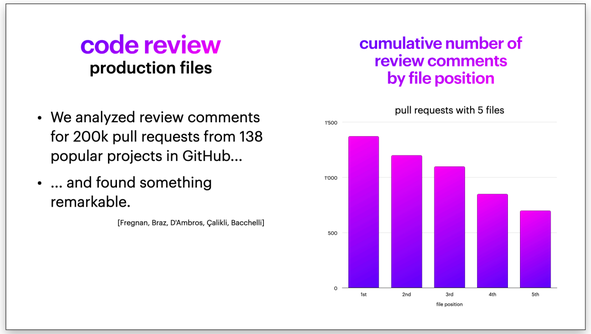
review

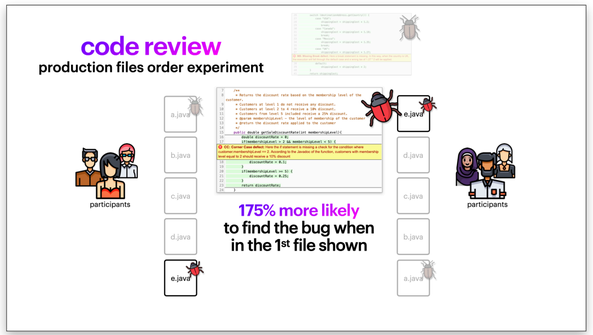












takeaways

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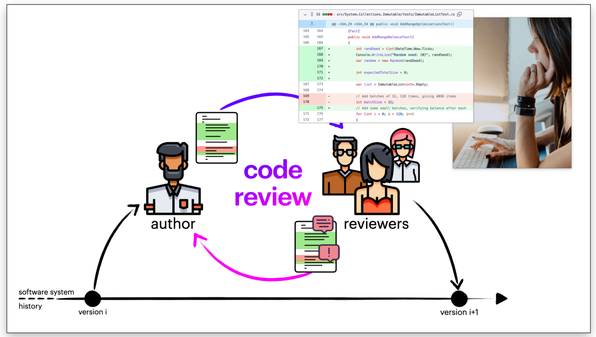
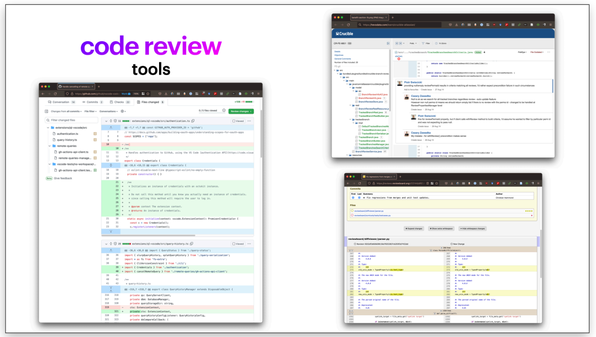
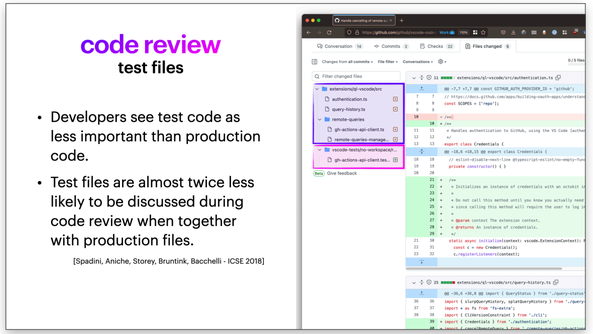
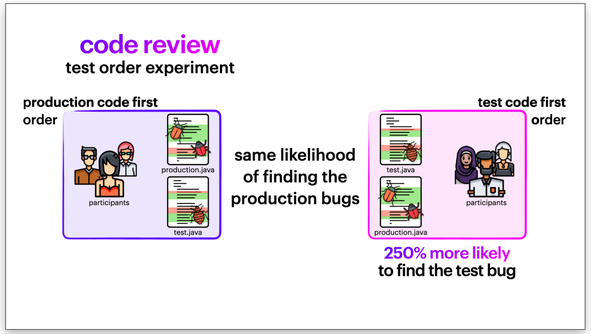
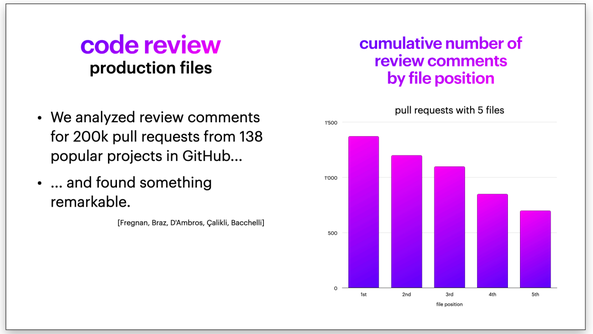
review

