Speculative Analysis: Exploring Future States of Software

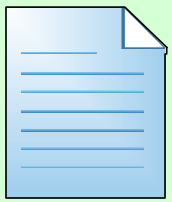
Yuriy Brun
Reid Holmes
Michael D. Ernst
David Notkin

University of Washington
University of Waterloo

Have you ever made a mistake while programming and only realized it later?

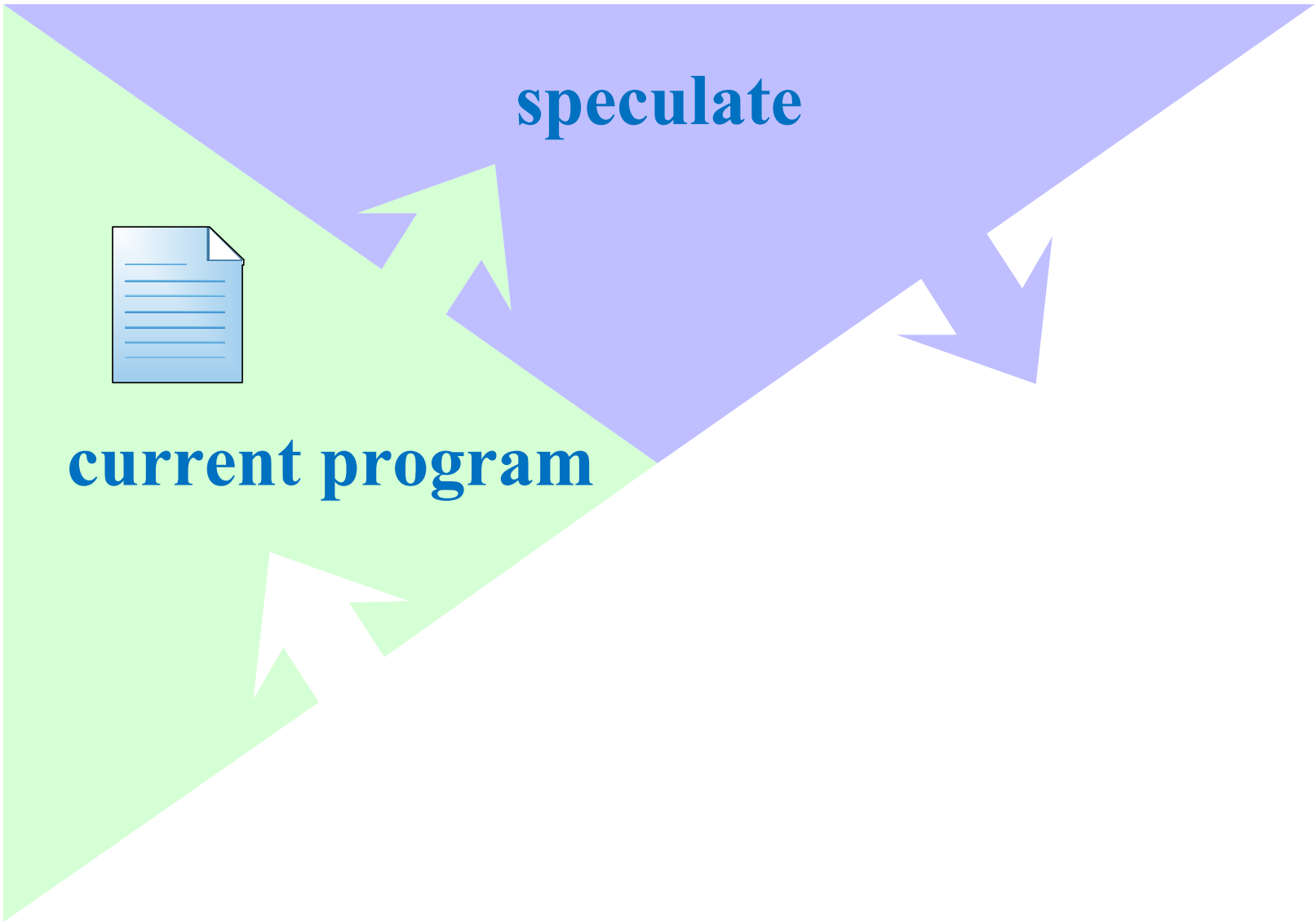
- design decision
- refactoring
- repeated someone else's work

