

ACTIVE SUPPORT FOR CLONE REFACTORING: A PERSPECTIVE

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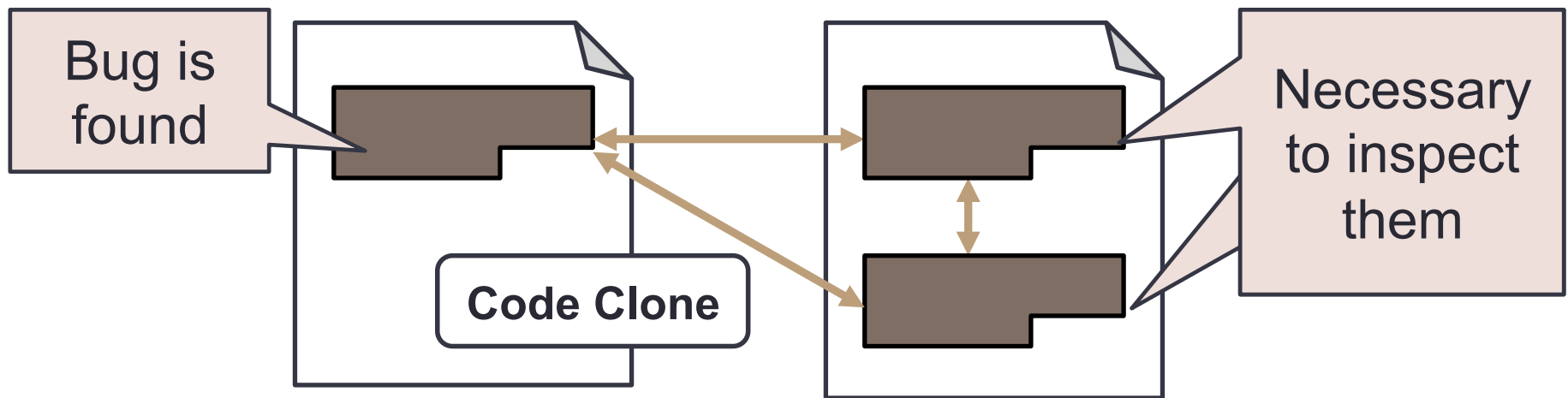


Outline

- Clone and its refactoring
- Previous research
 - Industrial experience in active clone refactoring
- Research proposal
 - Plan towards proactive support for clone refactoring
- Summary

What is Code Clone ?

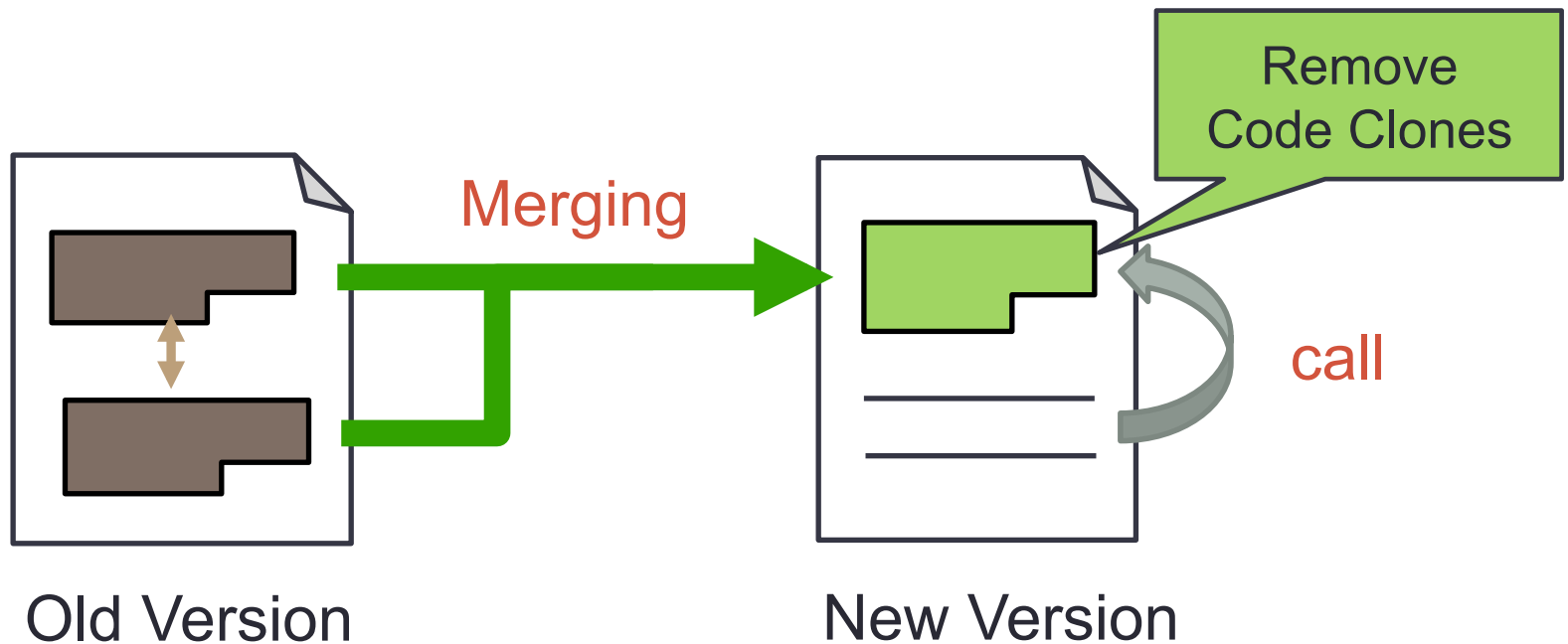
A code fragment that has similar or identical part in source code