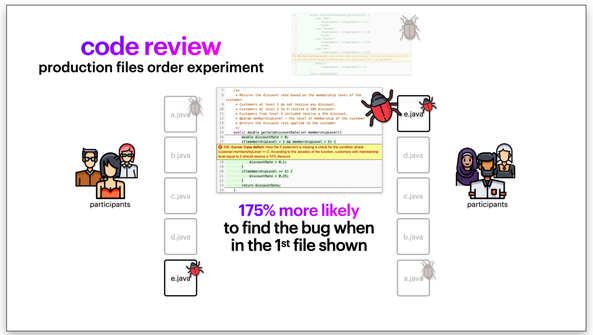












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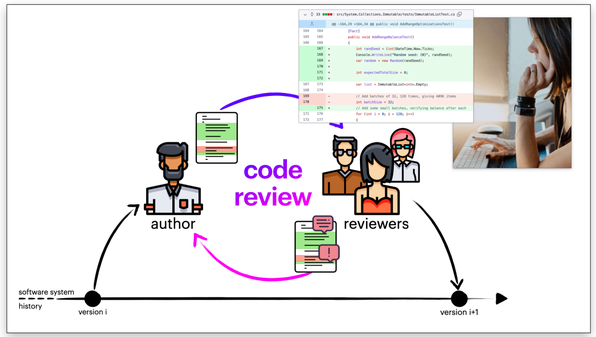
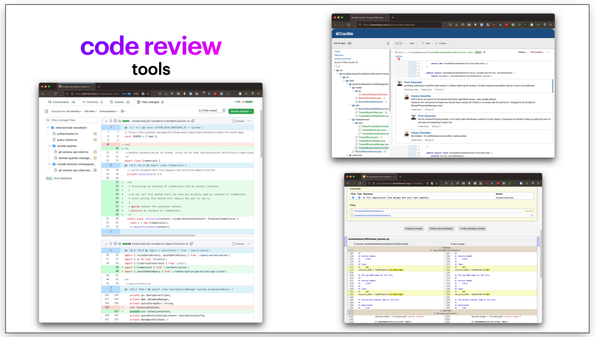
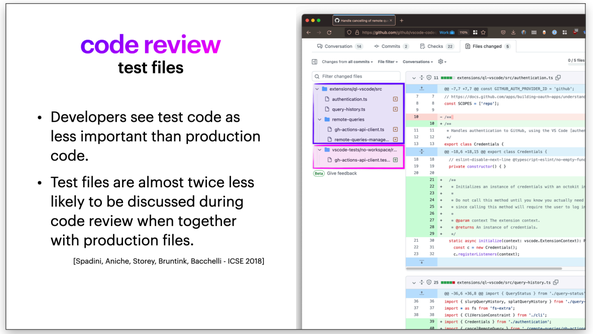
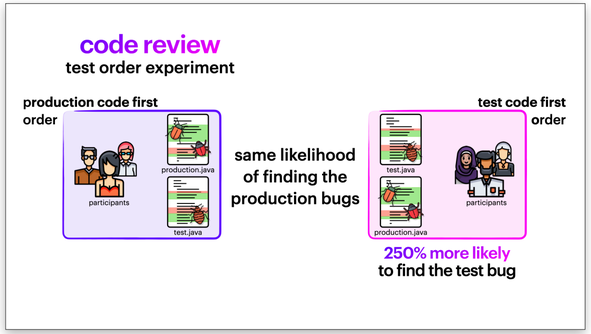
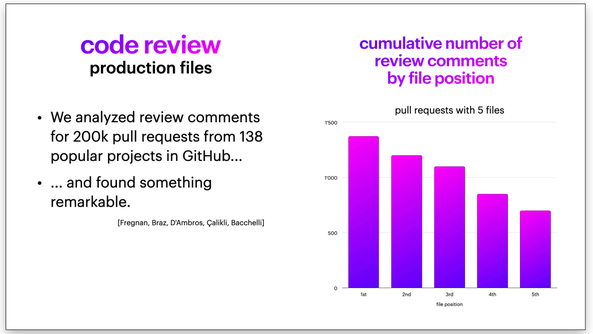
review

