An Empirical Study of Highly-Impactful Bugs in Mozilla Projects

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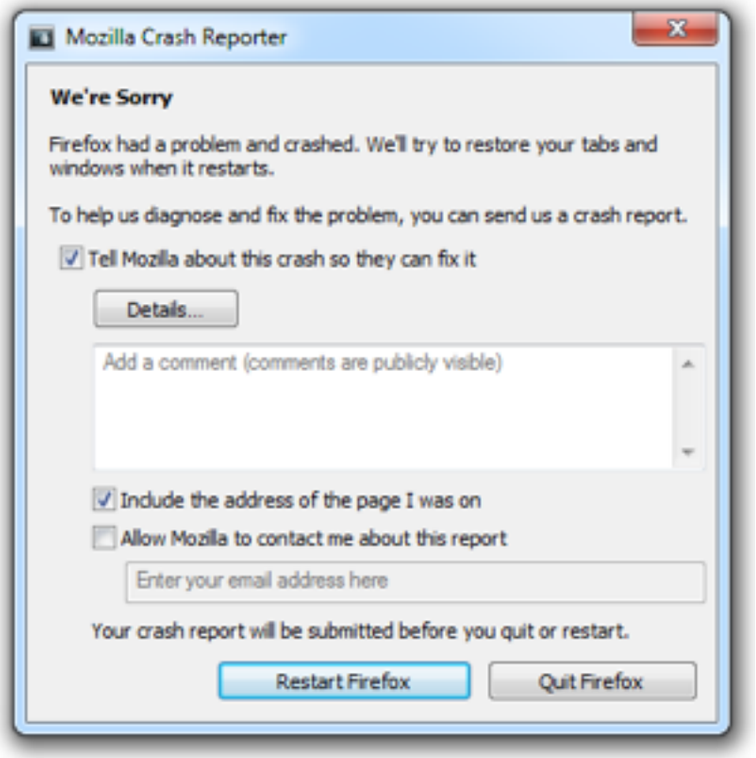
4 August, Vancouver, Canada

Outline

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

Crash Collecting System



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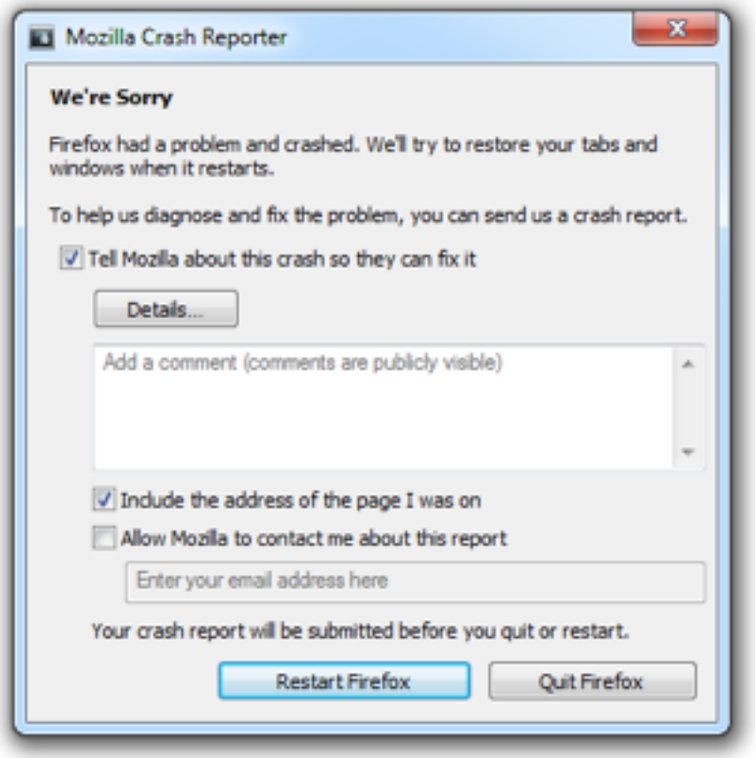

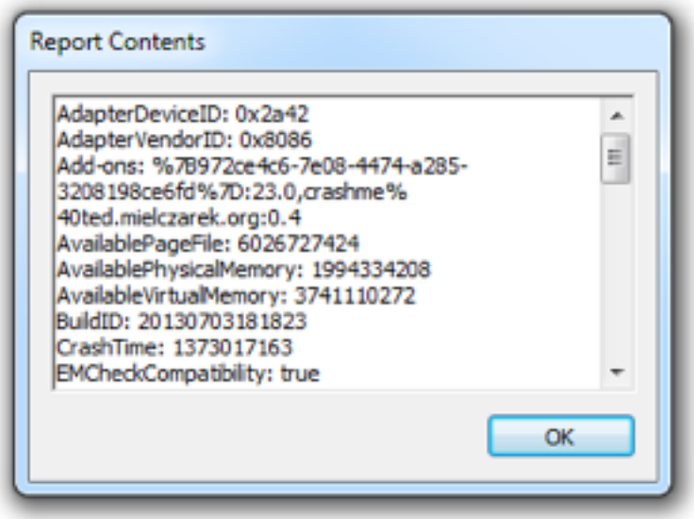

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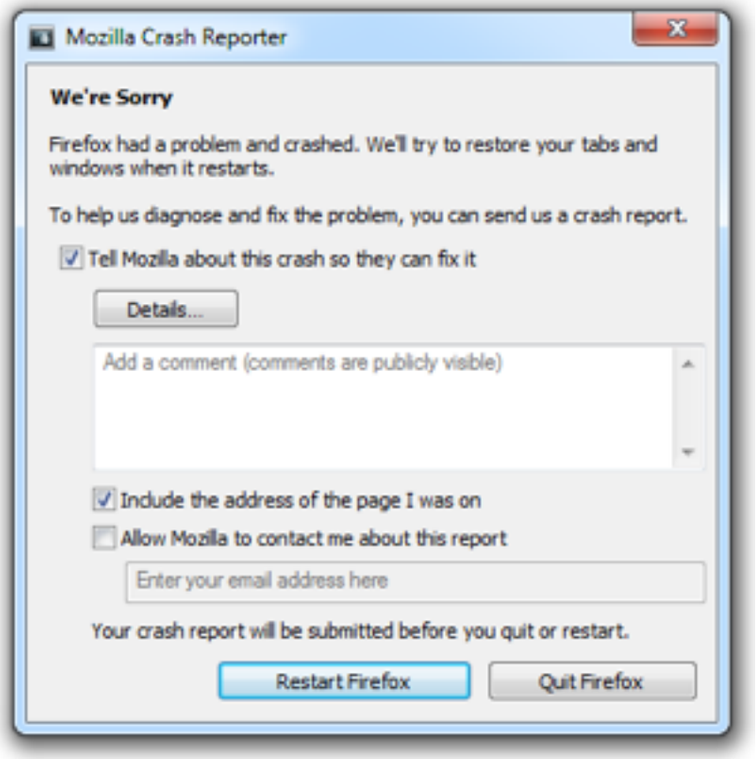
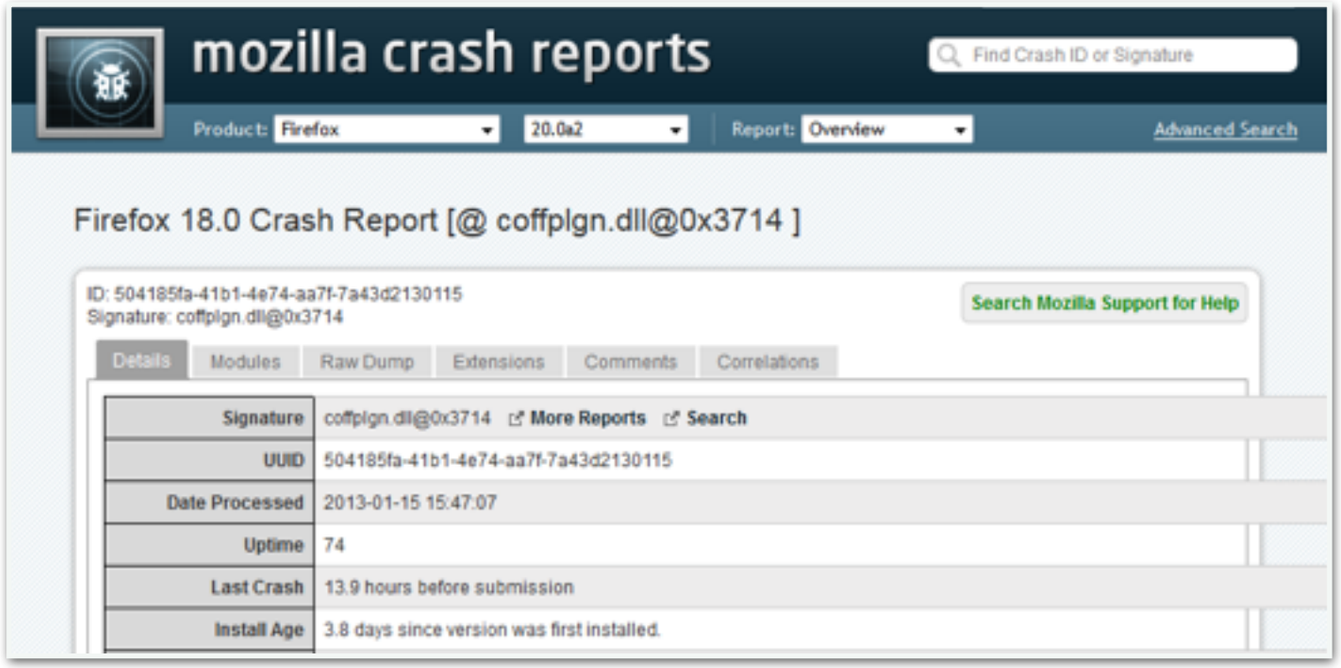
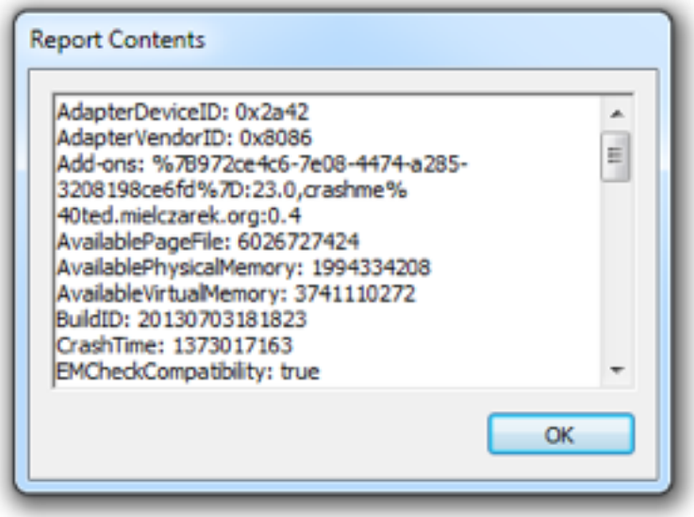
Crash Collecting System

