Proactive Detection of Collaboration Conflicts

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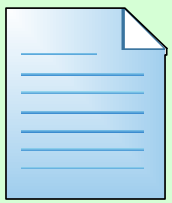
Have you ever made a mistake while programming and only realized it later?

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

Speculative analysis: Predict the future and analyze it



current program

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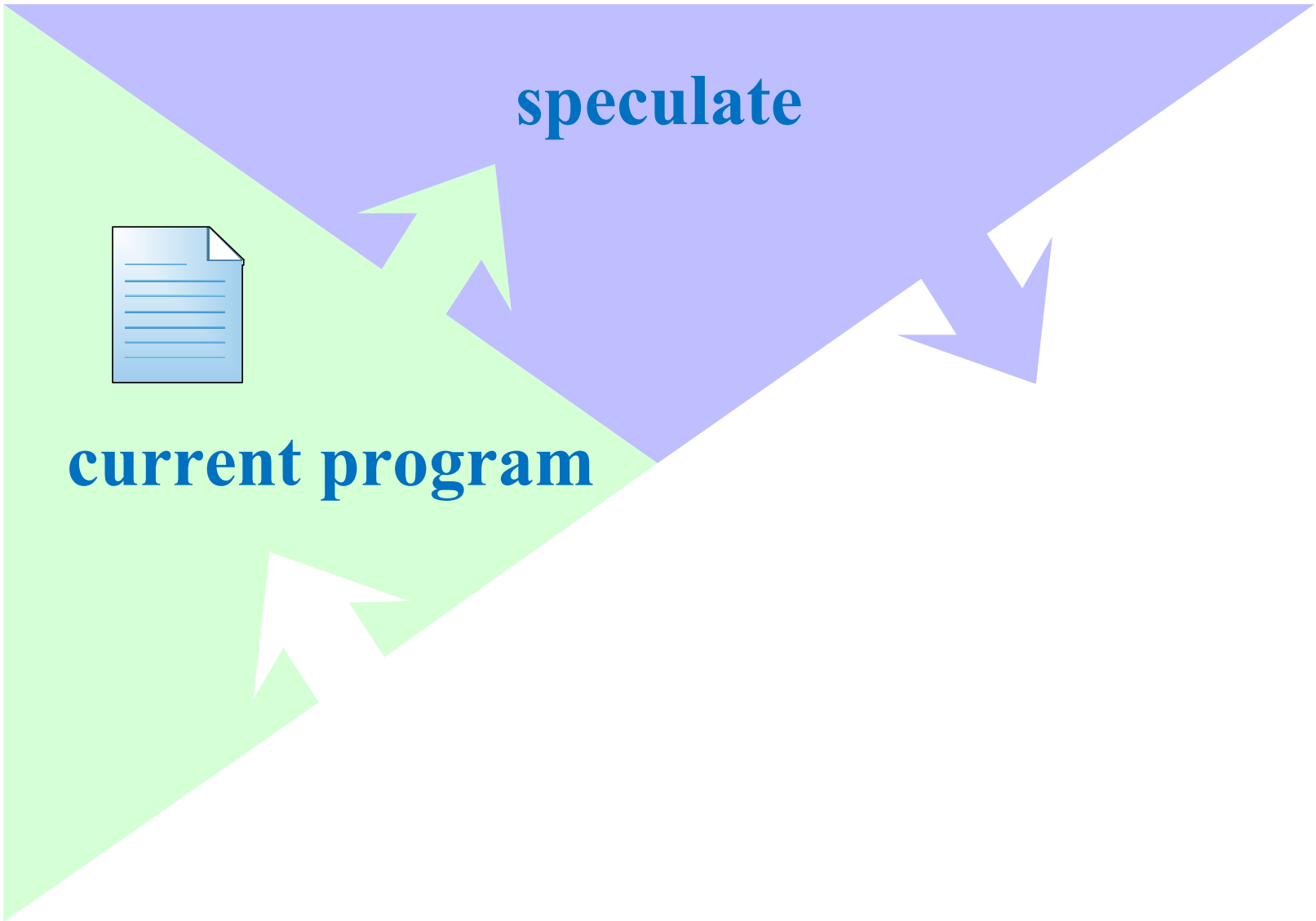

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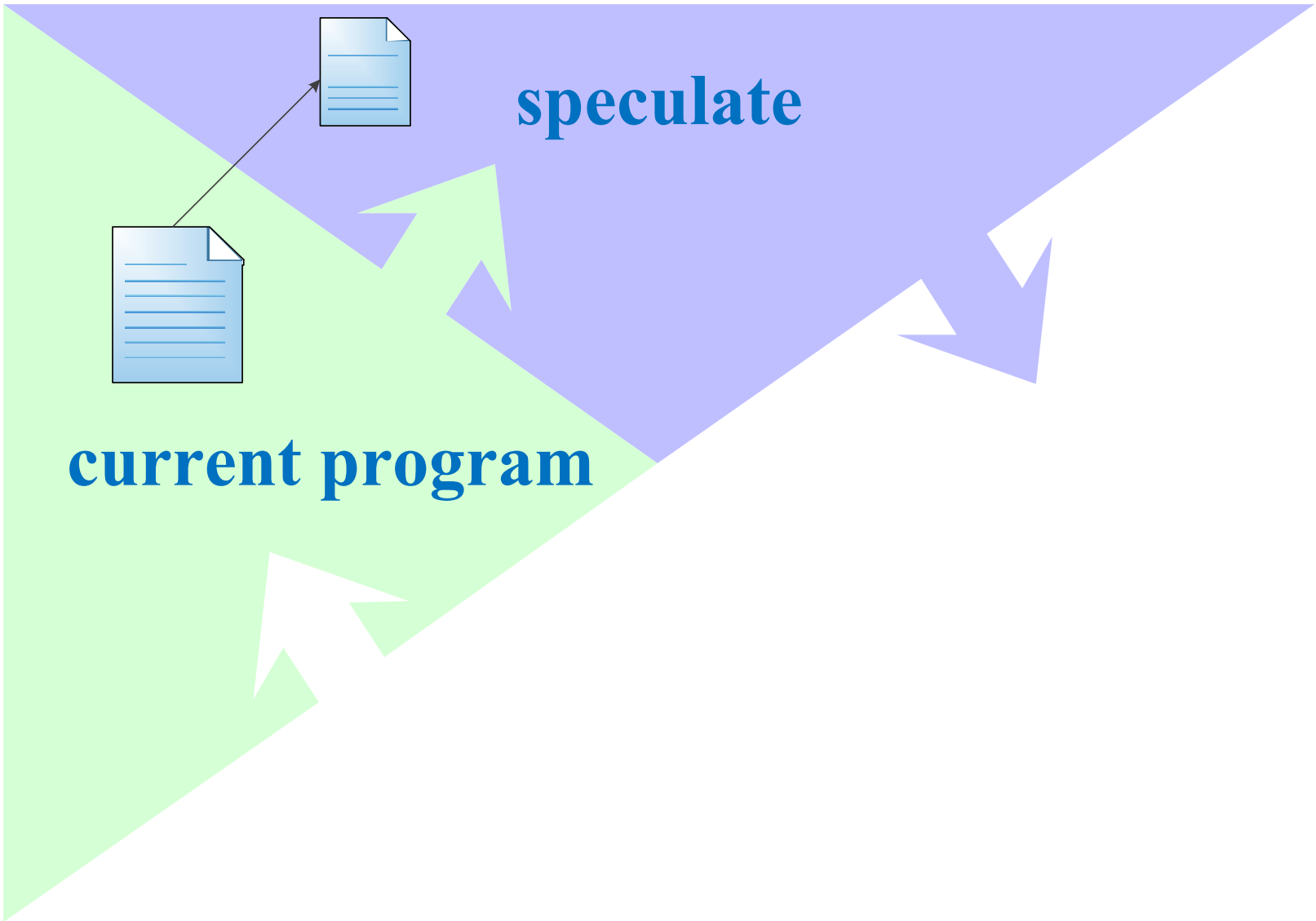