Speculative analysis: Predict the future and analyze it

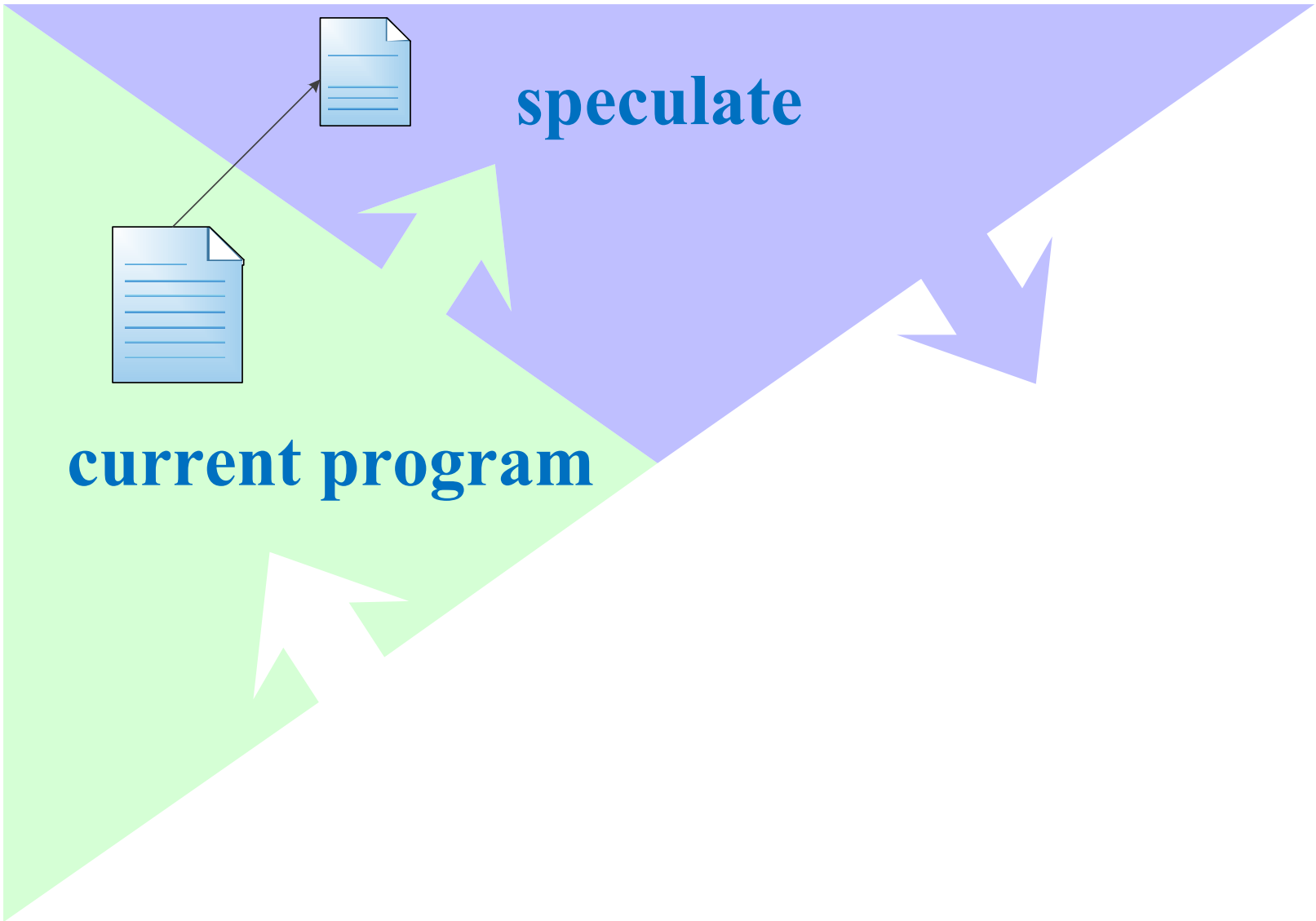


current program

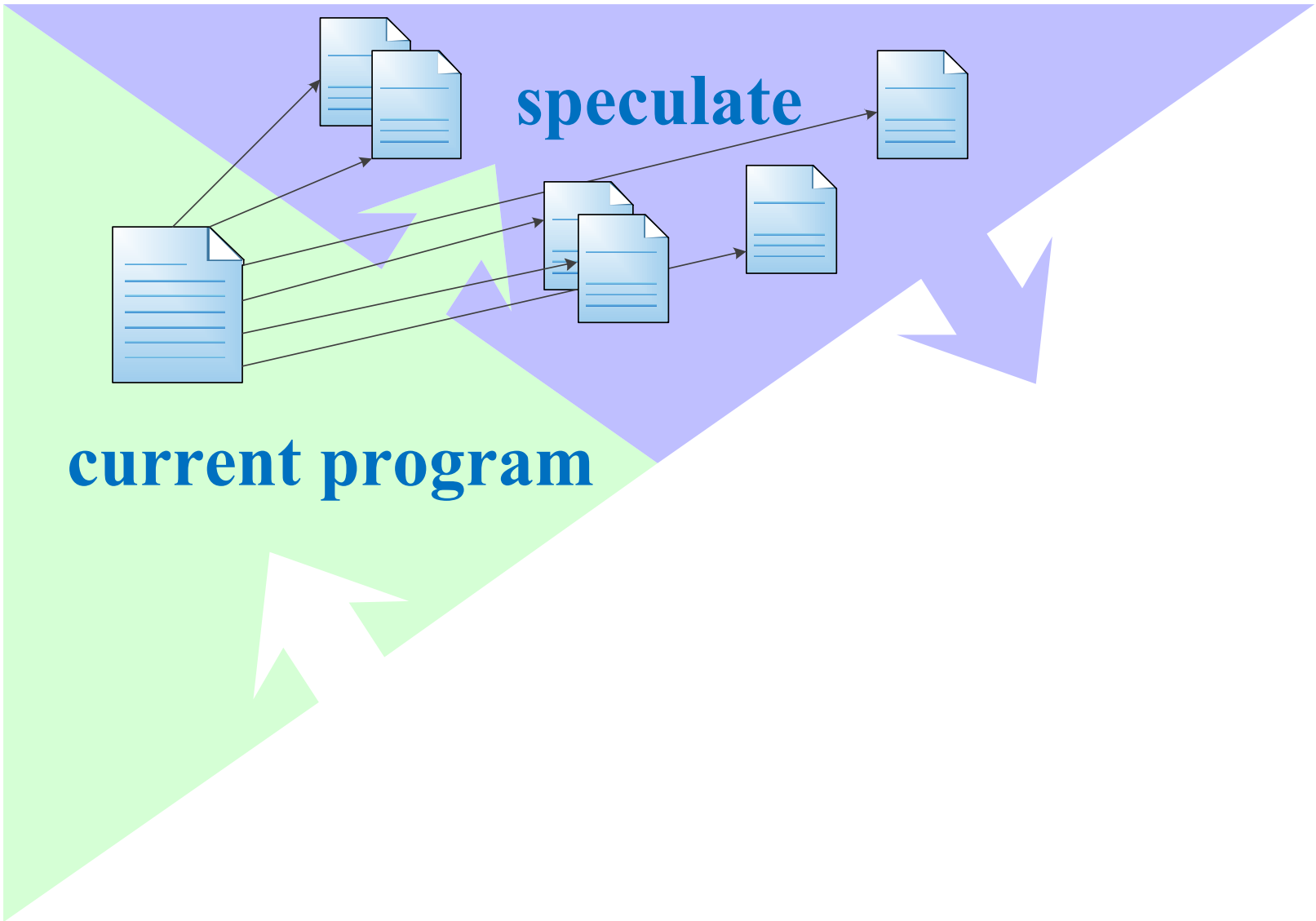
Speculative analysis: Predict the future and analyze it



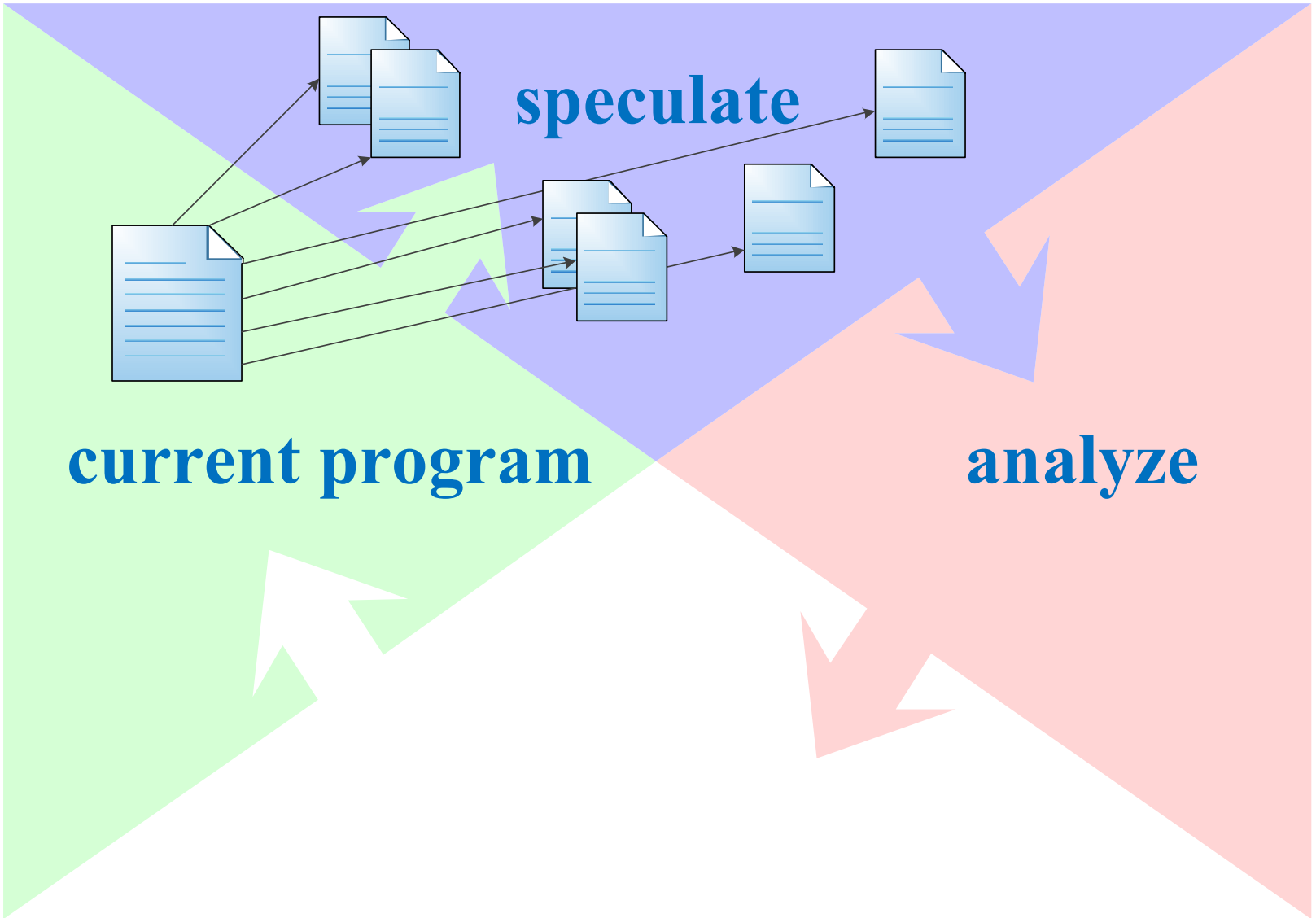
Speculative analysis: Predict the future and analyze it