If we modify one of them, it is necessary to determine whether or not we have to modify the others.

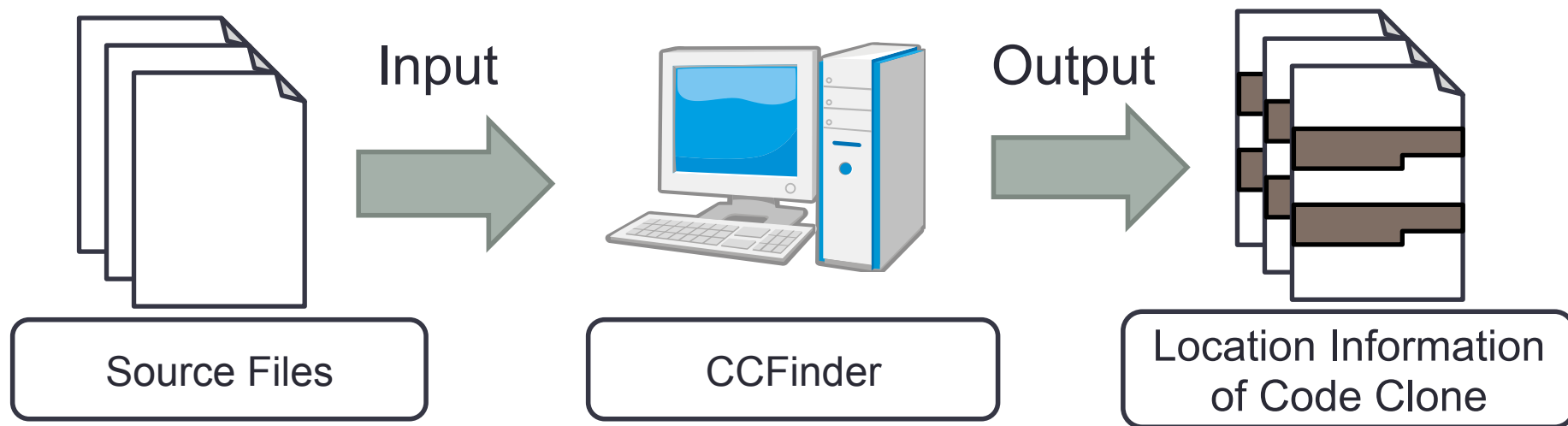
Clone Refactoring

Merging clones into a single program unit.



