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
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Exploring the future

- past version of the program
- present version of the program
- future version of the program

- delta debugging
- automated debugging
- continuous testing

Speculative analysis is predictive.
Exploring the future

- past version of the program
- present version of the program
- future version of the program

- speculative analysis
- collaborative conflicts
- utility evaluation
- contributions

- mining software repositories
- regression testing
- delta debugging
- continuous testing
- automated debugging

Continuous development
- execution
- compilation
- testing
- version control integration
Exploring the future

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]
Exploring the future

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

**Terminology:**

- **Local commit:**
  - decentralized: commit
  - centralized: save

- **Incorporate:**
  - decentralized: push and pull
  - centralized: commit and update
The Gates conflict

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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
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

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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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Are textual collaborative conflicts a real problem?

RQ1: How frequent are textual conflicts?

16% of the merges have textual conflicts.

RQ2: How long do textual conflicts persist?

Conflicts live a mean of 9.8 and median of 1.6 days. The worst case was over a year.

RQ3: How long do textually-safe merges persist?

Textually-safe merges live a mean of 11.0 and median of 1.9 days.
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RQ5: Do textually-safe merges devolve into conflicts?
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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?

<table>
<thead>
<tr>
<th>program</th>
<th>conflicts</th>
<th>safe merges</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>textual</td>
<td>build</td>
</tr>
<tr>
<td>Git</td>
<td>17%</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Perl5</td>
<td>8%</td>
<td>4%</td>
</tr>
<tr>
<td>Voldemort</td>
<td>17%</td>
<td>10%</td>
</tr>
</tbody>
</table>

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.

http://crystalvc.googlecode.com


Eclipse.


