



# Who Should Review My Code?

A File Location-Based Code-Reviewer Recommendation  
Approach for Modern Code Review



**Patanamon (Pick)  
Thongtanunam**



Chakkrit  
Tantithamtavorn



Raula G. Kula



Norihiro  
Yoshida



Hajimu Iida



Ken-ichi  
Matsumoto



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[@pamon](https://twitter.com/pamon)

**Modern Code Review** is a tool-based, and used regularly in practice nowadays at industrial and OSS projects



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**Rietveld**

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**Review Board™**



**Rietveld**

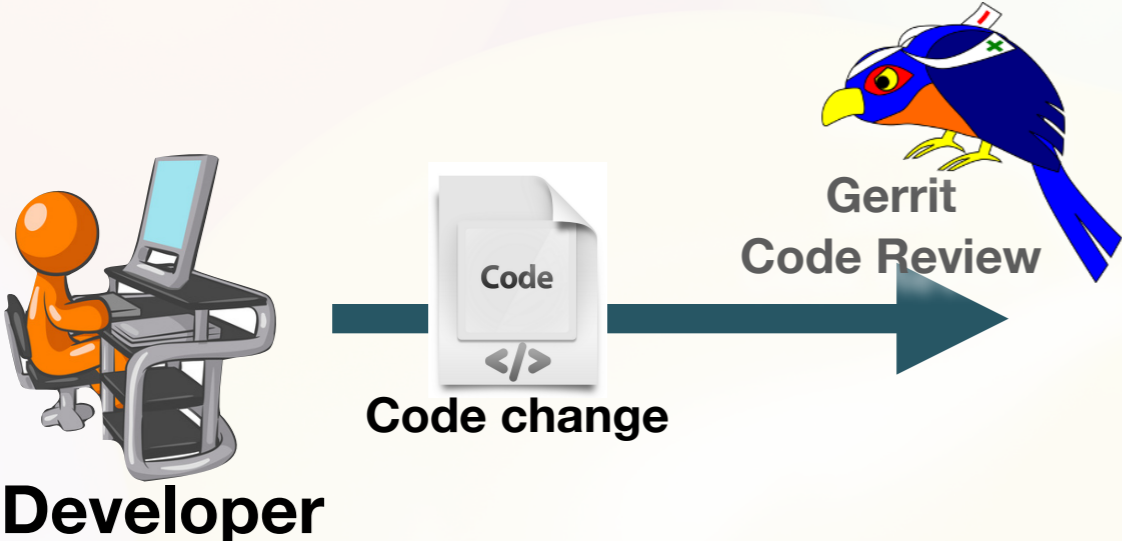


# Modern Code Review



**Developer**

# Modern Code Review



# Modern Code Review



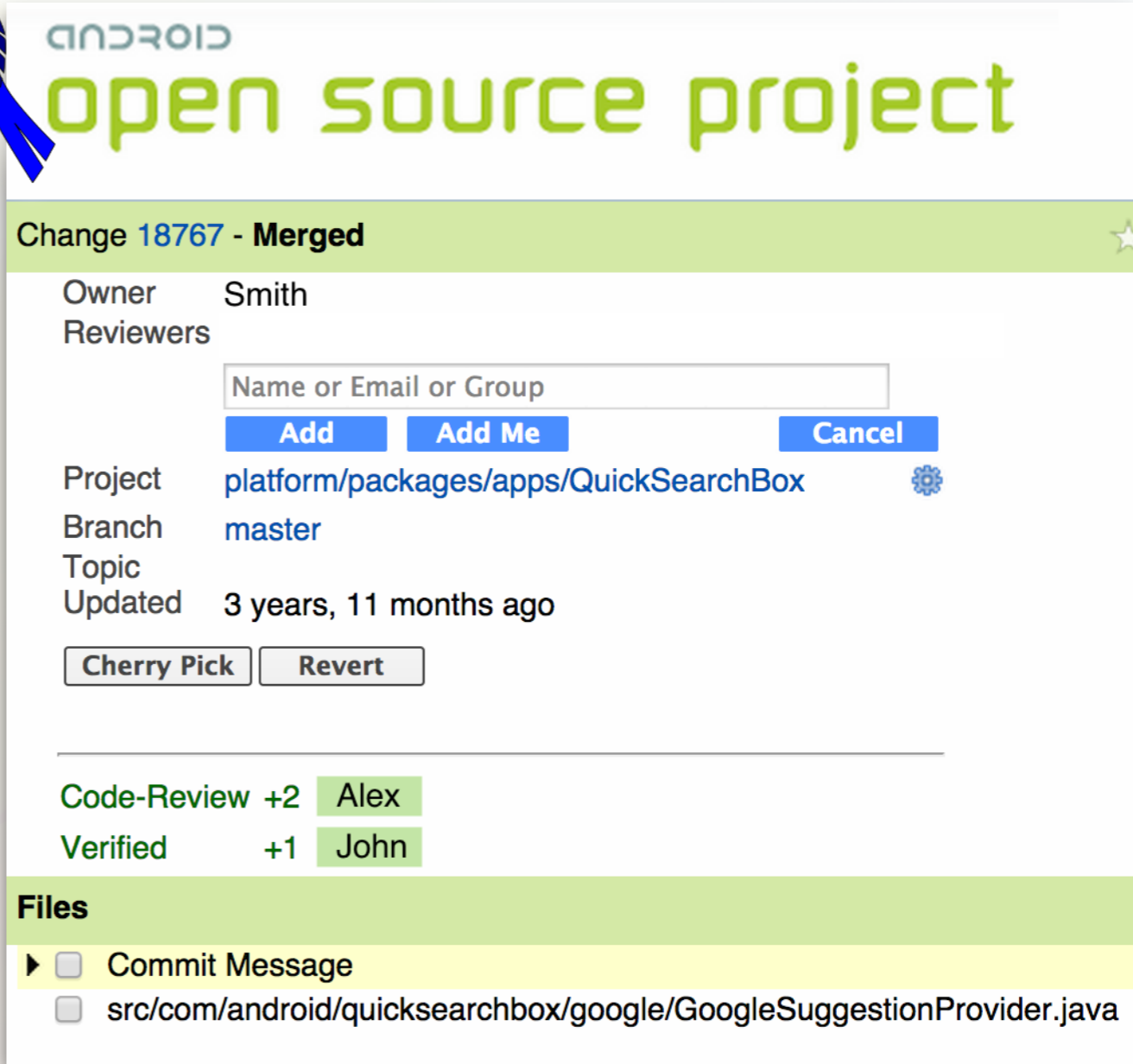
Developer



Code change



Gerrit Code Review




**ANDROID**  
**open source project**

Change **18767** - Merged

Owner: Smith  
Reviewers:

**Add** **Add Me** **Cancel**

Project: platform/packages/apps/QuickSearchBox   
Branch: master  
Topic:  
Updated: 3 years, 11 months ago

**Cherry Pick** **Revert**

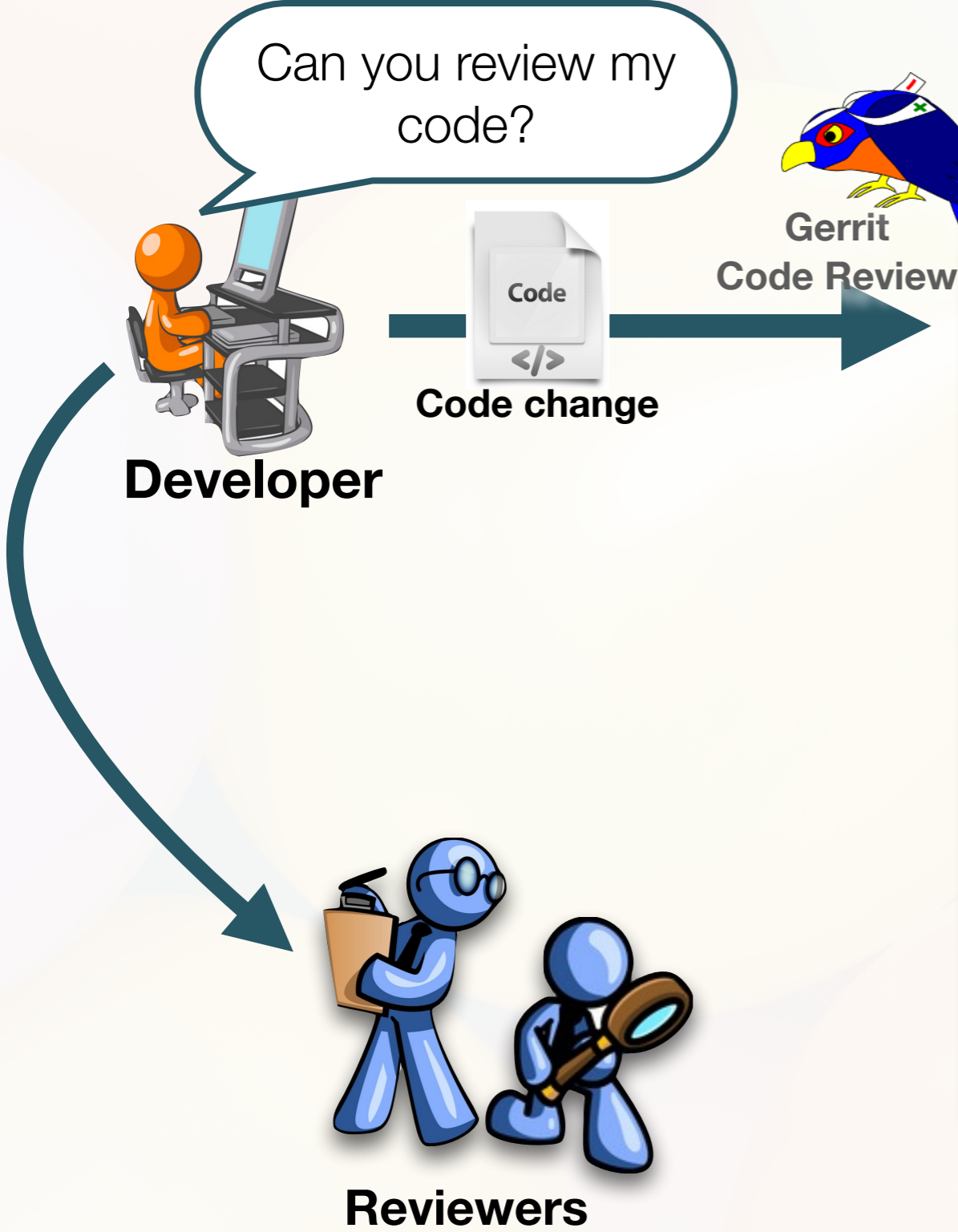
---

Code-Review +2 **Alex**  
Verified +1 **John**

**Files**

- Commit Message
- src/com/android/quicksearchbox/google/GoogleSuggestionProvider.java

# Modern Code Review



ANDROID  
open source project

Change 18767 - Merged

Owner	Smith
Reviewers	Alex John
<input type="text" value="Name or Email or Group"/>	
<input type="button" value="Add"/> <input type="button" value="Add Me"/> <input type="button" value="Cancel"/>	
Project	platform/packages/apps/QuickSearchBox
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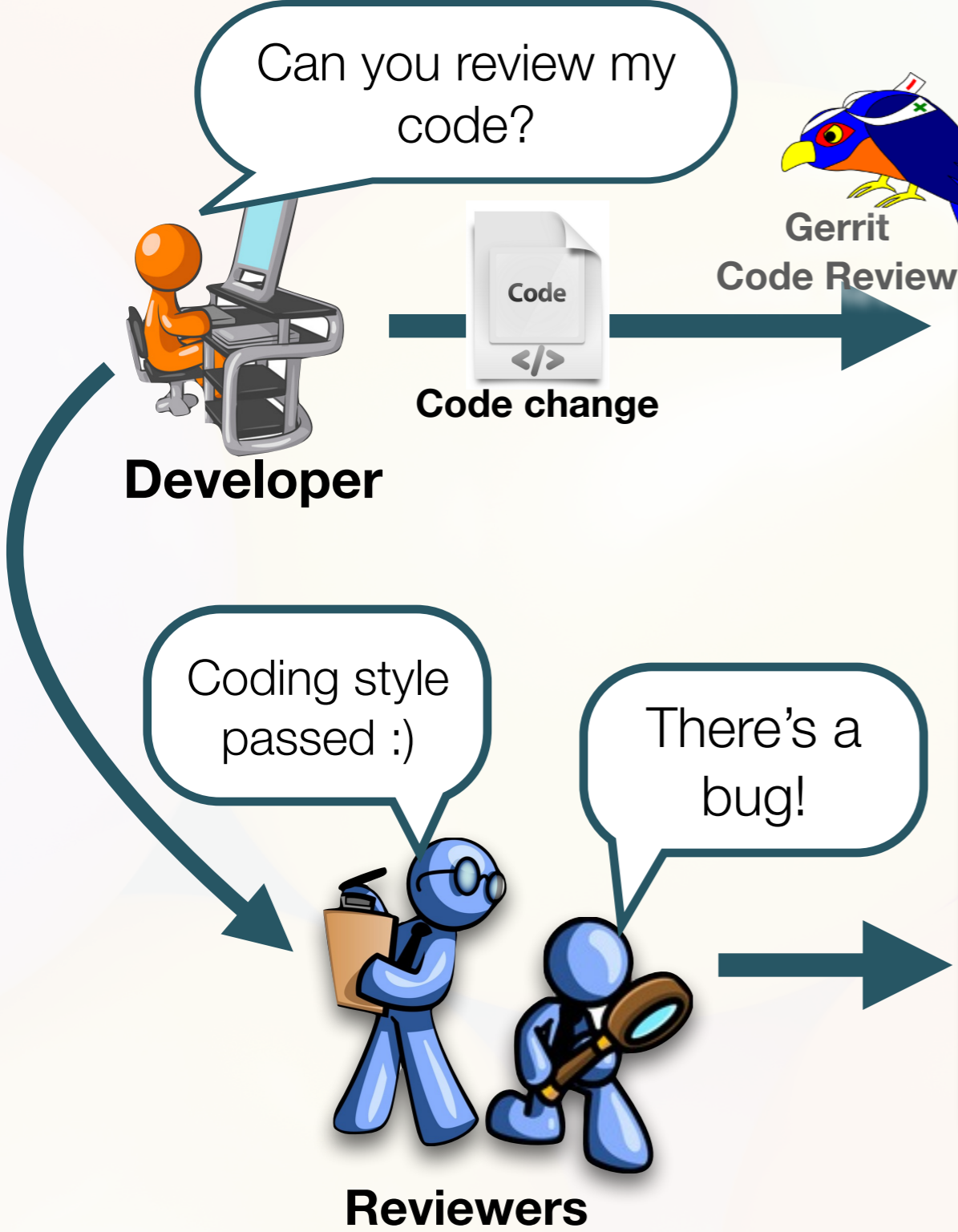
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- src/com/android/quicksearchbox/google/GoogleSuggestionProvider.java

Invite Reviewers



# Modern Code Review



ANDROID  
open source project

Change 18767 - Merged

Owner Smith

Reviewers Alex John

Name or Email or Group

Add Add Me Cancel

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Invite Reviewers

# Code-Reviewer Assignment Problem



Developer



Code change



Gerrit Code Review

android  
**open source project**

Change [18767](#) - Merged

Owner [Smith](#)

Reviewers

Project [platform/packages/apps/QuickSearchBox](#)

Branch [master](#)

Topic

Updated 3 years, 11 months ago

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Code-Review +2 [Alex](#)

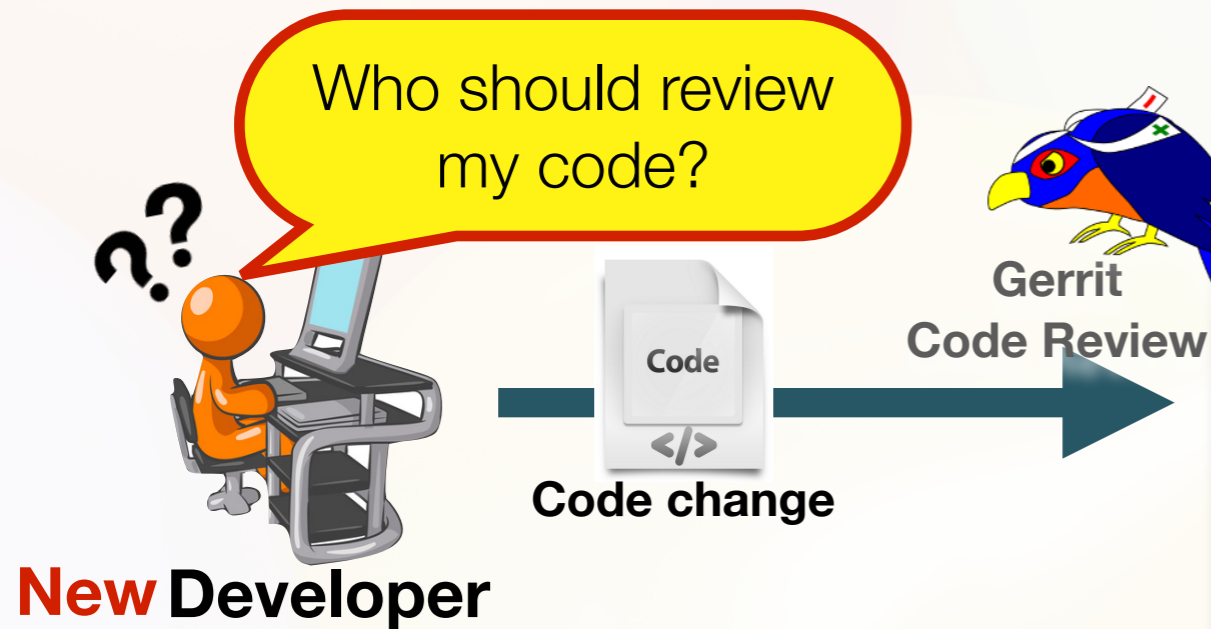
Verified +1 [John](#)