Clone Detection Tool : CCFinder [1]

- A token-based clone detection tool
 - Transform source code into sequence of tokens
 - Detect identical parts of the sequence as code clones
- Scalable and accurate



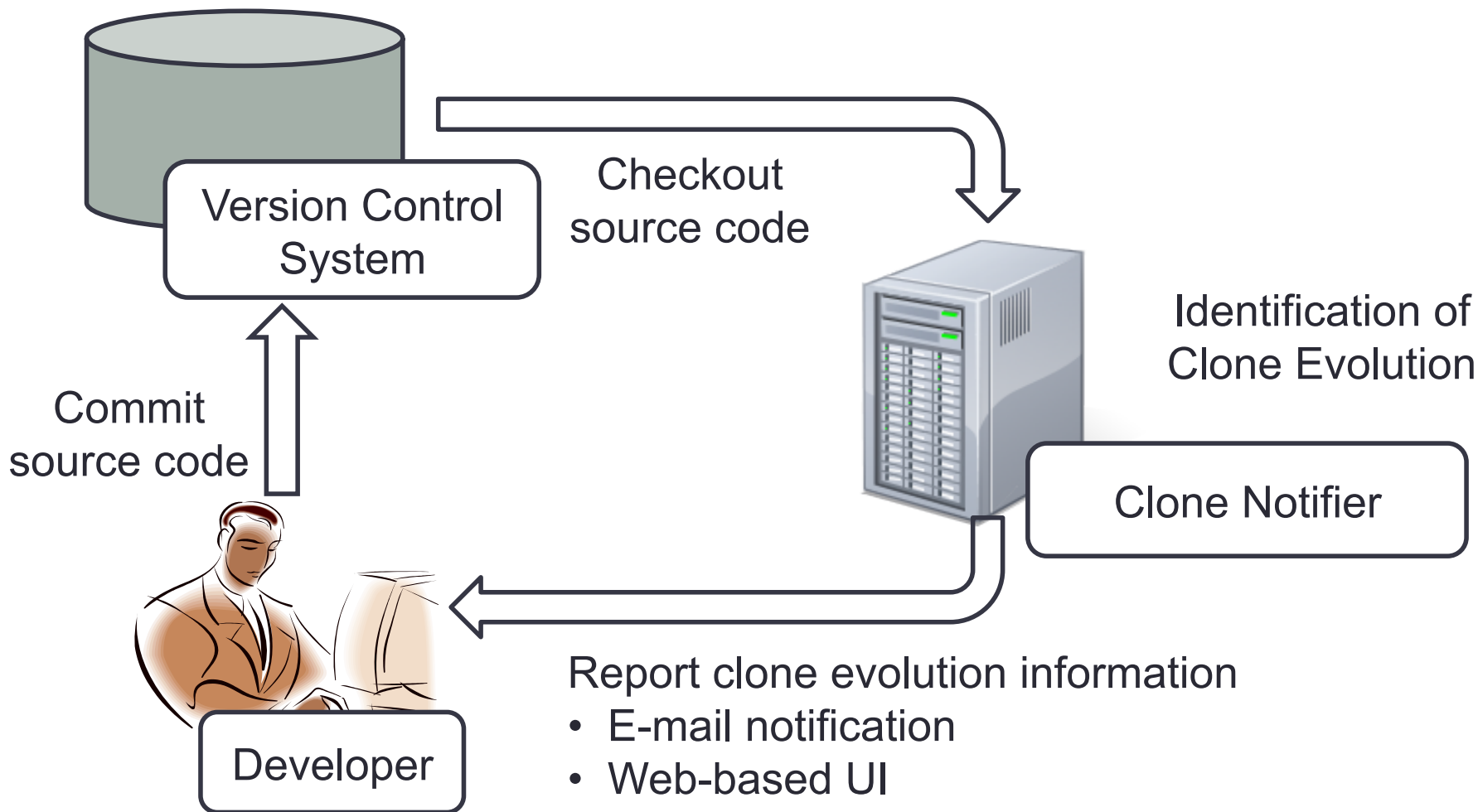
[1] T. Kamiya, S. Kusumoto, and K. Inoue, "CCFinder: A multilinguistic token-based code clone detection system for large scale source code", *IEEE Transactions on Software Engineering*, 28(7):654-670, 2002.

Industrial Experience in Clone Analysis

- Only hot clones can be refactored.
 - **Strike while the iron is hot!**
- In industry, cost of clone refactoring cannot be ignored.
 - Regression test after refactoring takes much cost to preserve behavior after refactoring.
 - Industrial developers do not touch source code after large-scale system test for releasing major version.

Active support of clone refactoring is needed to notify newly-appeared clones regularly to developers.