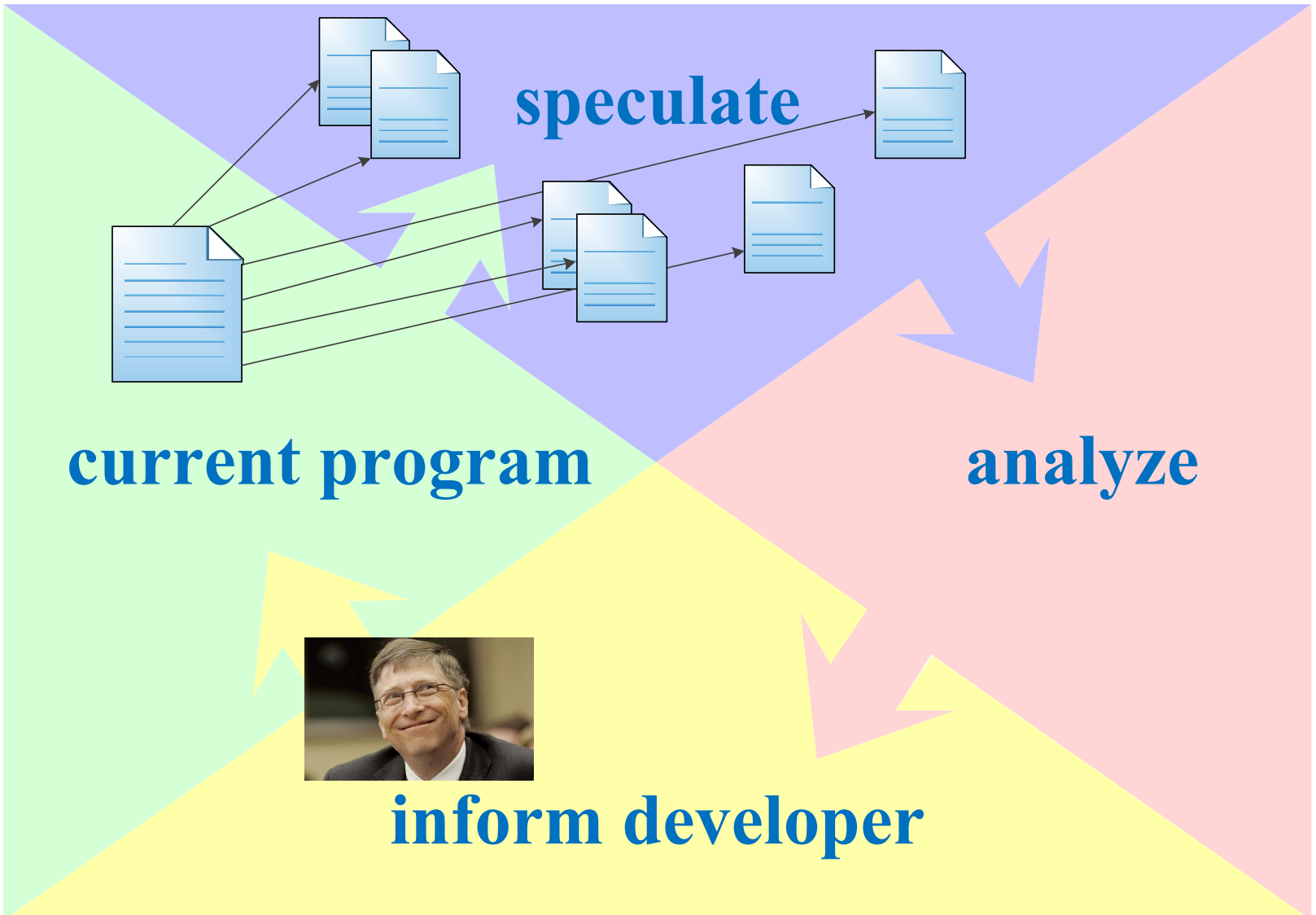
Speculative analysis: Predict the future and analyze it



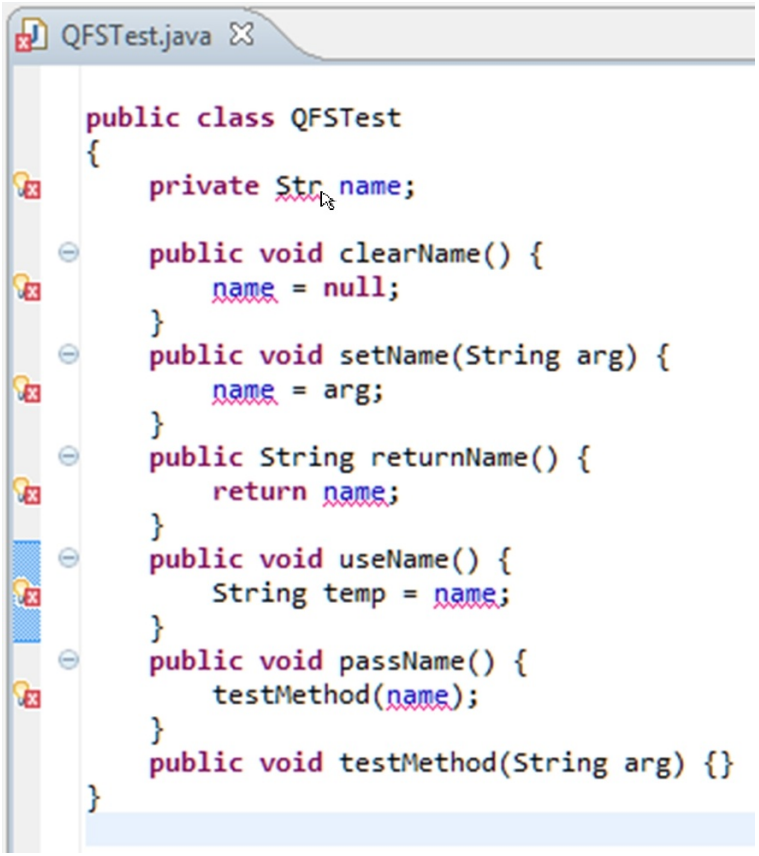
Speculative analysis: Predict the future and analyze it