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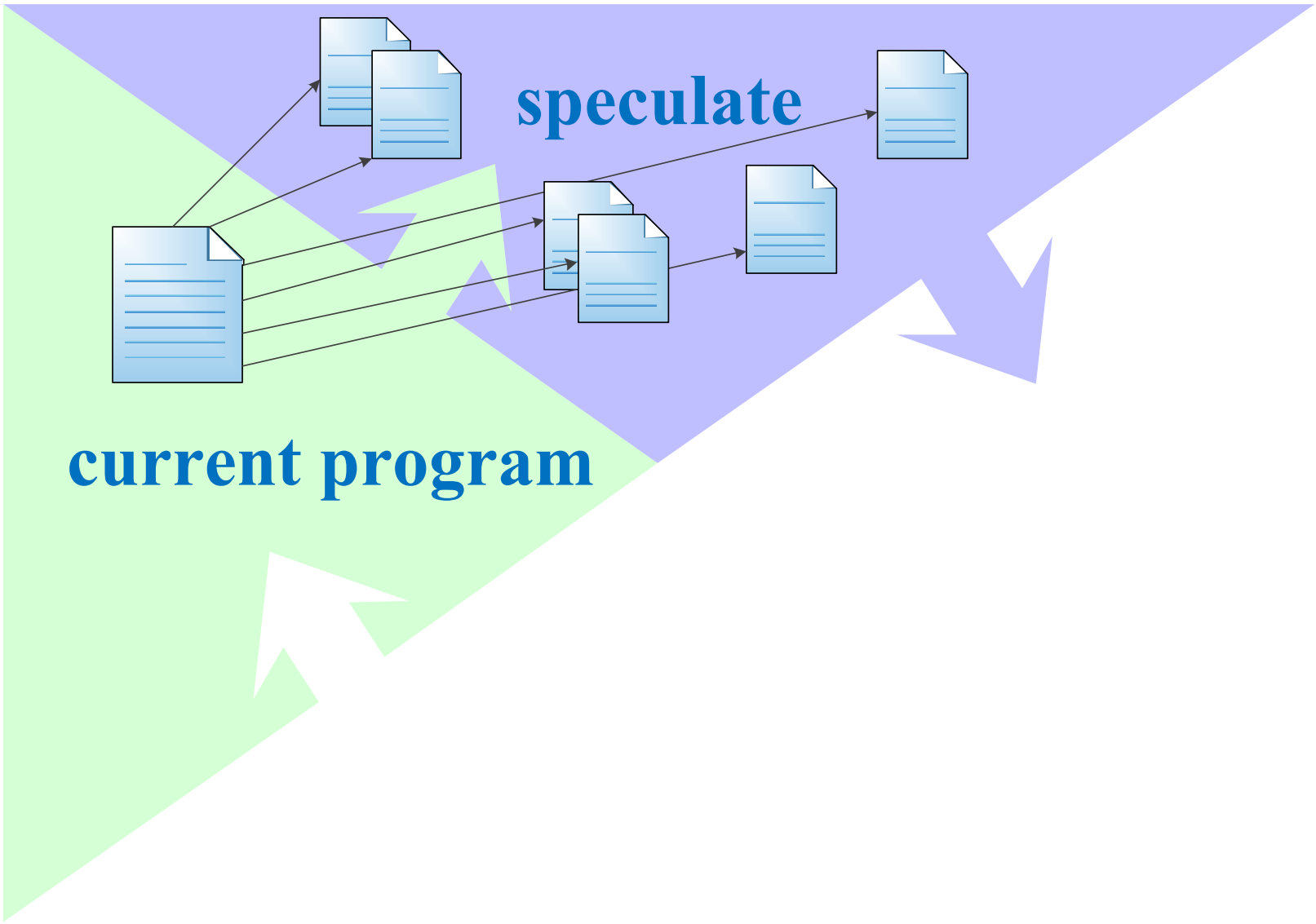

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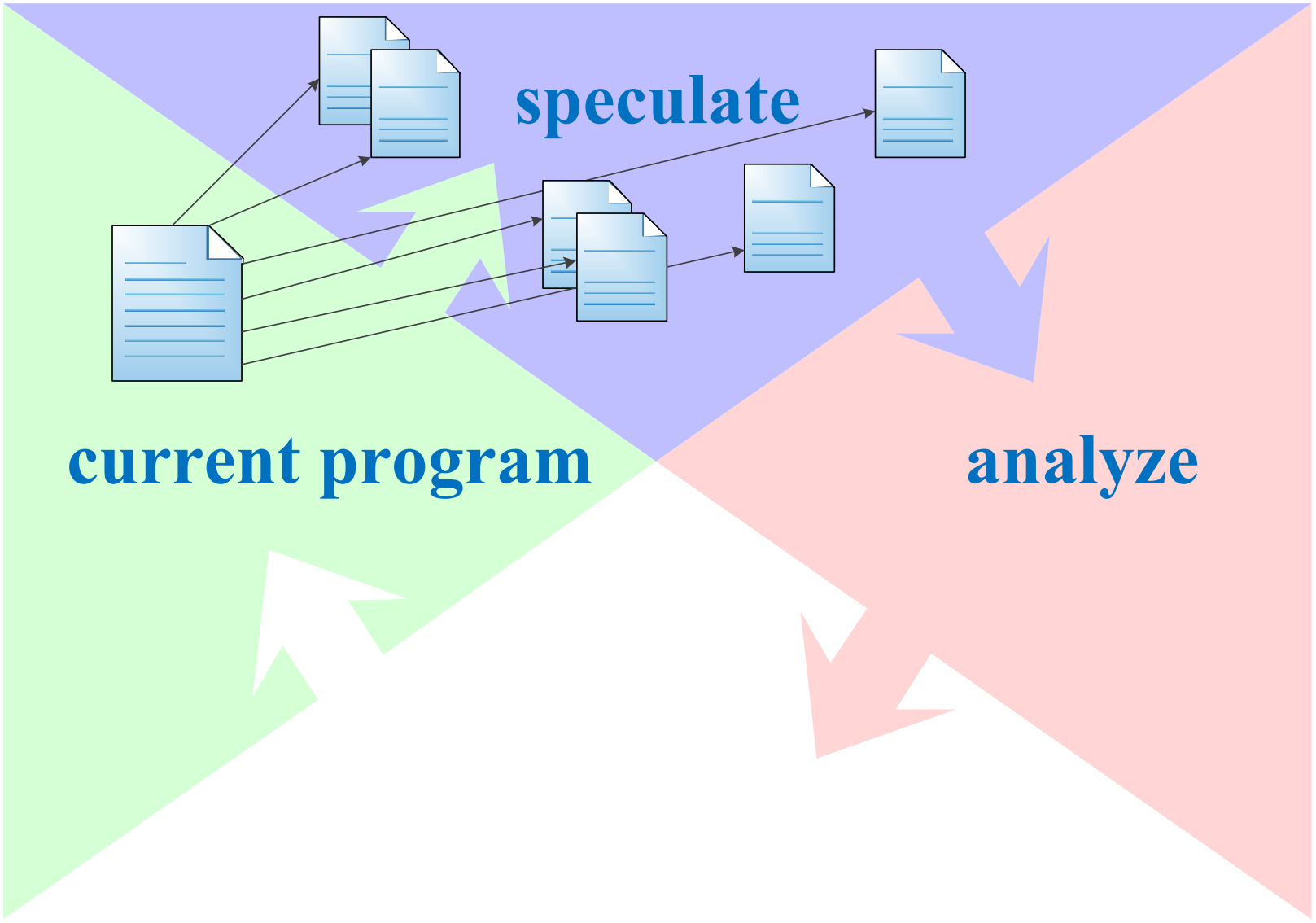