Socorro







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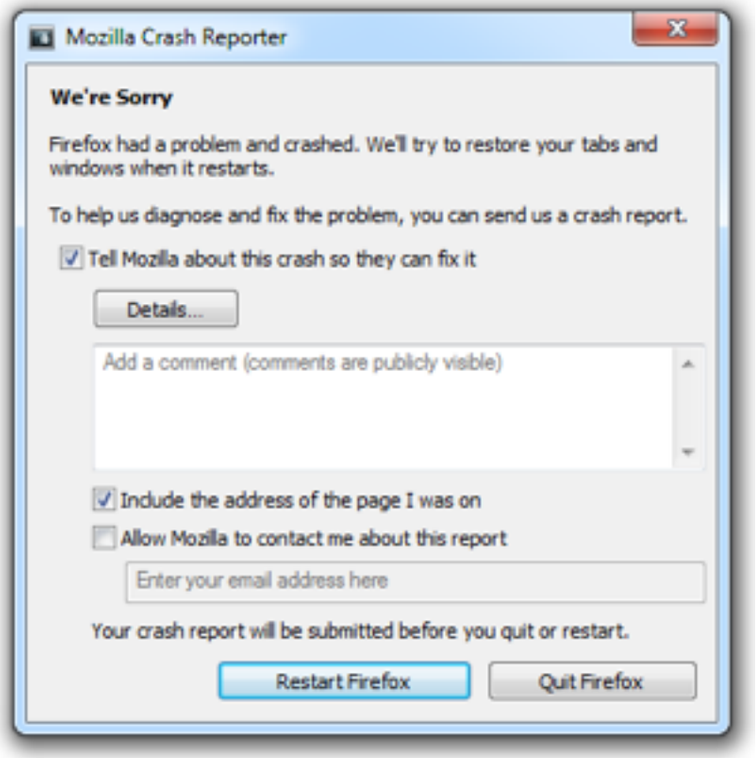

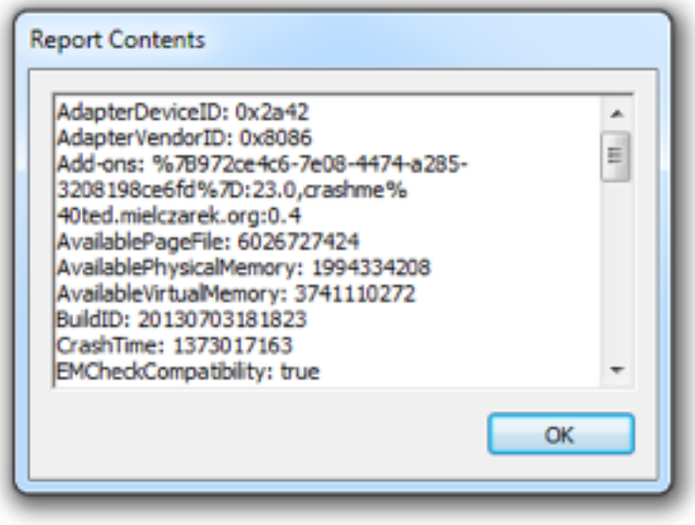

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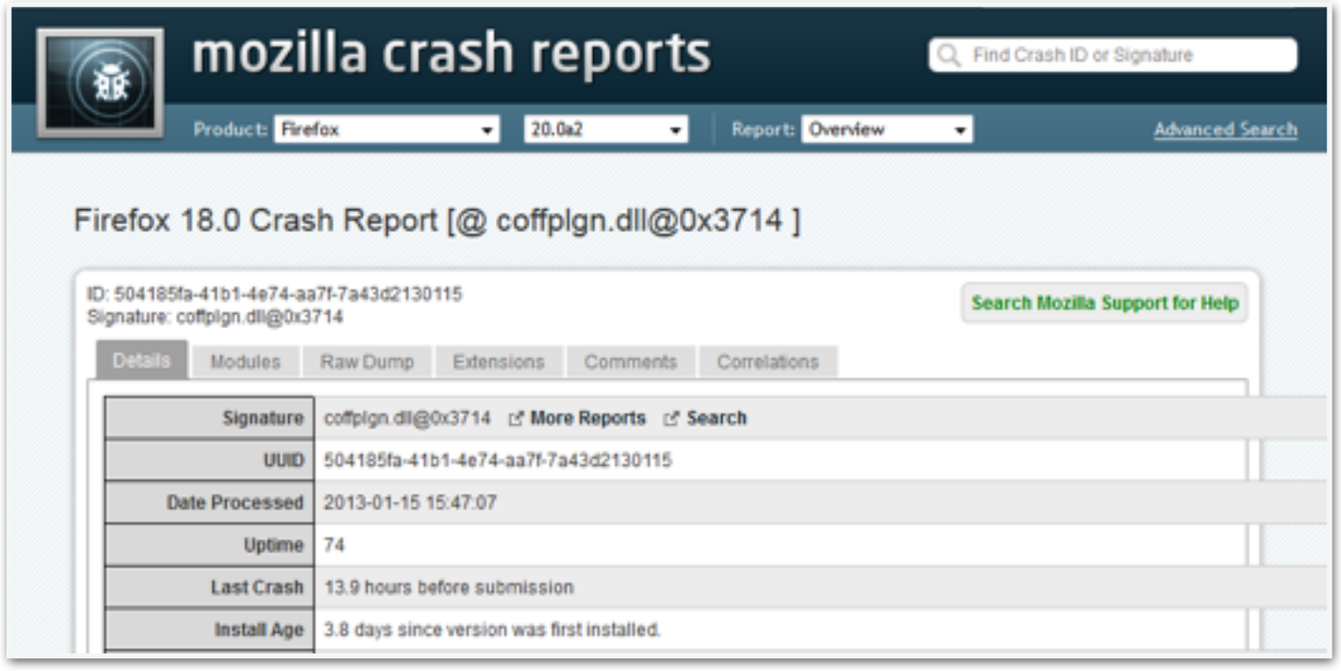