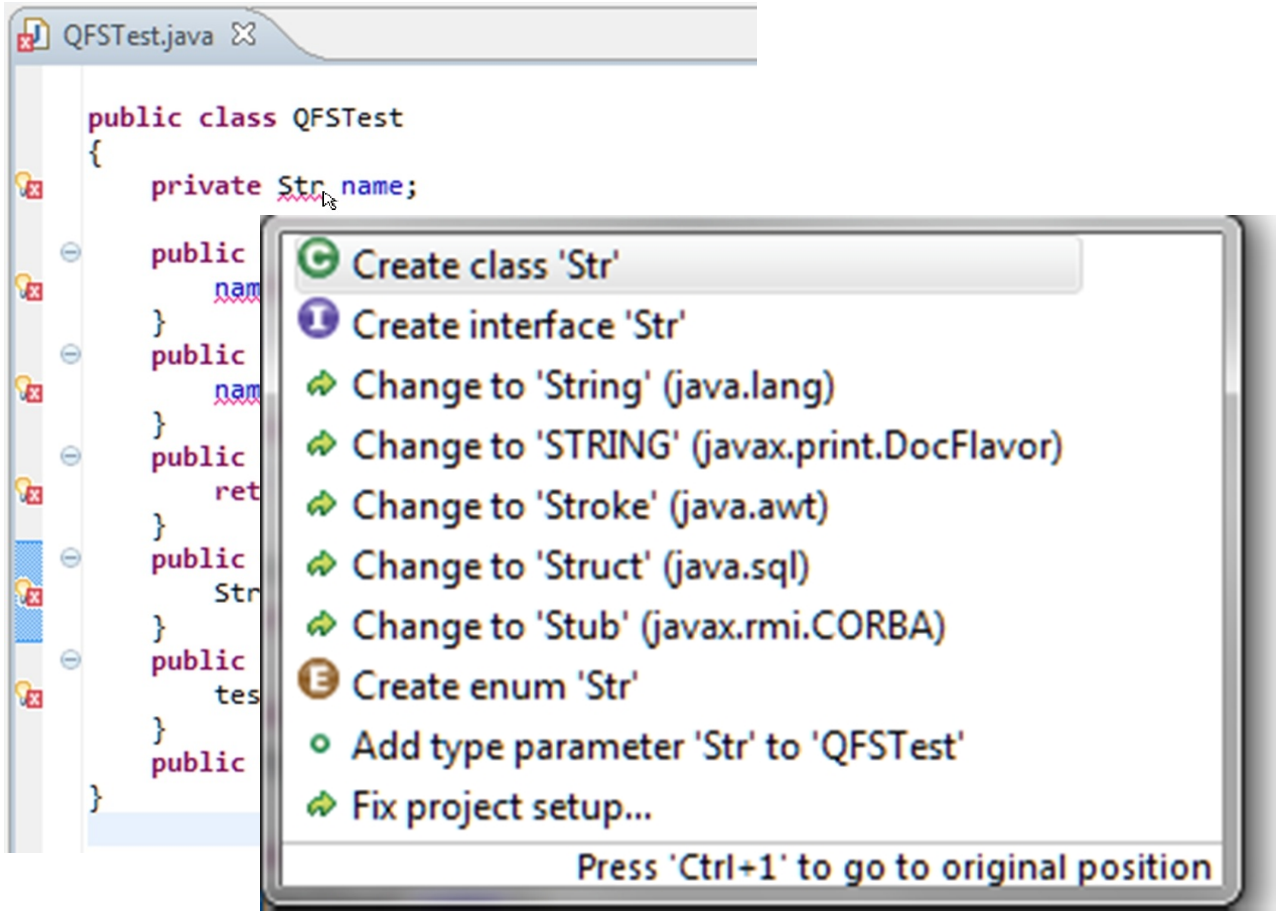
Speculative analysis: Predict the future and analyze it



