# An Empirical Study of Highly-Impactful Bugs in Mozilla Projects

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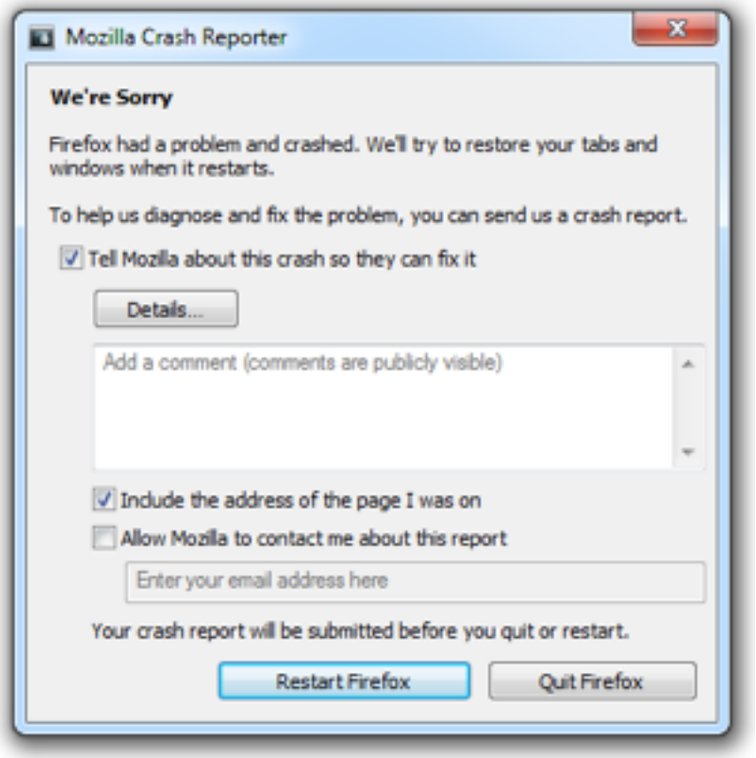
4 August, Vancouver, Canada


# Outline

- Background (Mozilla crash collecting system)
- Challenge
- Research questions
- Study design
- Case study results
- Conclusion

# Crash Collecting System




https://support.mozilla.org/en-US/kb/mozillacrashreporter

https://crash-stats.mozilla.com/

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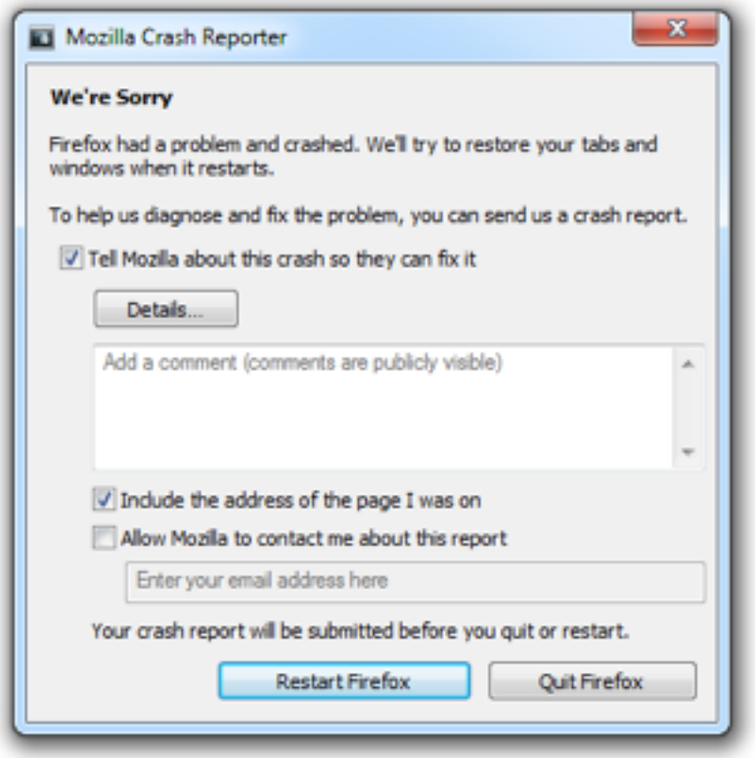


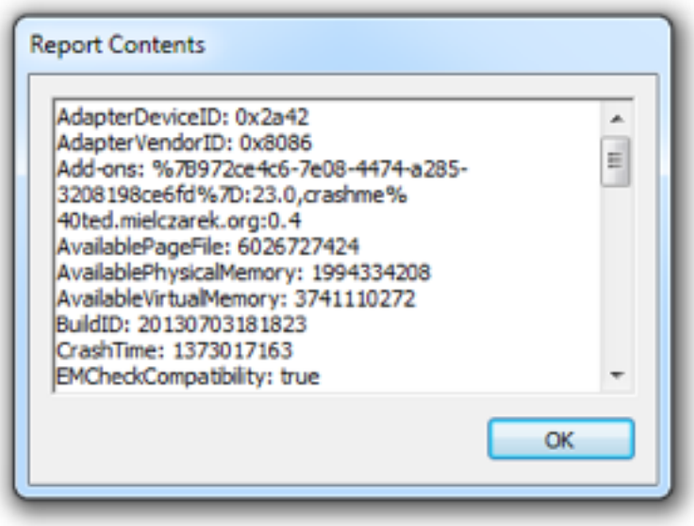


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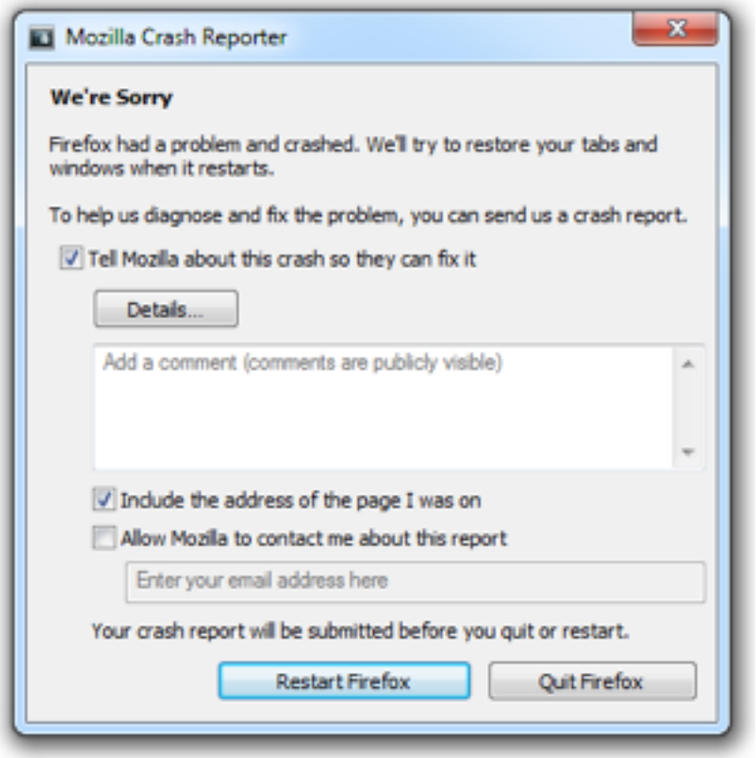
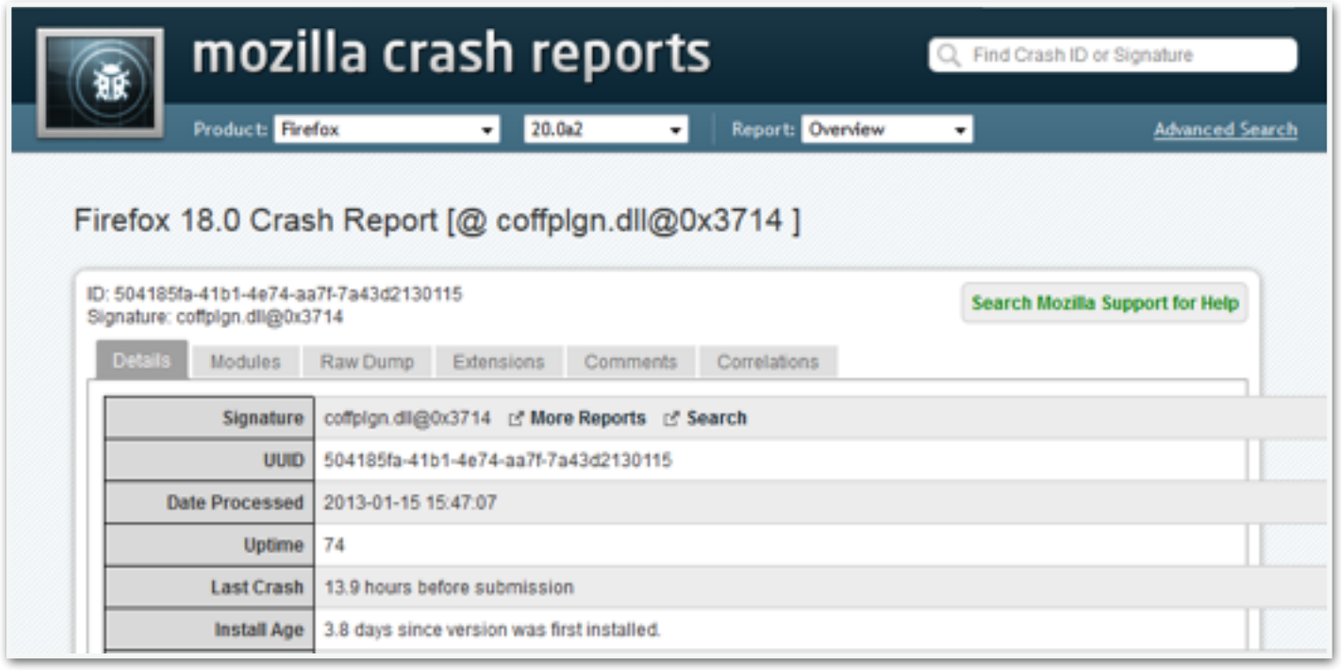
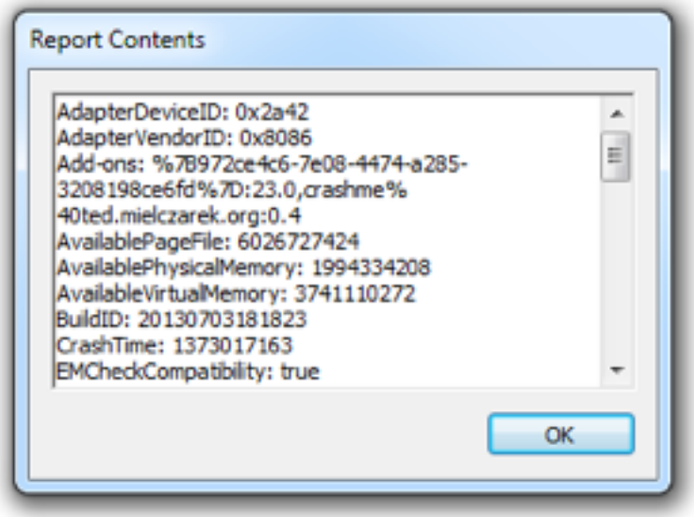
Socorro