**Files**

- Commit Message
- src/com/android/quicksearchbox/google/GoogleSuggestionProvider.java

Invite Reviewers

# Code-Reviewer Assignment Problem



android  
open source project

Change 18767 - Merged

Owner Smith

Reviewers

Name or Email or Group

Add Add Me Cancel

Project platform/packages/apps/QuickSearchBox

Branch master

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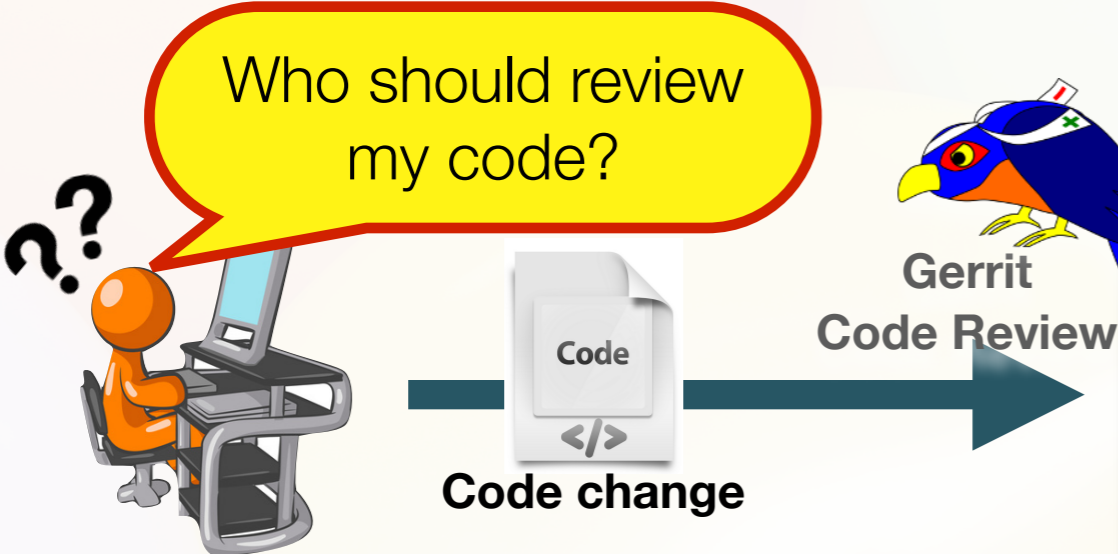
Files

- Commit Message
- src/com/android/quicksearchbox/google/GoogleSuggestionProvider.java

**Invite Reviewers**

The screenshot shows the Gerrit Code Review interface for a merged change. The "Reviewers" section is highlighted with a red box, and a red arrow points to it with the text "Invite Reviewers". The interface includes fields for "Name or Email or Group", "Add", "Add Me", and "Cancel" buttons. Below this, project details like "Project", "Branch", "Topic", and "Updated" are listed. At the bottom, there are sections for "Code-Review" (with +2 votes from Alex) and "Verified" (with +1 vote from John), followed by a "Files" section listing the commit message and a specific Java file.

# Code-Reviewer Assignment Problem



**New Developer**

**android open source project**

Change 18767 - Merged

Owner Smith

Reviewers

Name or Email or Group

Add Add Me Cancel

Project platform/packages/apps/QuickSearchBox

Branch master

**Invite Reviewers**

**Comments**

Smith Patch Set 1: Can you please review my change?

Smith Patch Set 1:  
Hi John  
Can you please add appropriate reviewers for this change?

src/com/android/quicksearchbox/google/GoogleSuggestionProvider.java

RQ1: How do reviews with code-reviewer assignment problem impact reviewing time?





# RQ1: How do reviews with code-reviewer assignment problem impact reviewing time?





Studied Projects



# RQ1: How do reviews with code-reviewer assignment problem impact reviewing time?

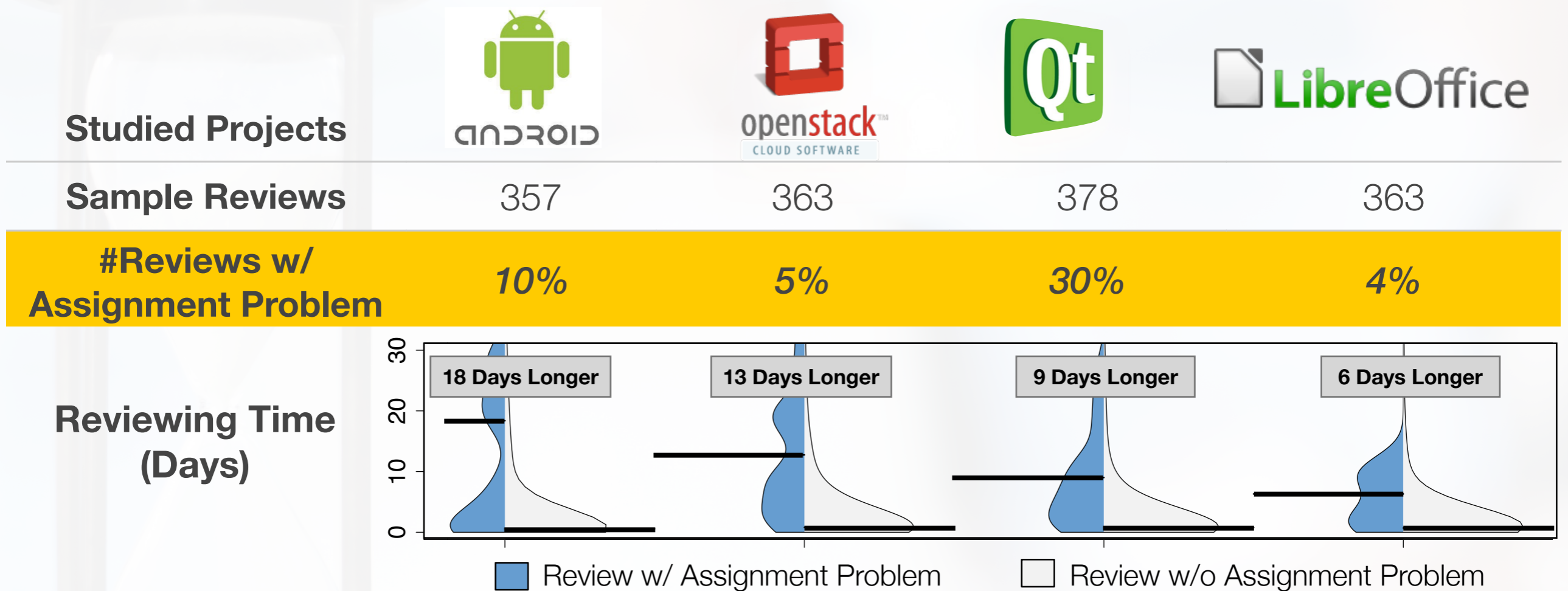
Studied Projects	 ANDROID	 openstack™ CLOUD SOFTWARE	 Qt	 LibreOffice
Sample Reviews	357	363	378	363

# RQ1: How do reviews with code-reviewer assignment problem impact reviewing time?

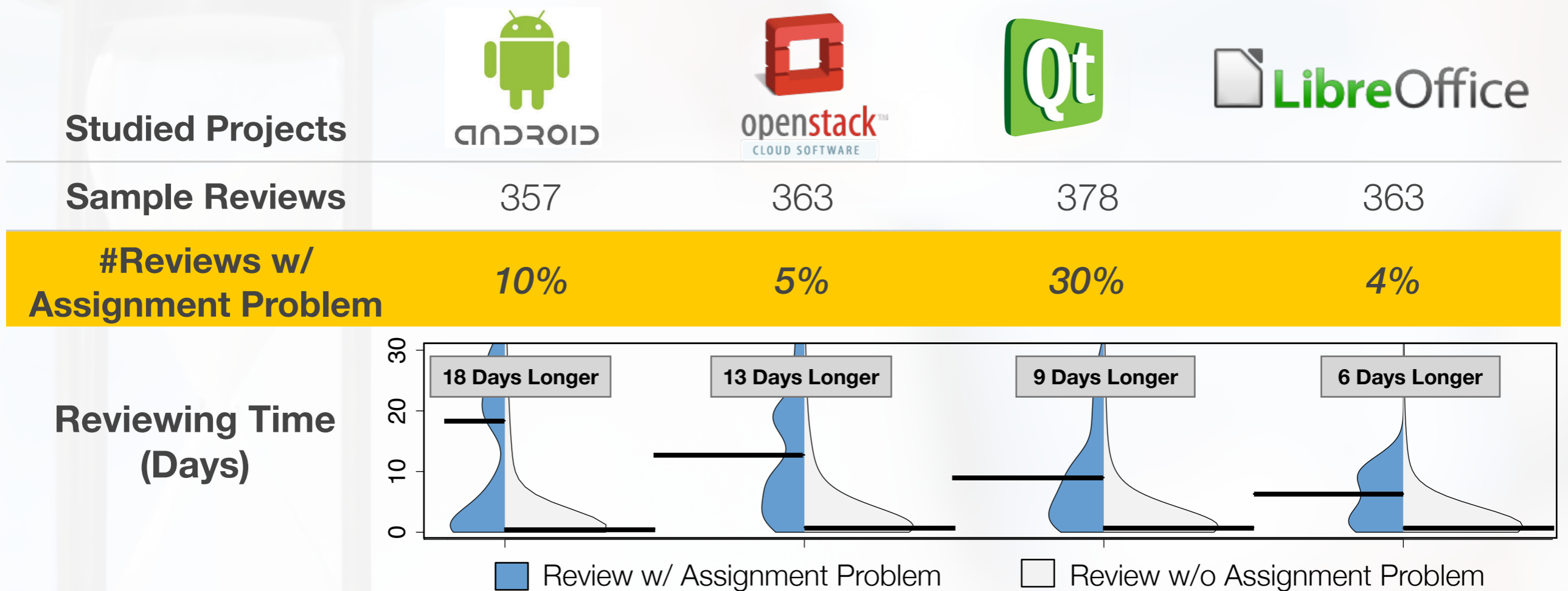
Studied Projects	 ANDROID	 openstack™ CLOUD SOFTWARE	 Qt	 LibreOffice
Sample Reviews	357	363	378	363
#Reviews w/ Assignment Problem	10%	5%	30%	4%



# RQ1: How do reviews with code-reviewer assignment problem impact reviewing time?



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*Reviews with code-reviewer assignment problem significantly take 12 days longer to approve a code change.*

RQ1: How do reviews with code-reviewer assignment problem impact reviewing time?



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Bojan Petrovic



Patch Set 3:

You might want to add some approvers to the reviewers list if you want it reviewed/approved.

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Bojan Petrovic



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You might want to add some approvers to the reviewers list if you want it reviewed/approved.

Peter Hartmann



Patch Set 1:

@Hanne: Feel free to add reviewers, I am not sure who needs to review this...

Deepika Sai Amuri

Patch Set 1:

Hi Jean,

Can you please add appropriate reviewers for this change?



# RQ1: How do reviews with code-reviewer assignment problem impact reviewing time?

Bojan Petrovic



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ANDROID

Robin Burchell



Patch Set 1: Looks good to me, but someone else must approve

for the future, it speeds things up often if you add reviewers for your changes :)

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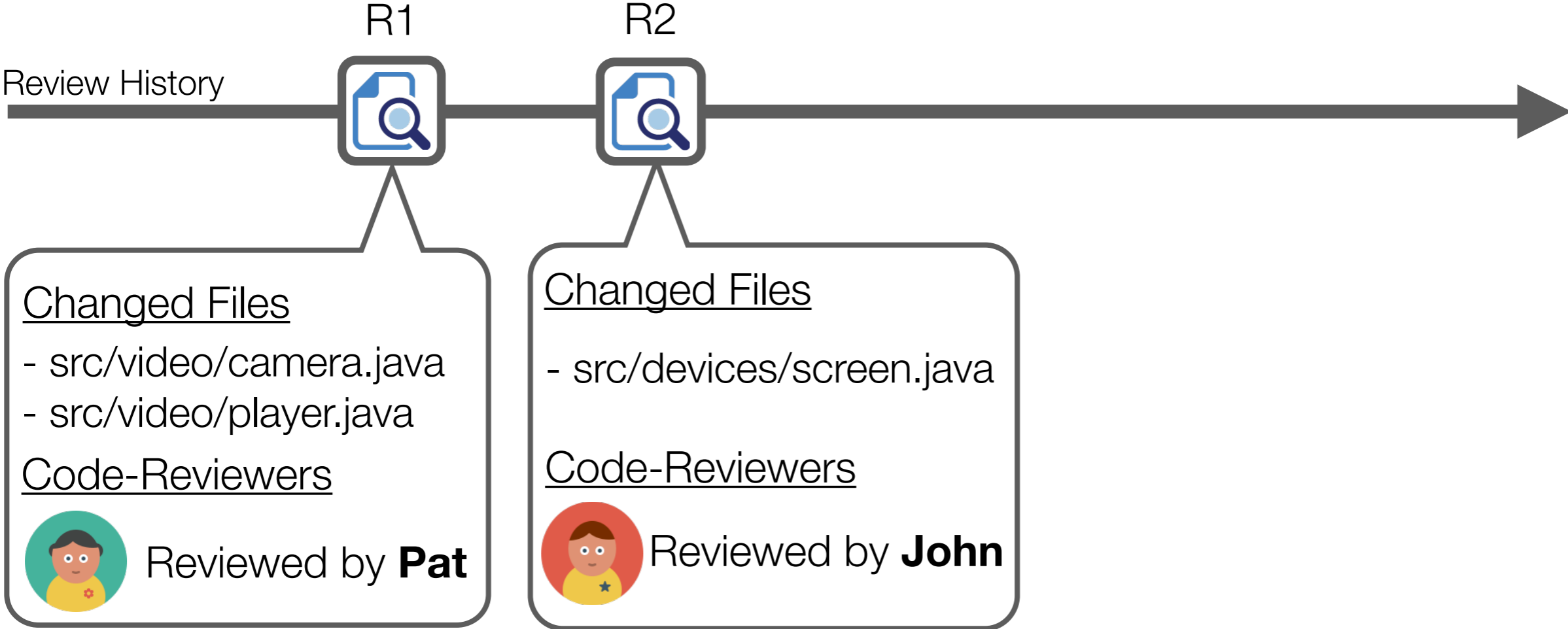
*A code-reviewer recommendation tool will be useful in distributed software development to speed up the code review process.*



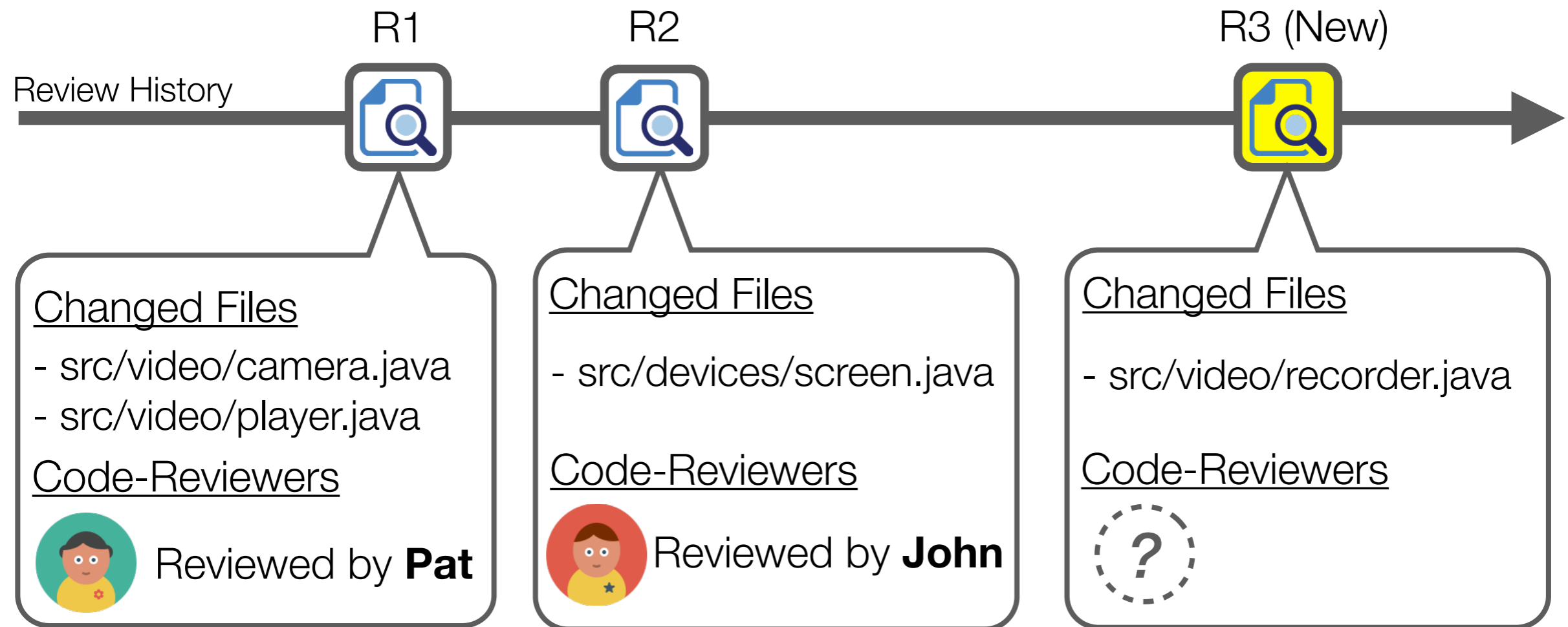
# **RevFinder:** A File Location-based Code-Reviewer Recommendation Approach