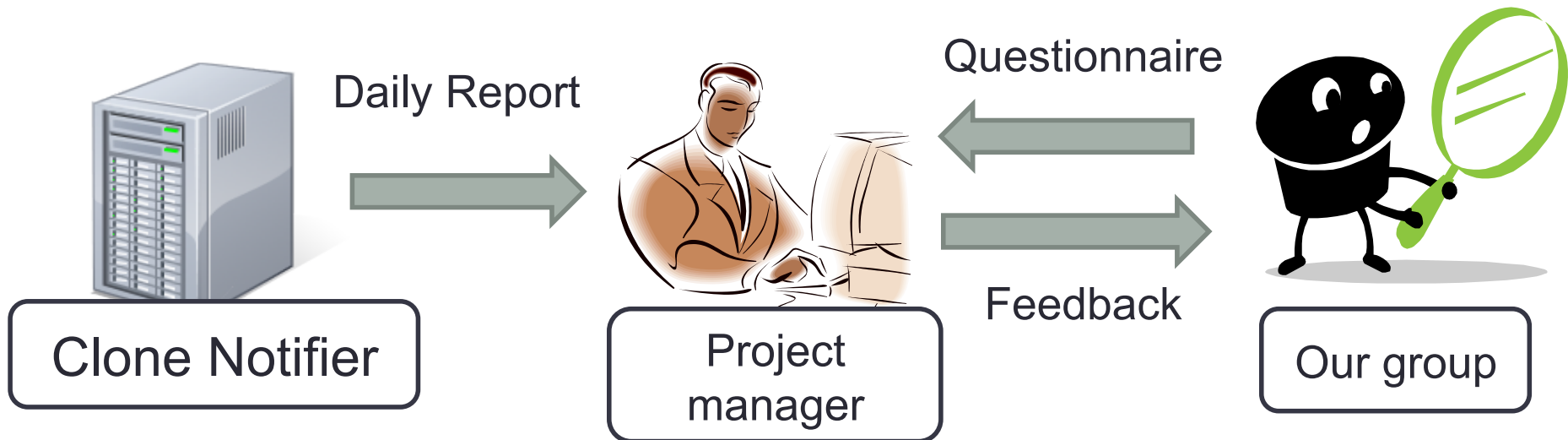
Clone Notifier : A Clone Change Management System [2]



[2] Yamanaka, et al.: "Applying Clone Change Notification System into an Industrial Development Process", ICPC 2013.

Applying to Industrial Process

- Applied Clone Notifier to development process in NEC
 - 6 programmers, 120 KLOC written in Java
- Got regular feedbacks from a project manager



10 sets of code clones were recognized as refactoring opportunities in 40 days.

Towards More Active Support

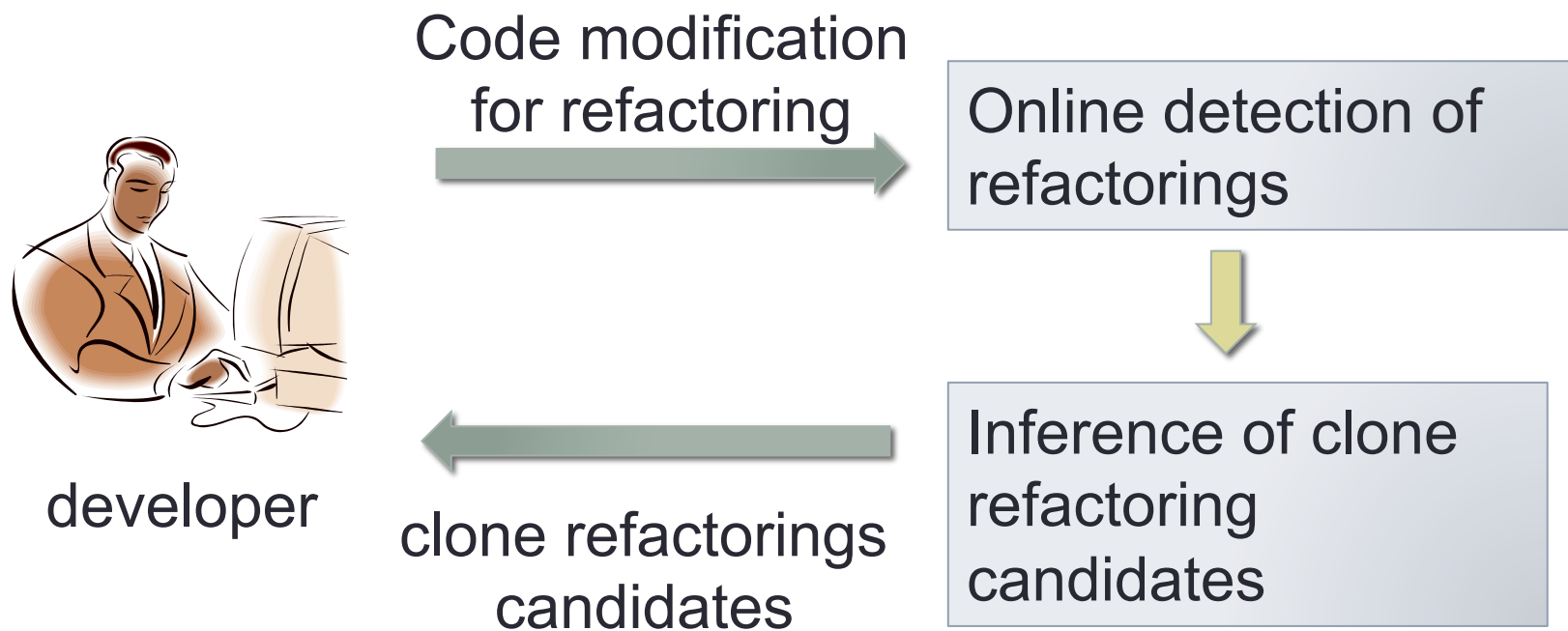
- **Related Work: Proactive Support for Refactoring**
 - Benefactor[2] and WitchDoctor[3] detect the beginning of refactoring, and recommend code transformations to complete it.
- **In the case of clone refactoring, existing tools lacks proactive support**
 - There is no tool that supports clone refactoring based on the online analysis of code modification.