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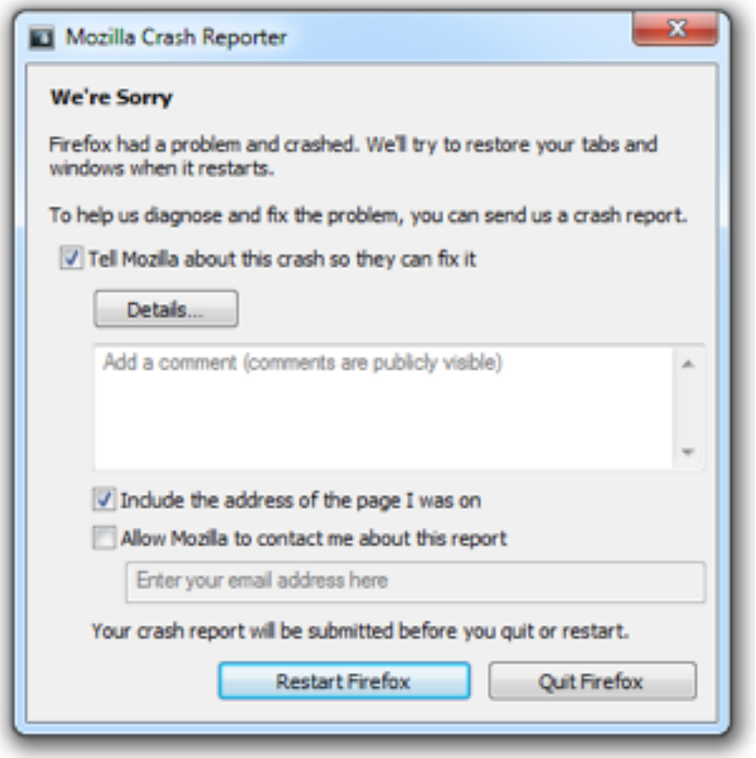


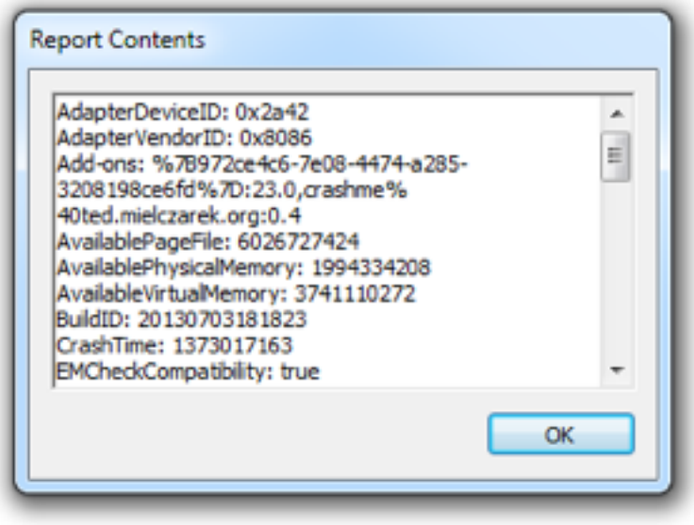


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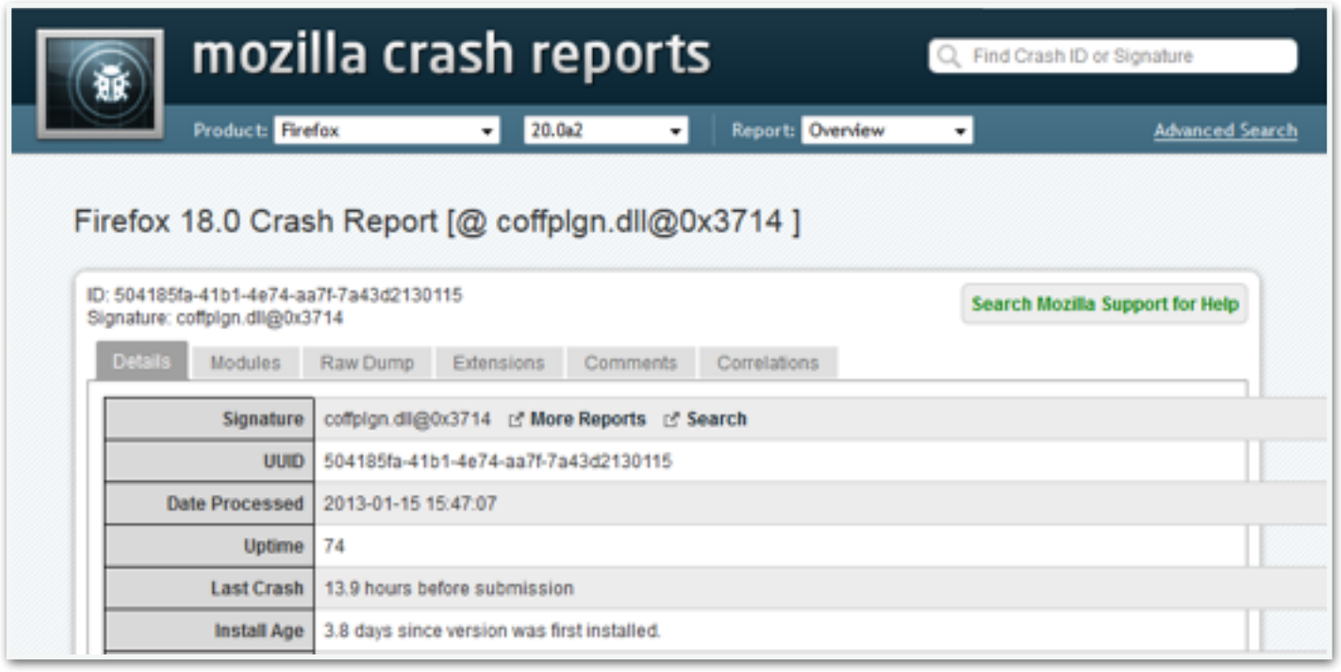