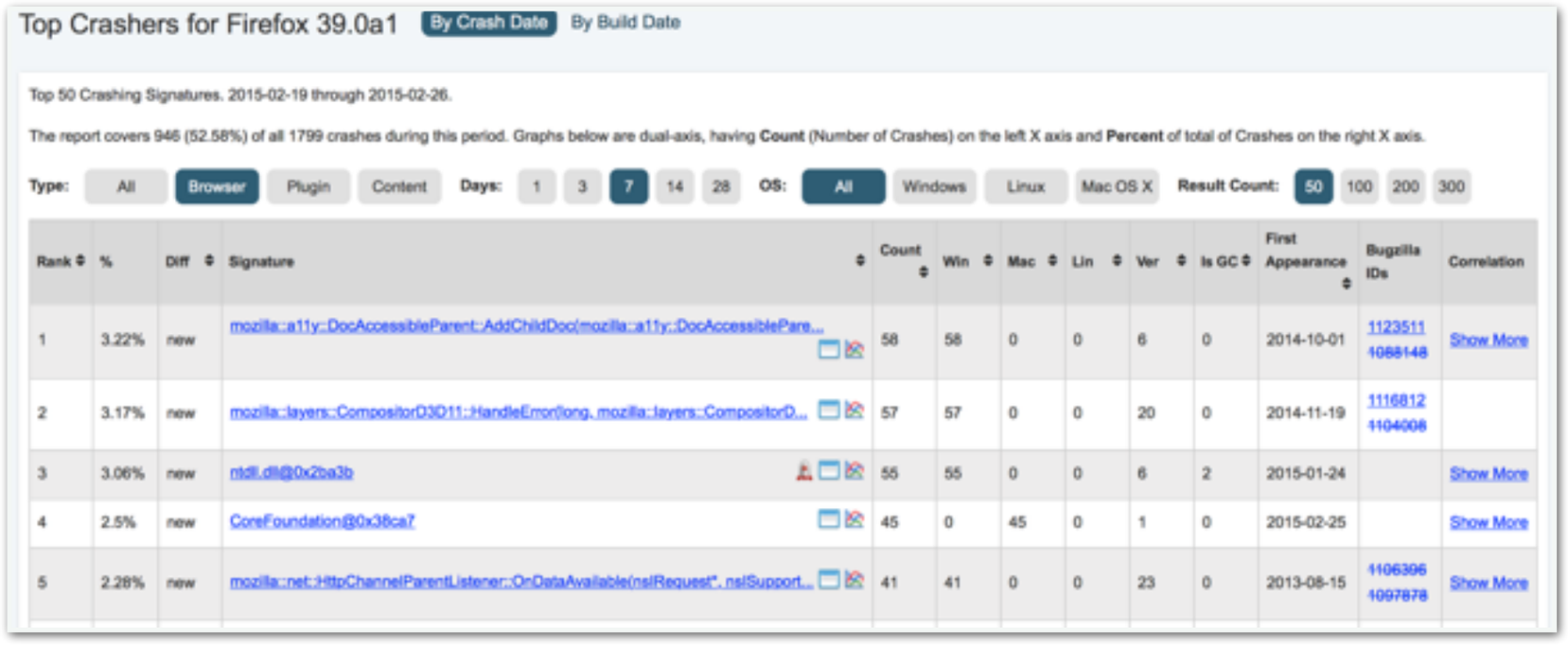

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Challenge

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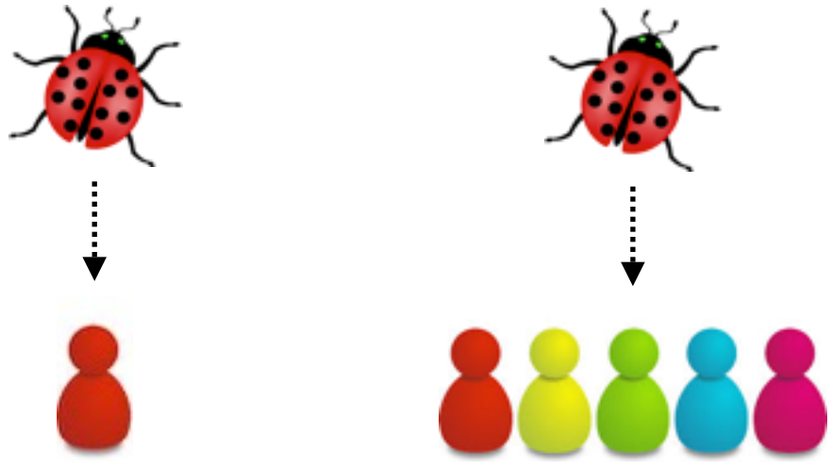

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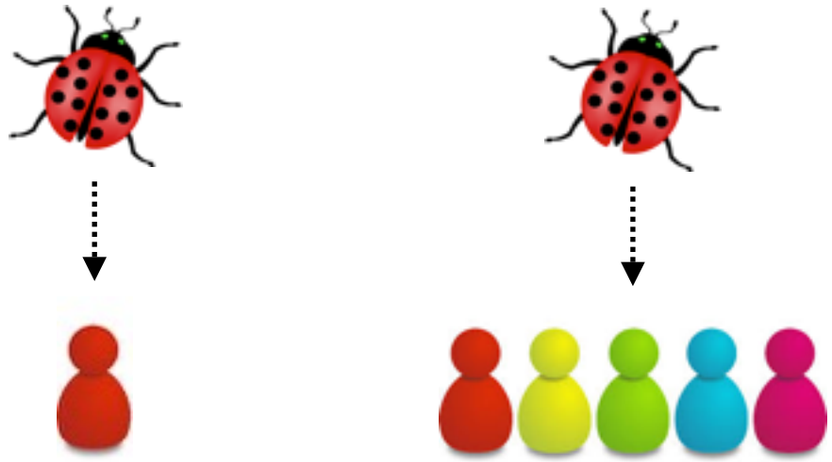

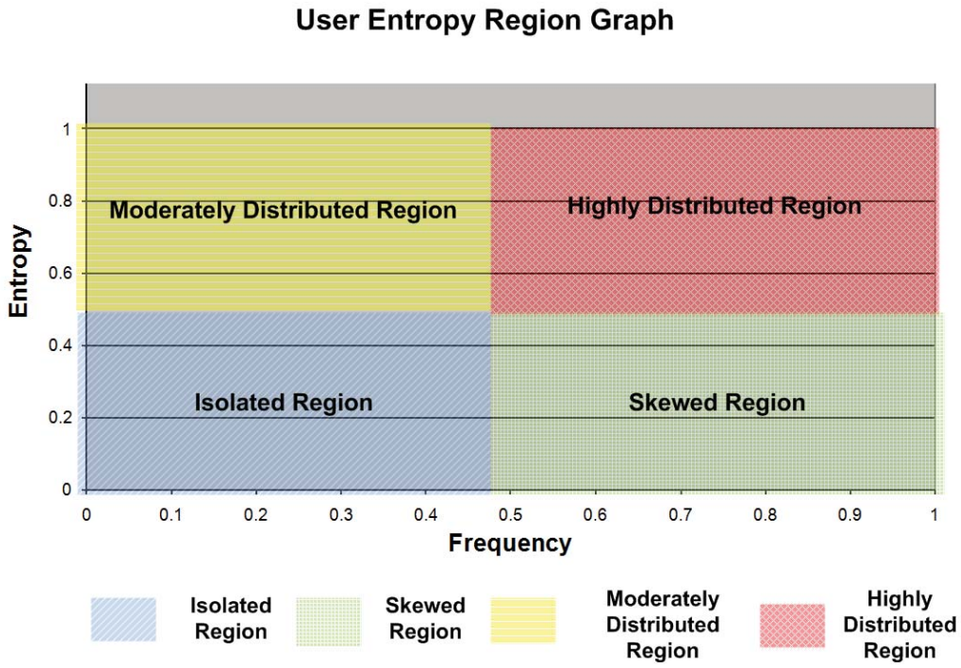

Khomh et al. (2011)

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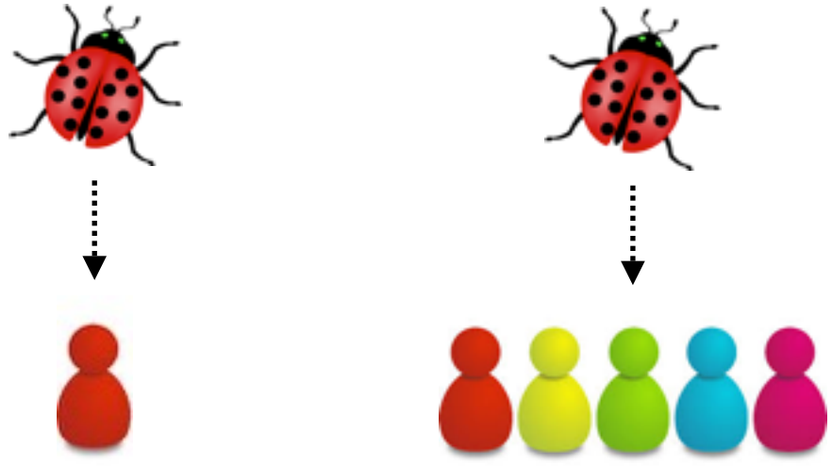
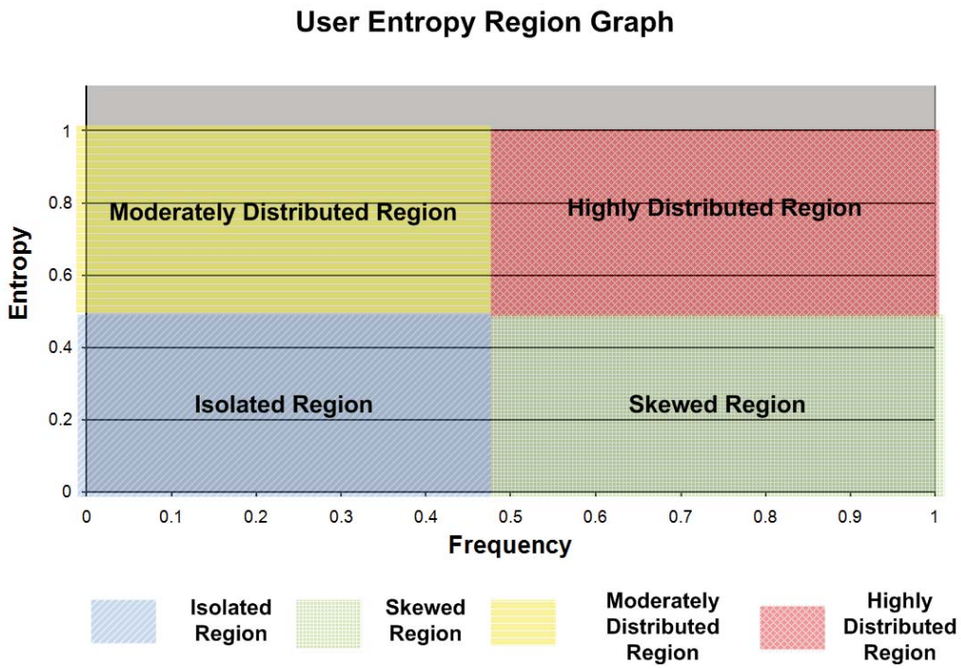


highly-impactful bugs = bugs affecting a large number of users with high crashing frequency