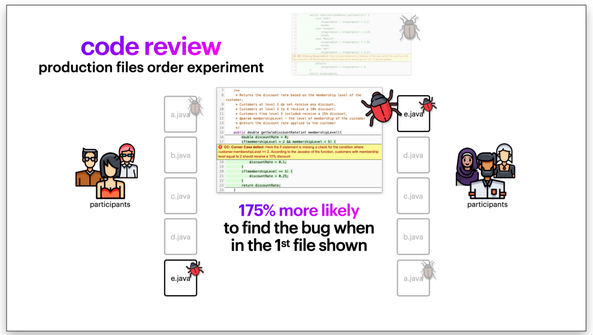












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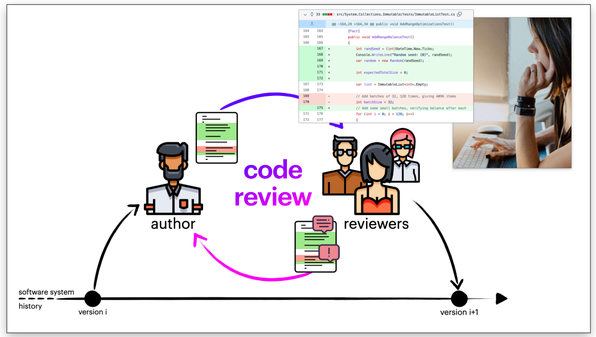
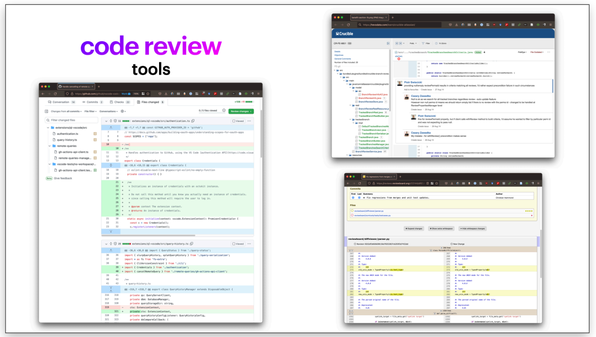
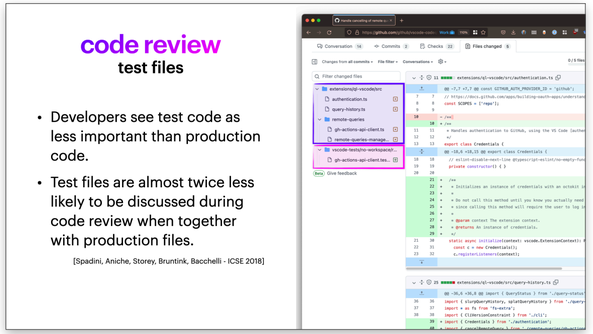
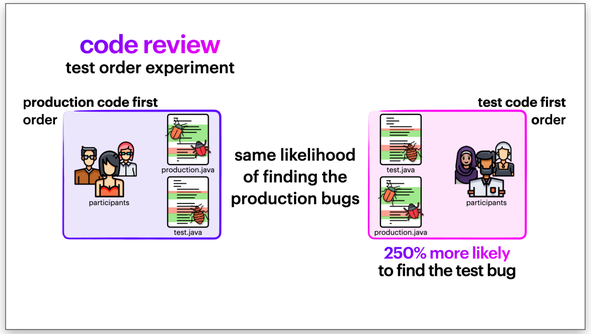
- **tool builders**: empower users to choose how to order their changes and more.