[3] Foster et al: WitchDoctor: IDE Support for Real-Time Auto-Completion of Refactorings, ICSE 2012.

[4] Ge et al: Reconciling manual and automatic refactoring, ICSE 2012.

Proactive Refactoring Candidate Detection Overview

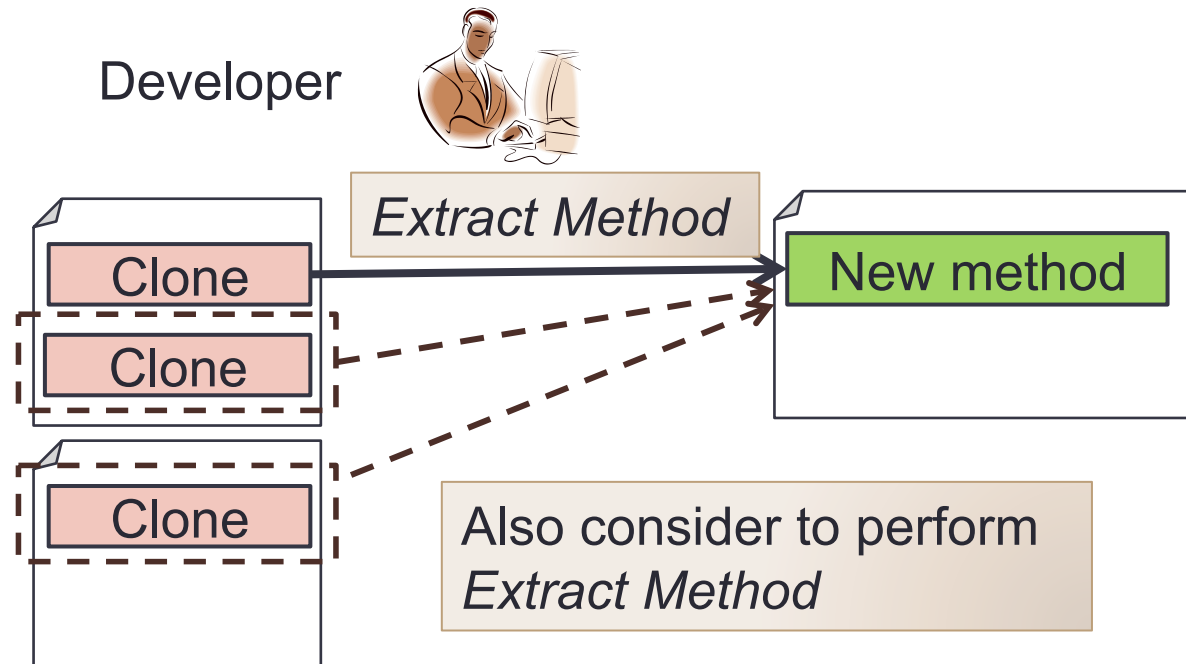
- We plan to develop an Eclipse plug-in for proactive refactoring candidate detection.
 - The detection is based on the online analysis of code modification.