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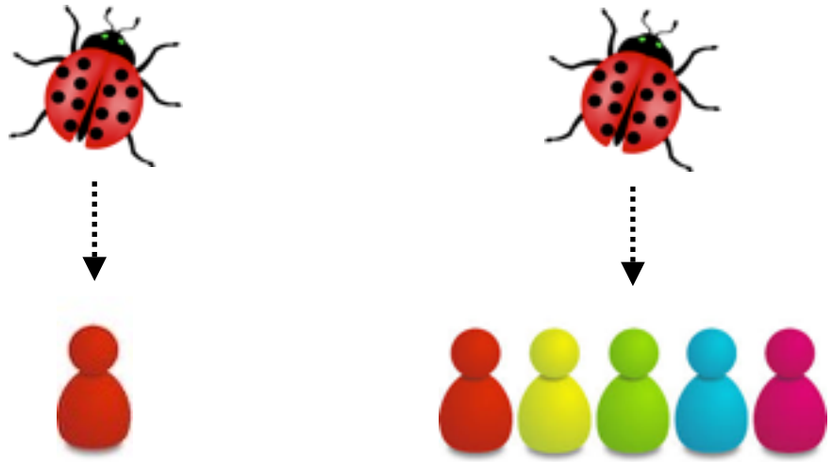

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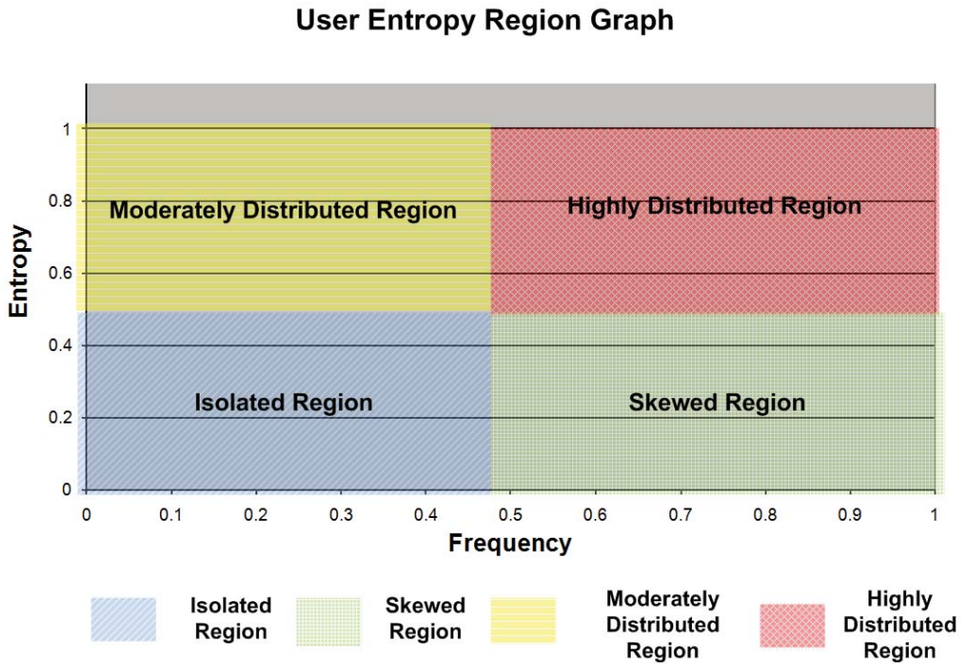

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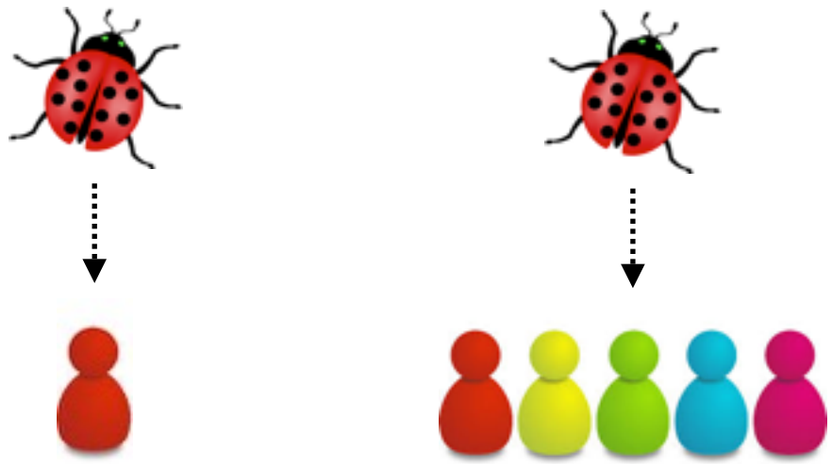

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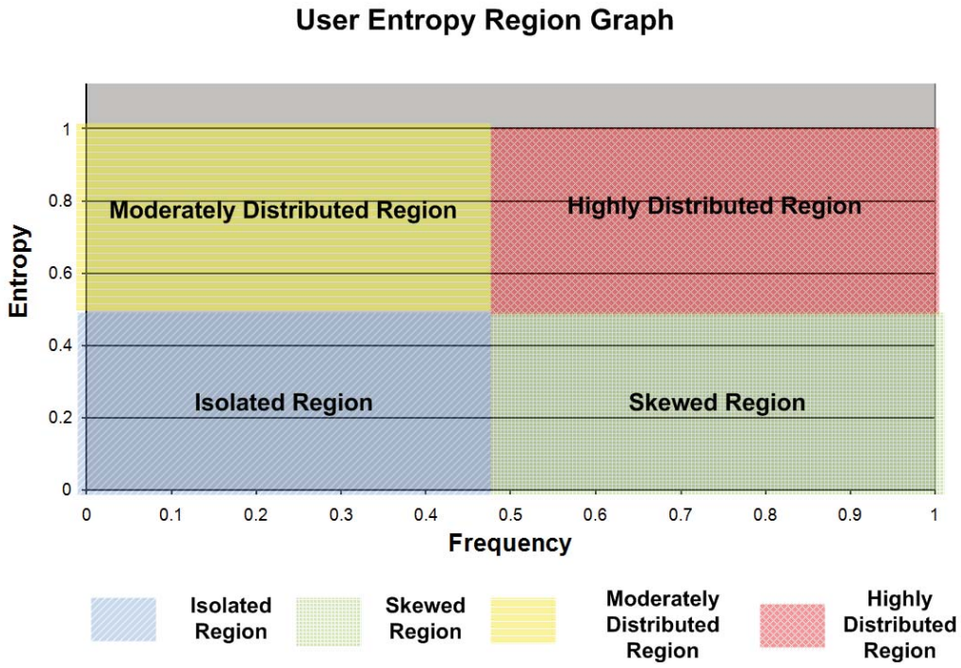


Khomh et al. (2011)

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?

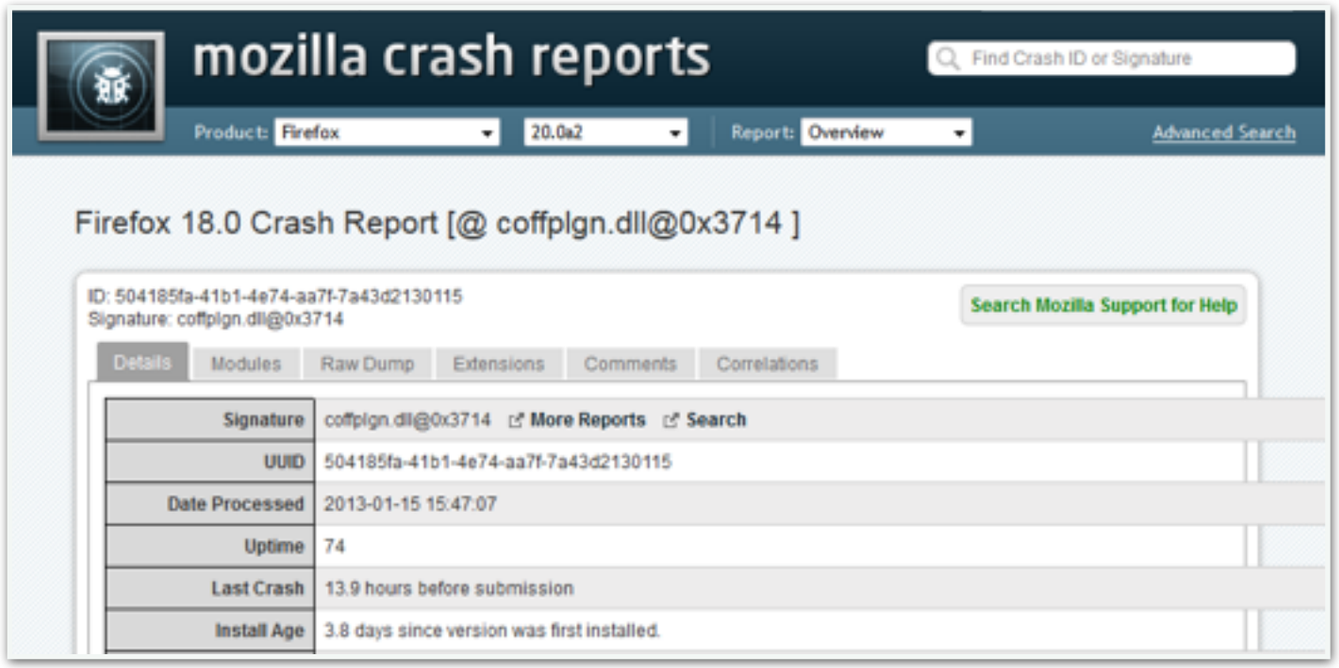
What are the benefits of applying our early triaging technique?