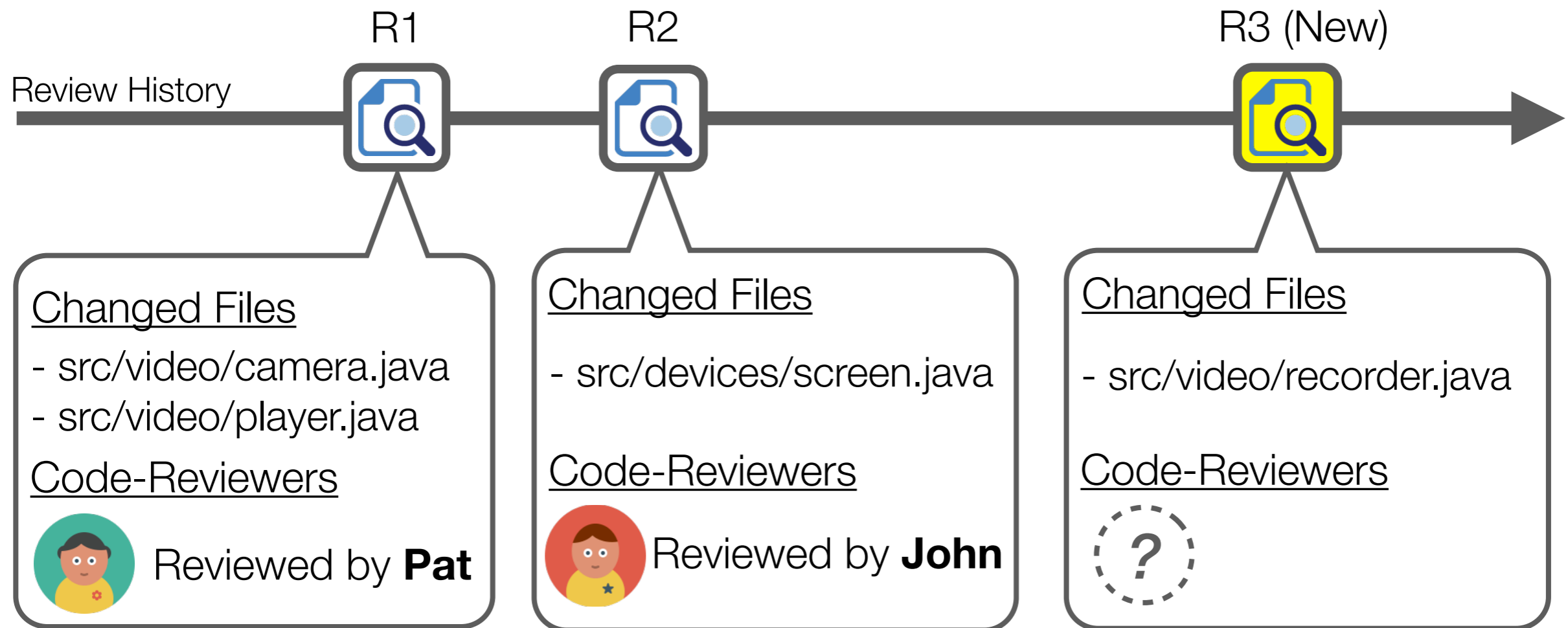
# RevFinder: Overview



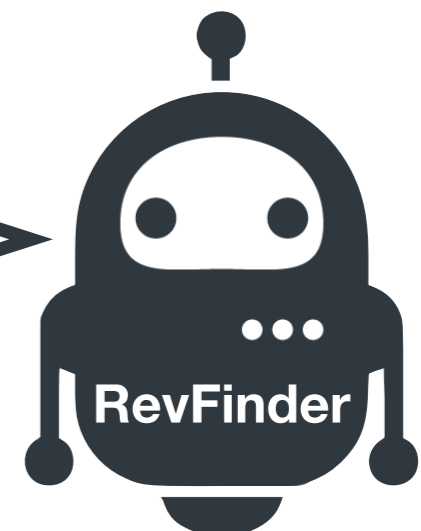
# RevFinder: Overview



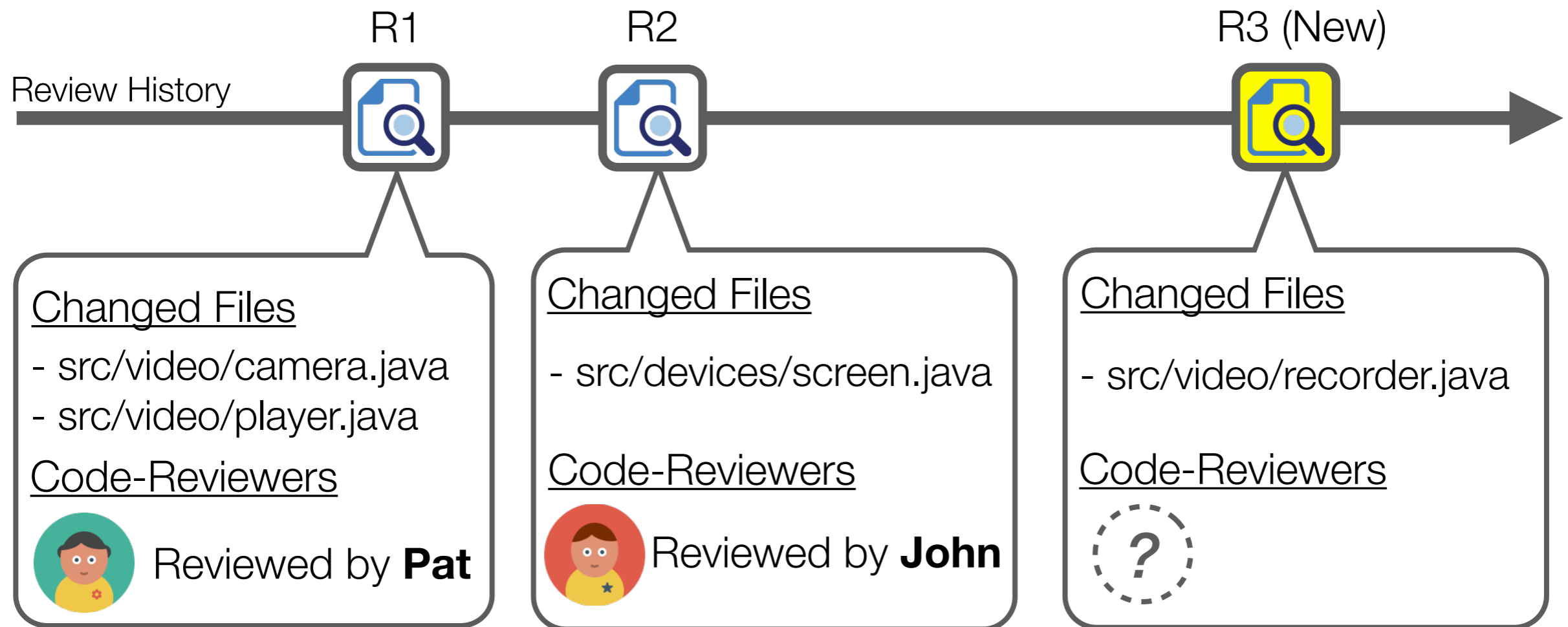
# RevFinder: Overview



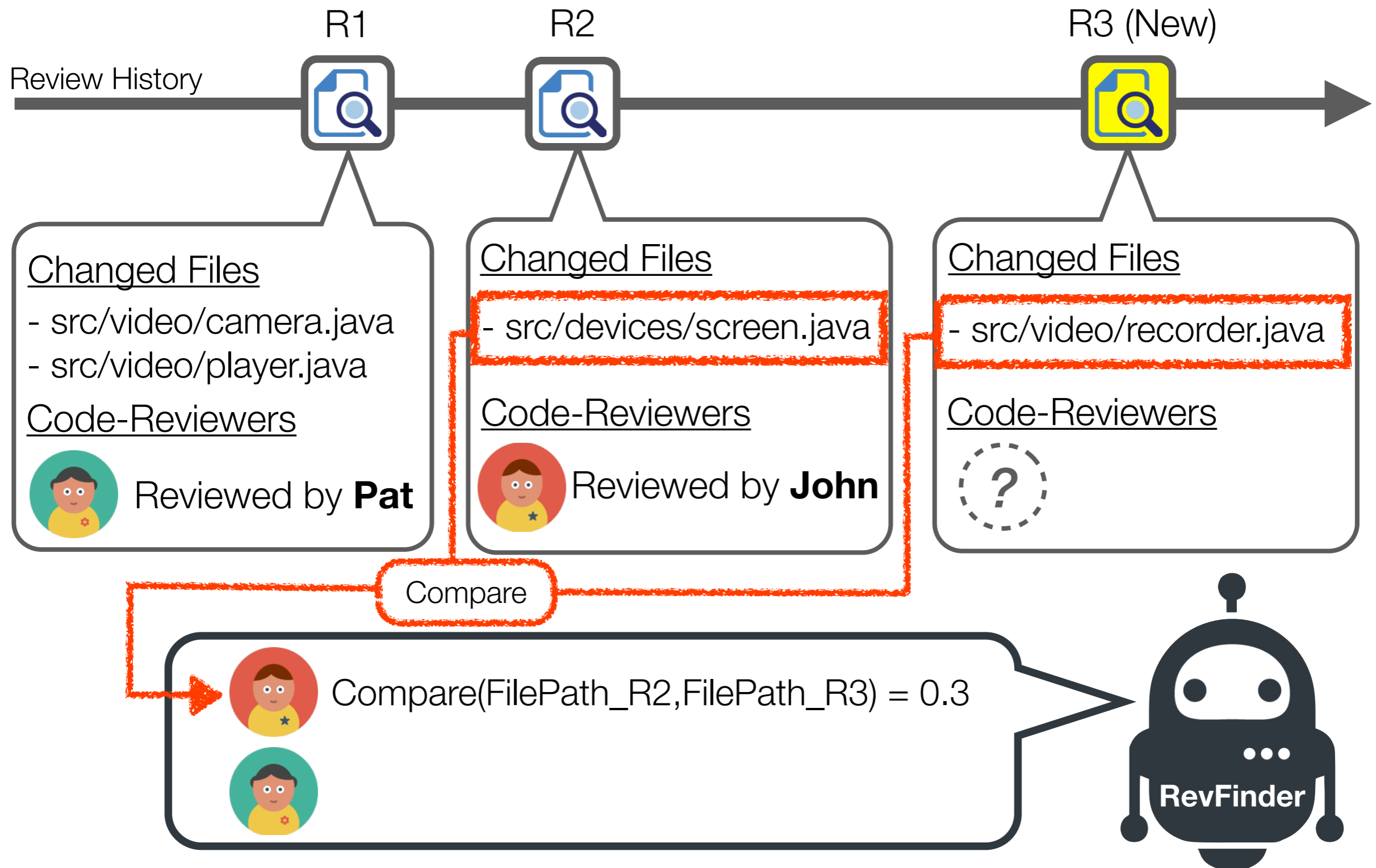
Find reviewers who have reviewed the most similar file paths