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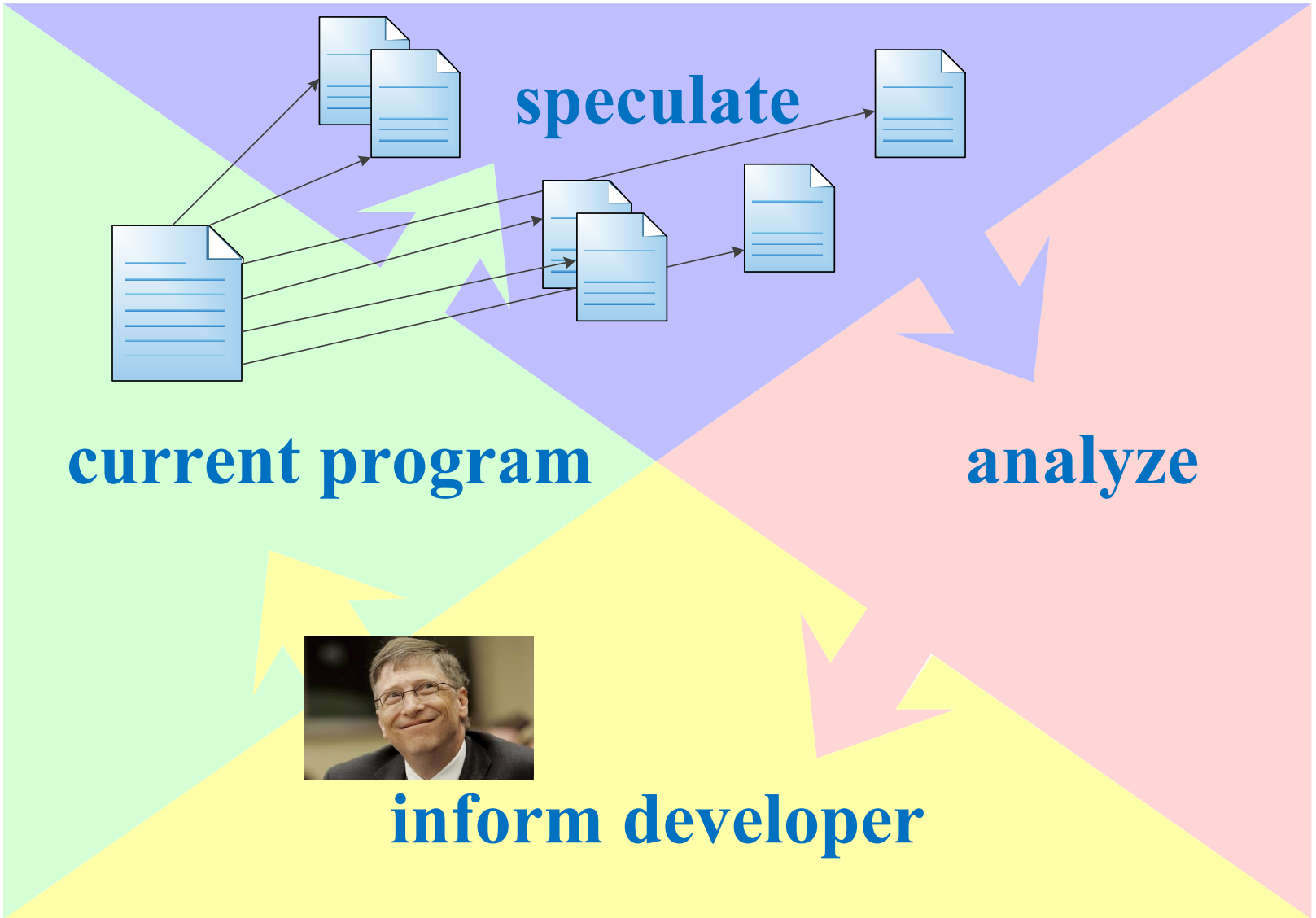
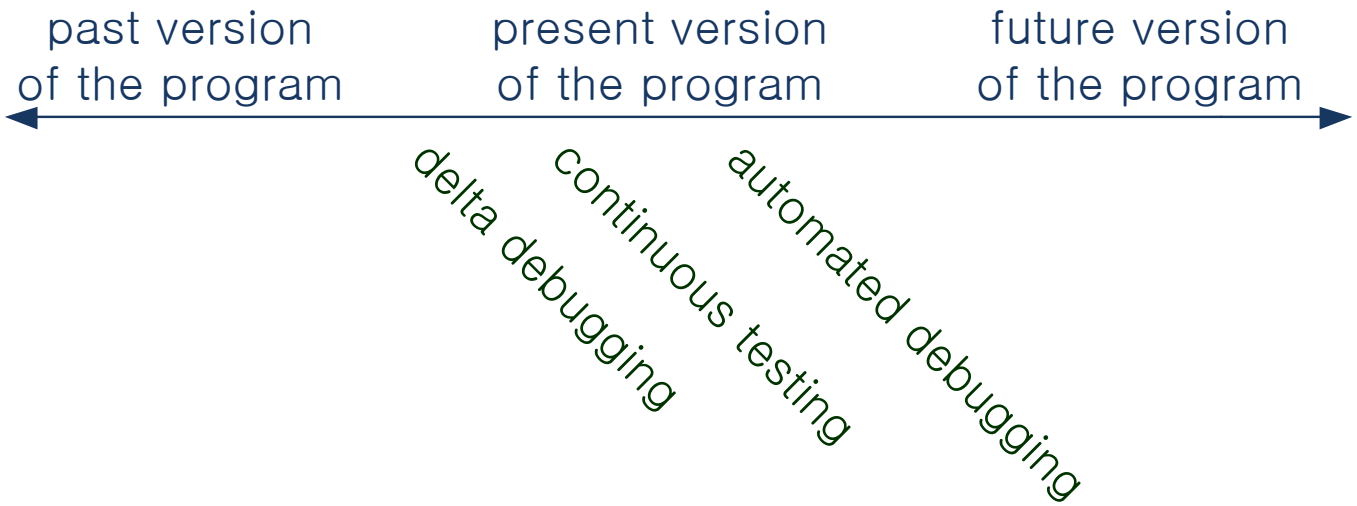


Exploring the future



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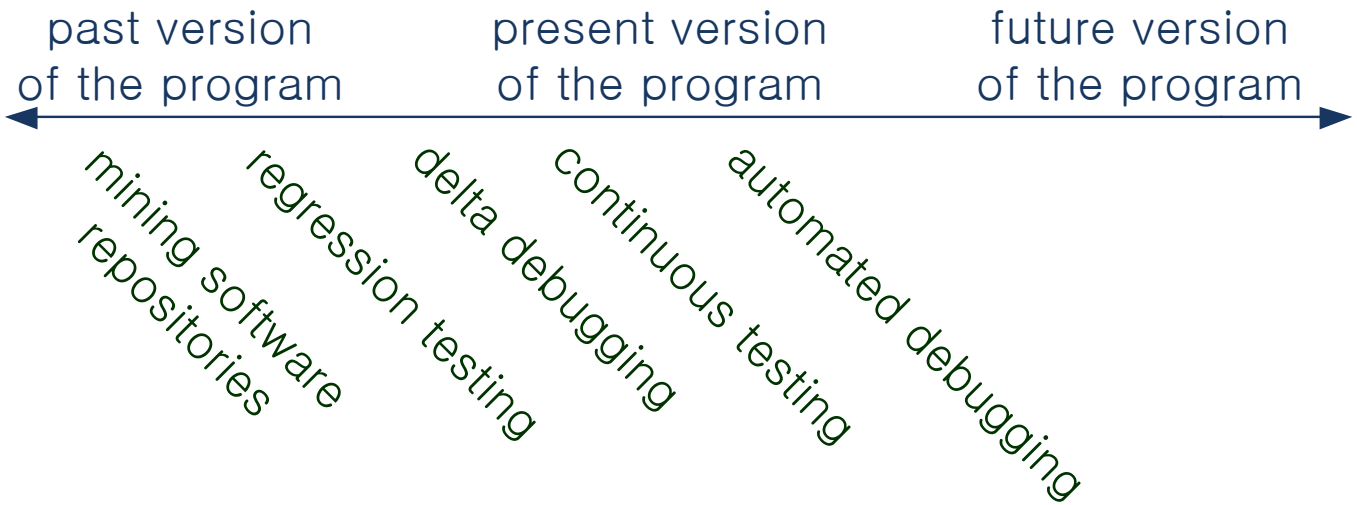