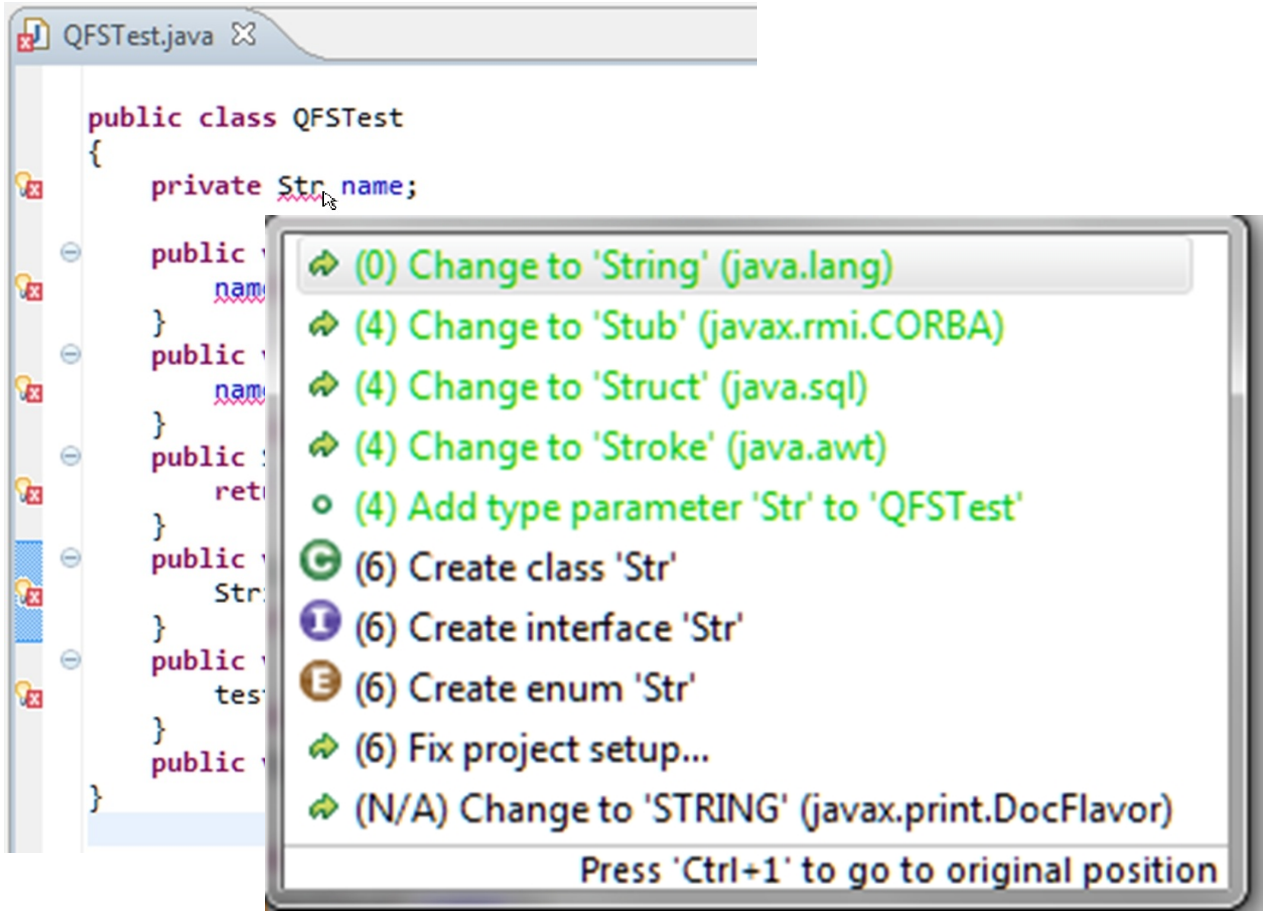
Speculative Quick Fix



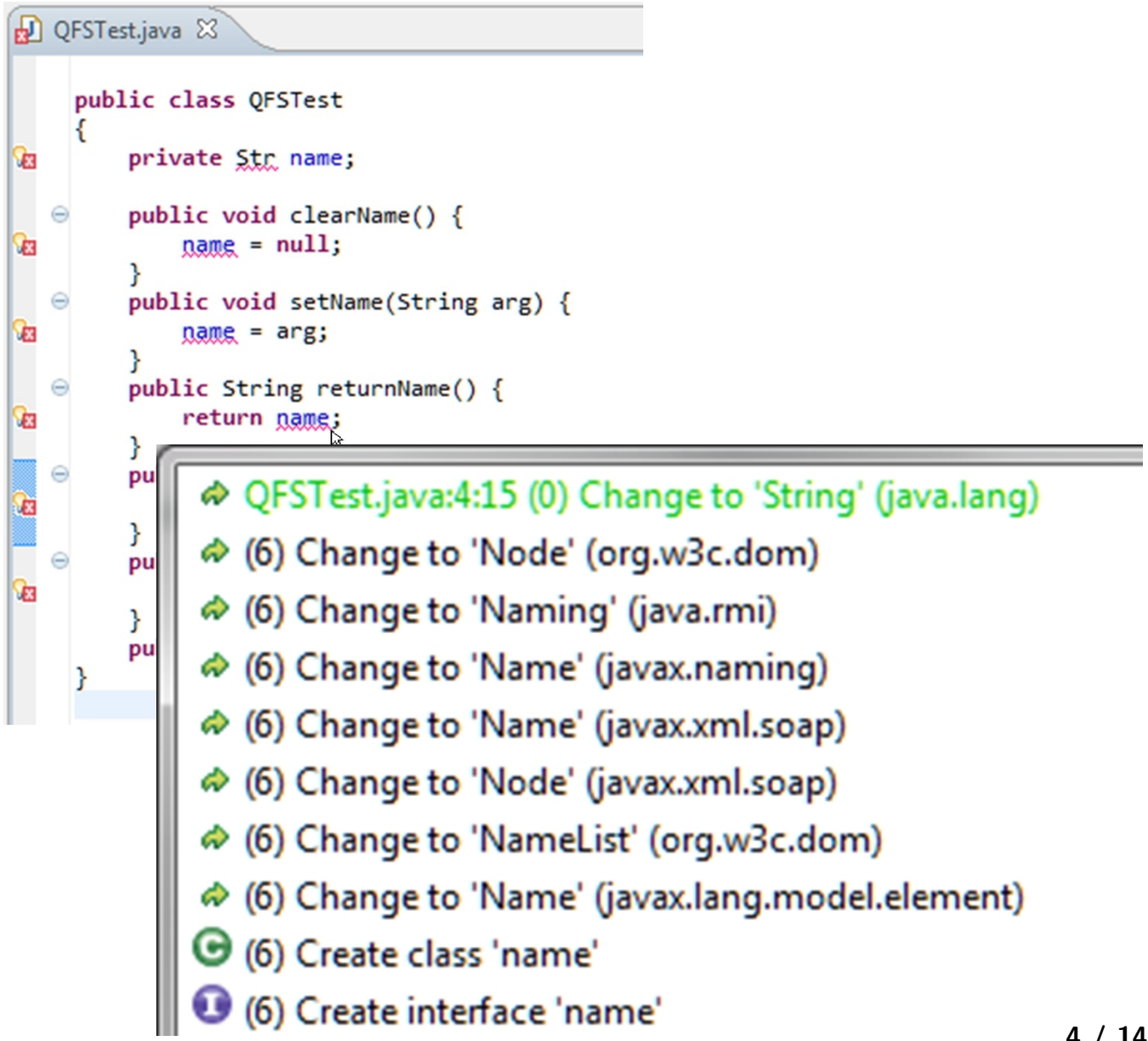
Speculative Quick Fix



Speculative Quick Fix



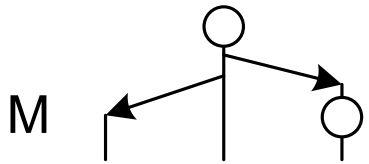
Speculative Quick Fix



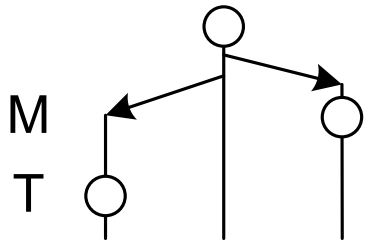
Contributions

- Speculative analysis
- Speculative analysis for collaborative development
  Crystal: prototype tool
- Problem space ideal for search-based solutions