Proactive Candidate Detection for Clone Refactoring

Key Idea

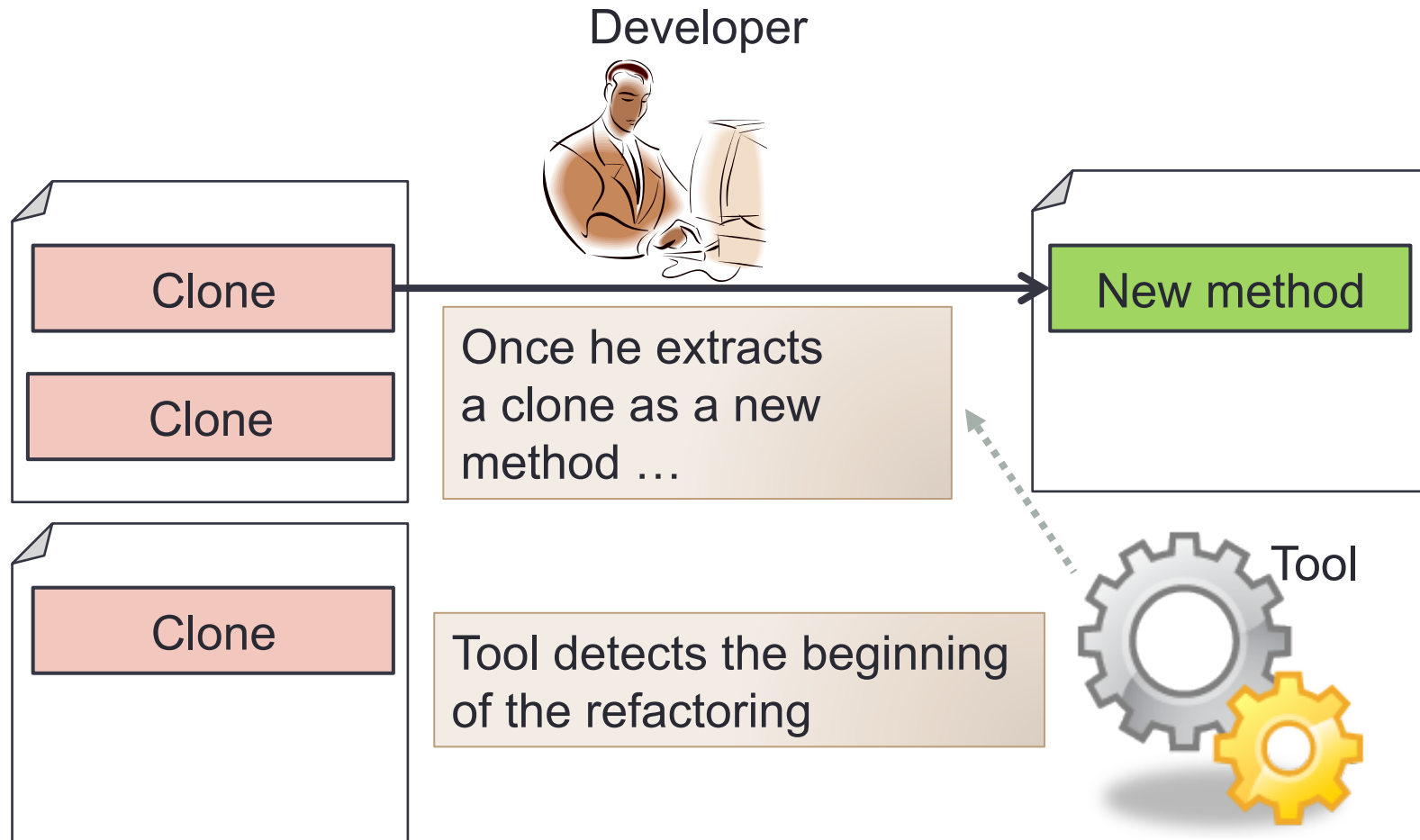
When a developer refactors a code fragment, he/she has to consider to refactor the clones of the code fragment.



If IDE catches the beginning of clone refactoring, it can proactively recommend clones to be refactored at once.