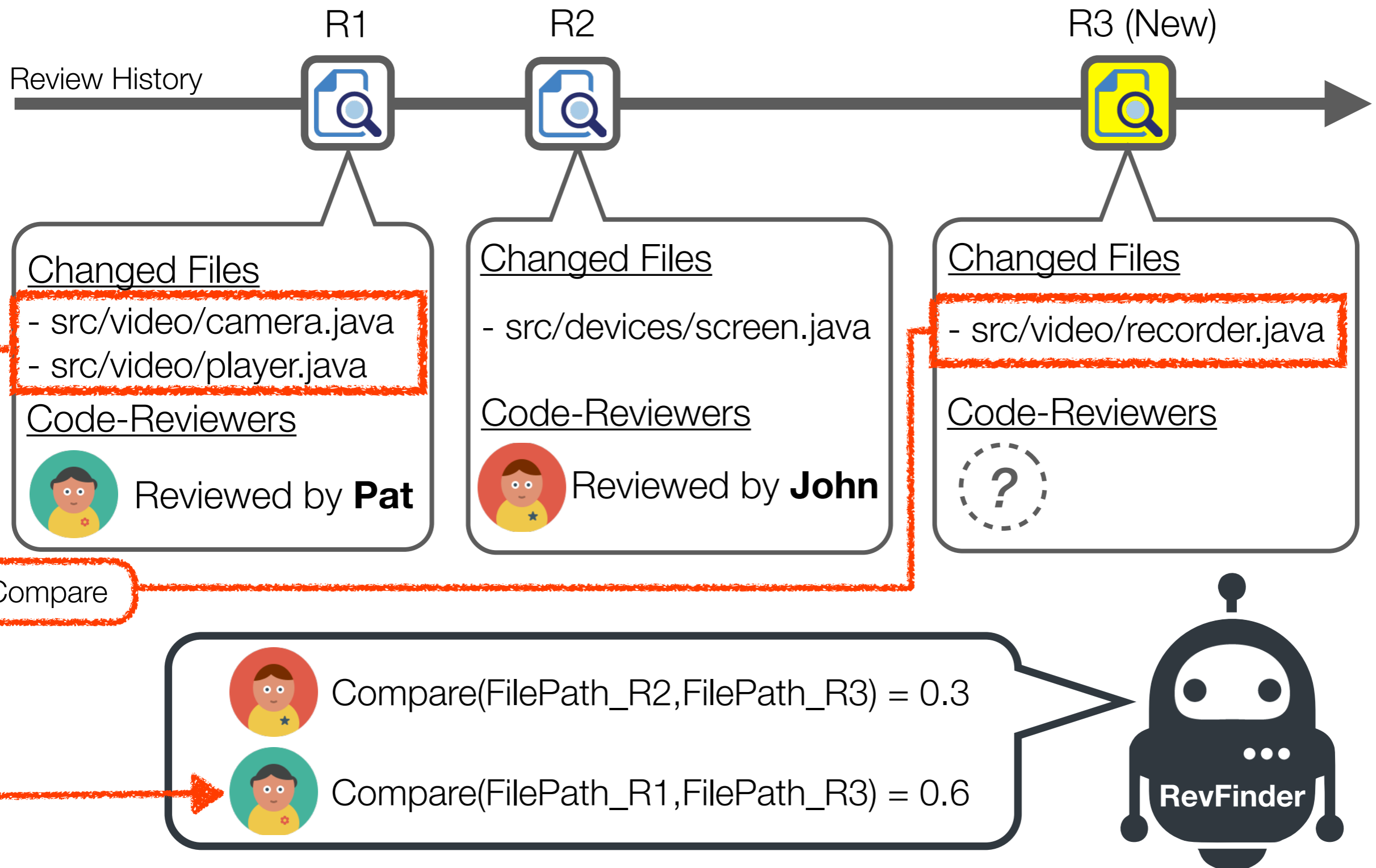
# RevFinder: Overview



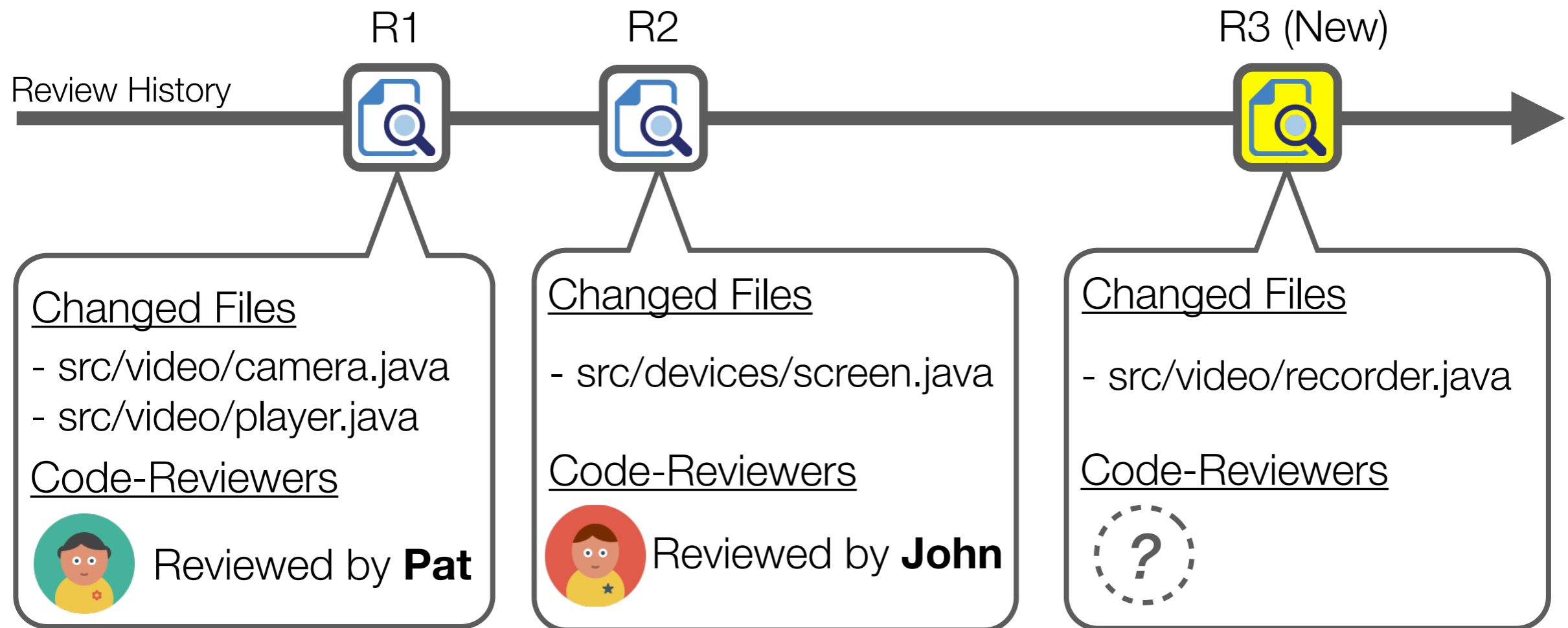
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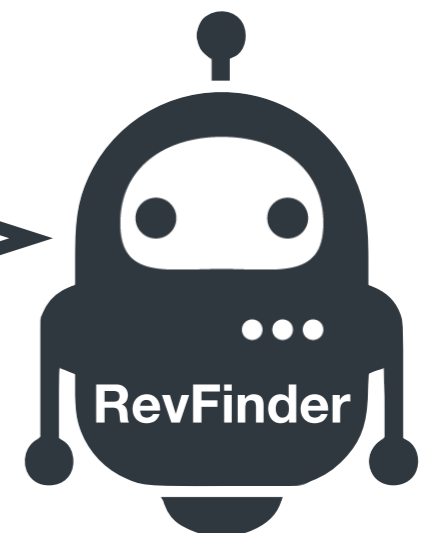
# RevFinder: Overview



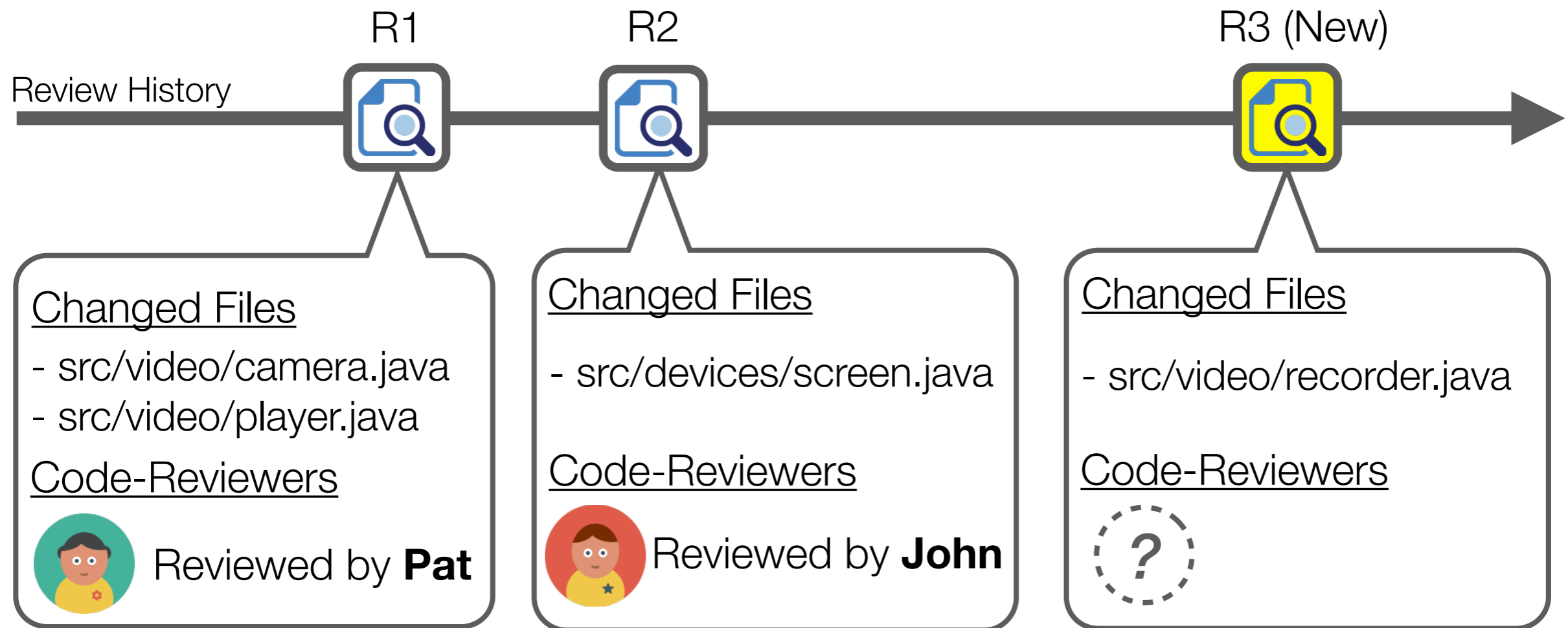
Compare(filePath\_R2, filePath\_R3) = 0.3



Compare(filePath\_R1, filePath\_R3) = 0.6

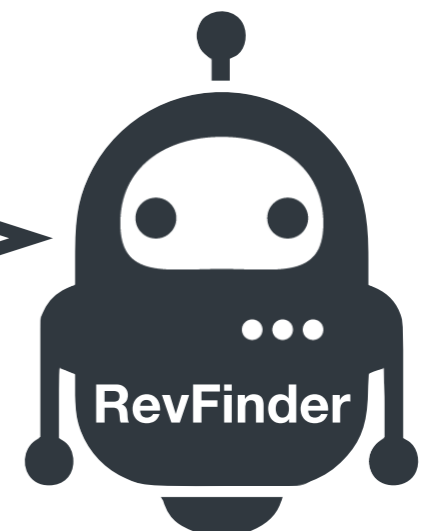


# RevFinder: Overview



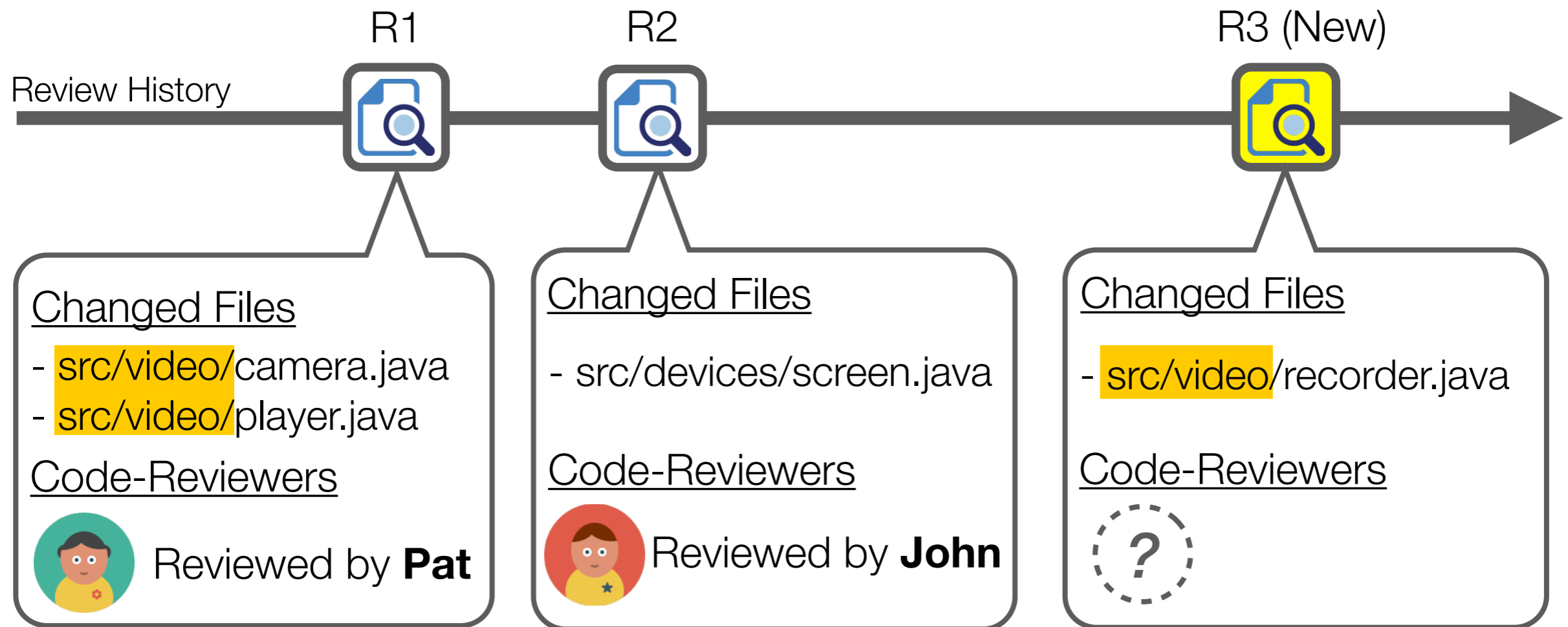
$\text{Compare}(\text{FilePath\_R1}, \text{FilePath\_R3}) = 0.6$

“**Pat** should review R3”



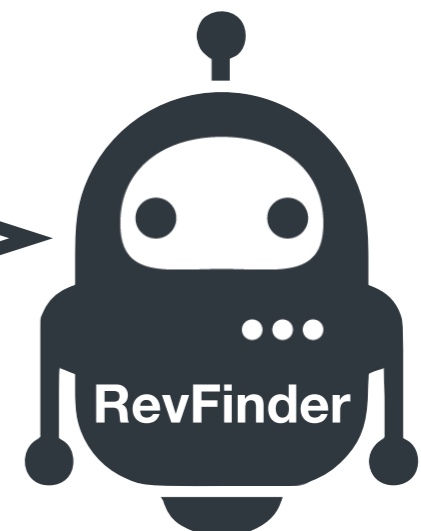


# RevFinder: Overview



Compare(filePath\_R1, filePath\_R3) = 0.6

“**Pat** should review R3”



# RevFinder: FilePath Comparison Techniques

## 4 String Comparison Techniques

Longest Common Prefix

Longest Common Suffix

Longest Common Substring

Longest Common  
Subsequence

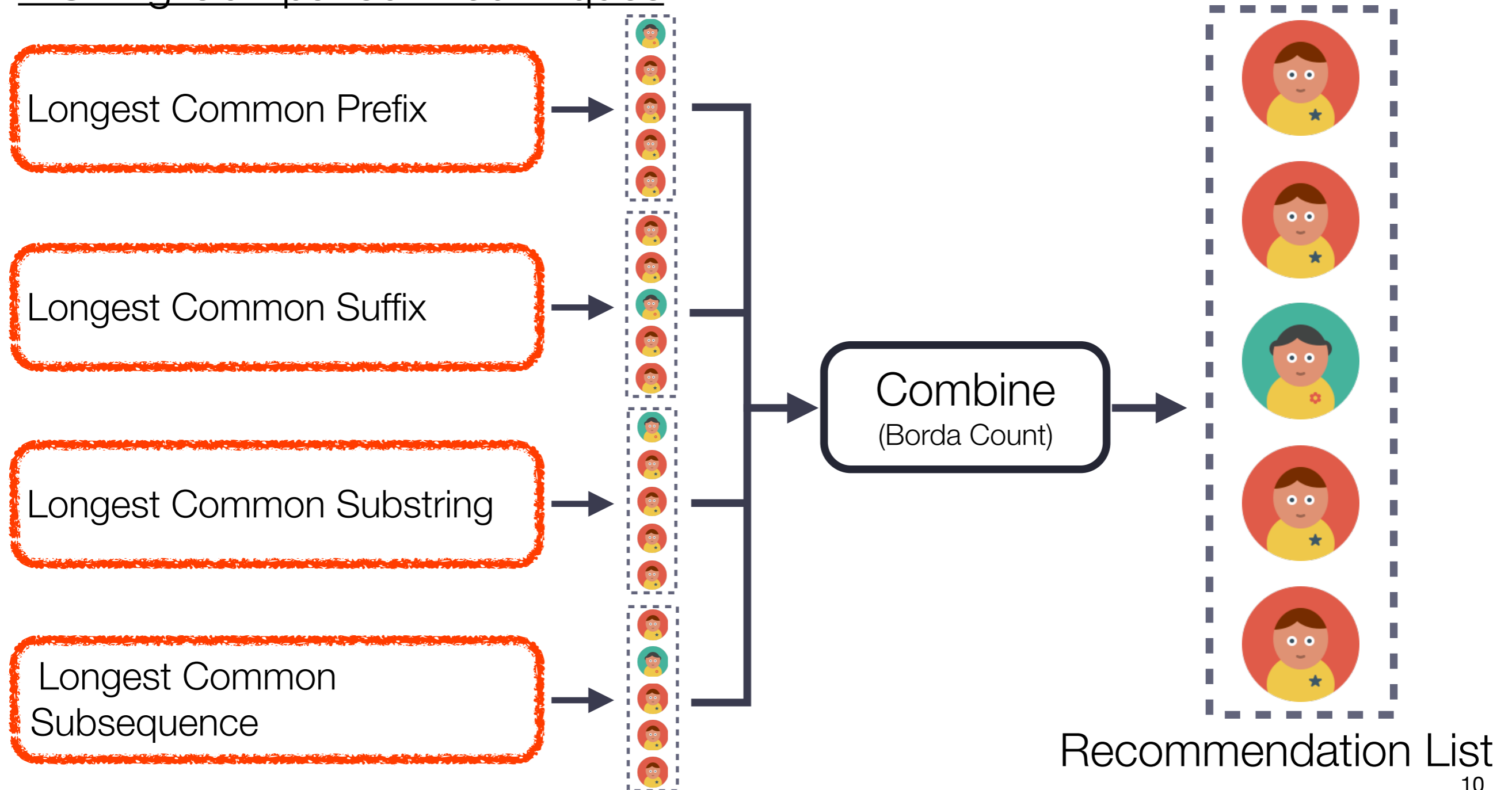
# RevFinder: FilePath Comparison Techniques

## 4 String Comparison Techniques



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## 4 String Comparison Techniques



# RevFinder: FilePath Comparison Techniques

## 4 String Comparison Techniques

Longest Common Prefix

Longest Common Suffix

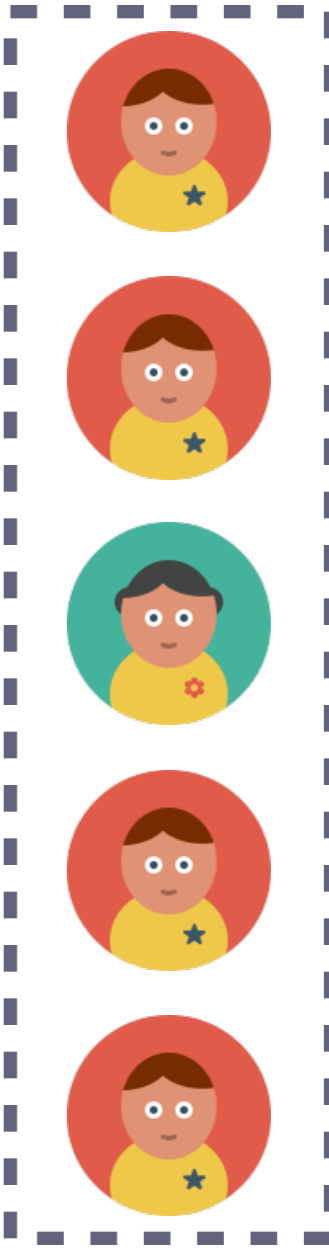
Longest Common Substring

Longest Common Subsequence



Combine  
(Borda Count)