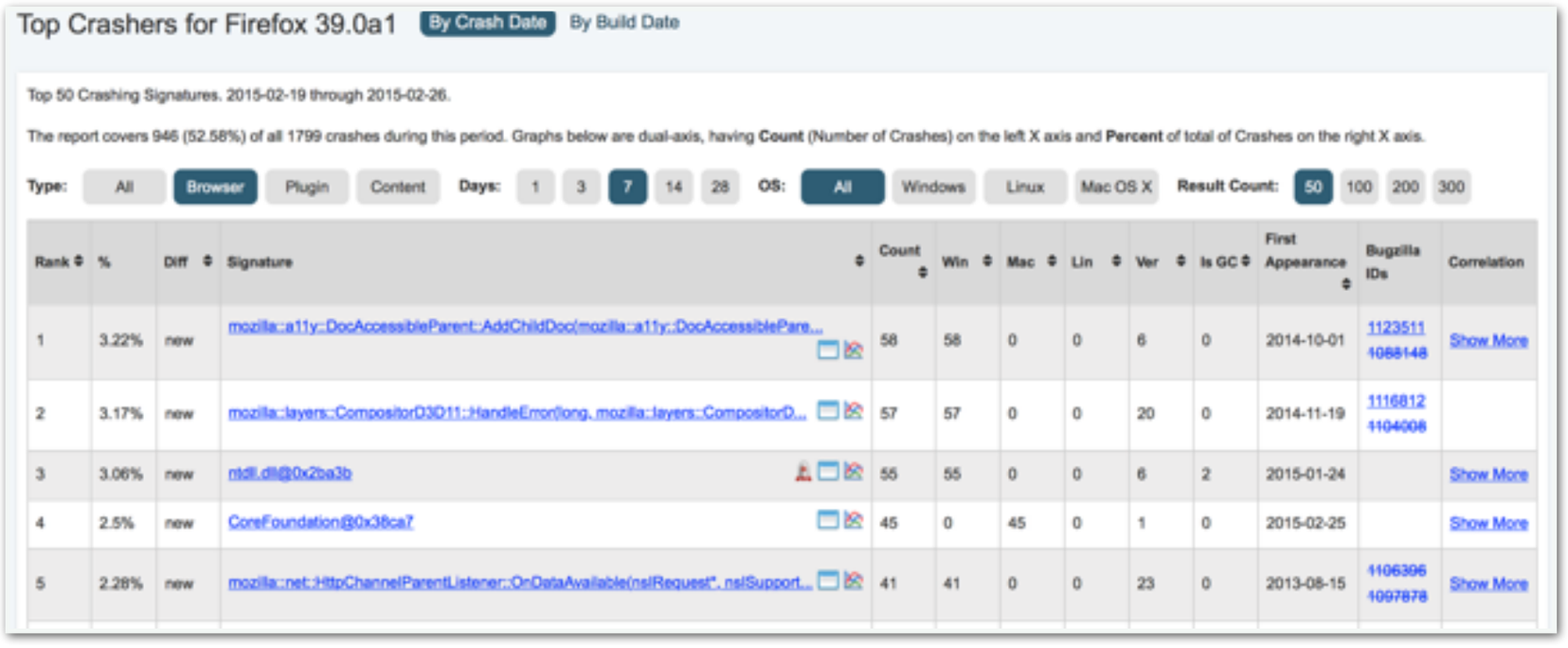


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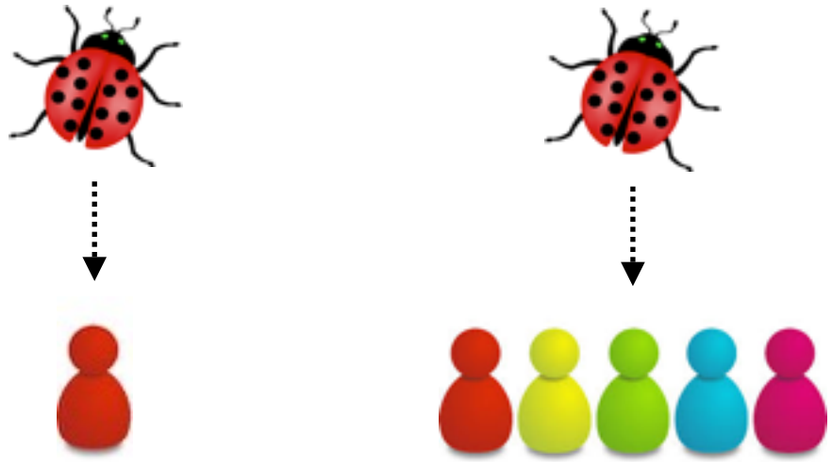

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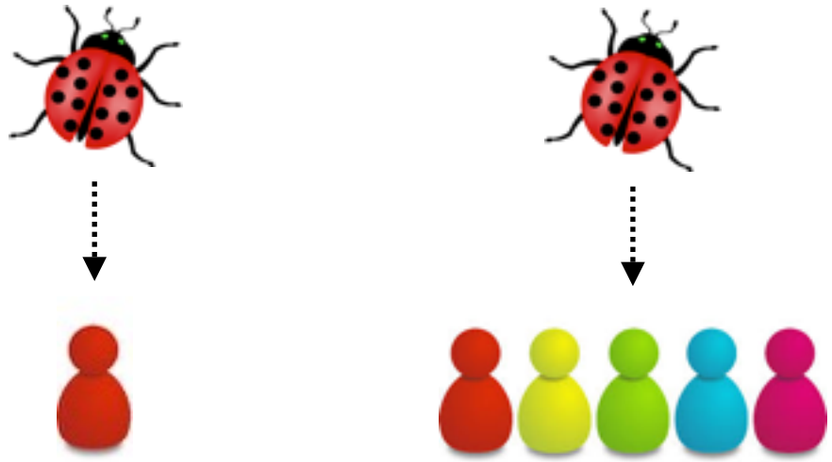

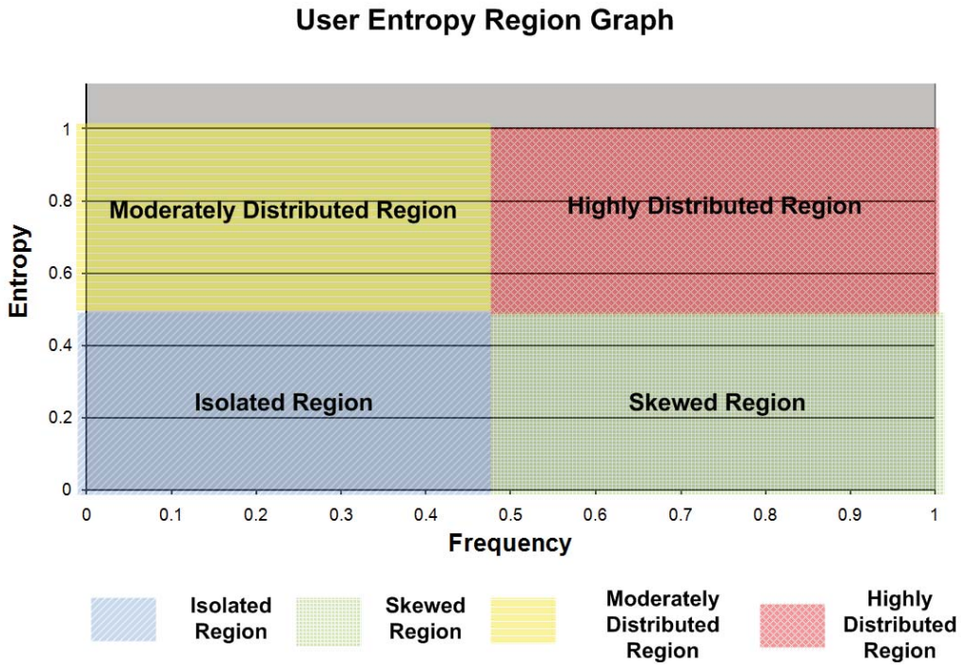


Khomh et al. (2011)

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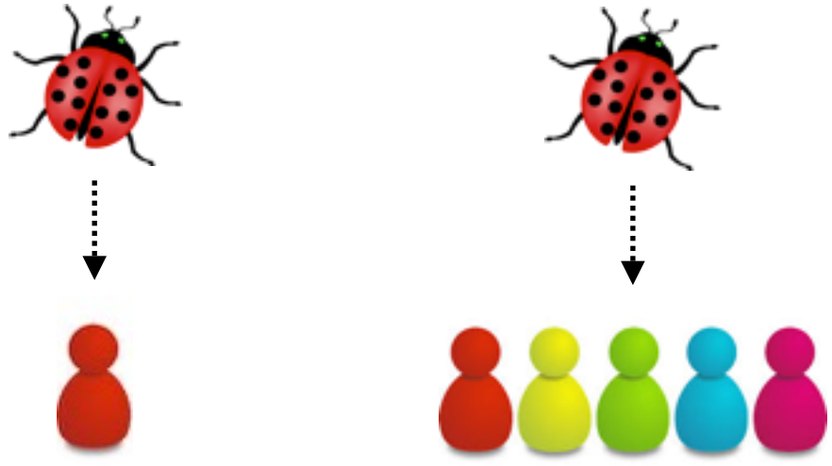
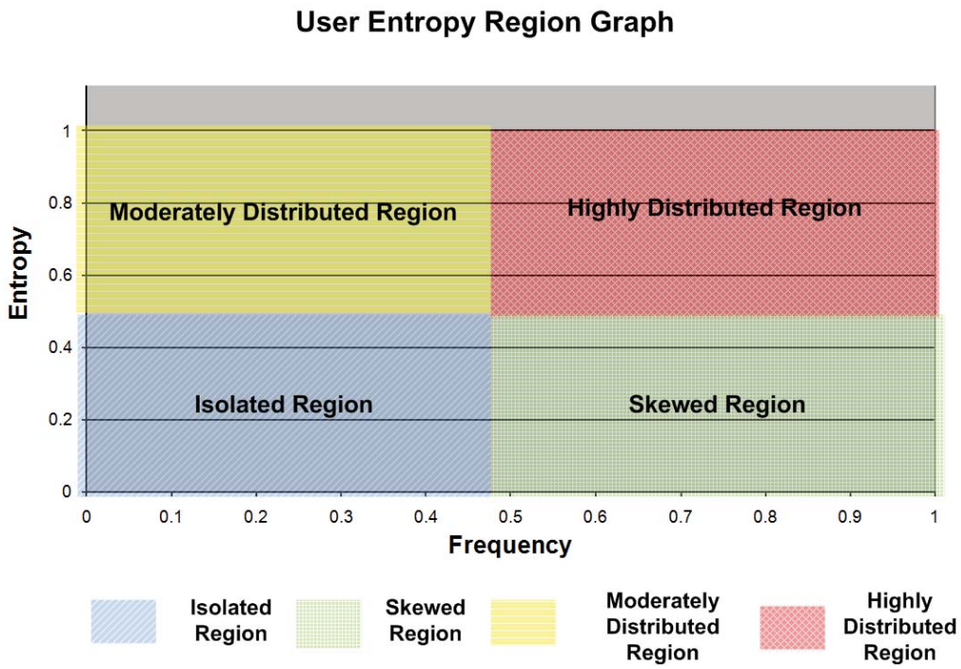