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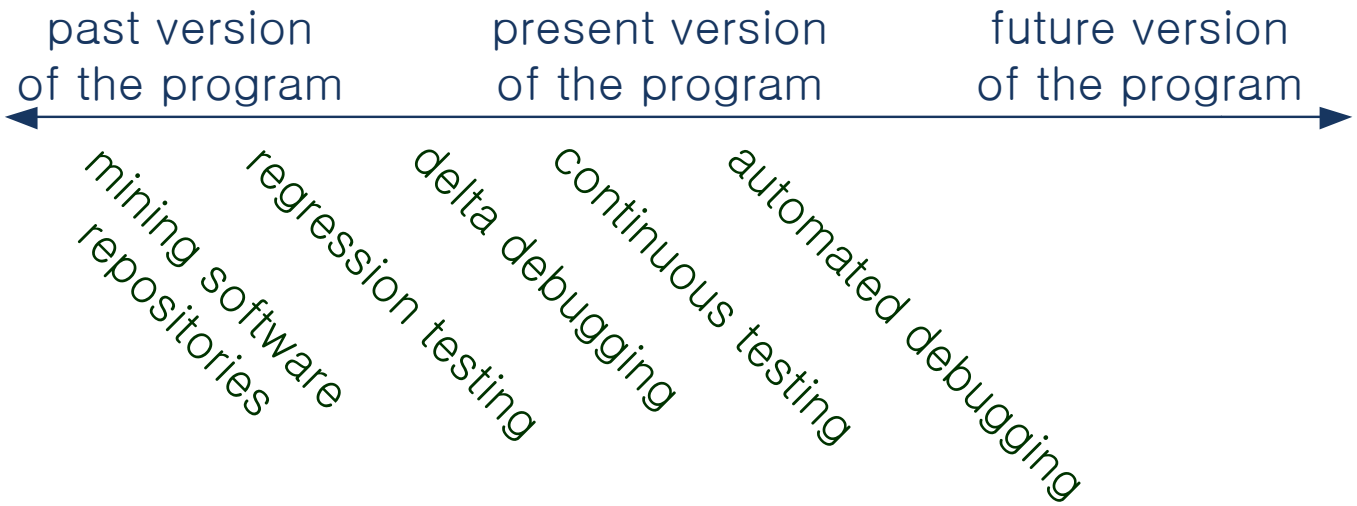

Continuous development

- execution [Henderson and Weiser 1985; Karinthi and Weiser 1987]
- compilation [Childers et al. 2003; Eclipse]
- testing [Saff and Ernst 2003, 2004]
- version control integration [Guimarães and Rito-Silva 2010]

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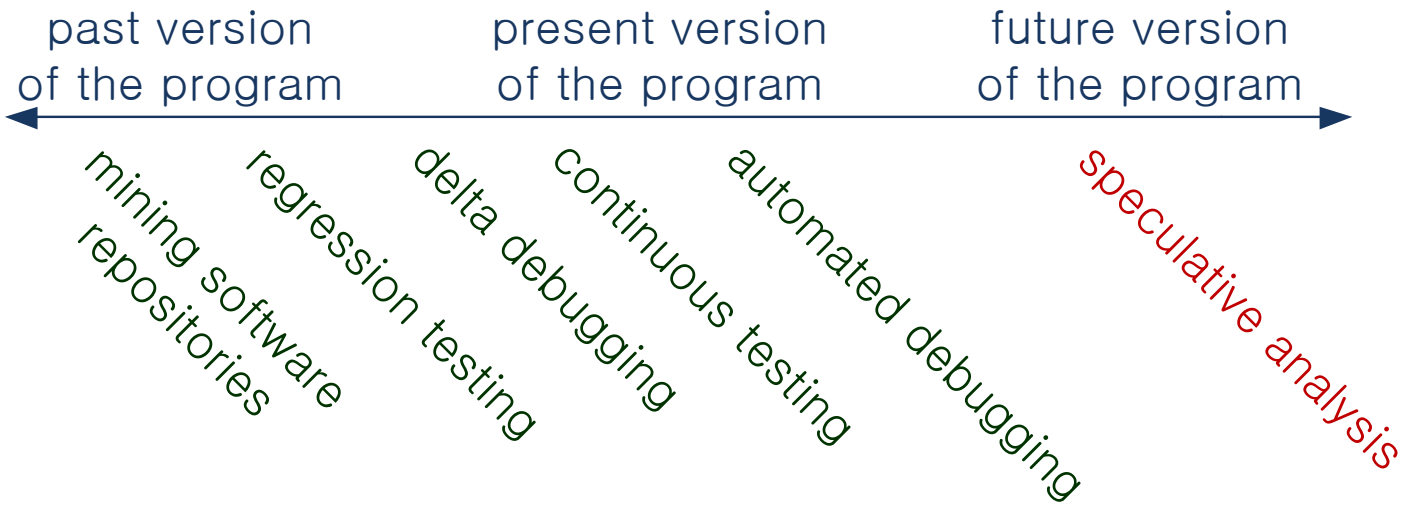

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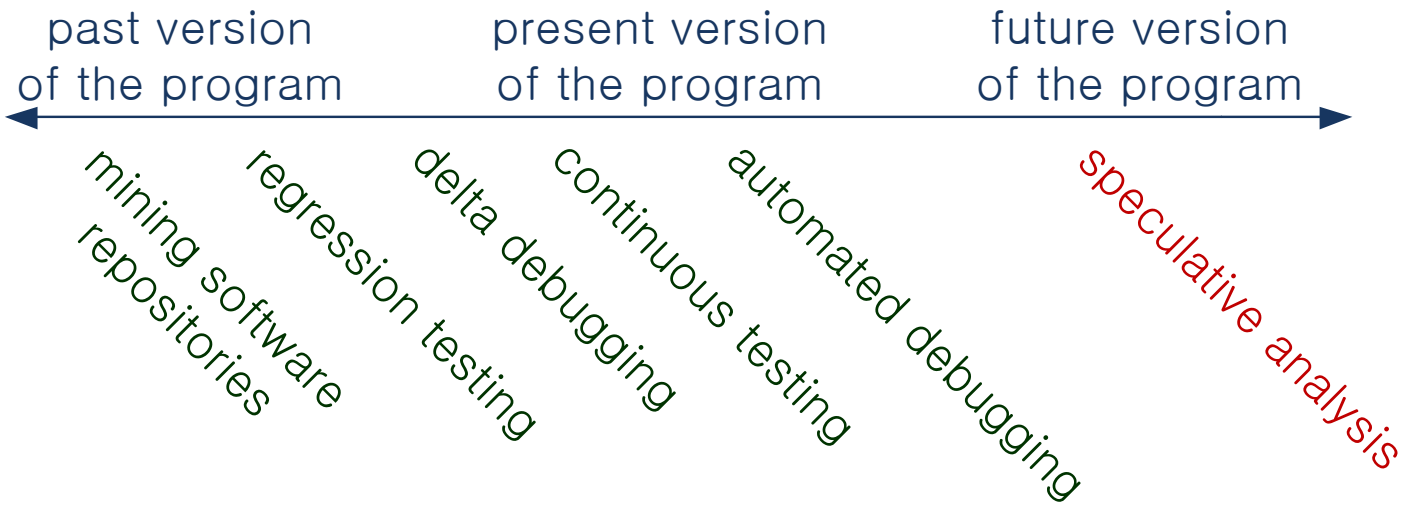

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Speculative analysis is **predictive**.