Subject Systems

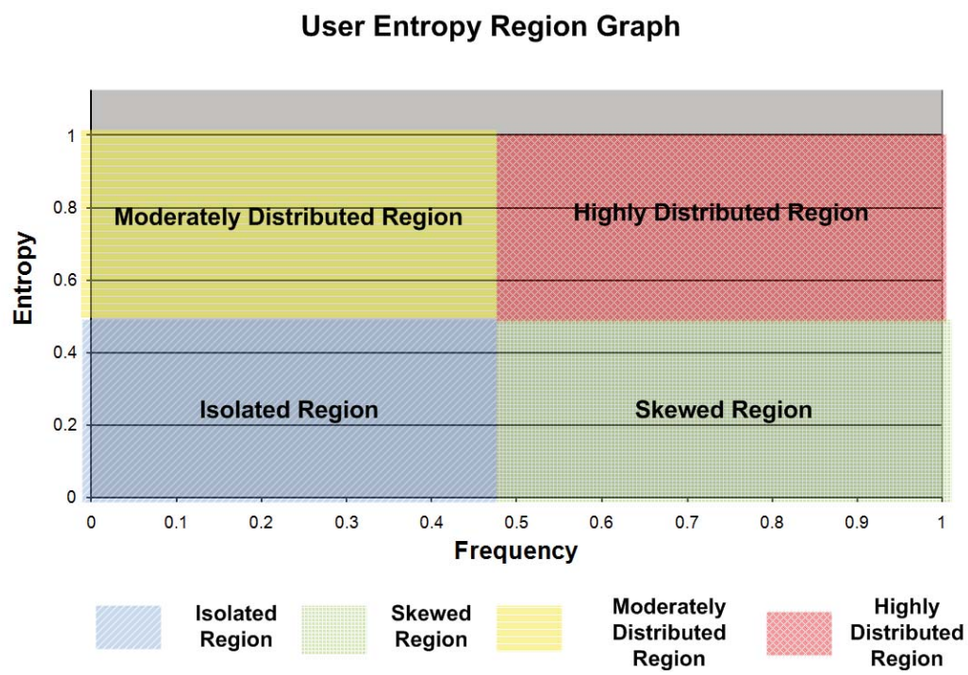
Mozilla Firefox

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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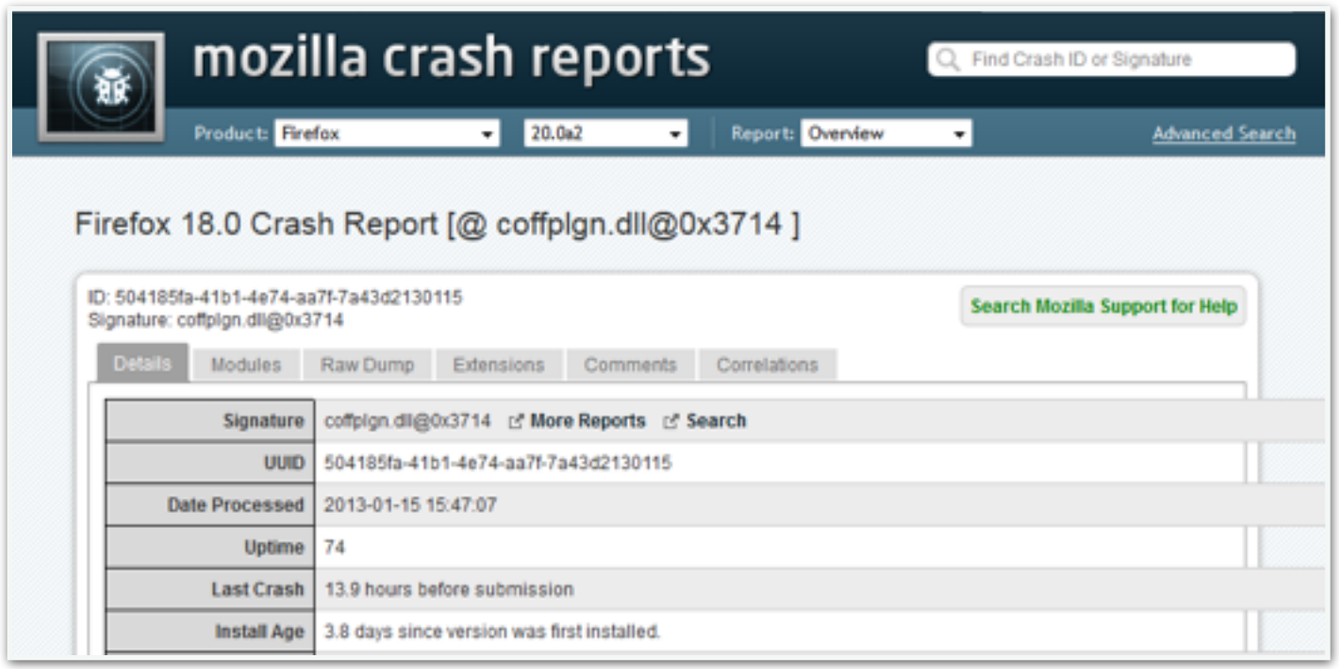

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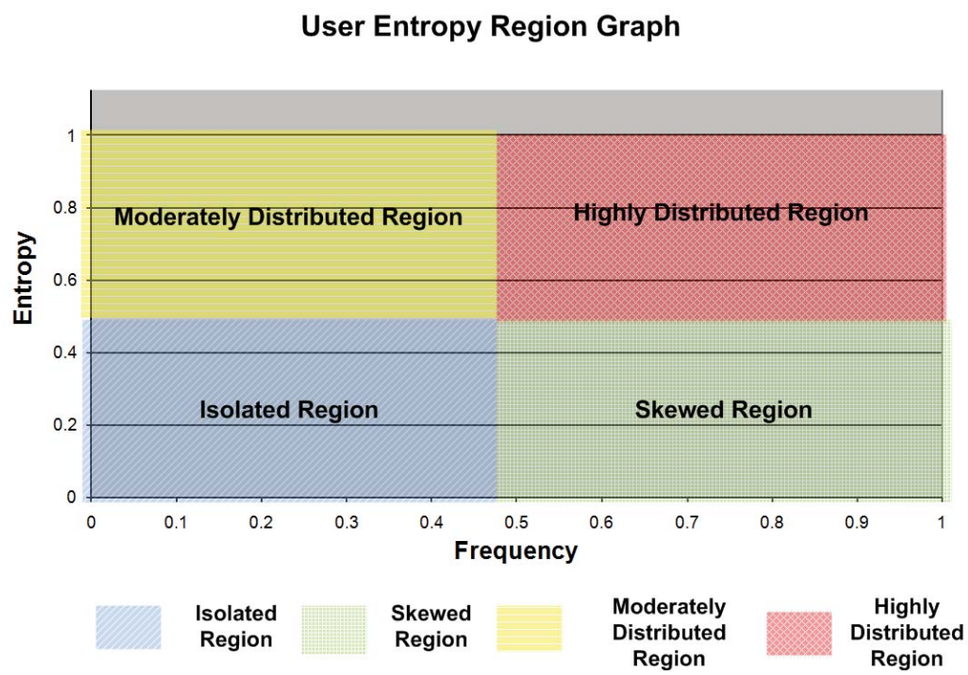
machine profile (CPU, OS, OS version)