**highly-impactful bugs** = bugs affecting a large number of users with high crashing frequency

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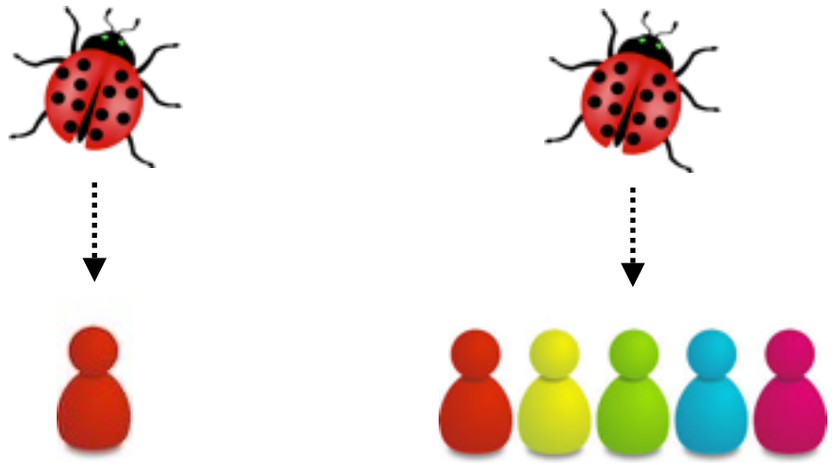
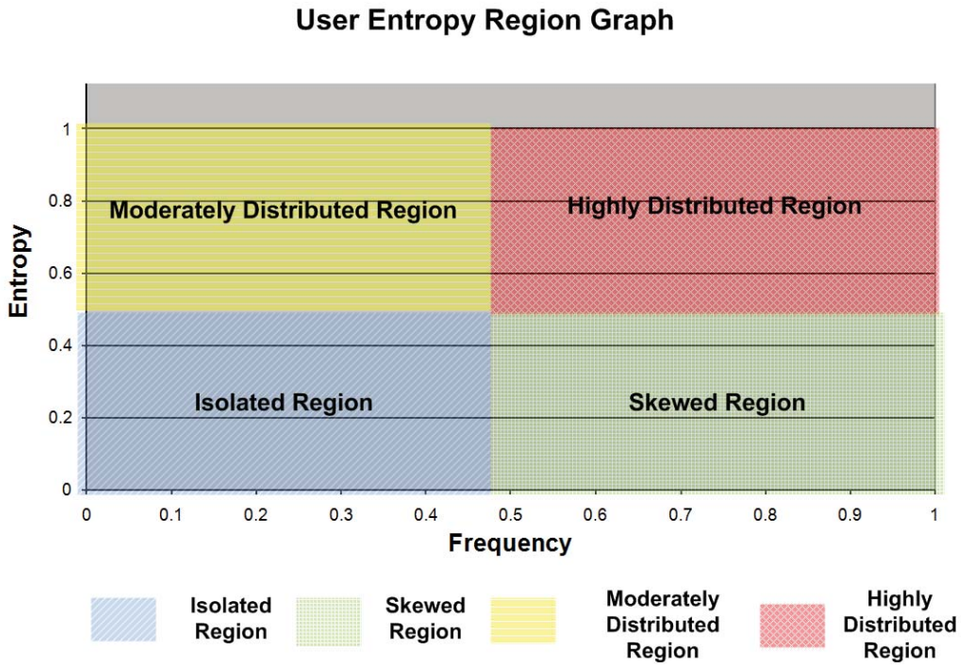


**highly-impactful bugs** = bugs affecting a large number of users (*entropy*) with high crashing frequency (*occurrences*)

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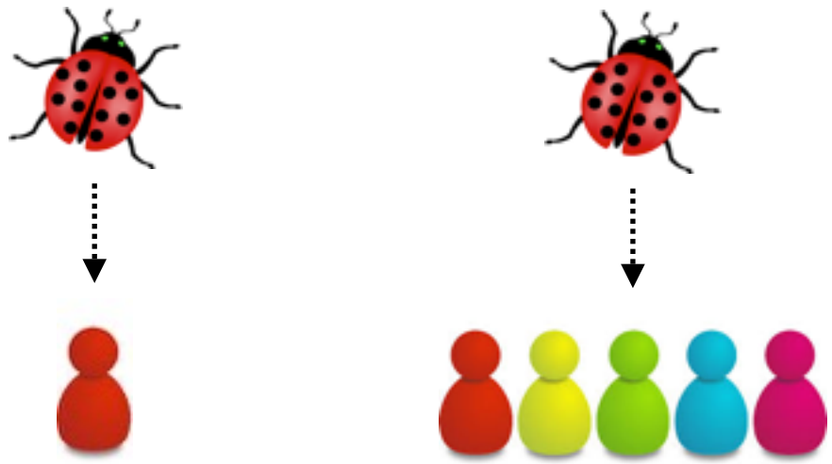

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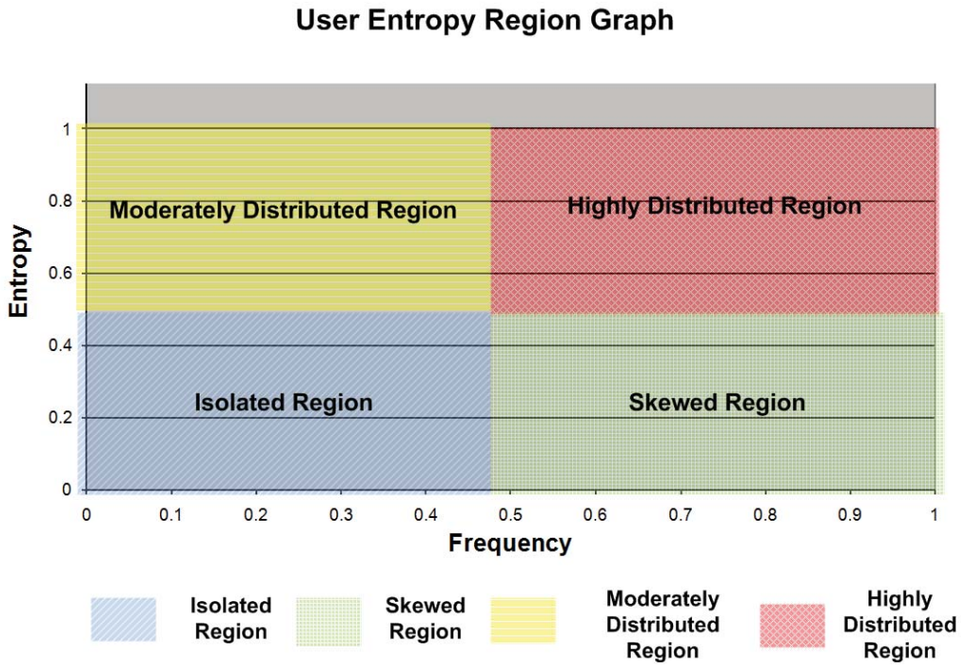



Khomh et al. (2011)

*When the region graph is built, large number of end users have been impacted from crashes for a long time*

# Research Questions?

What is the percentage of highly-impactful bugs?

What are the characteristics of highly-impactful bugs?

Could we predict highly-impactful bugs?