Contributions

- Speculative analysis
- Speculative analysis for collaborative development
  Crystal: prototype tool
- Utility of speculative analysis for collaborative development

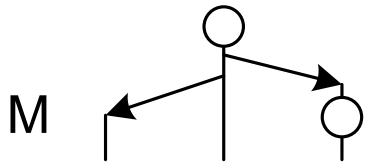
Version-control terminology

Proactive conflict detection applies to both centralized and decentralized version control.

Terminology:

	decentralized	centralized
local commit:	commit	save
incorporate:	push and pull	commit and update

The Gates conflict



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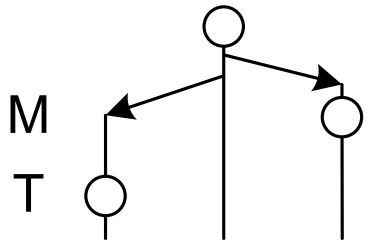

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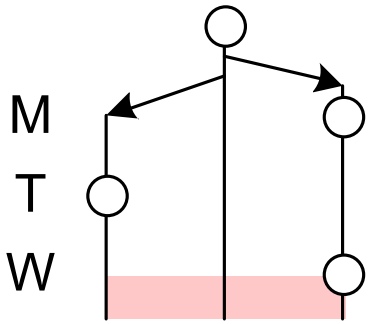

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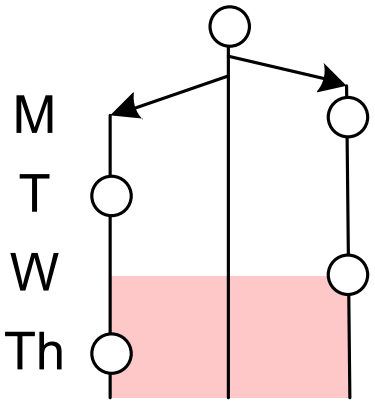

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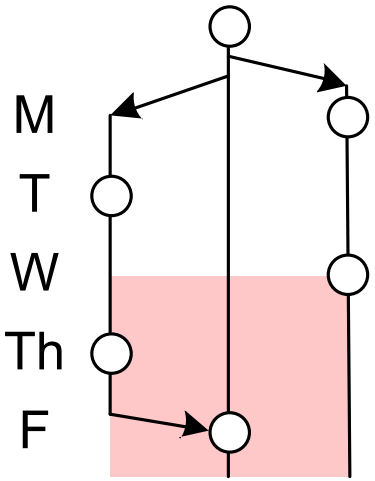

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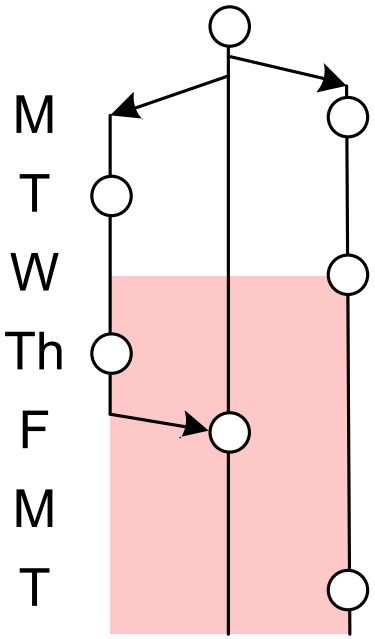

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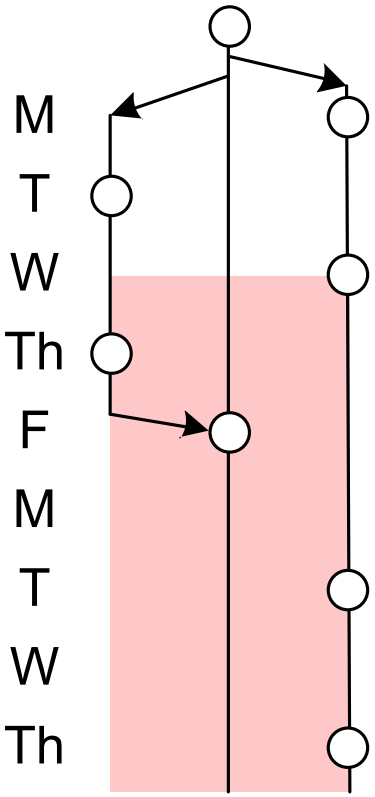

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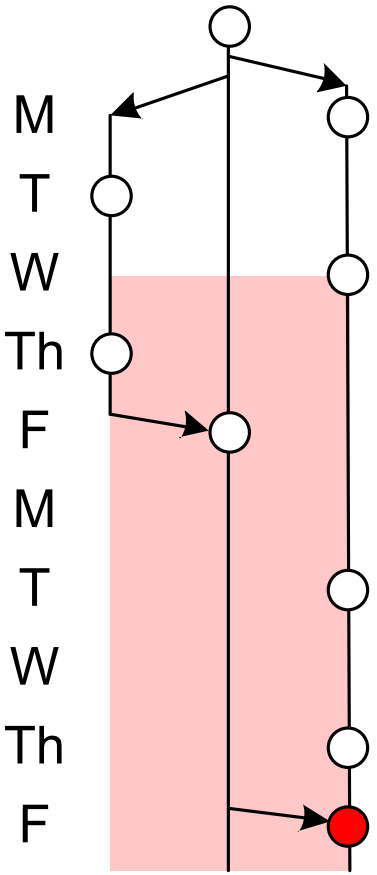

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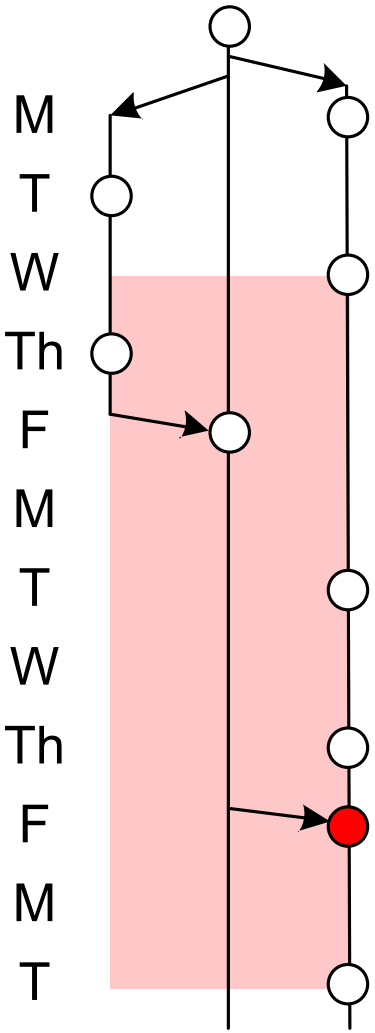

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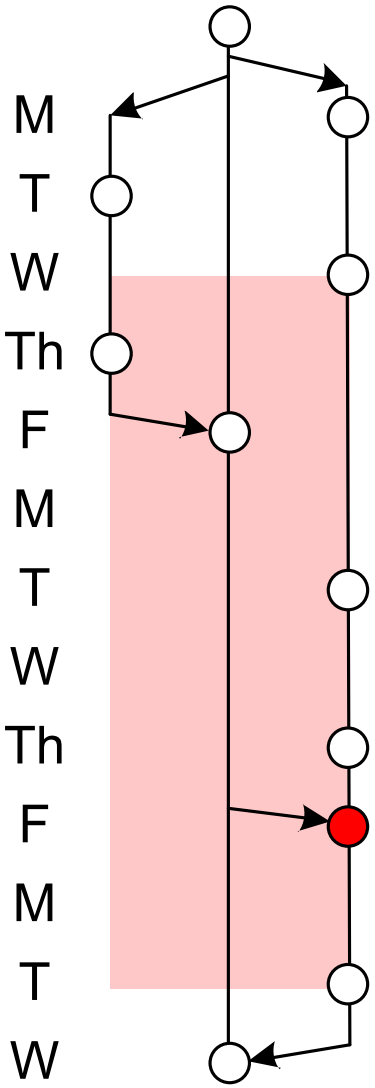