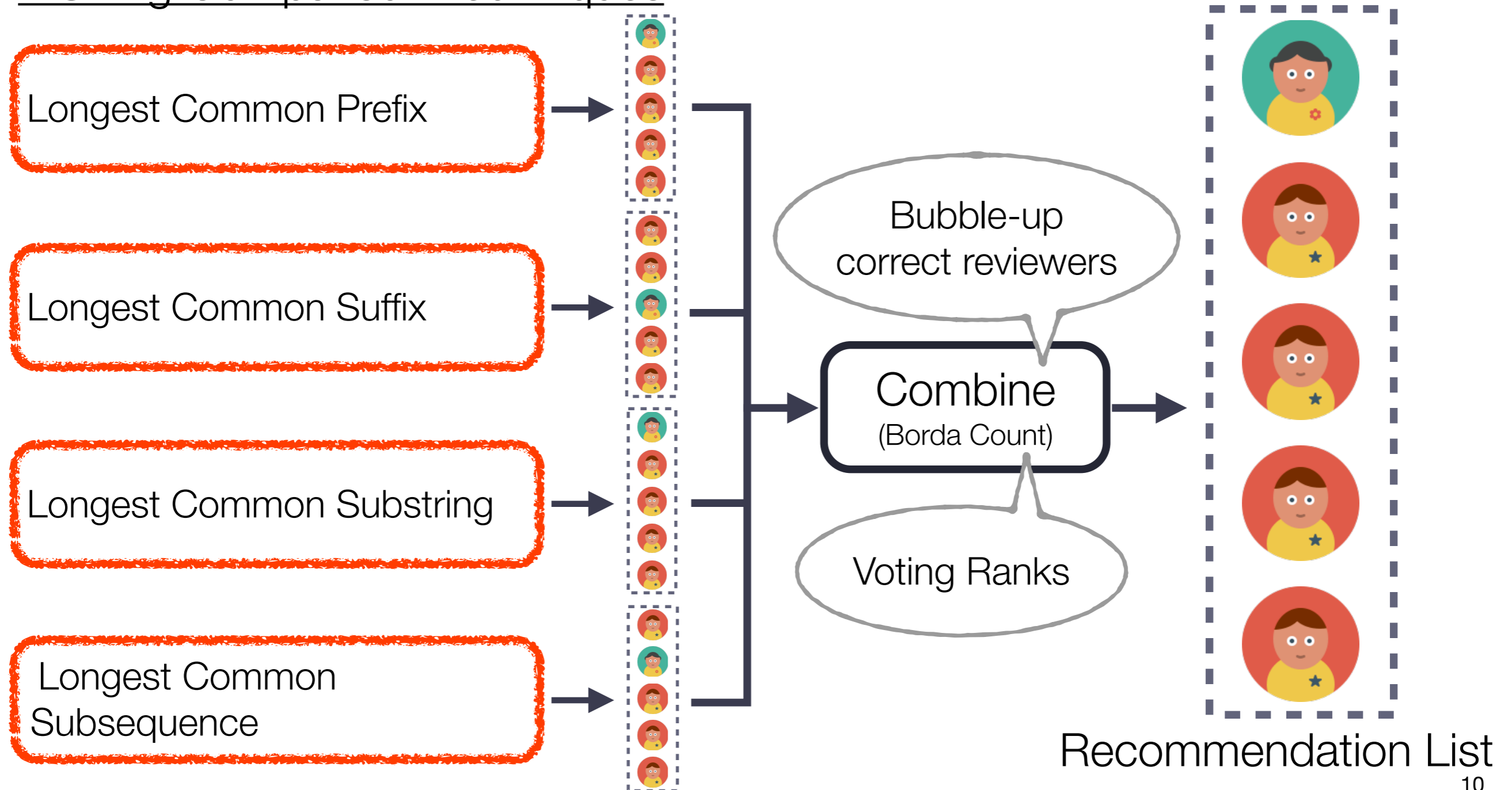
Voting Ranks










Recommendation List

# RevFinder: FilePath Comparison Techniques








## 4 String Comparison Techniques



# Empirical Evaluation

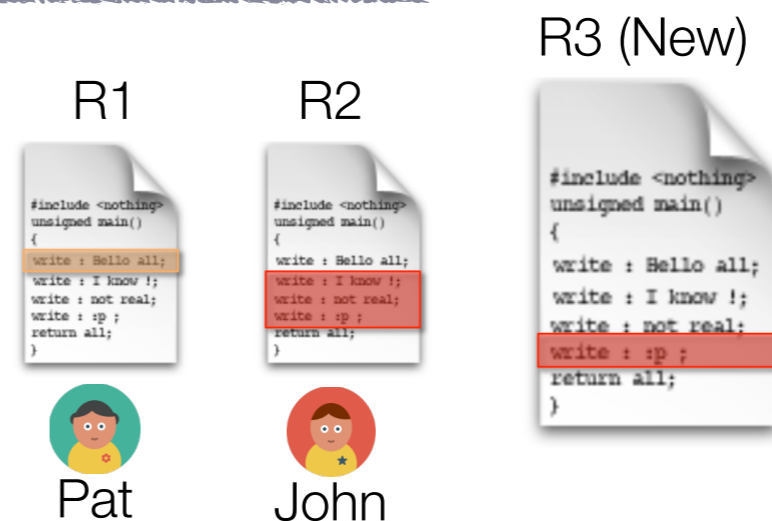
Studied Projects	 ANDROID	 openstack™ CLOUD SOFTWARE		 LibreOffice
Period 	~4 years	~1 year	~1 year	~2 year
#Reviews 	5,126	6,586	23,810	6,523
#Reviewers 	94	82	202	63

# Empirical Evaluation

Studied Projects	 ANDROID	 openstack™ CLOUD SOFTWARE		
Period 	~4 years	~1 year	~1 year	~2 year
#Reviews 	5,126	6,586	23,810	6,523
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Baseline Approach: ReviewBot (Balachandran ICSE'13)

“Recommend reviewers who have reviewed the same line of code changes”





# Empirical Evaluation


Studied Projects	 ANDROID	 openstack™ CLOUD SOFTWARE		
Period 	~4 years	~1 year	~1 year	~2 year
#Reviews 	5,126	6,586	23,810	6,523
#Reviewers 	94	82	202	63

Baseline Approach: ReviewBot (Balachandran ICSE'13)

“Recommend reviewers who have reviewed the same line of code changes”

R1


```
#include <nothing>
unsigned main()
{
write : Hello all;
write : I know !;
write : not real;
write : :p ;
return all;
}
```



Pat

R2

```
#include <nothing>
unsigned main()
{
write : Hello all;
write : I know !;
write : not real;
write : :p ;
return all;
}
```



John

R3 (New)

```
#include <nothing>
unsigned main()
{
write : Hello all;
write : I know !;
write : not real;
write : :p ;
return all;
}
```

John  
should review  
R3

# Empirical Evaluation

# Empirical Evaluation

Accuracy



*“RQ2: Does RevFinder **accurately** recommend reviewers?”*

# Empirical Evaluation

## Accuracy



*“RQ2: Does RevFinder **accurately** recommend reviewers?”*

## Ranking Performance



*“RQ3: Does RevFinder provide **a better ranking** of correct reviewers?”*

# Empirical Evaluation

## Accuracy



*“RQ2: Does RevFinder **accurately** recommend reviewers?”*

## Ranking Performance



*“RQ3: Does RevFinder provide **a better ranking** of correct reviewers?”*

# Empirical Evaluation

## Accuracy



*“RQ2: Does RevFinder **accurately** recommend reviewers?”*

Measure: Top-k Accuracy

## Ranking Performance



*“RQ3: Does RevFinder provide a **better ranking** of correct reviewers?”*

# Empirical Evaluation: Accuracy



Top-k Accuracy measures how many reviews does an approach can correctly recommend with a Top-k recommendation.

# Empirical Evaluation: Accuracy



Top-k Accuracy measures how many reviews does an approach can correctly recommend with a Top-k recommendation.



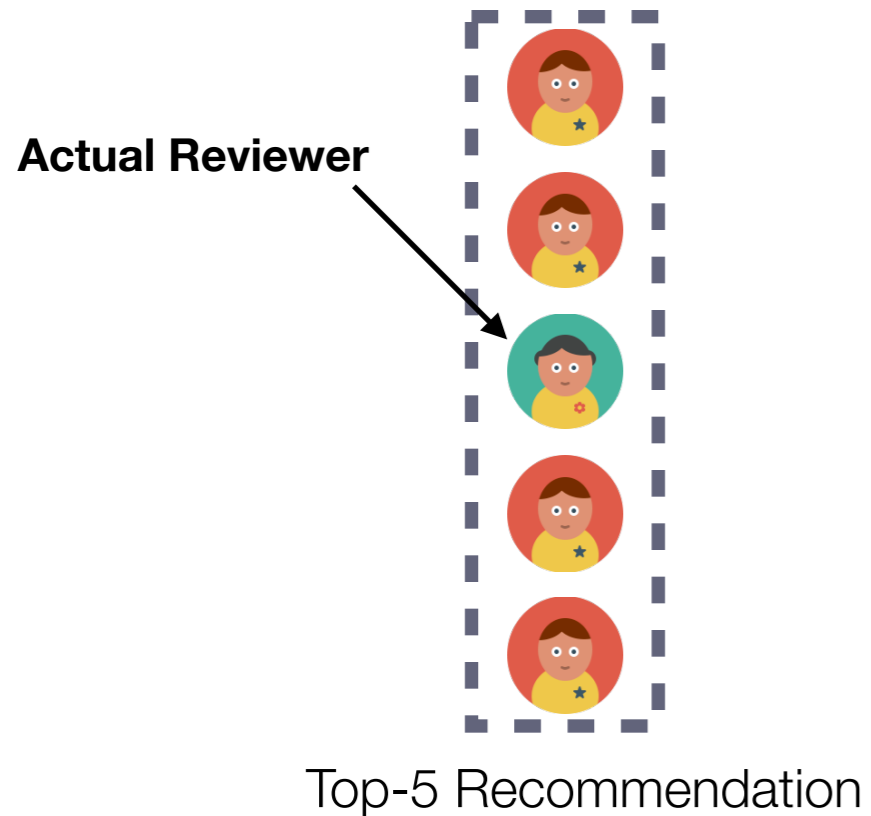
Top-5 Recommendation



# Empirical Evaluation: Accuracy



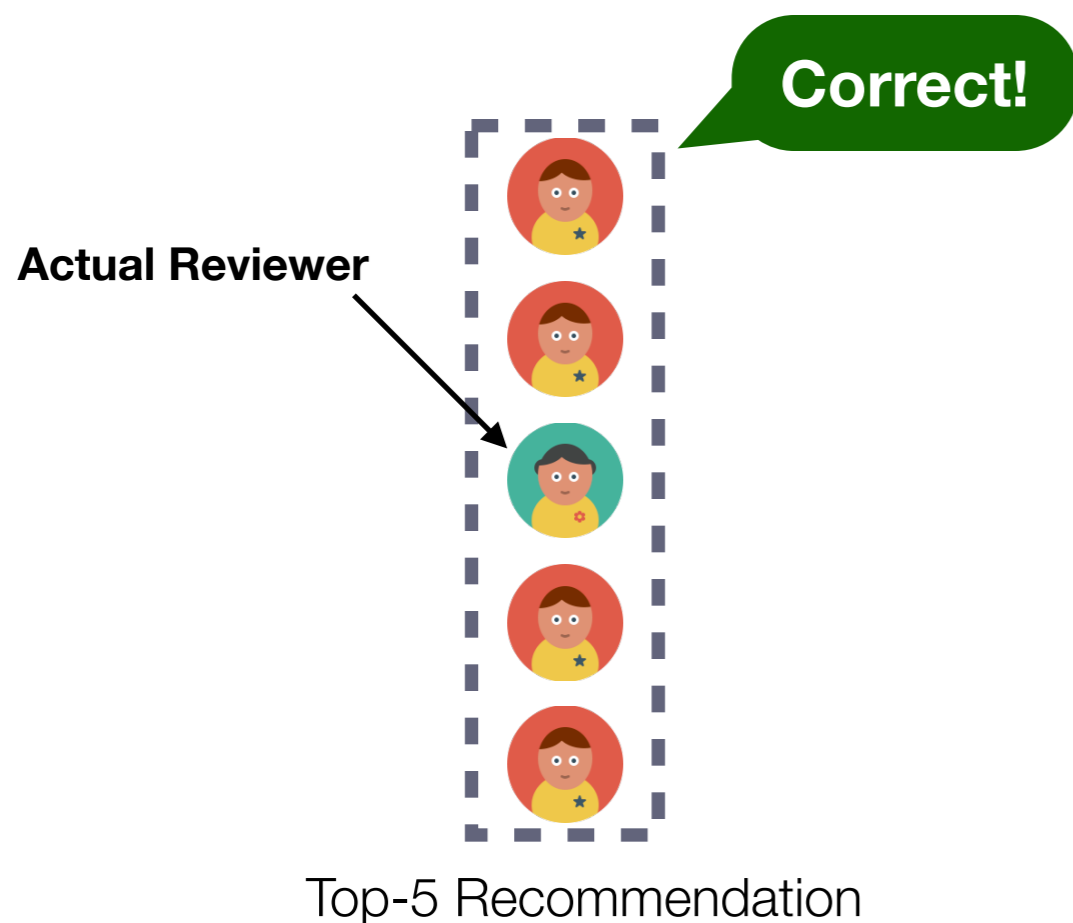
Top-k Accuracy measures how many reviews does an approach can correctly recommend with a Top-k recommendation.



# Empirical Evaluation: Accuracy



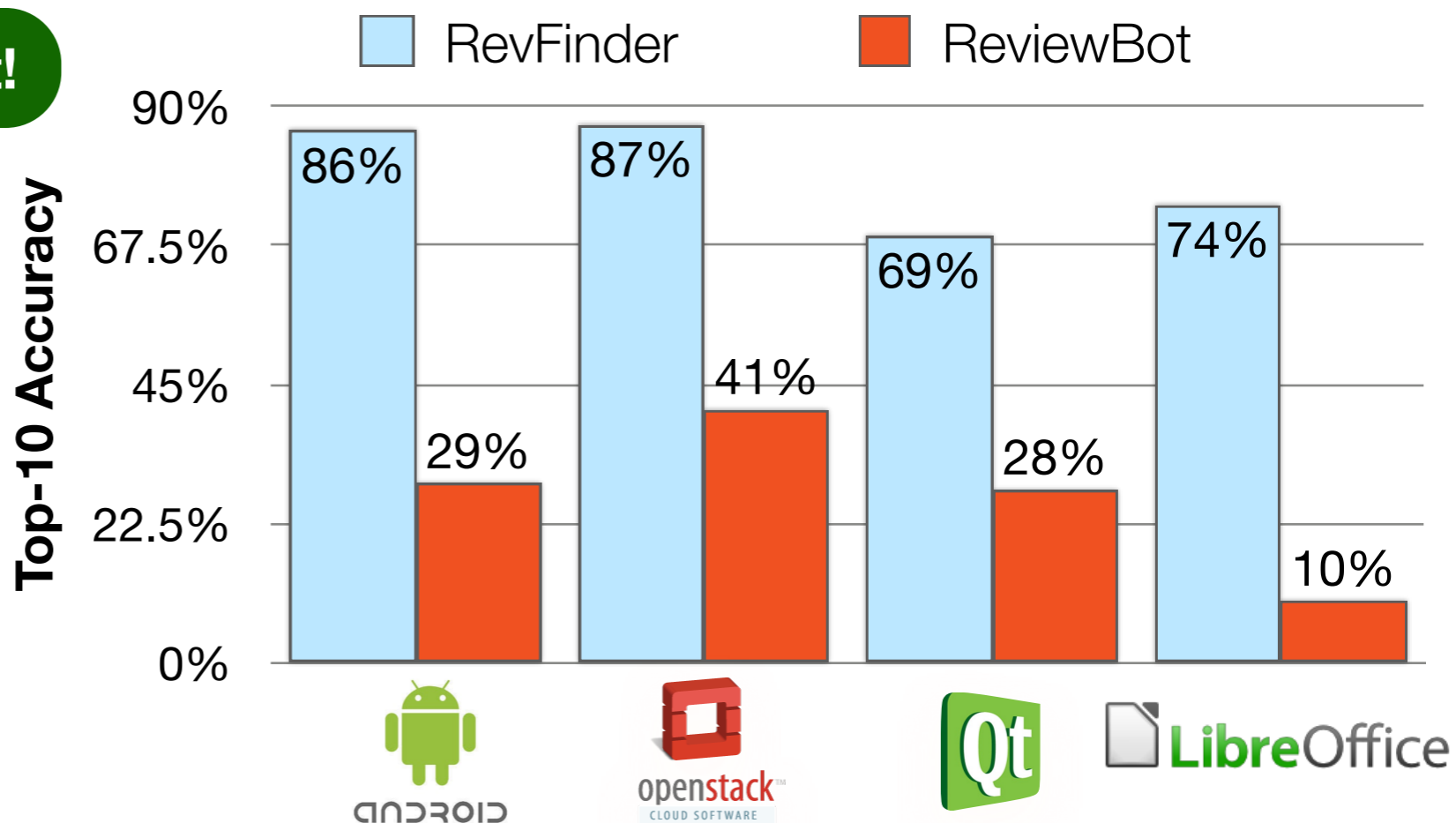
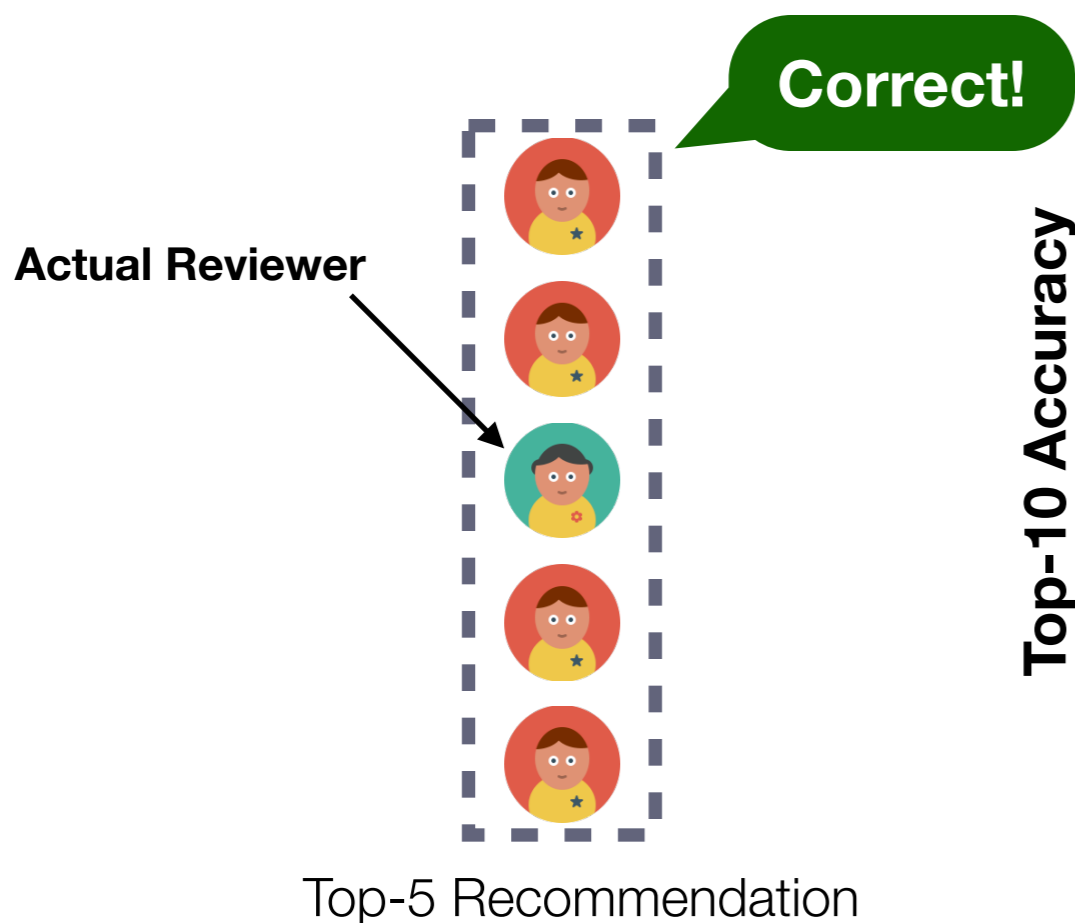
Top-k Accuracy measures how many reviews does an approach can correctly recommend with a Top-k recommendation.