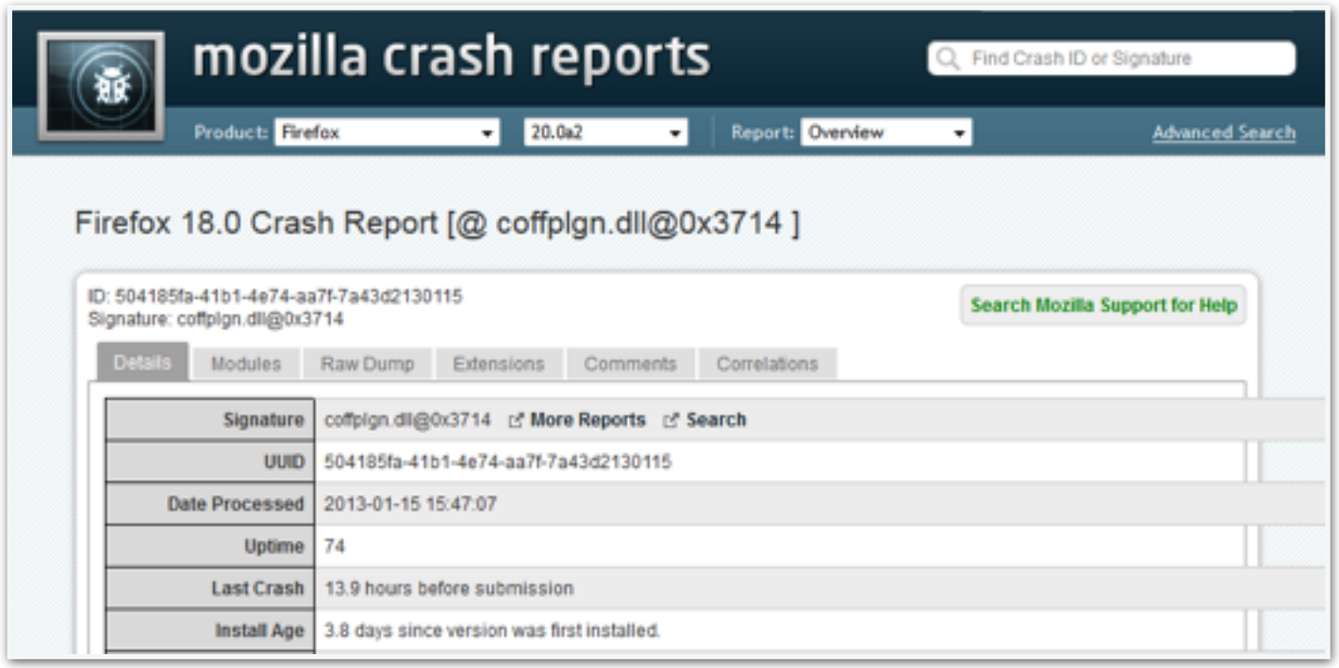
What are the benefits of applying our early triaging technique?

# Subject Systems

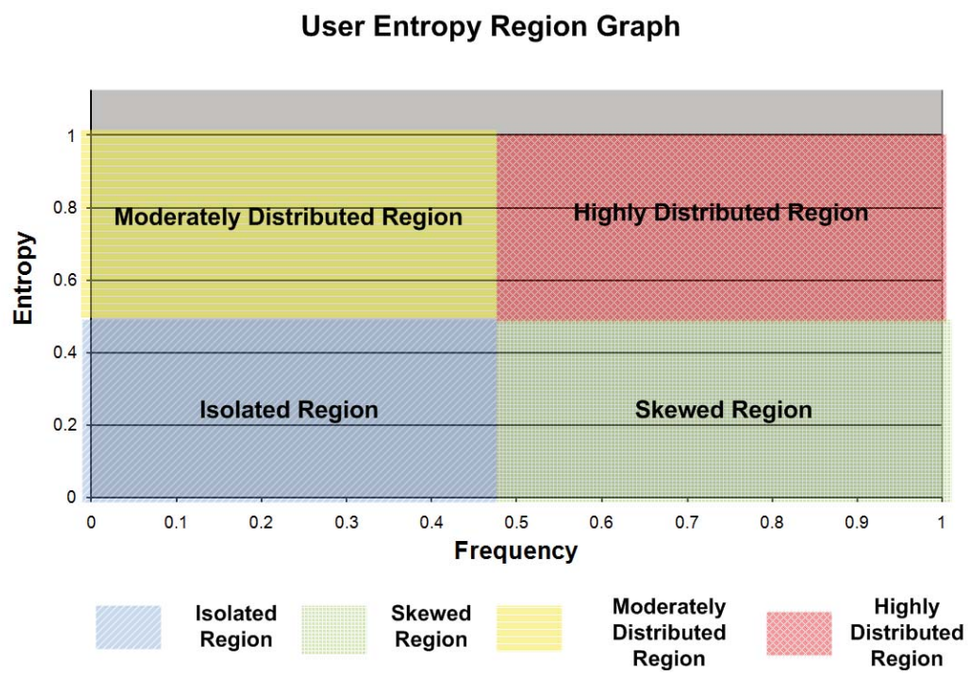
Mozilla Firefox

Mozilla Fennec
(for Android)

# Identification of Highly-impactful Bugs




$$H_n(b) = -\sum_{i=1}^{n} p_i \times log_n(p_i)$$

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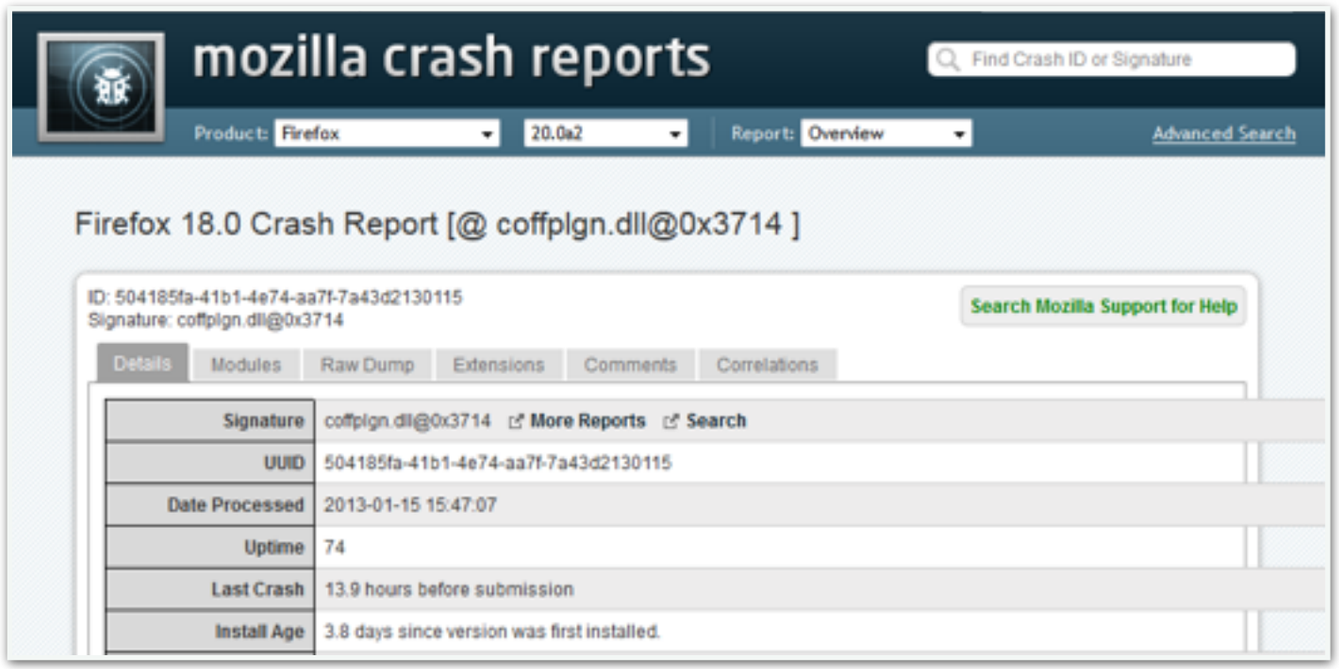


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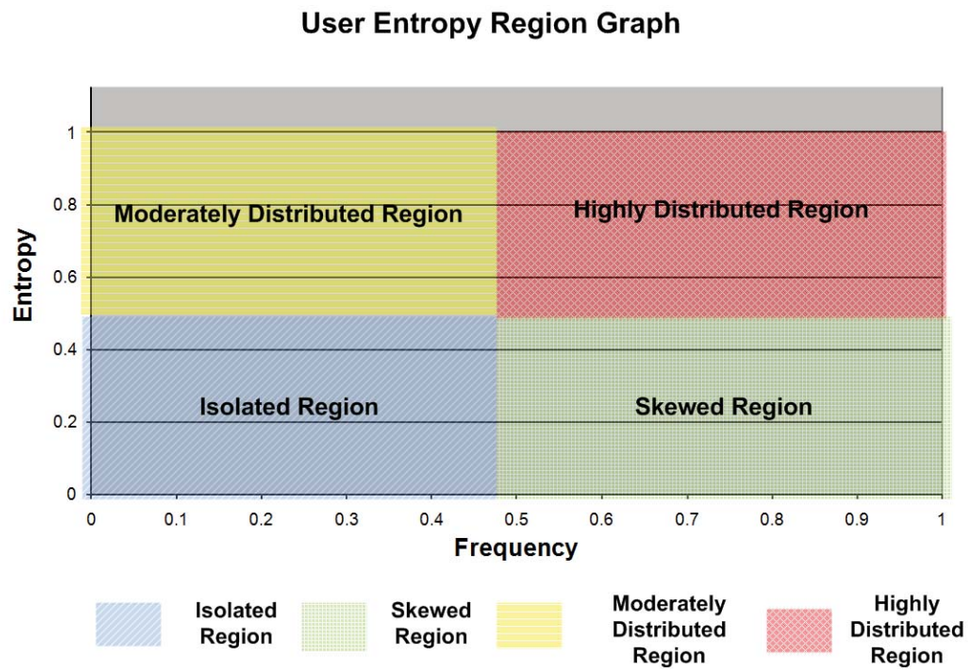
machine profile (CPU, OS, OS version)