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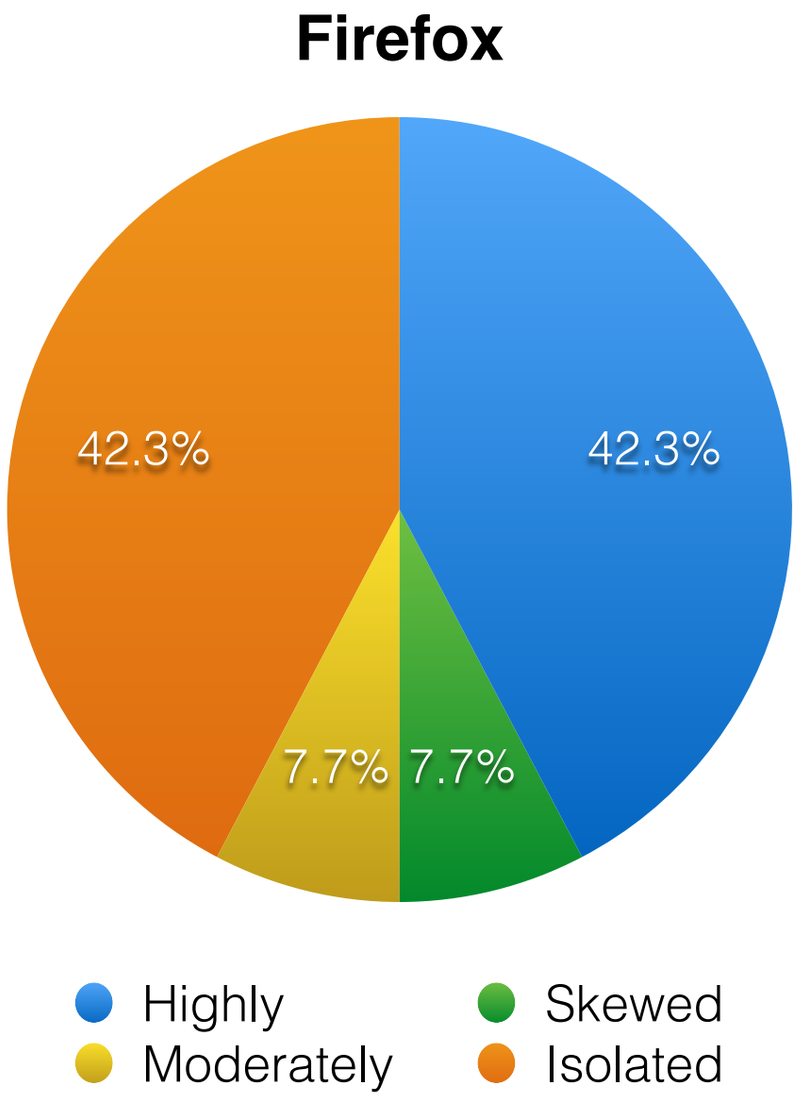
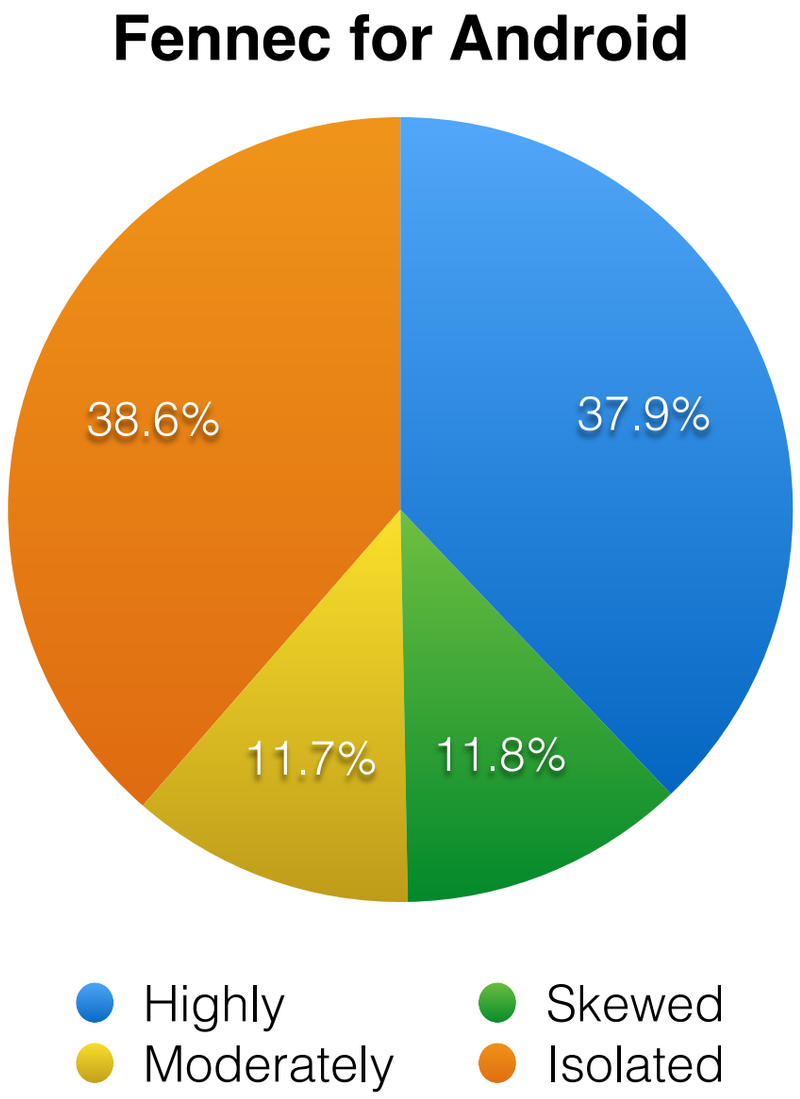
% of Highly-Impactful Bugs





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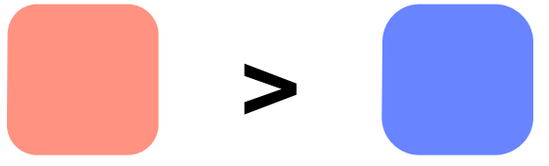
Highly-impactful vs. Other bugs

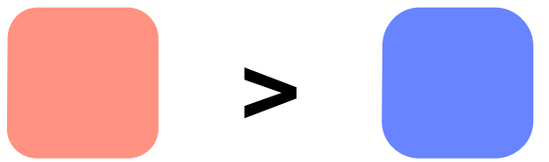
Highly-impactful bugs

Other bugs

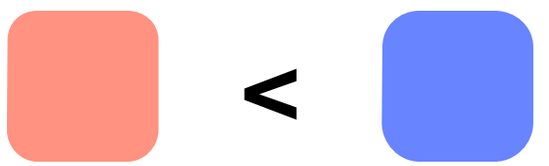
reporter experience



comment length



closed %



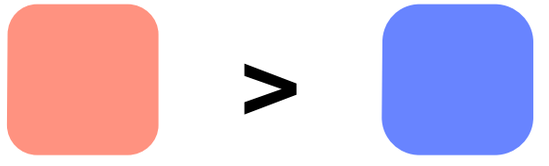
Highly-impactful vs. Other bugs

Highly-impactful bugs

Other bugs

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

reporter experience



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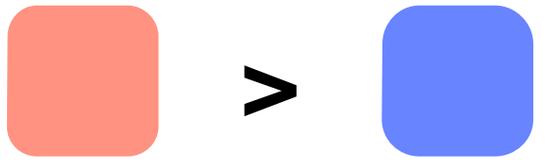

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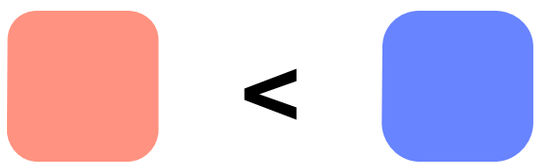

Identifying Highly-Impactful Bugs with Different Thresholds of Frequency & Entropy

50 percentile

70 percentile

90 percentile

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

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V.S.

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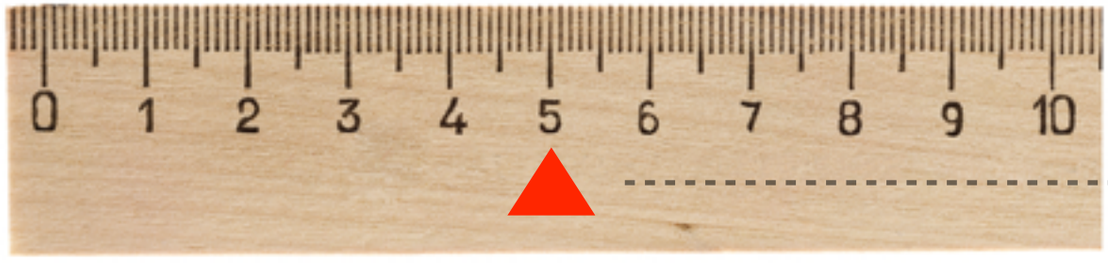

50 percentile

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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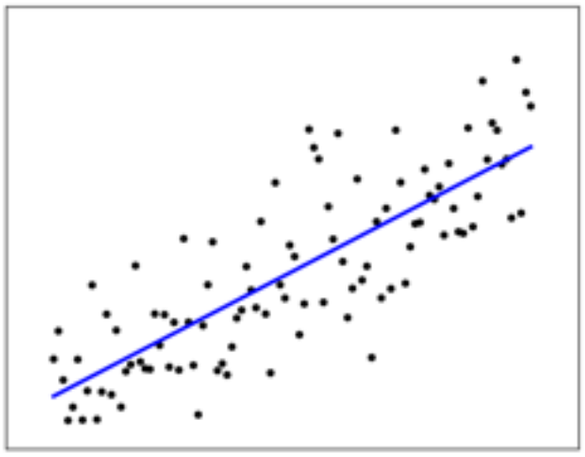
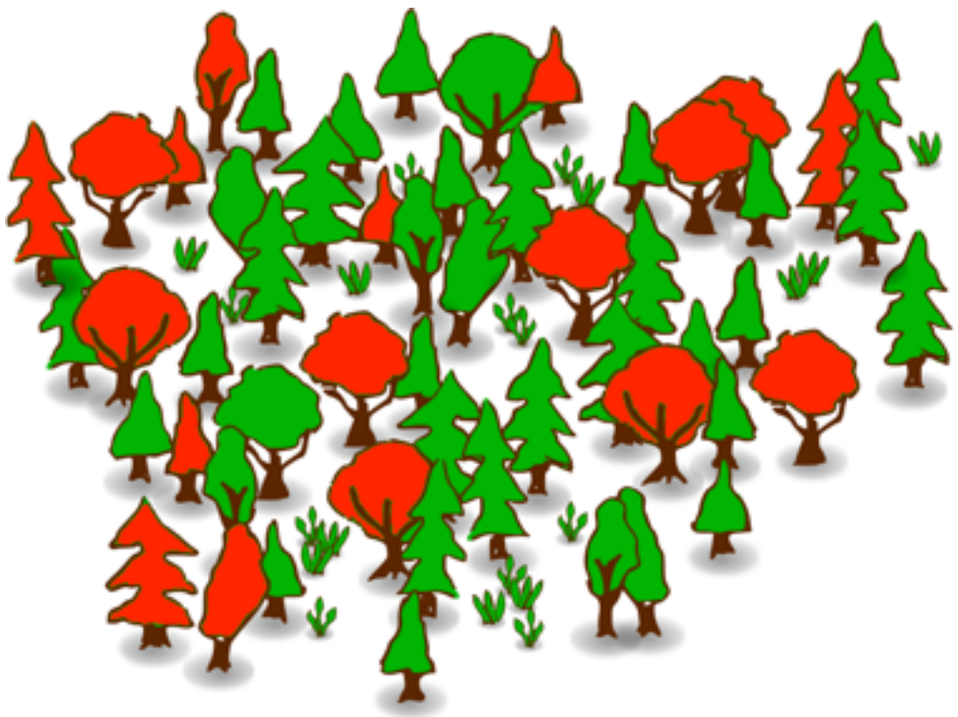
Predictive Algorithms