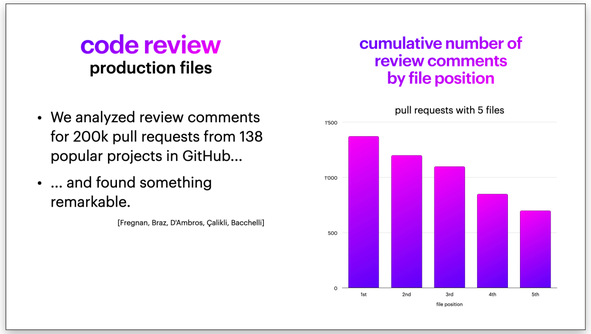
review

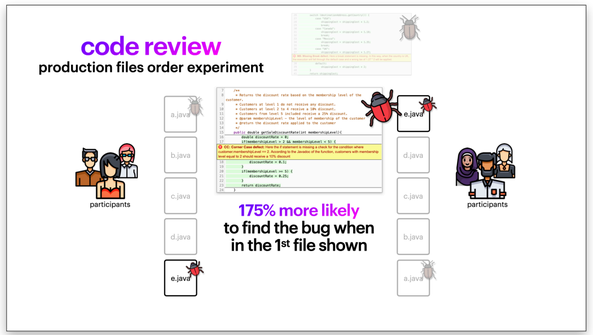












takeaways

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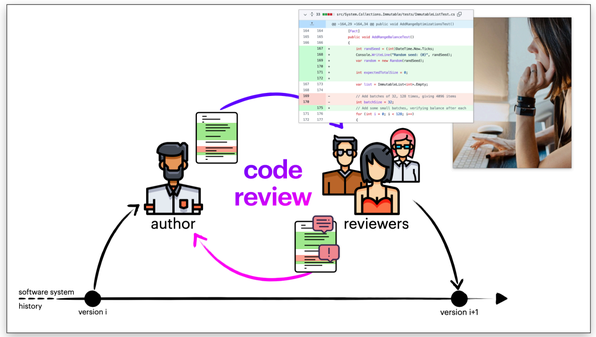
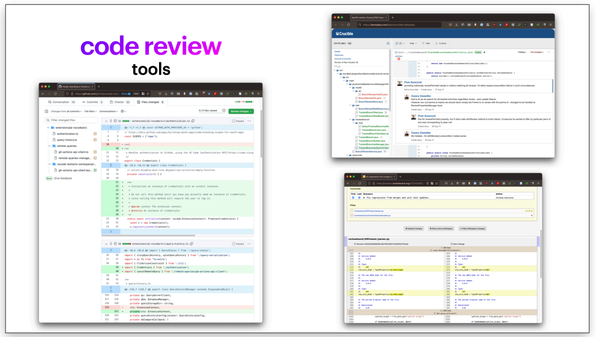
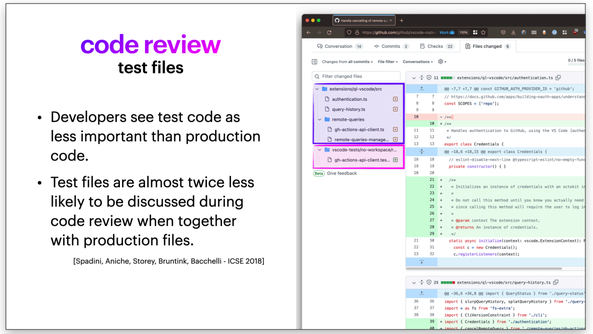
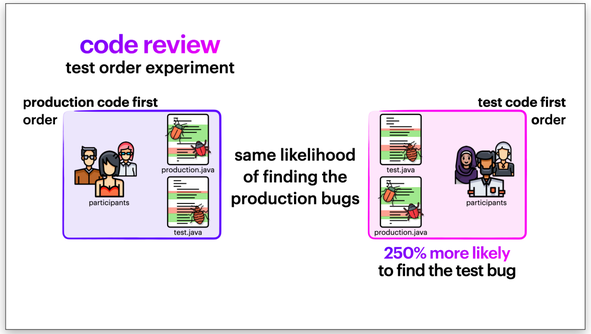
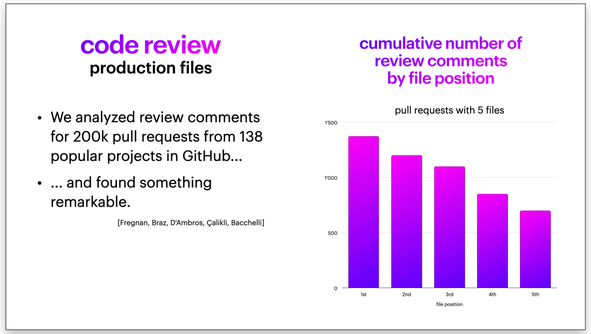
review

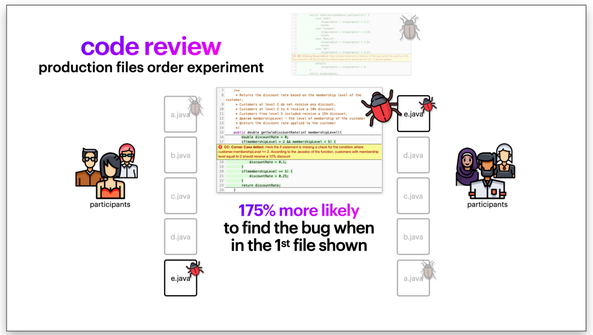












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