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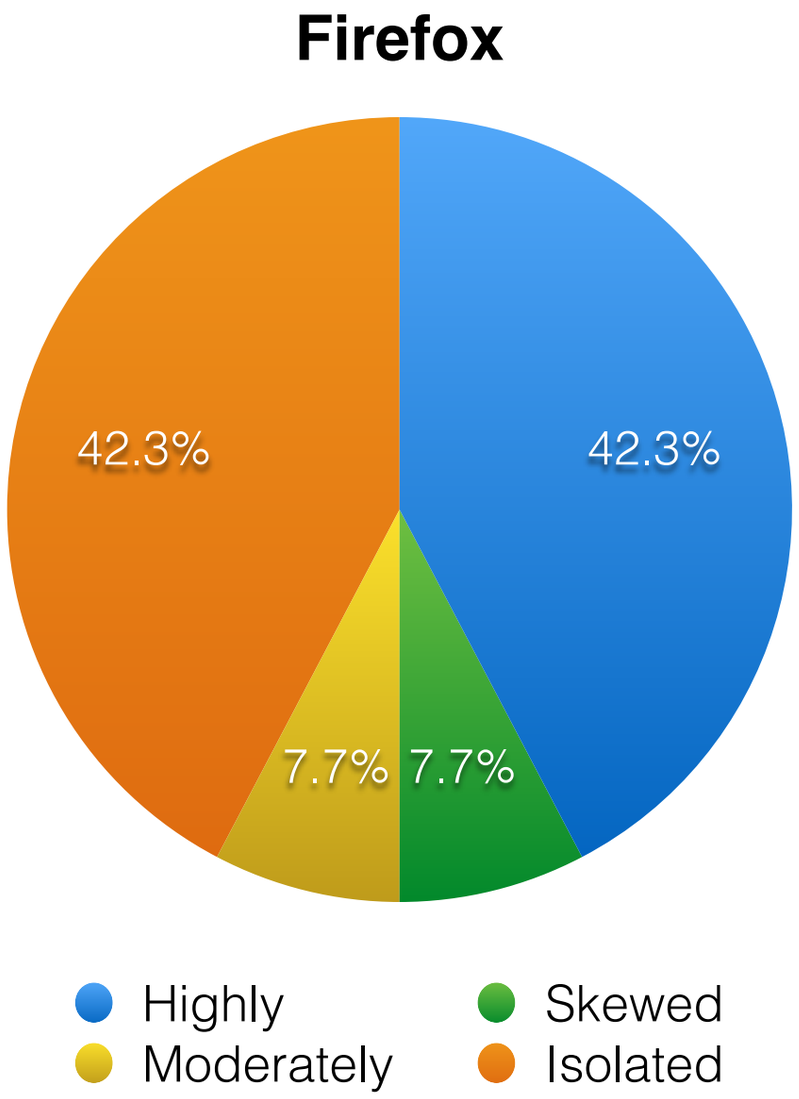
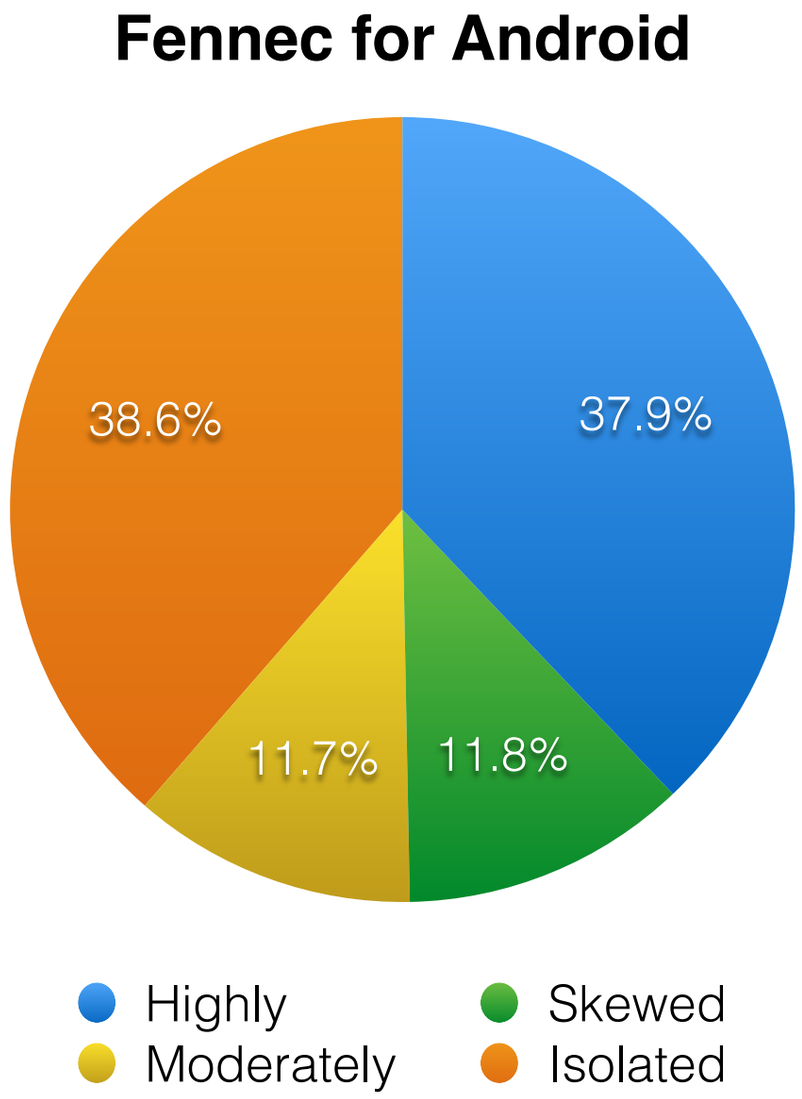
# % of Highly-Impactful Bugs



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# Highly-impactful vs. Other bugs

Highly-impactful bugs

Other bugs

reporter experience

> 

comment length

> 

closed %

< 

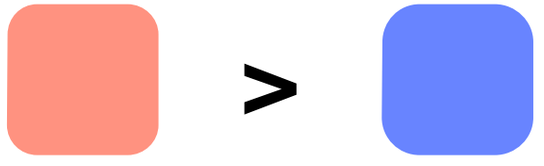
# Highly-impactful vs. Other bugs

Highly-impactful bugs

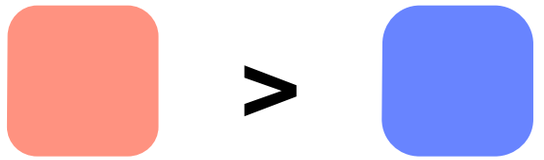
Other bugs

*Mozilla quality assurance teams do not prioritise highly-impactful bugs, though they impact a large user base.*

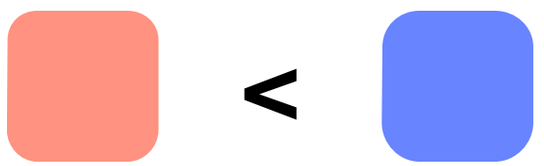
reporter experience



comment length



closed %



# Identifying Highly-Impactful Bugs with Different Thresholds of Frequency & Entropy


50 percentile


70 percentile


90 percentile

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V.S.


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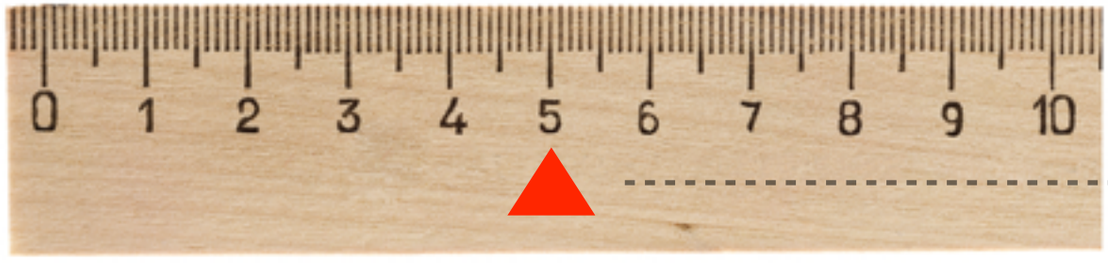


50 percentile

V.S.


70 percentile


90 percentile

- Only trivial changes could be observed from the results of 70/90 percentile.
- Very few highly-impactful bugs are identified if we increase the thresholds.
- Different thresholds will not affect our conclusion.