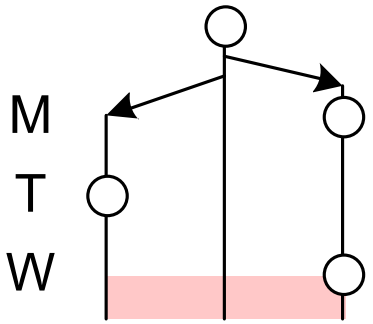
The Gates conflict



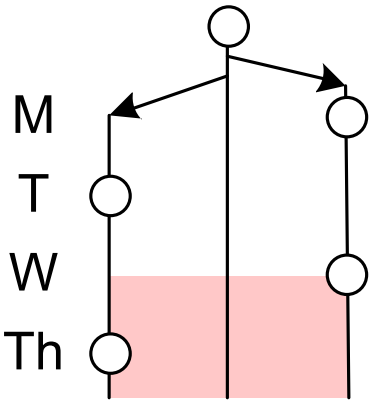
The Gates conflict



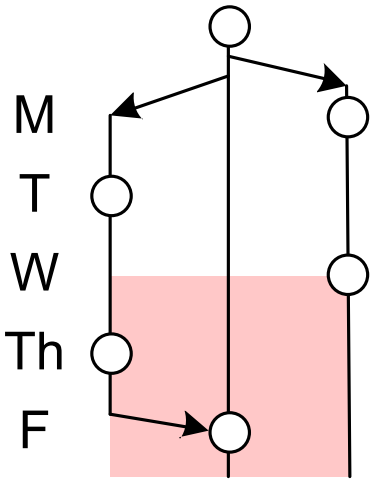
The Gates conflict



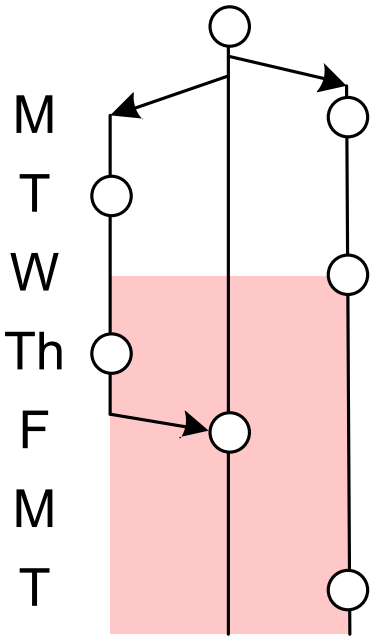
The Gates conflict



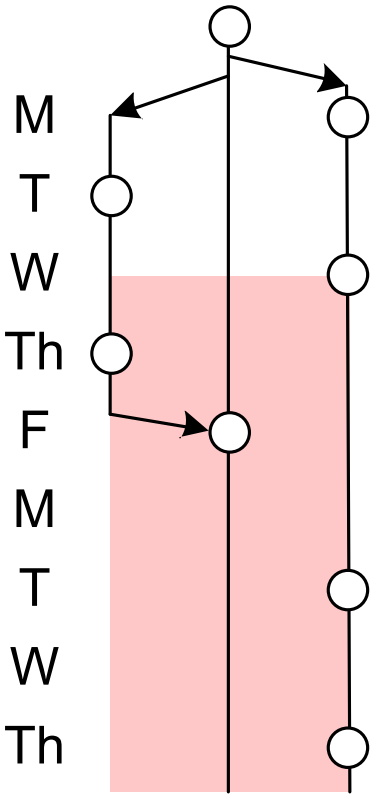
The Gates conflict



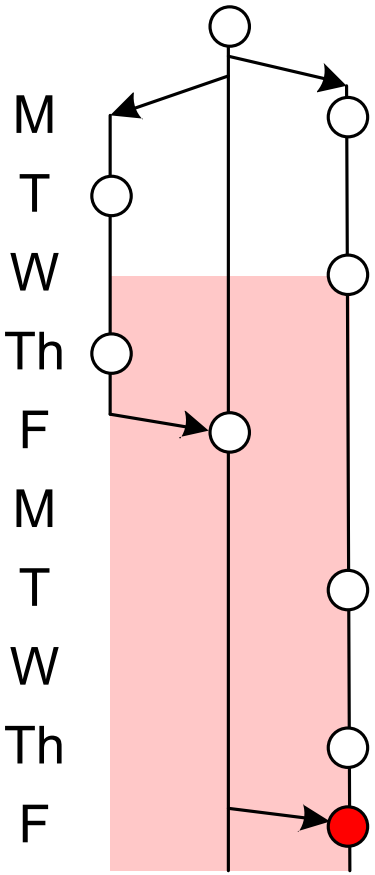
The Gates conflict



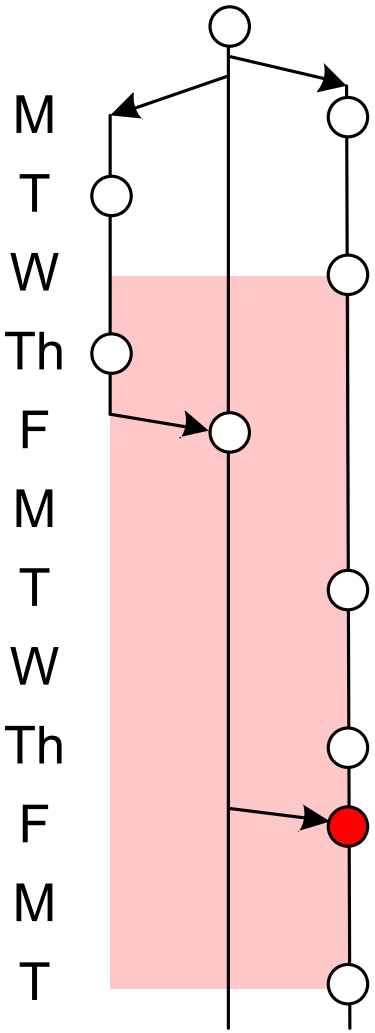
The Gates conflict



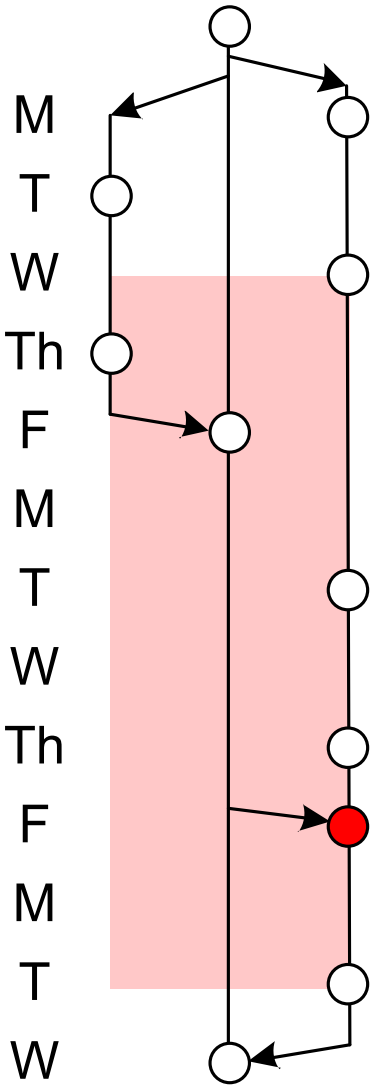