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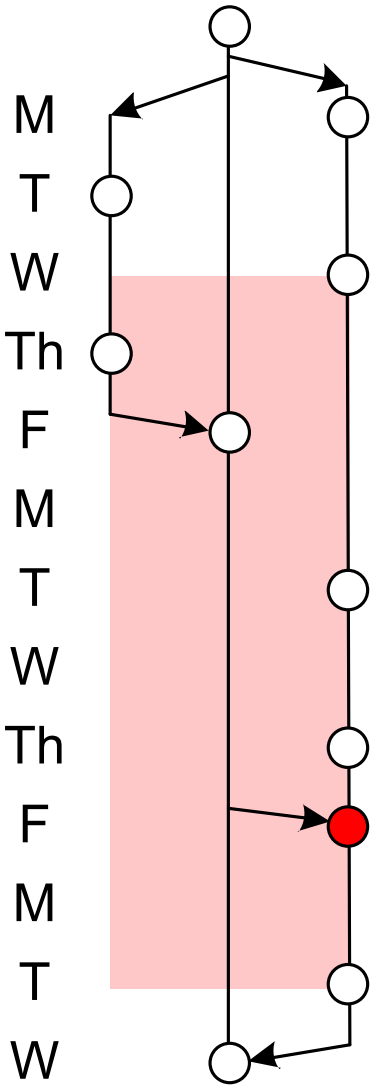
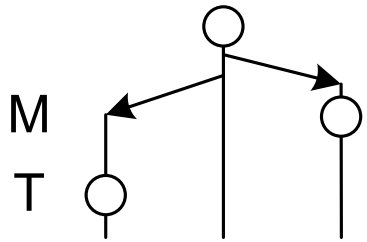


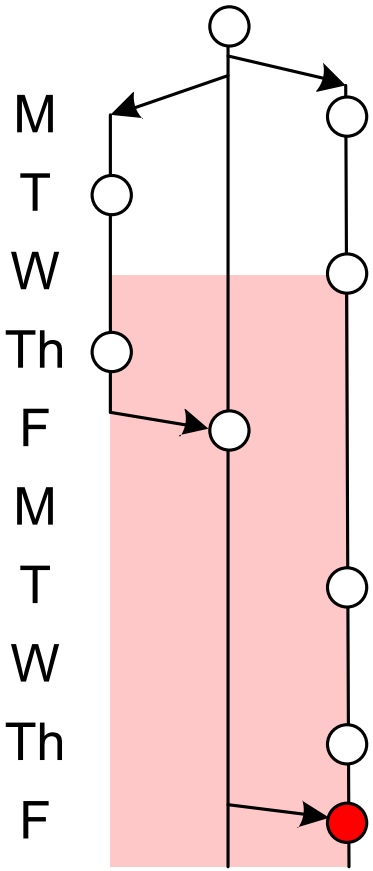
The information was all there, but the developers didn't know it.

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

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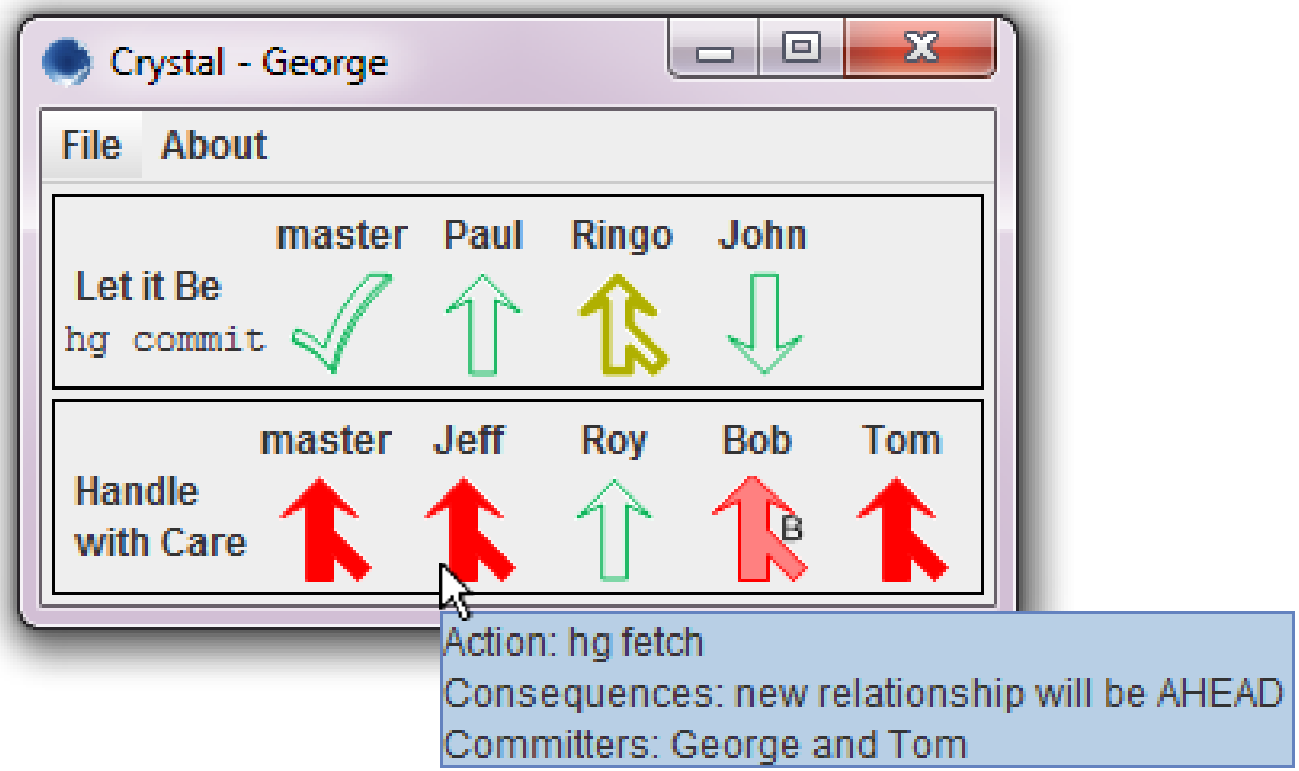
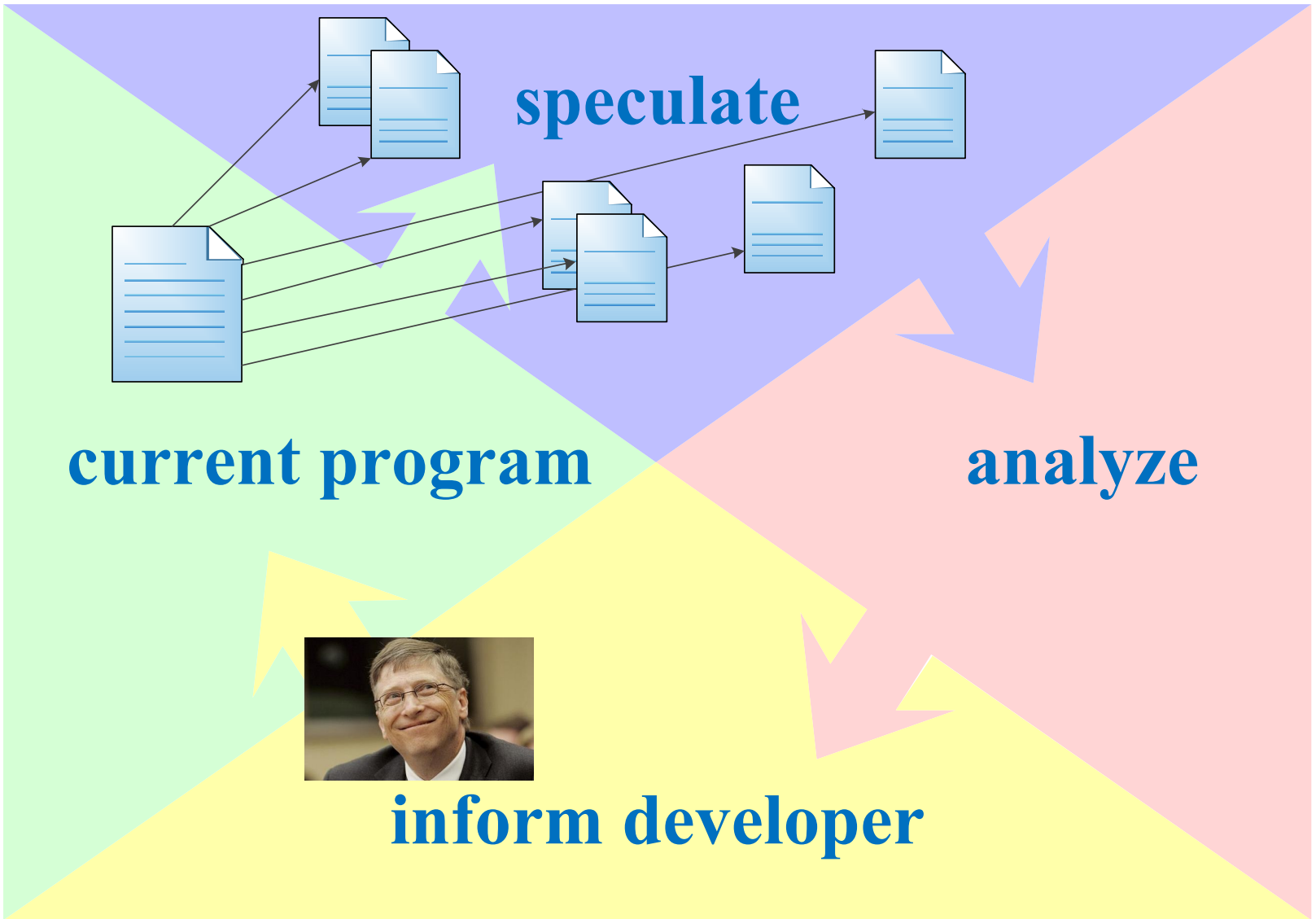
DEMO