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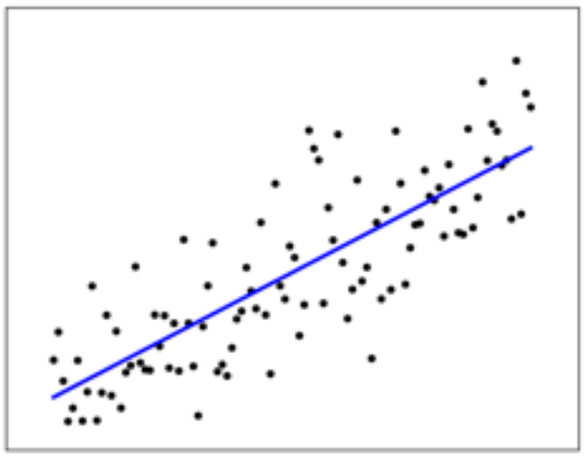
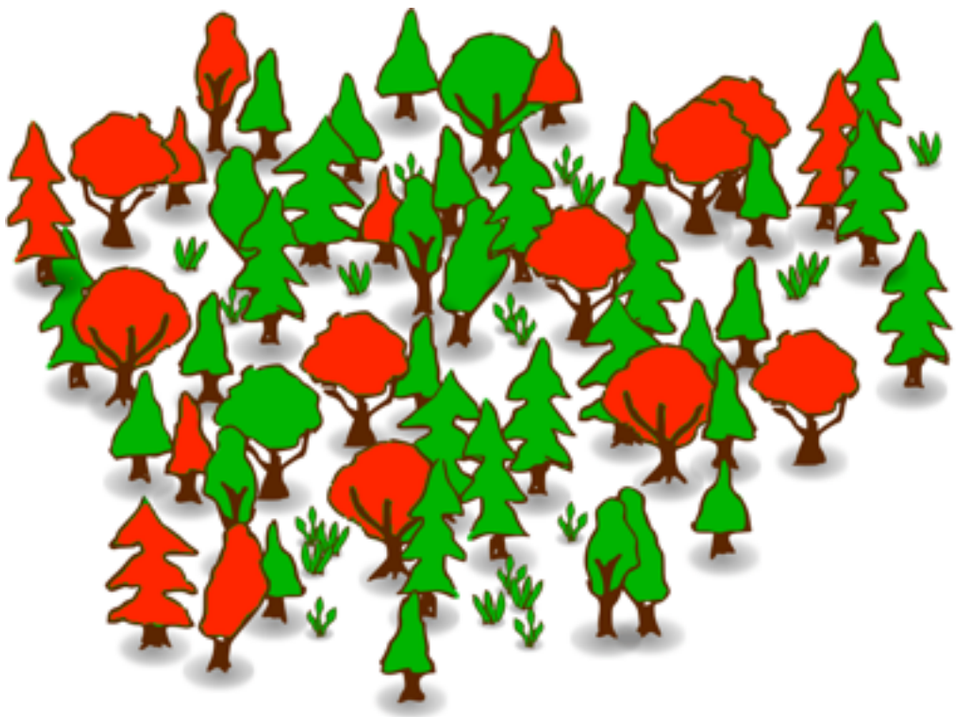
# Predictive Algorithms