# Empirical Evaluation: Accuracy



Top-k Accuracy measures how many reviews does an approach can correctly recommend with a Top-k recommendation.



*RevFinder can correctly recommended 69%-87% of reviews with a top-10 recommendation. RevFinder is 4 times more accurate than ReviewBot.*

# Empirical Evaluation

## Accuracy



*“Does RevFinder **accurately** recommend reviewers?”*

Measure: Top-k Accuracy

## Ranking Performance



*“Does RevFinder provide a **better ranking** of correct reviewers?”*

# Empirical Evaluation

## Accuracy



*“Does RevFinder **accurately** recommend reviewers?”*

*On average, RevFinder can correctly recommend reviewers for 79% of reviews with a top-10 recommendation.*

## Ranking Performance



*“Does RevFinder provide a **better ranking** of correct reviewers?”*

# Empirical Evaluation

## Accuracy



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*“Does RevFinder provide **a better ranking** of correct reviewers?”*

# Empirical Evaluation

## Accuracy



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## Ranking Performance



*“Does RevFinder provide **a better ranking** of correct reviewers?”*

Measure: Mean Reciprocal Rank (MRR)

# Empirical Evaluation: Ranking Performance



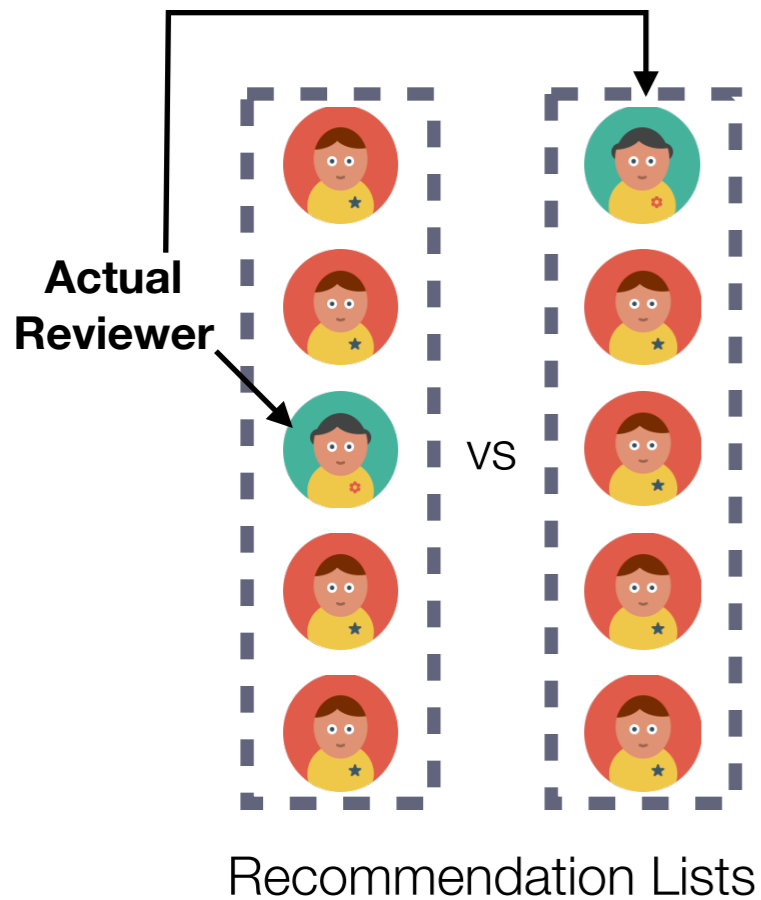
Mean Reciprocal Rank measures an average rank of correct reviewer that an approach can recommend.



# Empirical Evaluation: Ranking Performance



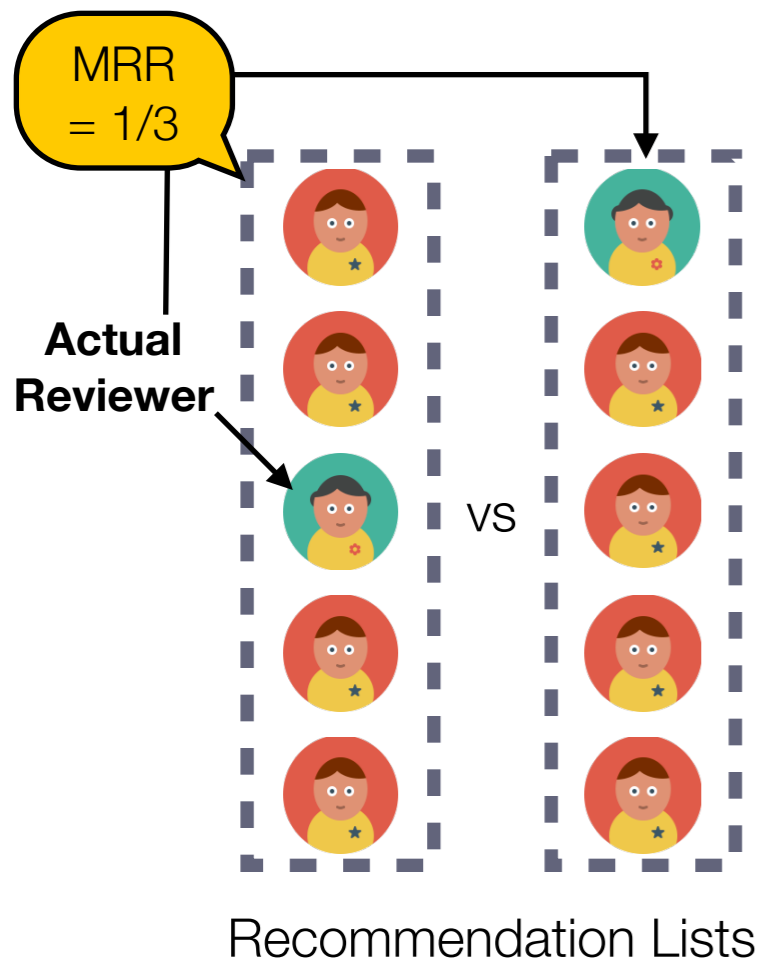
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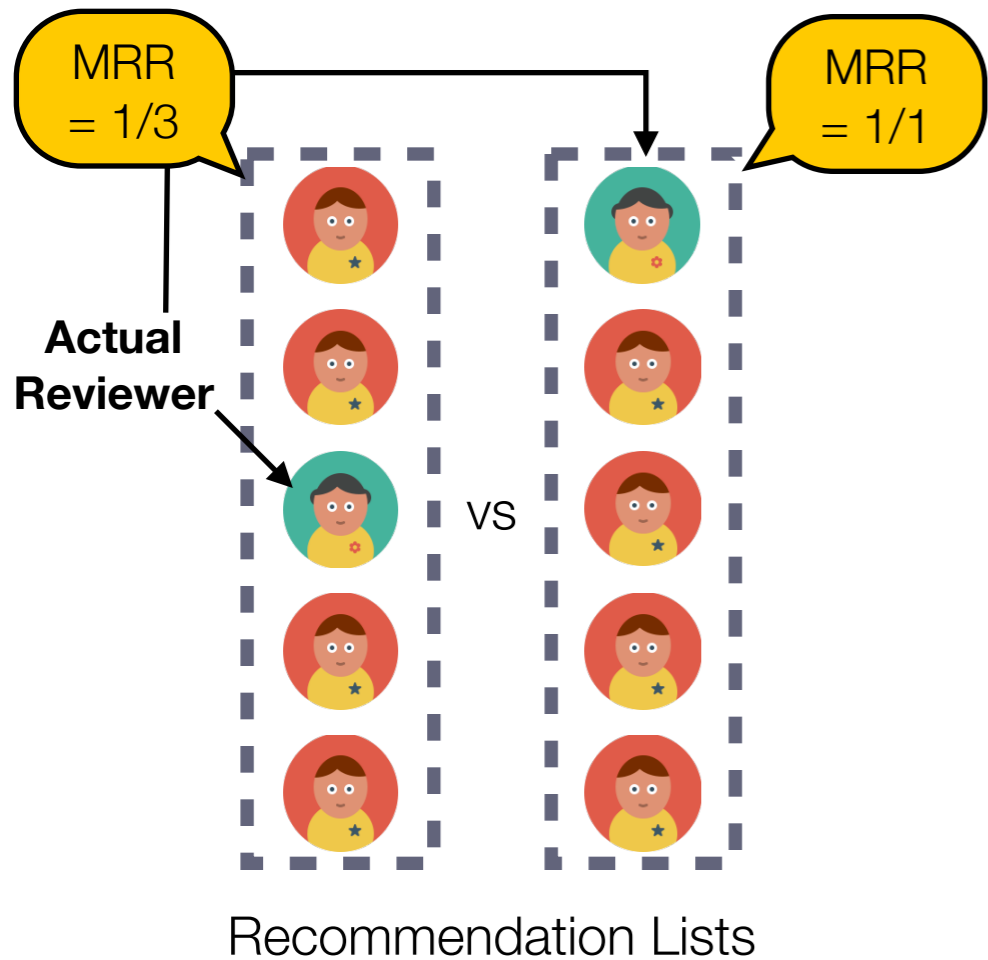
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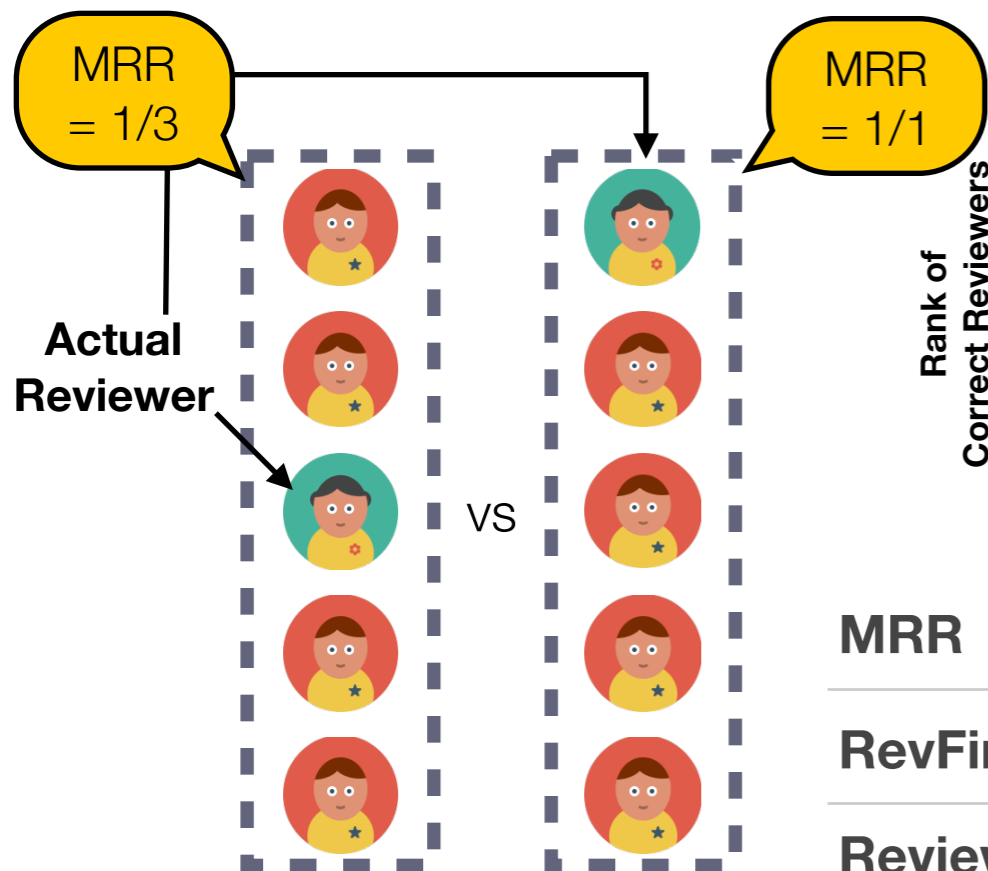
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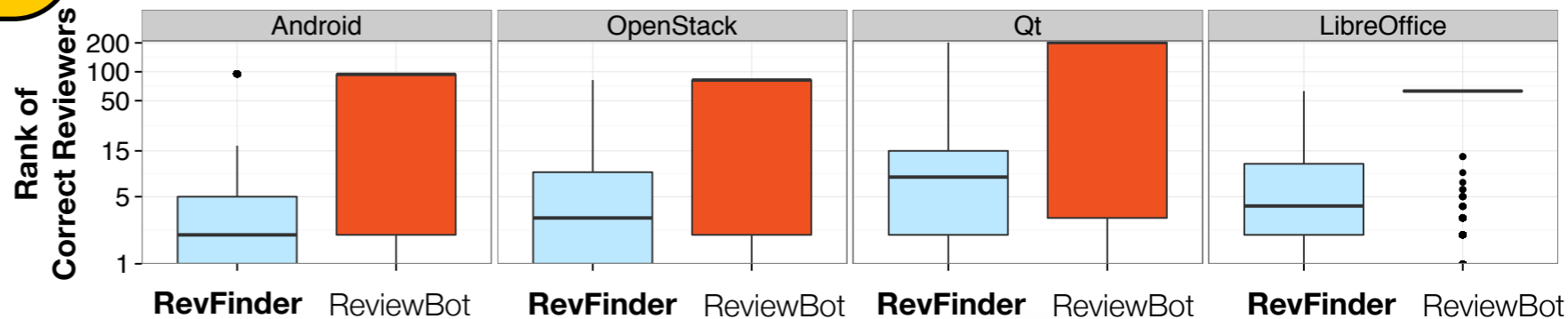
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Recommendation Lists