The Gates conflict



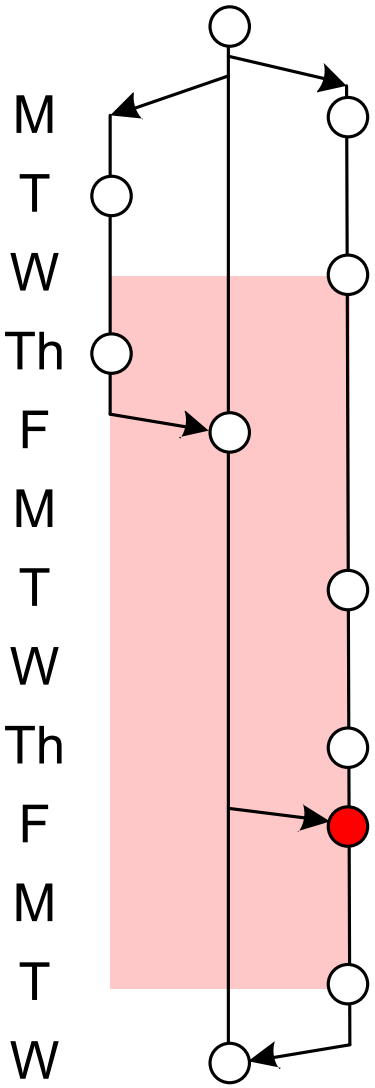
The Gates conflict



The Gates conflict

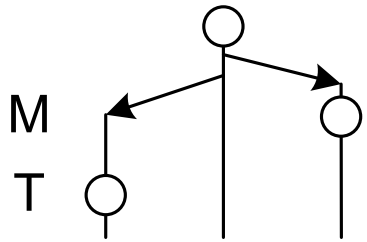


The Gates conflict



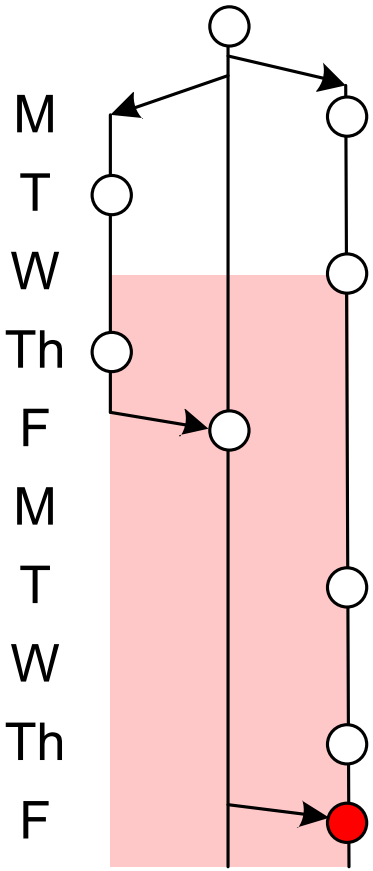
The information was all there, but the developers didn't know it.

What could well-informed developers do?



- Avoid conflicts

What could well-informed developers do?



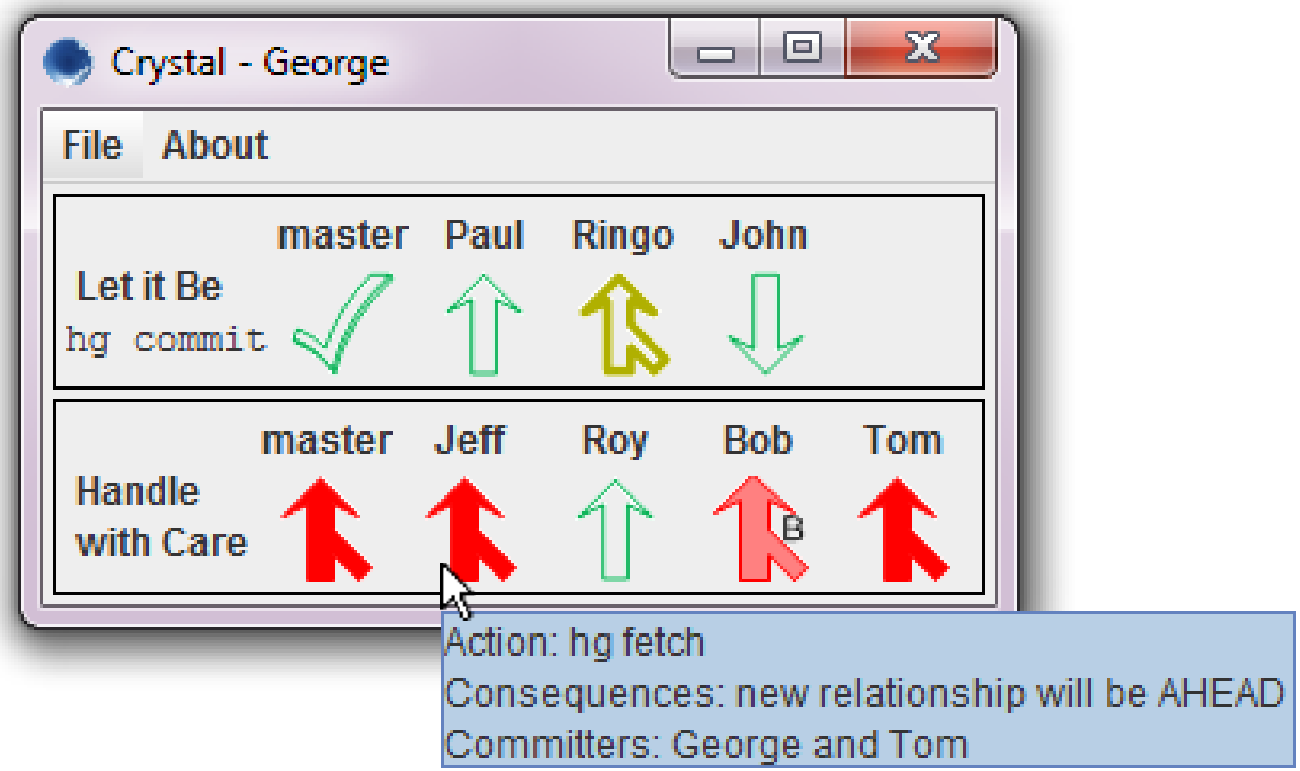
- Avoid conflicts
- Reduce conflict severity