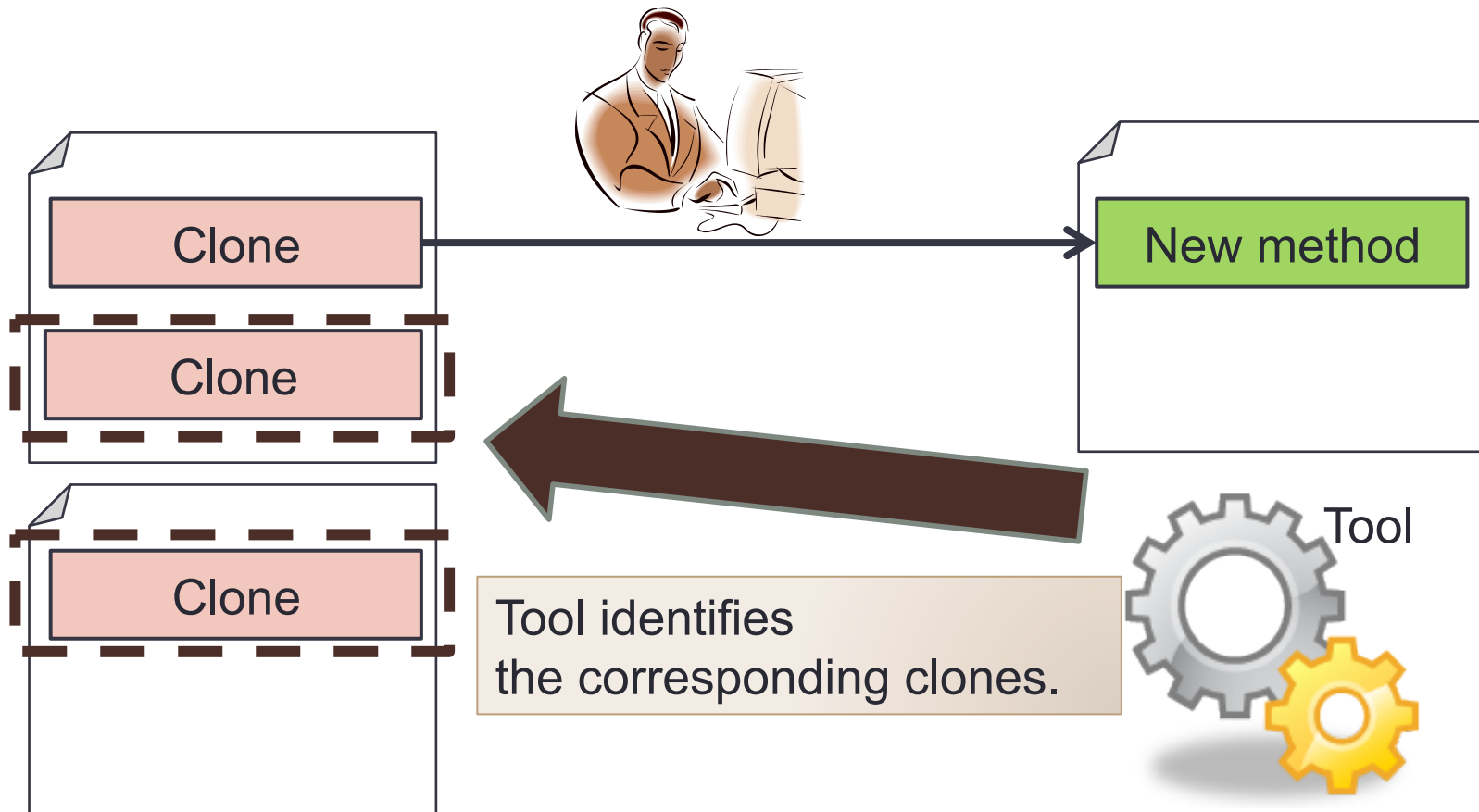
Proactive Candidate Detection for Clone Refactoring