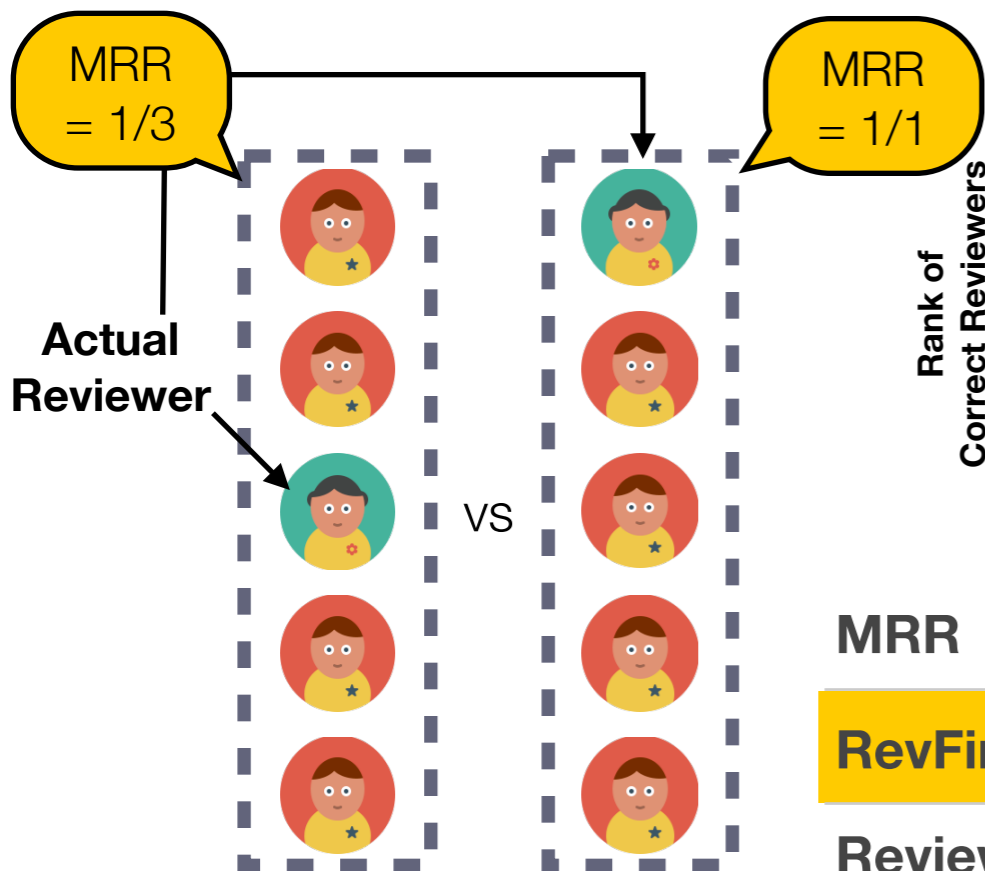
MRR	 ANDROID	 OPENSTACK CLOUD SOFTWARE	 Qt	 LibreOffice
RevFinder	0.6	0.55	0.31	0.40
ReviewBot	0.25	0.30	0.22	0.07

*RevFinder recommended the correct code-reviewers with a median rank of 2 - 8. The code-reviewers ranking of RevFinder is 3 times better than that of ReviewBot.*

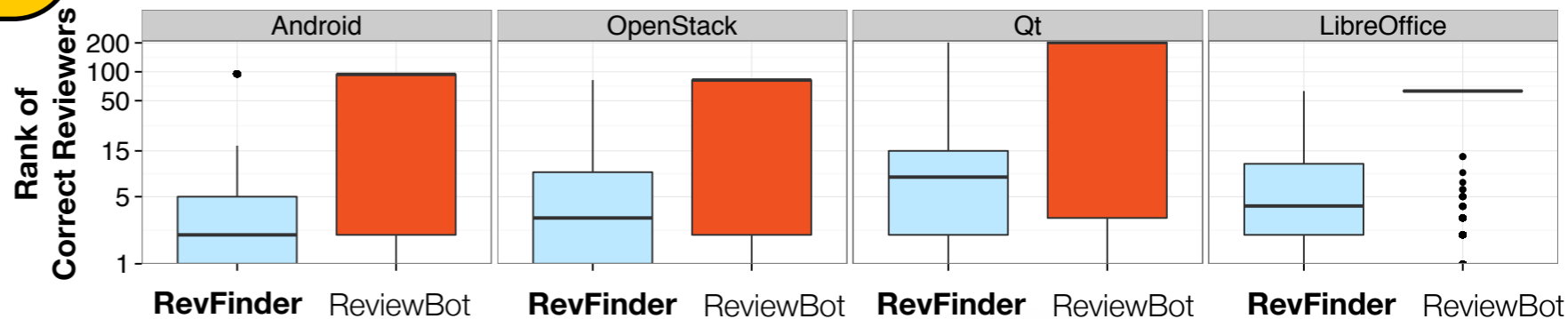
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Recommendation Lists



MRR	Android	OpenStack	Qt	LibreOffice
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*On average, RevFinder can correctly recommend reviewers for 79% of reviews with a top-10 recommendation.*

## Ranking Performance



*“Does RevFinder provide **a better ranking** of correct reviewers?”*

*On average, RevFinder can recommend reviewers with a median rank of 4.*

# Empirical Evaluation

## Accuracy



*“Does RevFinder **accurately** recommend reviewers?”*

*On average, RevFinder can correctly recommend reviewers for 79% of reviews with a top-10 recommendation.*

## Ranking Performance



*“Does RevFinder provide **a better ranking** of correct reviewers?”*

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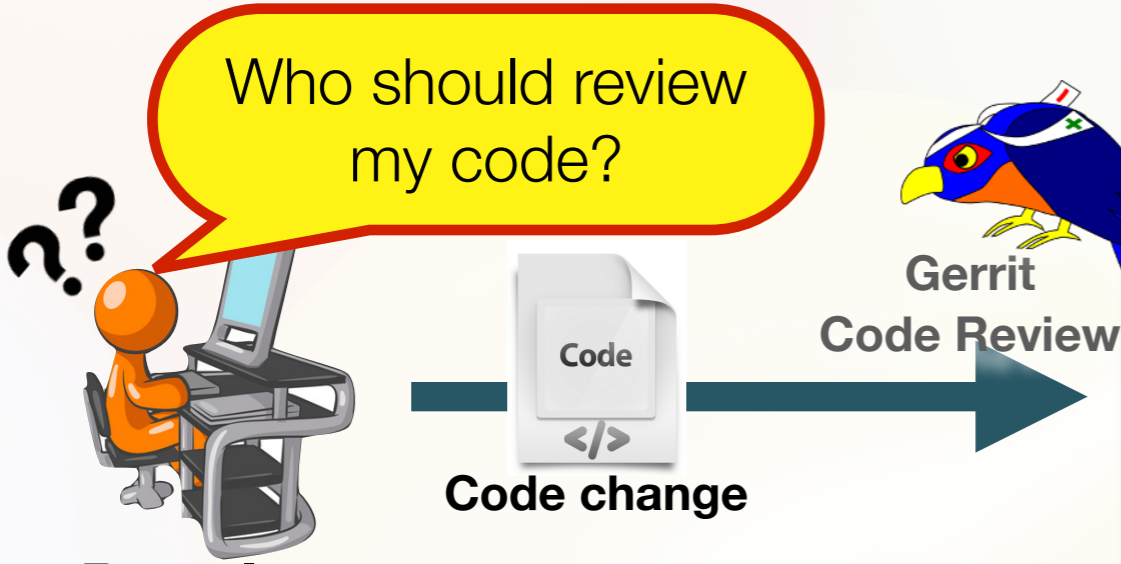
*We can use a similarity of previously reviewed file paths to recommend code-reviewers for new code changes.*



# Summary

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# Code-Reviewer Assignment Problem



**New Developer**

android  
open source project

Change 18767 - Merged

Owner Smith

Reviewers

Name or Email or Group

Add Add Me Cancel

Project platform/packages/apps/QuickSearchBox

Branch master

src/com/android/quicksearchbox/google/GoogleSuggestionProvider.java

## Comments

Smith Patch Set 1: Can you please review my change?

Smith  
Patch Set 1:  
Hi John  
Can you please add appropriate reviewers for this change?

**Invite Reviewers**

# Code-Reviewer Assignment Problem

Who should review my code?

New Developer

Code change

Gerrit Code Review

Change 18767 - Merged

Owner Smith

Reviewers

Name or Email or Group

Add Add Me Cancel

Project platform/packages/apps/QuickSearchBox

Branch master

Invite Reviewers

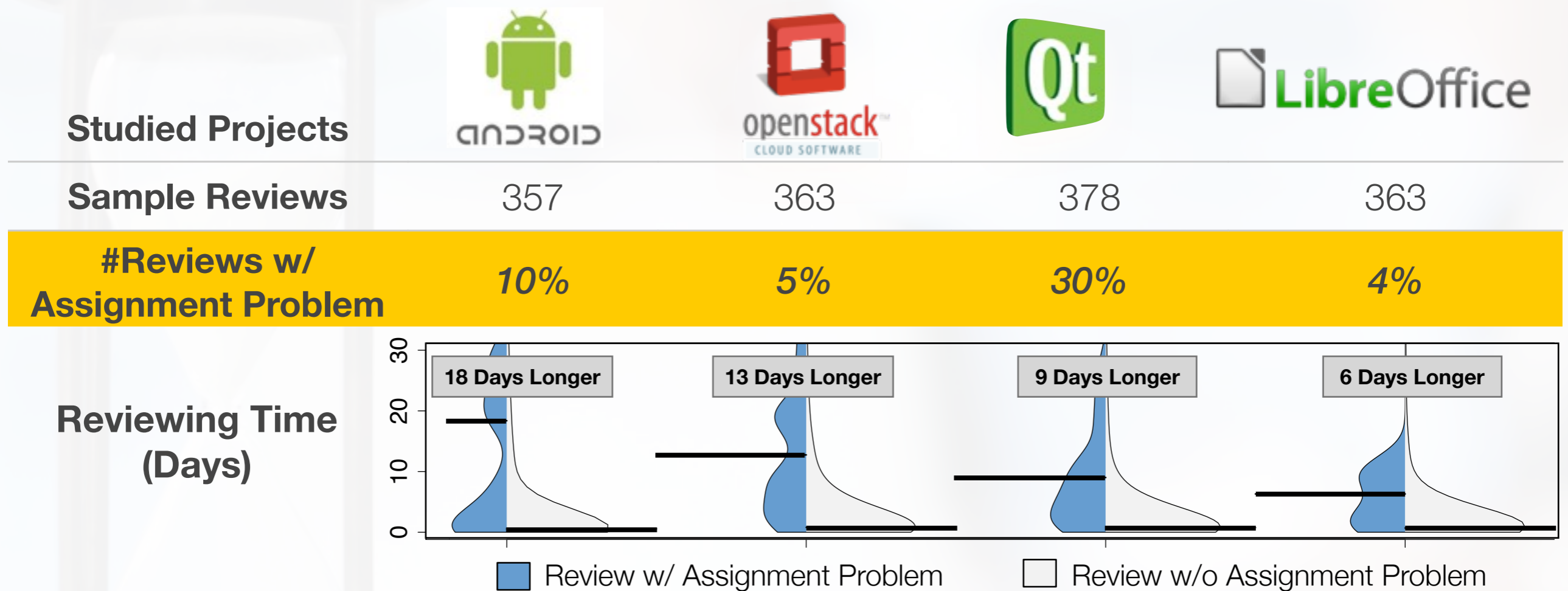
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Who should review my code?

New Developer

Code change

Gerrit Code Review

Change 18767 - Merged

Owner: Smith

Reviewers:  Name or Email or Group

Buttons: Add, Add Me, Cancel

Project: platform/packages/apps/QuickSearchBox

Branch: master

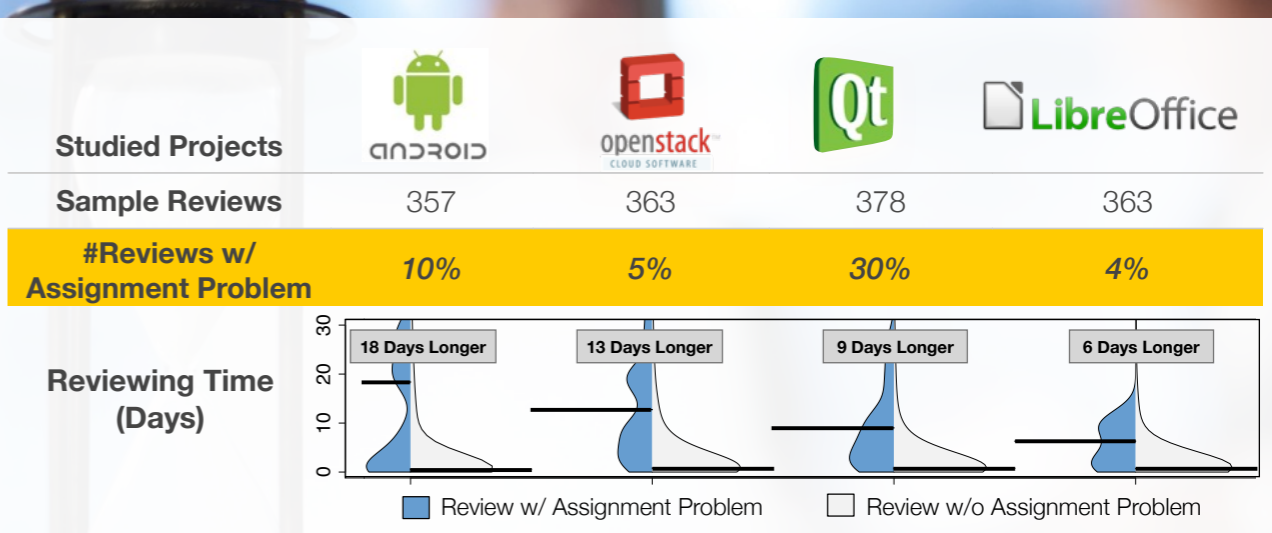
Invite Reviewers

Comments:

- Smith: Patch Set 1: Can you please review my change?
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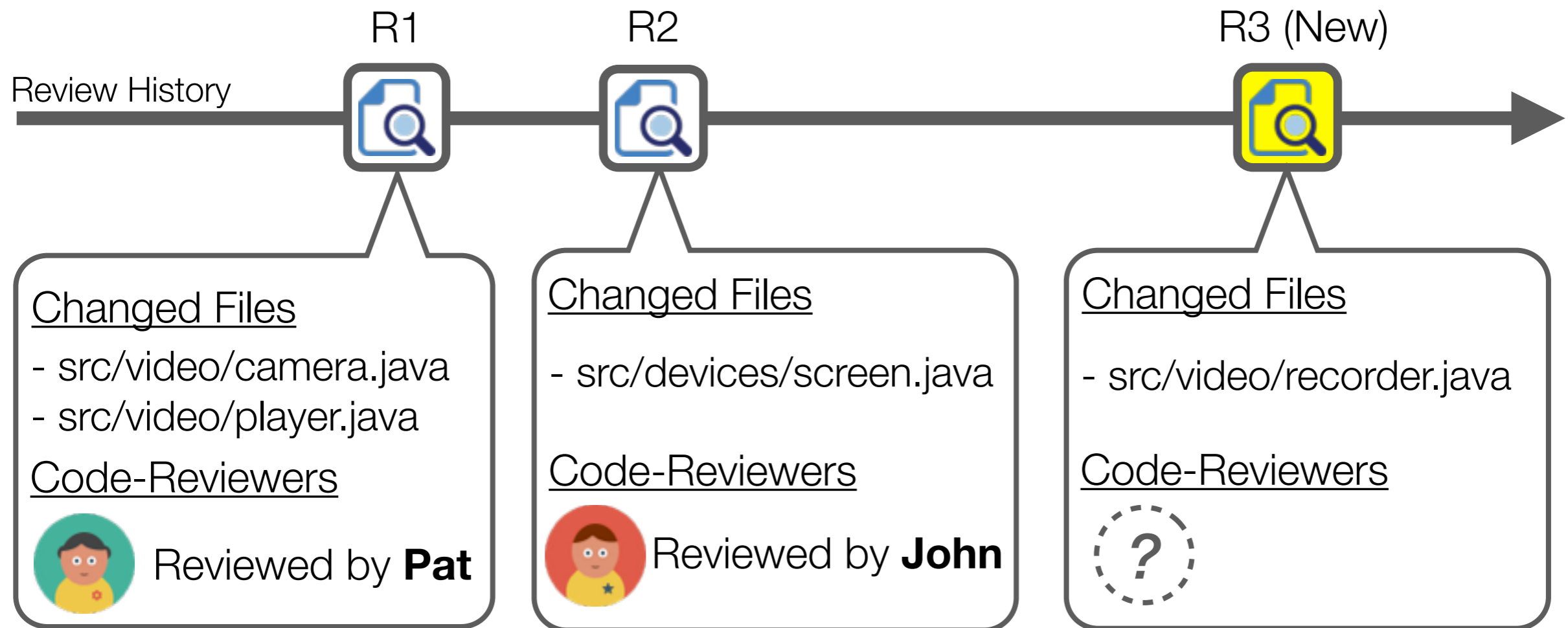
src/com/android/quicksearchbox/google/GoogleSuggestionProvider.java

# How do reviews with code-reviewer assignment problem impact reviewing time?

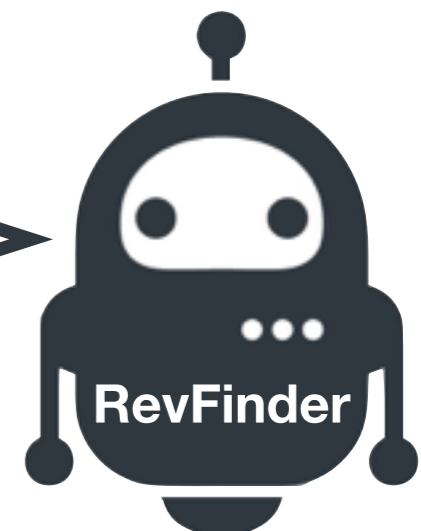


*Reviews with code-reviewer assignment problem significantly take 12 days longer to approve a code change.*

# RevFinder: Overview



Find reviewers who have reviewed the most similar file paths



# Code-Reviewer Assignment Problem

Who should review my code?