**General Linear Model**

**C5.0** **ctree (party)**

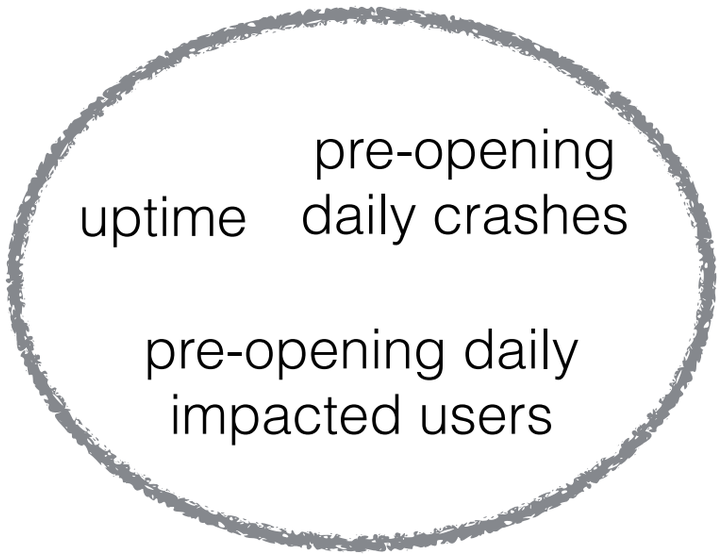


**randomForest** **cforest (party)**

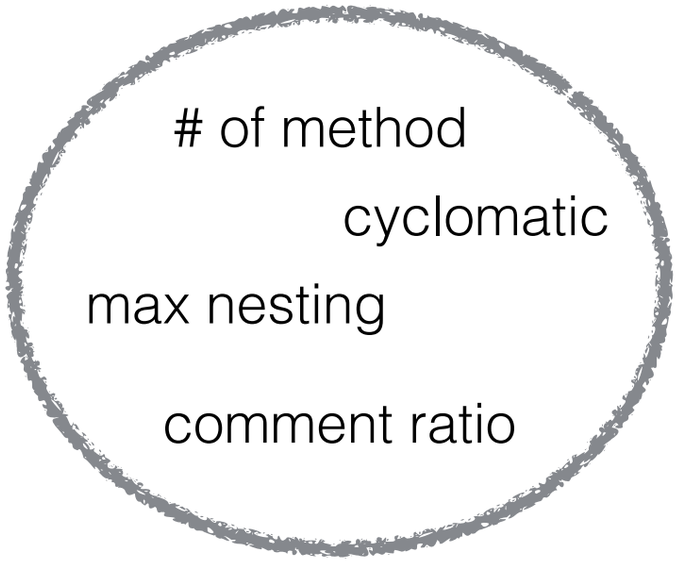
# Predictive Metrics and Results

**Bug report**

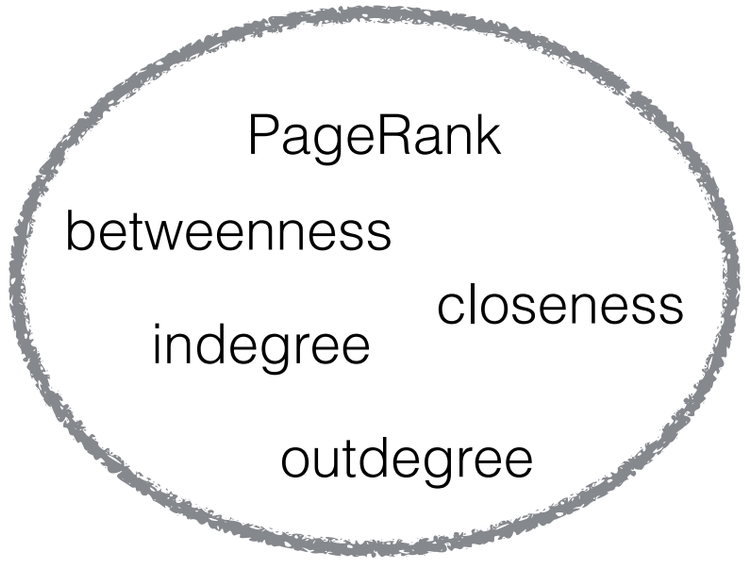

**Crash report**




**Code complexity**




**Social network analysis**



# Predictive Metrics and Results

**Bug report**

day in month

hour

weekday

component

M

reporter experience

**Crash report**

uptime

pre-opening daily crashes

pre-opening daily impacted users

**cforest is the best model in our case study**

**Code complexity**

# of method

cyclomatic

max nesting

comment ratio

**Social network analysis**

PageRank

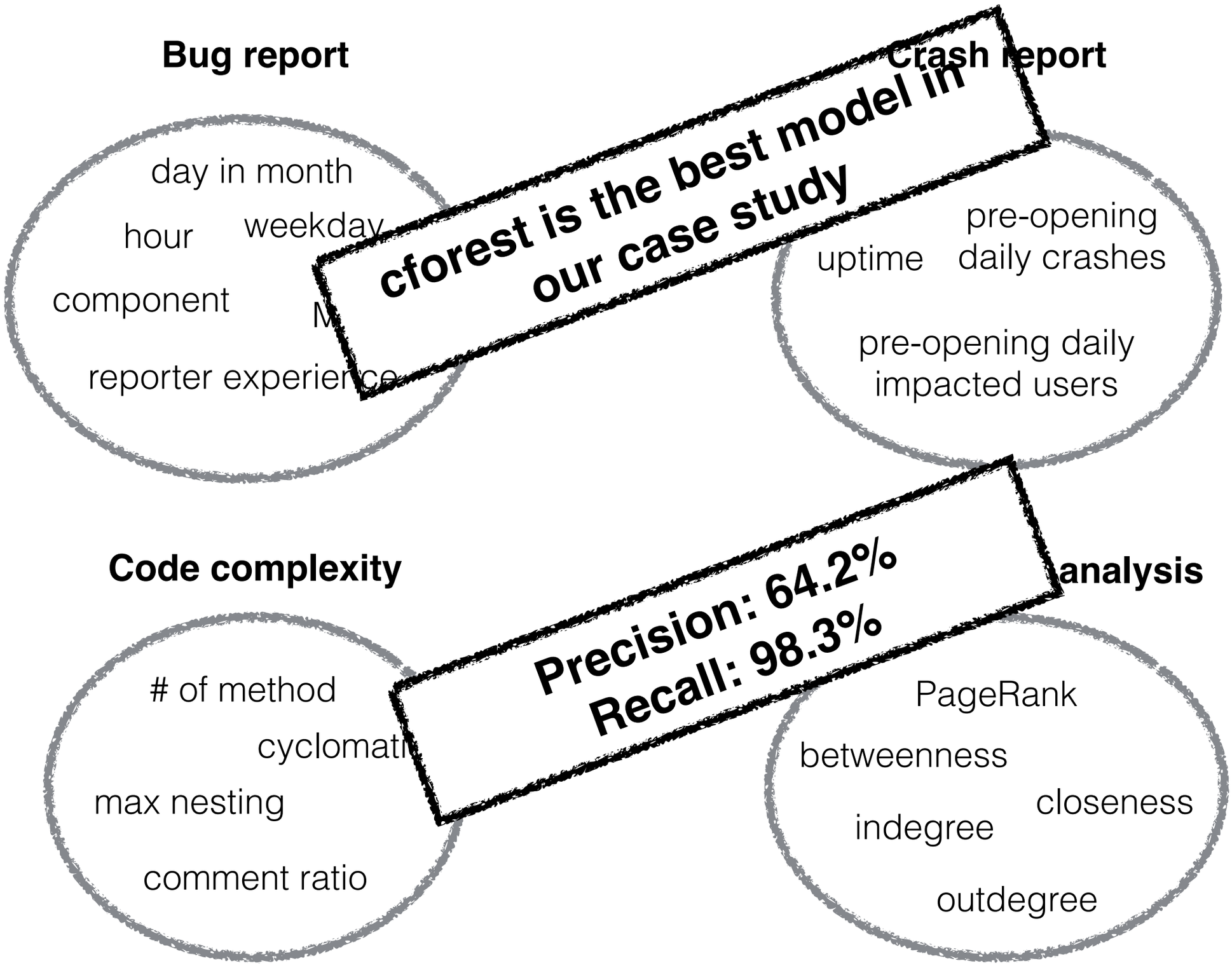
betweenness

closeness

indegree

outdegree

# Predictive Metrics and Results



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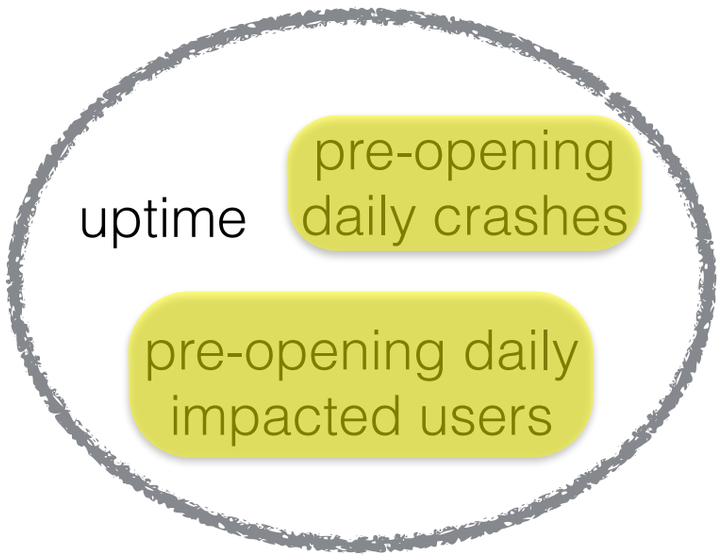


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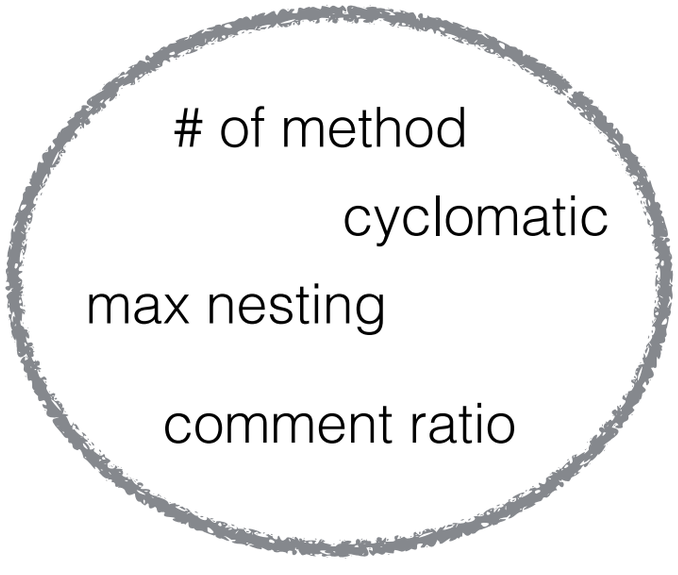


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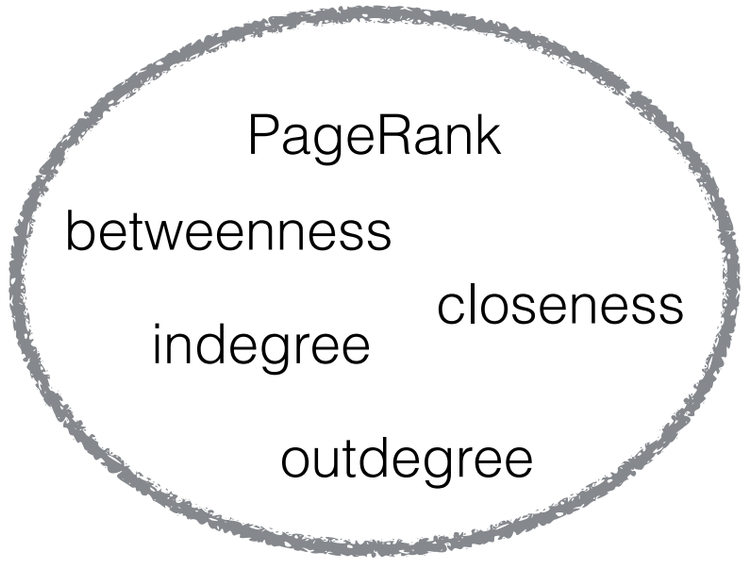

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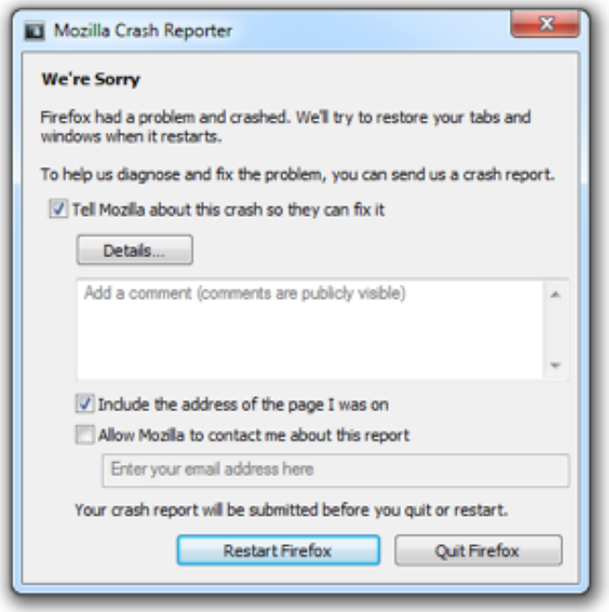
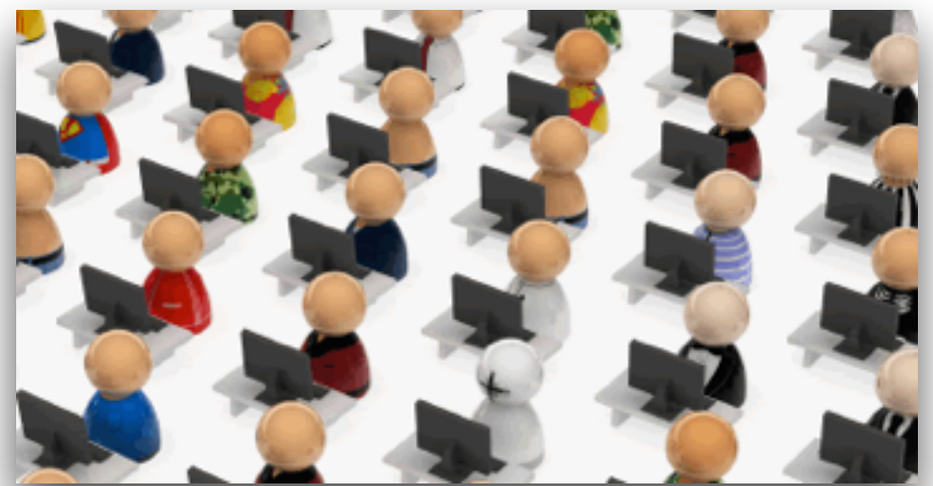
# Benefit Analysis




crash occurrences

Firefox 23%

Fennec 13.4%



unique impacted users

Firefox 28.6%

Fennec 49.4%