Step 1: Refactoring detection



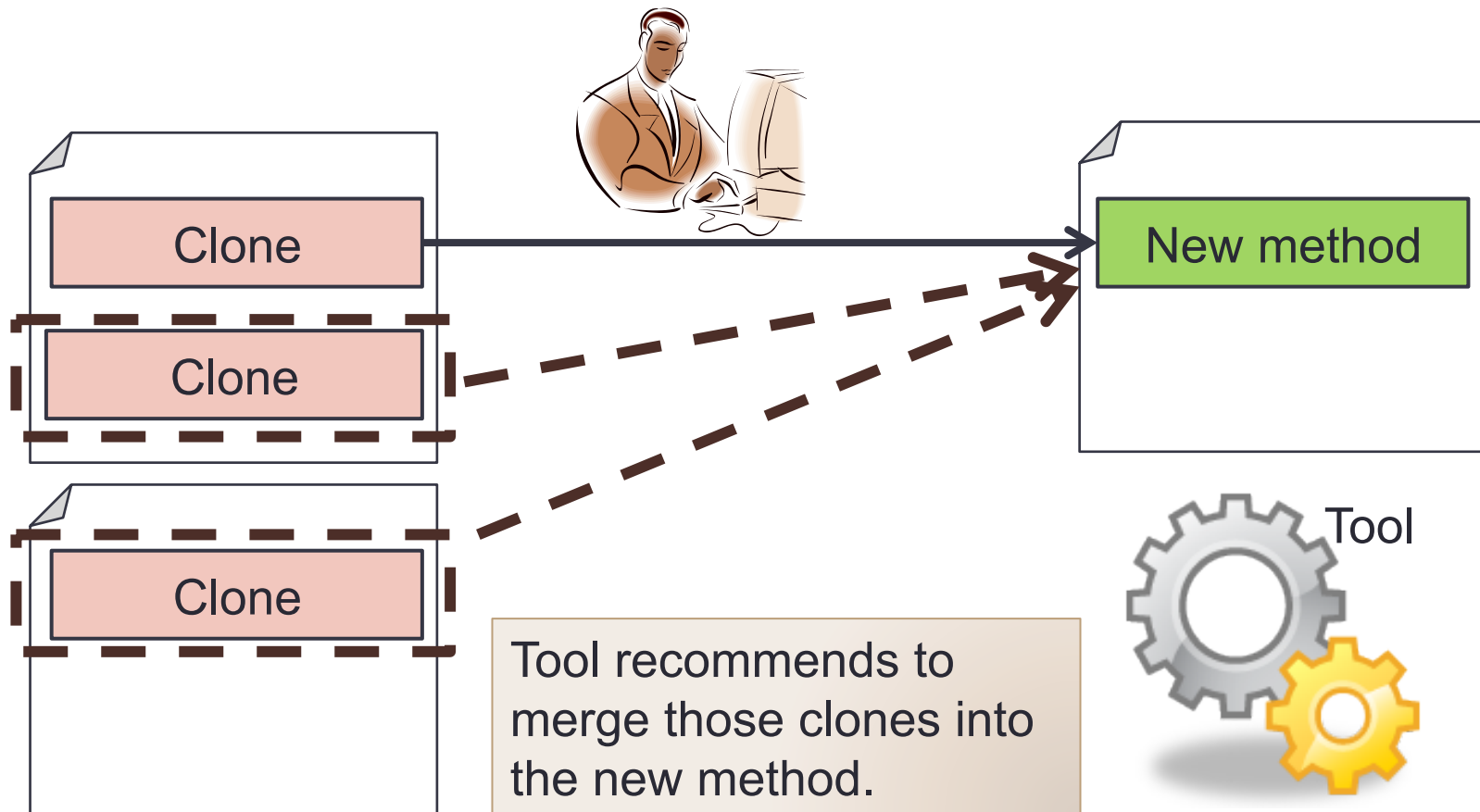
Proactive Candidate Detection for Clone Refactoring

Step2: Clone detection



Proactive Candidate Detection for Clone Refactoring

Step3: Recommendation of refactoring candidates



Other Challenges for Proactive Support for Clone Refactoring

- Near real time clone detection
 - Invoked by modification in a source code editor
 - Finish the detection by the timing of next modification.
- Precise detection of refactoring candidate selection
 - Clones are not always refactoring candidates
 - Syntactically incomplete clone
 - Clone accidentally created by only the replacement of statements.
 - Discovering further heuristics is needed for eliminating clones that should not be detected.

Summary

- We discussed active and proactive support for clone refactoring
 - Industrial experience in active support for clone refactoring
 - Plan for developing tool that supports clone refactoring proactively
- Currently, we are developing a prototype tool that supports clone refactoring proactively.