General Linear Model

C5.0 **ctree (party)**

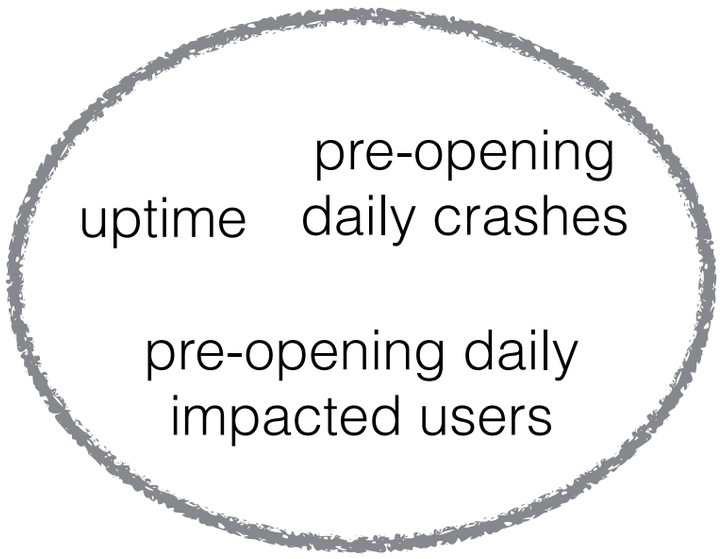


randomForest **cforest (party)**

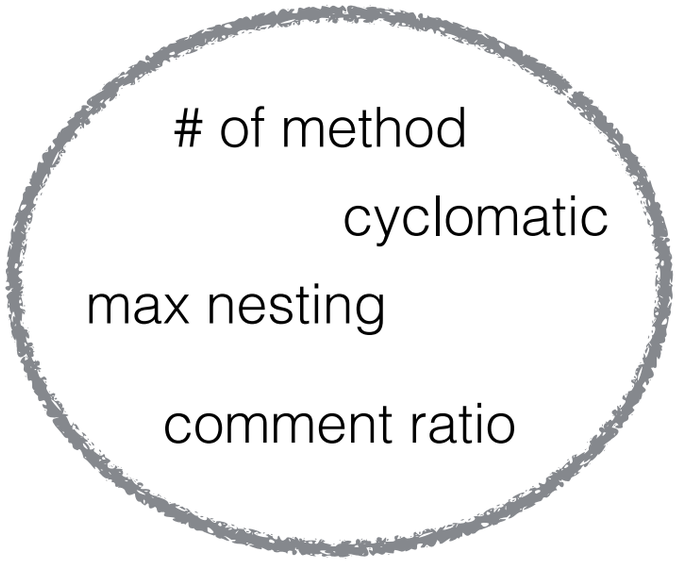
Predictive Metrics and Results

Bug report

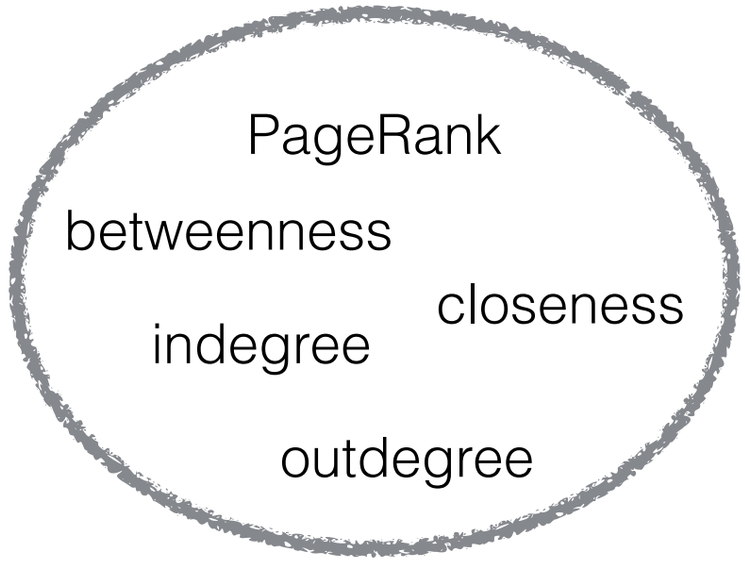
Crash report



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

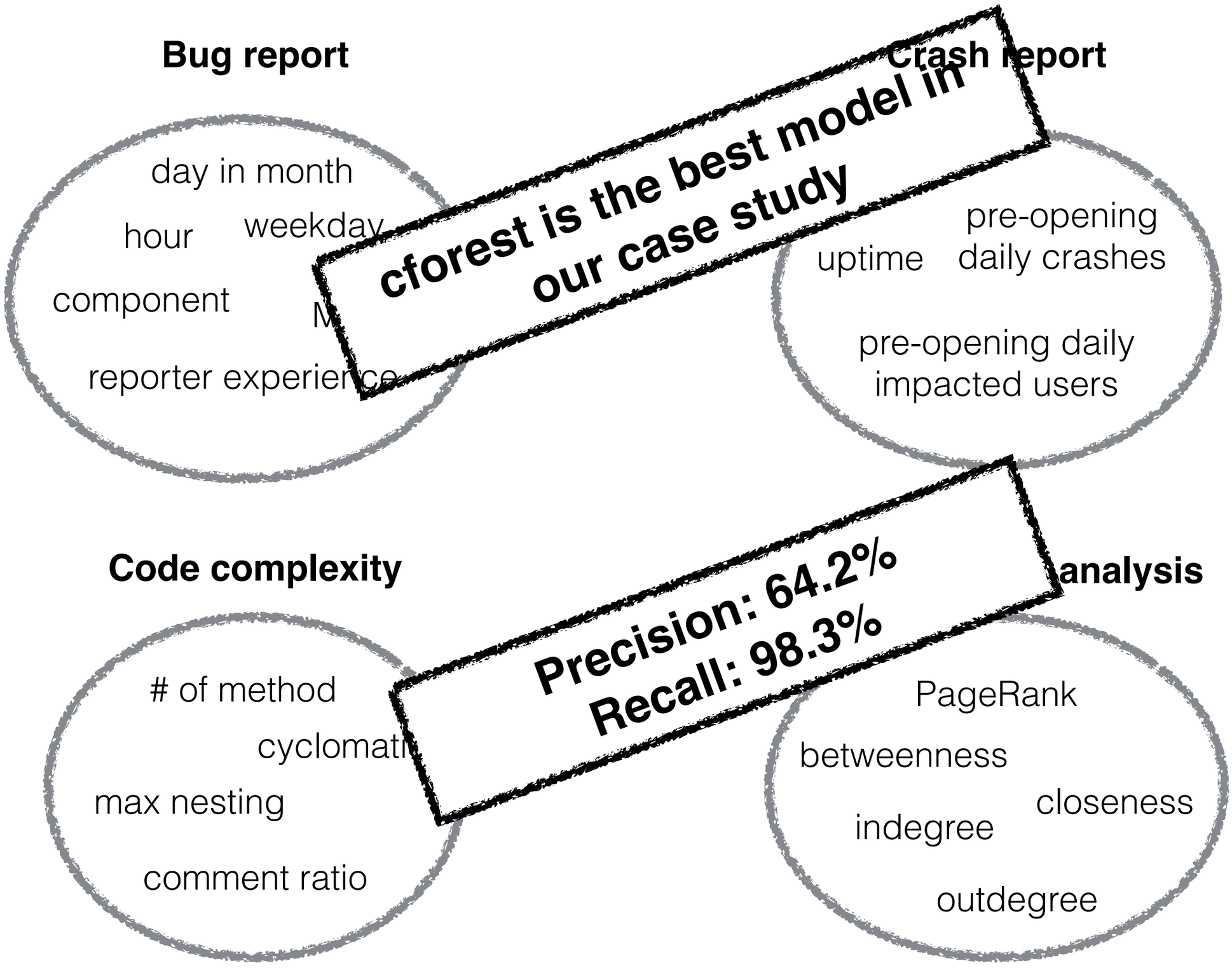
betweenness

closeness

indegree

outdegree

Predictive Metrics and Results



Predictive Metrics and Results

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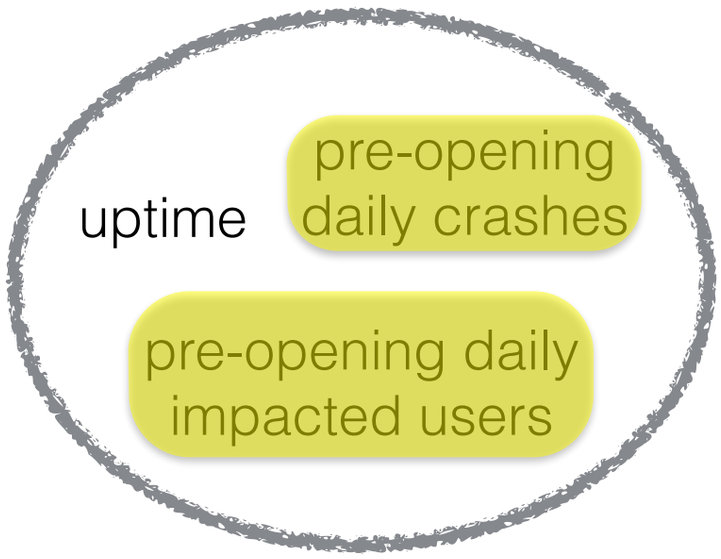