New Developer

Code change

Gerrit Code Review

open source project

Change 18767 - Merged

Owner: Smith

Reviewers: [Add] [Add Me] [Cancel]

Project: platform/packages/apps/QuickSearchBox

Branch: master

Invite Reviewers

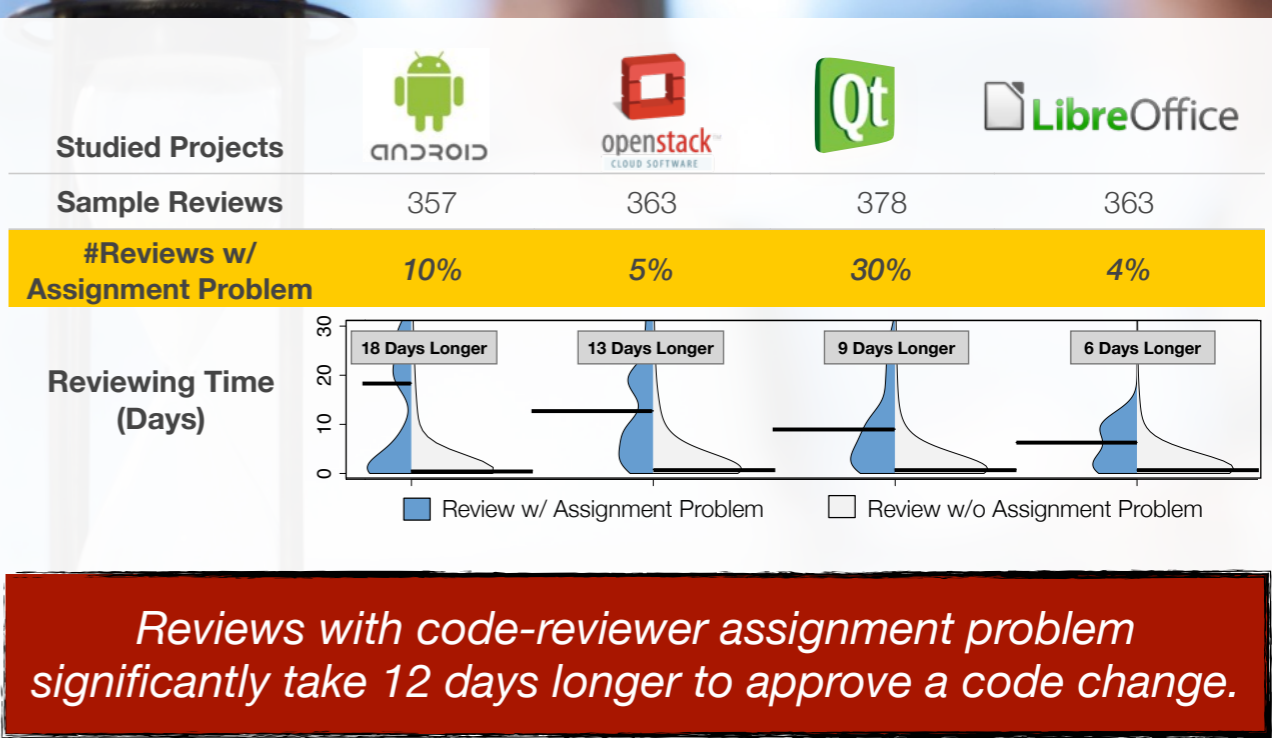
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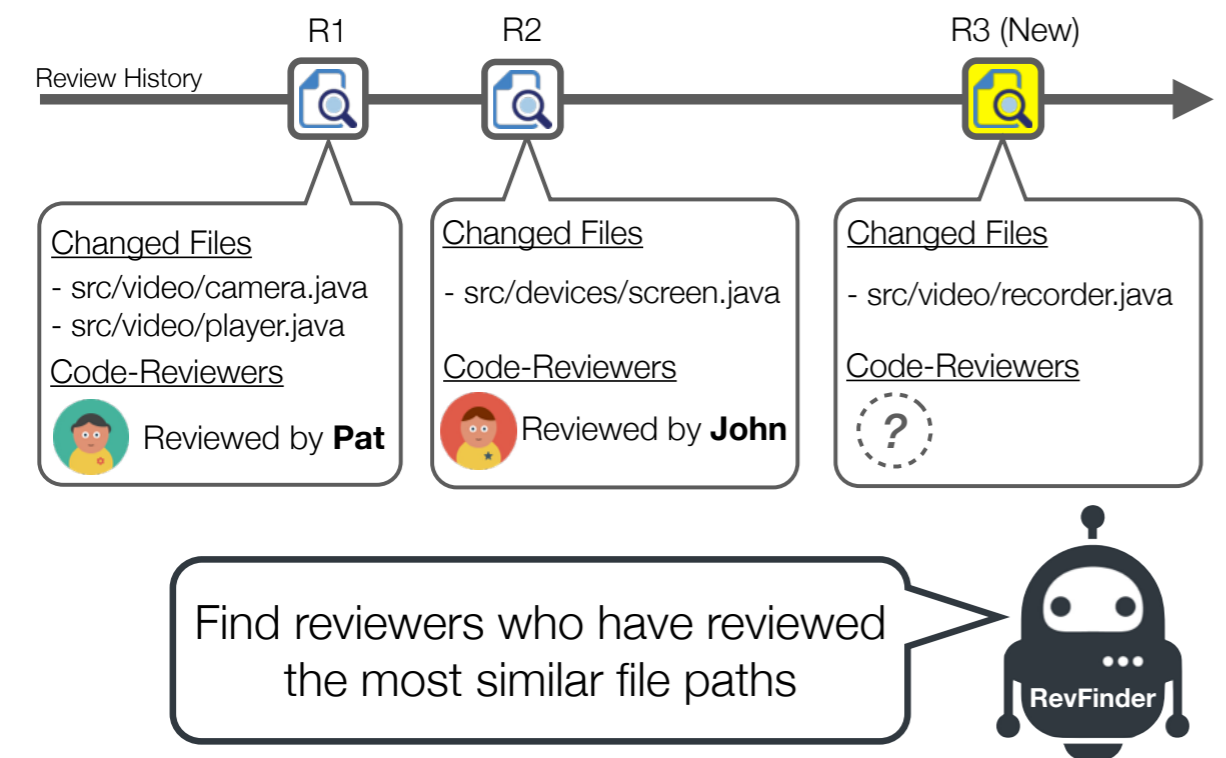
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# Empirical Evaluation

## Accuracy



*“Does RevFinder **accurately** recommend reviewers?”*

*On average, RevFinder can correctly recommend reviewers for 79% of reviews with a top-10 recommendation.*

## Ranking Performance



*“Does RevFinder provide **a better ranking** of correct reviewers?”*

*On average, RevFinder can recommend reviewers with a median rank of 4.*

*We can use a similarity of previously reviewed file paths to recommend code-reviewers for new code changes.*



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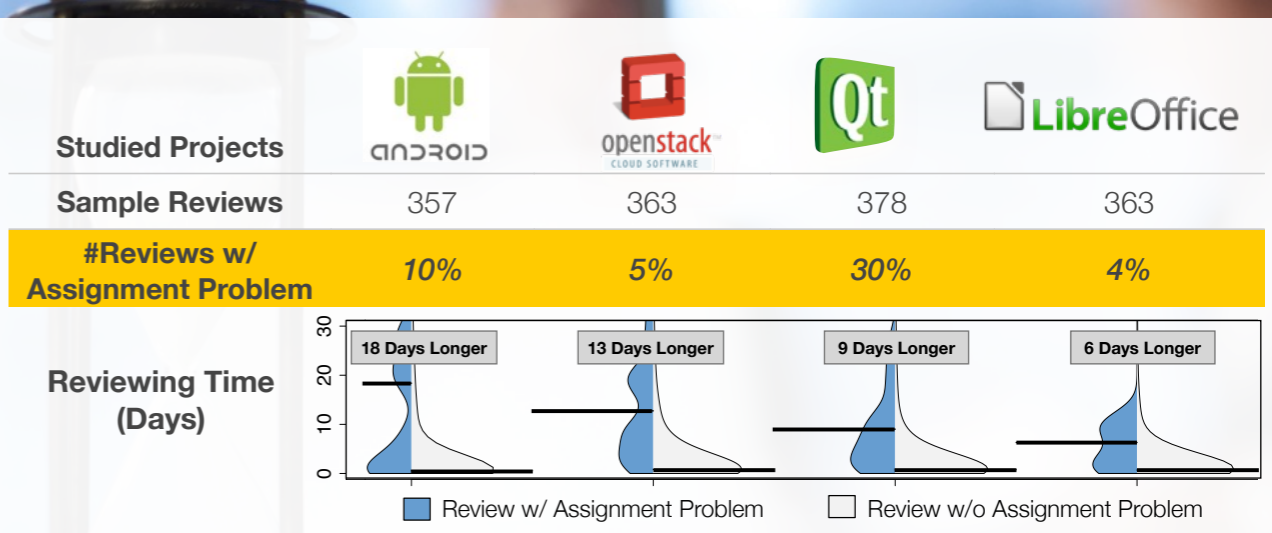
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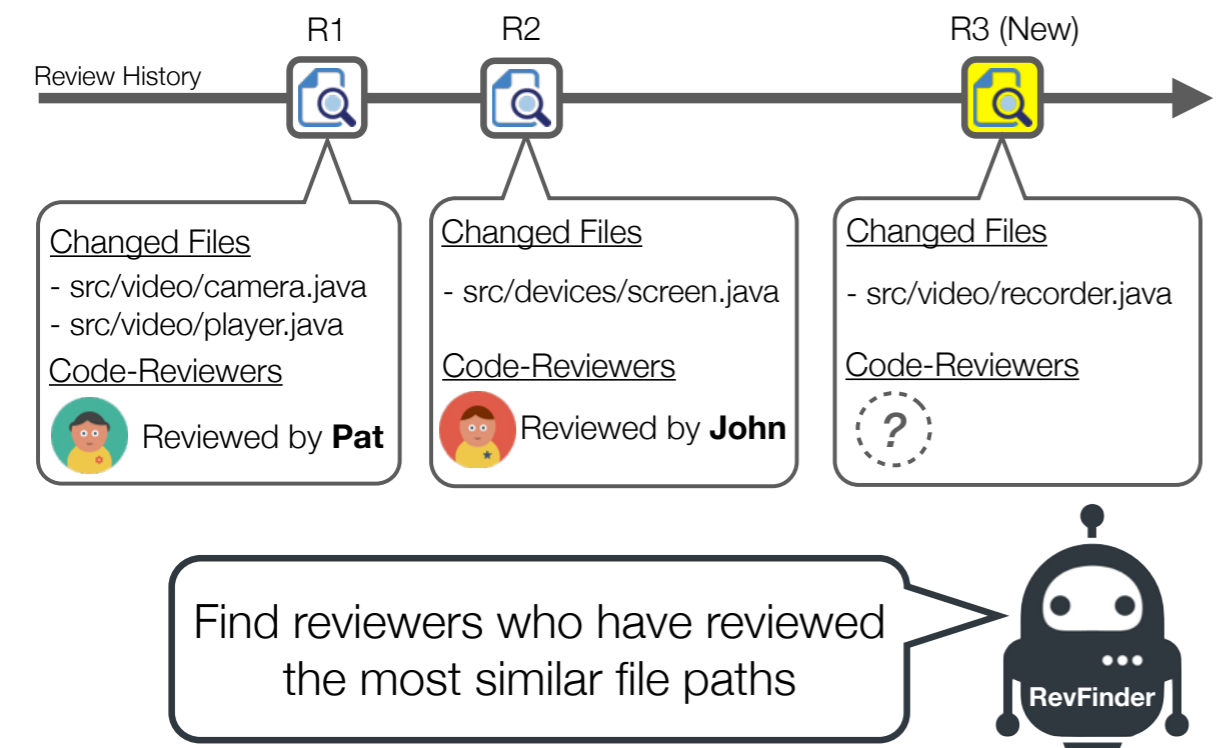
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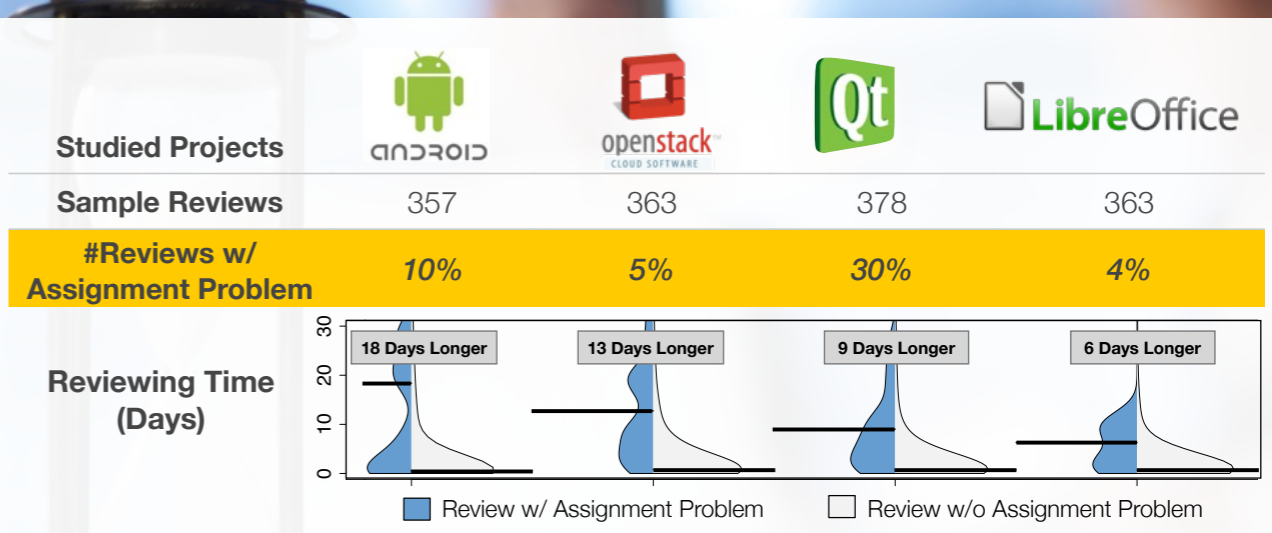
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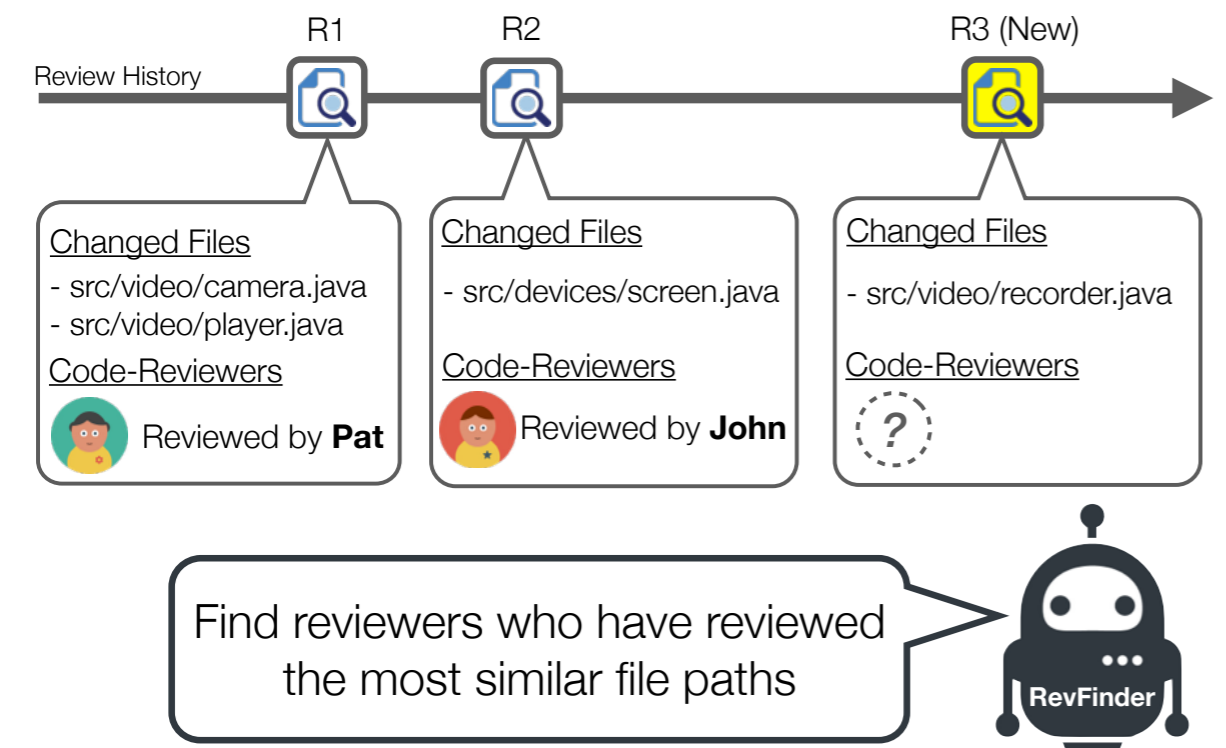
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