Introducing Crystal: A proactive conflict detector

DEMO

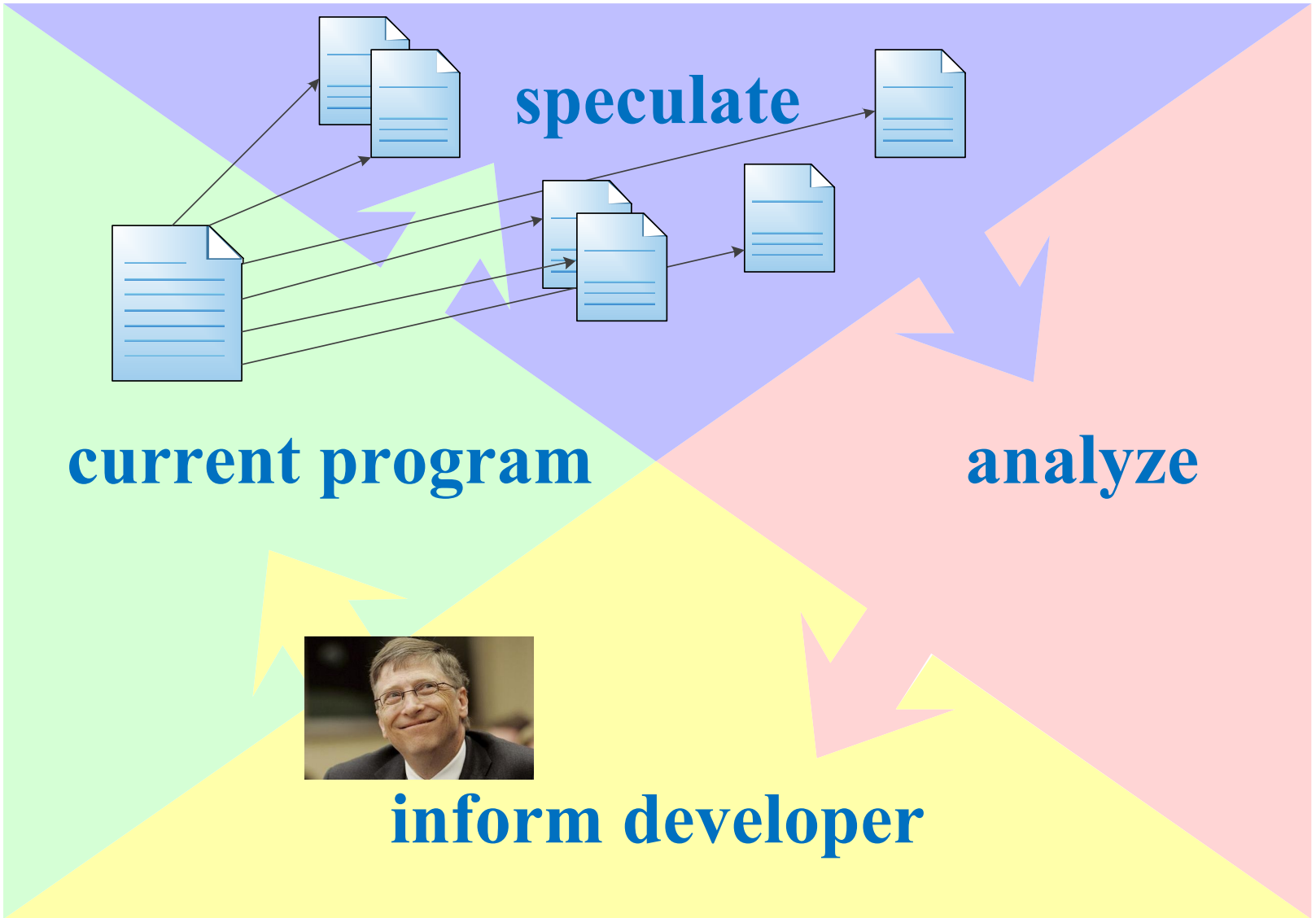
Introducing Crystal: A proactive conflict detector

DEMO



http://crystalvc.googlecode.com

Speculative analysis in collaborative development



Reducing false positives in conflict prediction

Collaborative awareness

- Palantír [Sarma et al. 2003]
- FASTDash [Biehl et al. 2007]
- Syde [Hattori and Lanza 2010]
- CollabVS [Dewan and Hegde 2007]
- Safe-commit [Wloka et al. 2009]
- SourceTree [Streeting 2010]

Reducing false positives in conflict prediction

Collaborative awareness

- Palantír [Sarma et al. 2003]
- FASTDash [Biehl et al. 2007]
- Syde [Hattori and Lanza 2010]
- CollabVS [Dewan and Hegde 2007]
- Safe-commit [Wloka et al. 2009]
- SourceTree [Streeting 2010]

Crystal analyzes **concrete artifacts**,
eliminating false positives and false negatives.

Utility of proactive collaborative conflict detection

- Are textual collaborative conflicts a real problem?
  - 16% of the merges have textual conflicts.
  - Conflicts live a mean of 9.8 days.
- How dangerous are safe merges?
  - 93% of textual conflicts developed from safe merges.
  - 20% of textually-safe merges developed into conflicts.
- Do higher-order collaborative conflicts exist?
  - One in three conflicts are of higher-order.

[Brun et al. 2011]

Crystal is in the wild

> "Crystal handles several projects and users effortlessly and presents the necessary information in a simple and understandable way."
>
> – a user

Microsoft Beacon

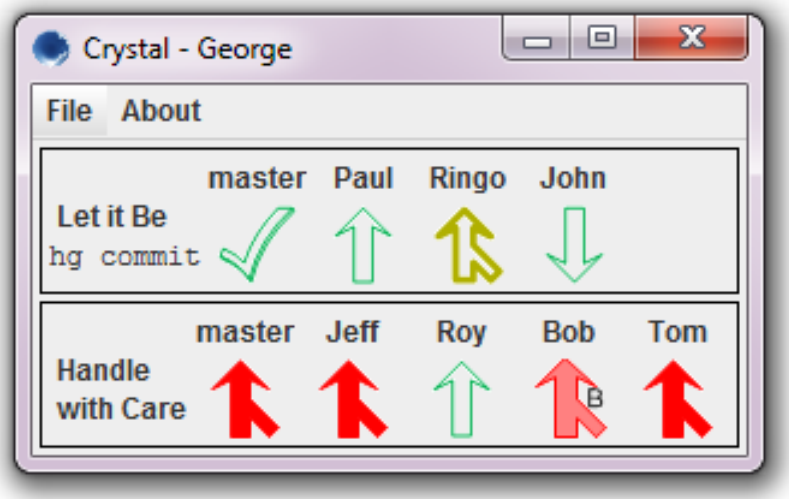
- A centralized version control-based tool.
- Microsoft product groups will use Beacon to help identify conflicts earlier in the development process.
- We will conduct user studies to measure effects on developers.

Open problem:

How to search speculative analysis' many possible futures?

Contributions

- Introduced speculative analysis to guide future actions.
- Developed Crystal to precisely detect conflicts and unobtrusively inform developers.
- Identified a problem space ideal for search-based solutions.



http://crystalvc.googlecode.com

Jacob T. Biehl, Mary Czerwinski, Greg Smith, and George G. Robertson. FASTDash: A visual dashboard for fostering awareness in software teams. pages 1313–1322, San Jose, CA, USA, 2007. ISBN 978-1-59593-593-9. doi: 10.1145/1240624.1240823.

Yuriy Brun, Reid Holmes, Michael D. Ernst, and David Notkin. Proactive detection of collaboration conflicts. In *ESEC FSE*, Szeged, Hungary, Sep. 2011.

Prasun Dewan and Rajesh Hegde. Semi-synchronous conflict detection and resolution in asynchronous software development. In *ECSCW*, pages 159–178, Limerick, Ireland, 2007.

Lile Hattori and Michele Lanza. Syde: A tool for collaborative software development. In *ICSE Tool Demo*, pages 235–238, Cape Town, South Africa, May 2010. ISBN 978-1-60558-719-6. doi: 10.1145/1810295.1810339.

Anita Sarma, Zahra Noroozi, and André van der Hoek. Palantír: Raising awareness among configuration management workspaces. In *ICSE*, pages 444–454, Portland, OR, May 2003. ISBN 0-7695-1877-X.

Steve Streeting. Sourcetree. `http://www.sourcetreeapp.com`, 2010.

Jan Wloka, Barbara Ryder, Frank Tip, and Xiaoxia Ren. Safe-commit analysis to facilitate team software development. In *ICSE*, pages 507–517, Vancouver, BC, Canada, May 2009. ISBN 978-1-4244-3453-4. doi: 10.1109/ICSE.2009.5070549.