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

Utility of proactive collaborative conflict detection

- Are textual collaborative conflicts a real problem?
- How dangerous are safe merges?
- Do higher-order collaborative conflicts exist?

Are textual collaborative conflicts a real problem?

histories of 9 open-source projects:

size:	26K–1.4MSLoC
developers:	298
versions:	140,000

Perl5, Rails, Git, jQuery, Voldemort, MaNGOS, Gallery3, Samba, Insoshi

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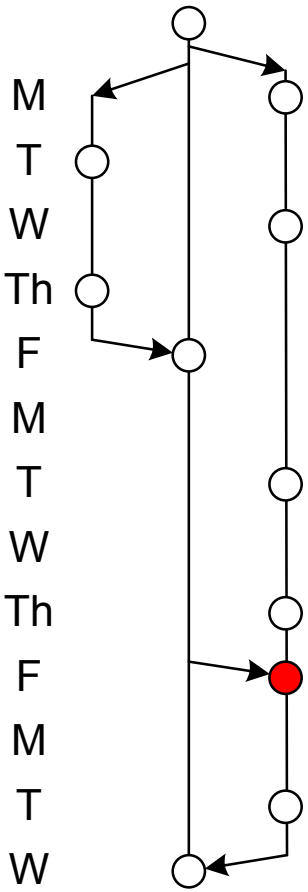

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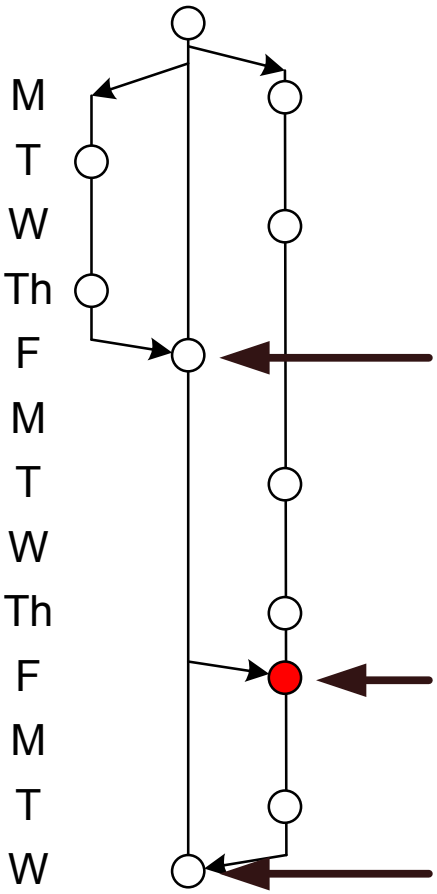
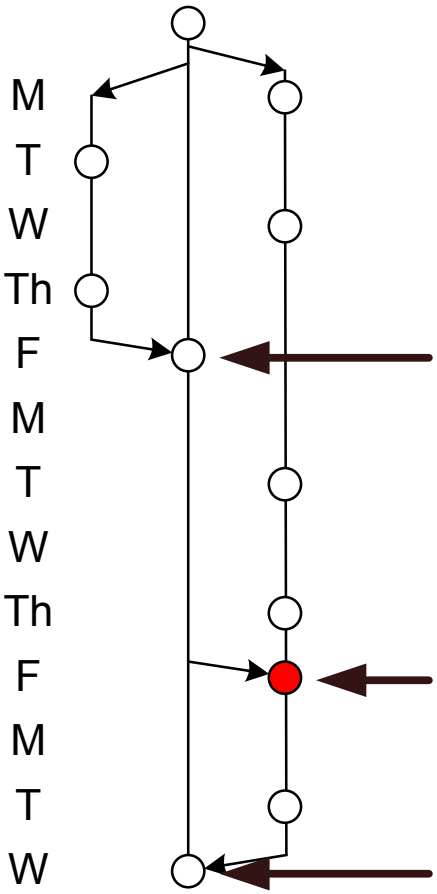


RQ1: How frequent are textual conflicts?

Are textual collaborative conflicts a real problem?



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16% of the merges have textual conflicts.

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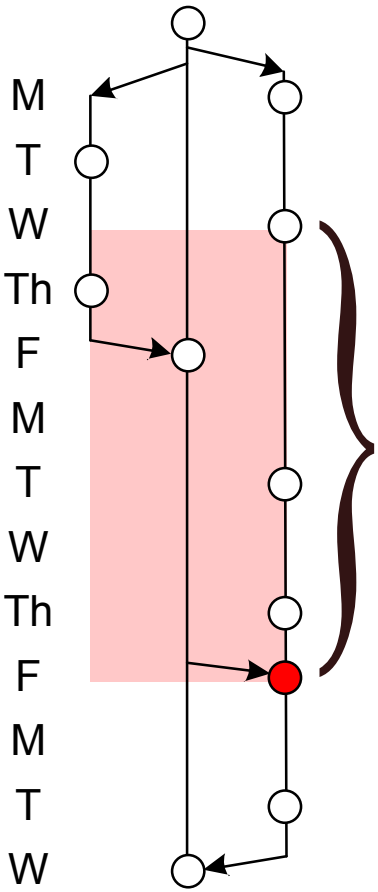

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RQ2: How long do textual conflicts persist?