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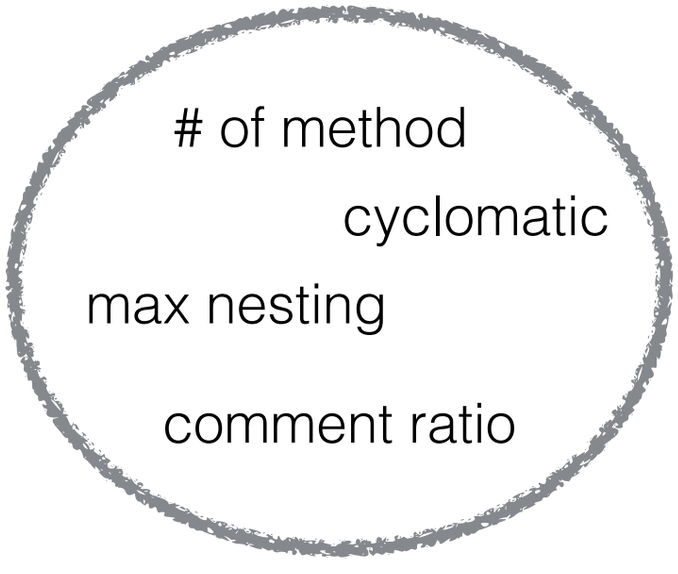

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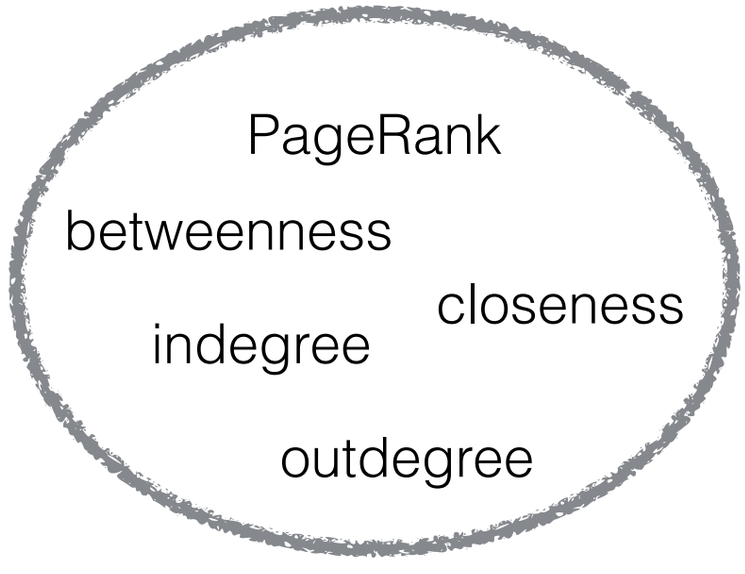

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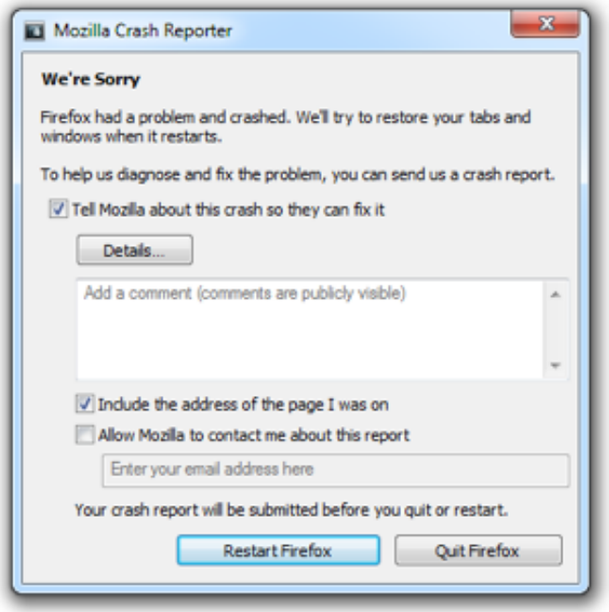
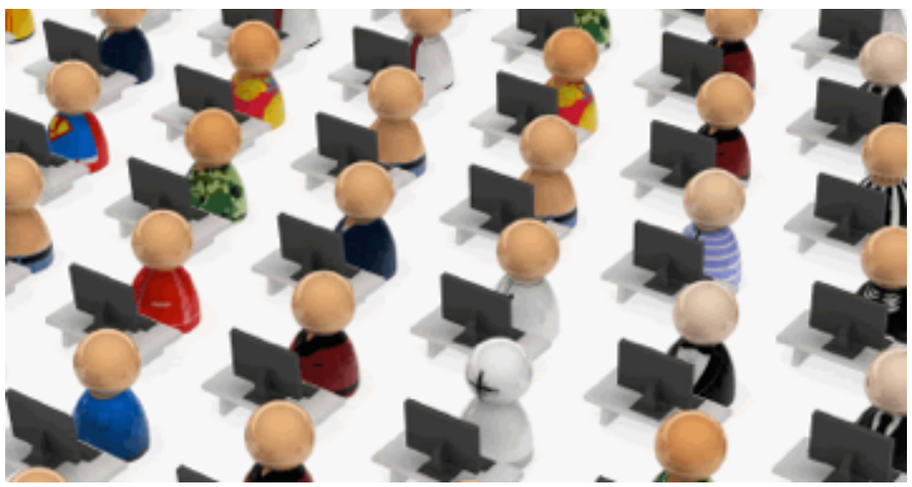
Benefit Analysis



crash occurrences

Firefox	Fennec
23%	13.4%



unique impacted users

Firefox	Fennec
28.6%	49.4%

Conclusion

Crash Collecting System

Challenge

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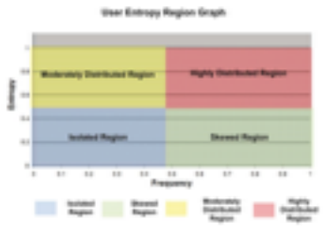

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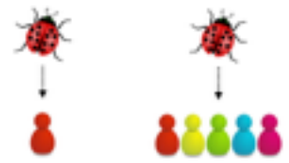
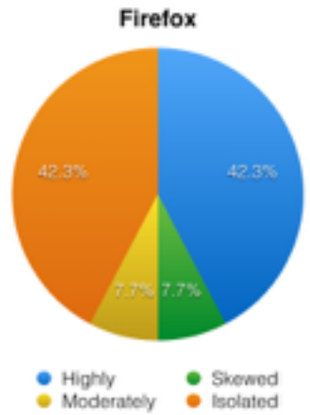
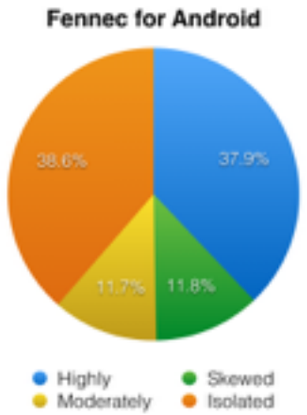


highly-impactful bugs = bugs with high crashing frequency + entropy

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

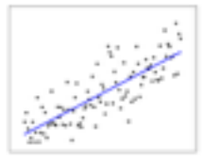
% of highly-impactful bugs





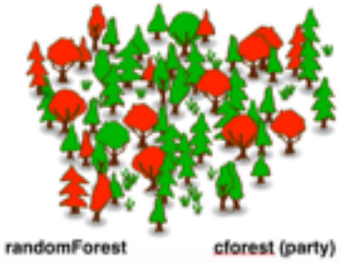
Highly-impactful vs. Other bugs

Predictive algorithms



General Linear Model

C5.0 ctree (party)

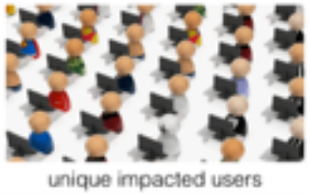


randomForest cforest (party)

Benefit Analysis

crash occurrences

Firefox	Fennec
23%	13.4%



unique impacted users

Firefox	Fennec
28.6%	49.4%