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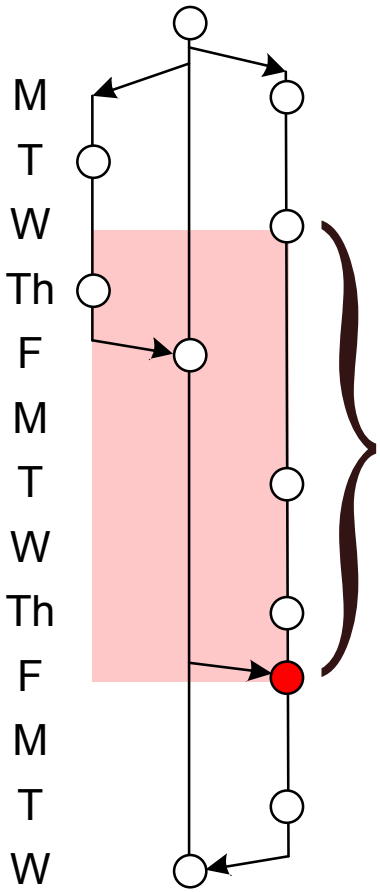

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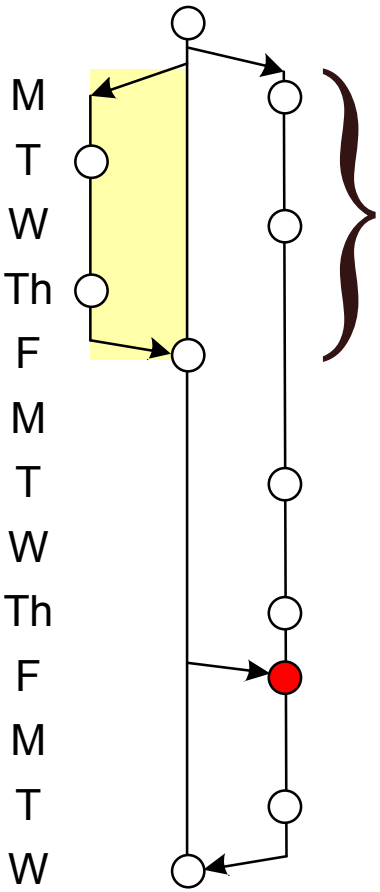
The worst case was over a year.

Are textual collaborative conflicts a real problem?



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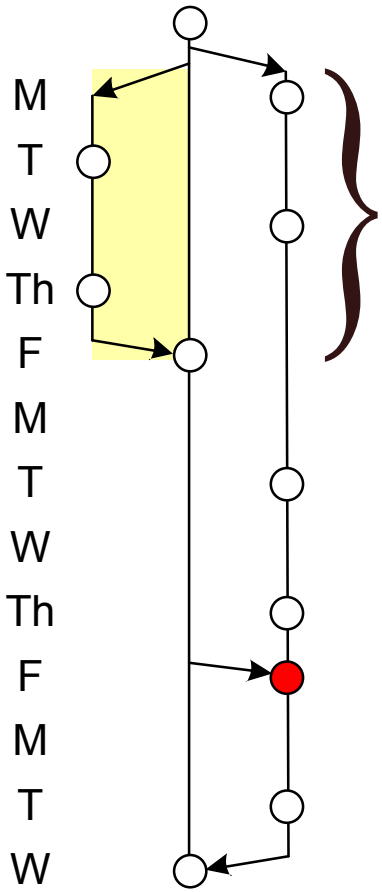

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Textually-safe merges live a mean of 11.0 and median of 1.9 days.

How dangerous are safe merges?

RQ4: Where do textual conflicts come from?

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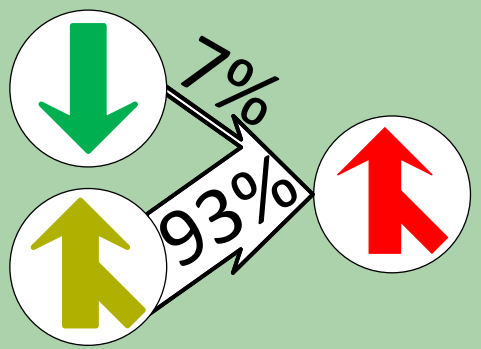
93% of textual conflicts developed from safe merges.



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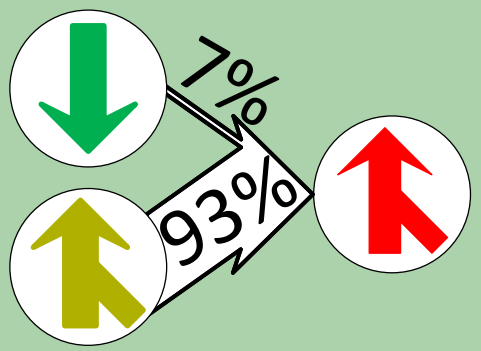

RQ5: Do textually-safe merges devolve into conflicts?

How dangerous are safe merges?

RQ4: Where do textual conflicts come from?

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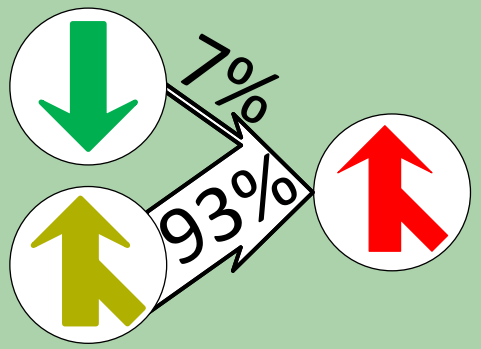
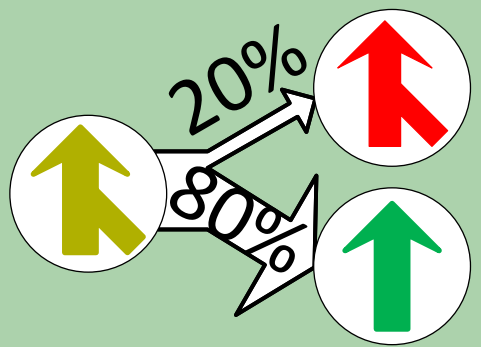


RQ5: Do textually-safe merges devolve into conflicts?

20% of textually-safe merges developed into conflicts.



Do higher-order collaborative conflicts exist?

program	conflicts			safe merges
	textual	build	test	
Git	17%	<1%	4%	79%
Perl5	8%	4%	28%	61%
Voldemort	17%	10%	3%	69%

RQ6: Does merged code fail to build or fail tests?

One in three conflicts are of higher-order.

Crystal is in the wild

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

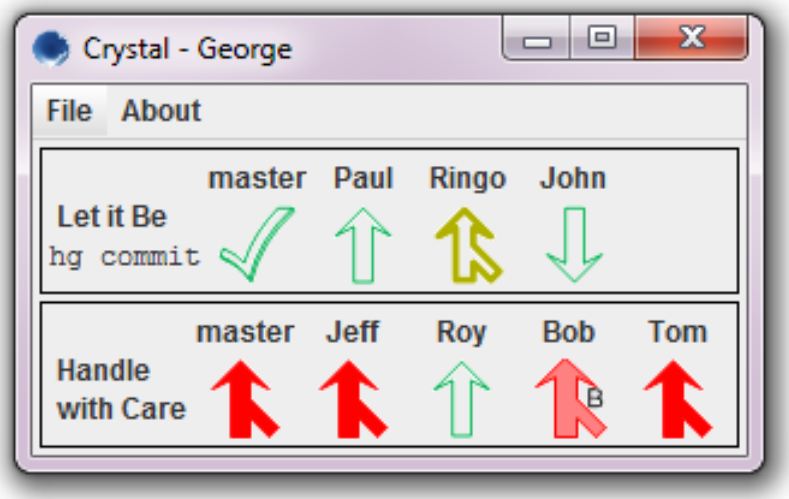
– a user

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.

Contributions

- Introduced speculative analysis to guide future actions.
- Developed Crystal to precisely detect conflicts and unobtrusively inform developers.
- Analyzed 9 projects with over 140,000 versions: conflicts are frequent and persistent.



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