Sentimine: a cregit Plugin to Analyze the Sentiment Behind the Linux Kernel Code

Towards

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Linux Foundation

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University of Victoria

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Polytechnique Montréal
Linus Torvalds’ temporary leave in September 2018 ...

From: Linus Torvalds <torvalds@linux-foundation.org>
To: Linux Kernel Mailing List <linux-kernel@vger.kernel.org>
Subject: Linux 4.19-rc4 released, an apology, and a maintainership note
Date: Sun, 16 Sep 2018 12:22:43 -0700
Message-ID: <CA+55aPv+Hv905citAawS+mVZ0+ywCKd9NQ2wxUamGsz9ZJzqgJQ@mail.gmail.com>

This week people in our community confronted me about my lifetime of not understanding emotions. My flippant attacks in emails have been both unprofessional and uncalled for. Especially at times when I made it personal. In my quest for a better patch, this made sense to me. I know now this was not OK and I am truly sorry.

The above is basically a long-winded way to get to the somewhat painful personal admission that hey, I need to change some of my behavior, and I want to apologize to the people that my personal behavior hurt and possibly drove away from kernel development entirely.

I am going to take time off and get some assistance on how to understand people’s emotions and respond appropriately.
... sparked a Rich and Diverse Discussion about Change in the Community ...
With Linux’s founder stepping back, will the community change its culture?

By Adi Robertson @thedetroitchrony | Sep 21, 2018, 3:00pm EDT

Linux community acts after years of complaints like Sarah Sharp’s

Years after Sarah Sharp stepped down from her direct work in the Linux kernel community because of abusive behavior, Linus Torvalds has stepped away and the community adopted a Code of Conduct.

I’m very disappointed in Linus Torvalds

What happened Linus?
... even after Linus’ comeback, discussions continued
... even after Linus’ comeback, discussions continued

Linus Torvalds returns to Linux development with new code of conduct in place
Torvalds took a self-imposed break to rethink his controversial treatment of others
By Nick Statt | @nickstatt | Oct 22, 2018, 8:18pm EDT

Linus Torvalds returns to head Linux coding community

Linus Torvalds is back in charge of Linux
After a few weeks off to reconsider his role in the Linux community, Linus Torvalds is back in the saddle.

(By Steven J. Vaughan-Nichols for Linux and Open Source | October 22, 2018 -- 10:45 GMT (03:45 PDT) | Topic: Enterprise Software)
Almost half a year later, what did the community learn or change?
Code of Conflict became Code of Conduct :-)

Code of Conflict became Code of Conduct :-)
..., but a Code of Conduct just treats the symptoms, what is the root of the problem?
..., but a Code of Conduct just treats the symptoms, what is the root of the problem?

**civility**

/səˈvɪlɪdɪ/ ˌˈsɪ-

noun

formal politeness and courtesy in behavior or speech.

"I hope we can treat each other with civility and respect"

**synonyms:** courtesy, courteousness, politeness, good manners, mannerliness, gentlemanliness, chivalry, gallantry, graciousness, consideration, respect, gentility; More

- polite remarks used in formal conversation.
  plural noun: civilities
  "she was exchanging civilities with his mother"

**synonyms:** polite remark, politeness, courtesy; formality
  "she didn't waste time on civilities"
How civil is the Linux community?

Is it a recent problem?

Is it a problem that is increasing over time?

How does civility change across release cycles?

How is the civility in the Linux community compared to other open source projects?
Civility is not (yet) part of CHA OSS
Initial idea: Measuring civility through sentiment
Initial idea: Measuring civility through sentiment

Politeness
Initial idea: Measuring civility through sentiment

Politeness

Sentiment

POSITIVE

NEUTRAL

NEGATIVE
Initial idea: Measuring civility through sentiment

Politeness  Sentiment  Emotion

POSITIVE  NEUTRAL  NEGATIVE

JOY  SURPRISE  ANGER  DISGUST  FEAR  SADNESS
Initial idea: Measuring civility through sentiment

positive
neutral
negative

Sentiment
Initial idea: Measuring civility through sentiment

great work, guys!
Initial idea: Measuring civility through sentiment

great work, guys!

WTF, a package refactoring and class renaming in one patch?
Initial idea: Measuring civility through sentiment

- **Great work, guys!**
- **WTF, a package refactoring and class renaming in one patch?**

**Sentiment**
- **Positive**
- **Neutral**
- **Negative**

**Good civility**

**Bad civility**
Challenges
Challenges

Identify the target of the sentiment

- Is the sentiment about the person (civility) or about the code (review)?
Challenges

Identify the **target of the sentiment**
- Is the sentiment about the **person** (civility) or about the **code** (review)?

Identify the right **granularity** to analyze sentiments
- Individual e-mails vs. e-mail threads?
- Subsystem vs. the whole kernel?
- Week vs. month vs. release cycle?
Can we measure differences in sentiment between releases?
Can we measure differences in sentiment **between releases**?

Can we measure differences in sentiment **across time**?
Can we measure differences in sentiment **between releases**?

Can we measure differences in sentiment **across time**?

Can we measure differences in sentiment **between maintainers and non-maintainers**?
Approach
Approach

Step 1

Extract LKML data
Public-inbox e-mails from
Jan 2017 to Jan 2019
Approach

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Step 2
Group e-mails by threads
Mailboxminer tool
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**Step 1**
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**Step 3**
Filter threads
>= 2 e-mails in a thread
ignore e-mails that have patch
Approach
Approach

Step 4

Calculate metrics
- Release cycle
- Month, week, weekday
- Maintainer vs. non-maintainers
Approach

Step 4

Calculate metrics
Release cycle
Month, week, weekday
Maintainer vs. non-maintainers

Results
A lot of communication across releases...

E-mail threads by release

![Bar chart showing email threads by release](image)
Phase 2 in the release cycle has more discussion
Phase 2 in the release cycle has more discussion

### Phase 1
- February 11: 4.16-rc1, **merge**, **window** closes
- February 18: 4.16-rc2
- February 25: 4.16-rc3
- March 4: 4.16-rc4
- March 11: 4.16-rc5
- March 18: 4.16-rc6
- March 25: 4.16-rc7

### Phase 2

### Phase 3
- April 1: 4.16 stable release
Phase 2 in the release cycle has more discussion

<table>
<thead>
<tr>
<th>Date</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>January 28</td>
<td>4.15 stable release</td>
</tr>
<tr>
<td>February 11</td>
<td>4.16-rc1, <strong>merge</strong> <strong>window</strong> closes</td>
</tr>
<tr>
<td>February 18</td>
<td>4.16-rc2</td>
</tr>
<tr>
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<td>4.16-rc7</td>
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<td>April 1</td>
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</tbody>
</table>

![E-mail threads by release phase](chart.png)
Approach

**Step 1**
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Release cycle
Subsystem
Maintainer vs. non-maintainers
Approach

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Step 5: Detect sentiment
   - Senti4SD
Approach

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Step 5: Detect sentiment
Senti4SD

Answer questions about civility
Senti4SD

Lexicon-based features
Senti4SD

Lexicon-based features

Keyword-based features
Senti4SD

Lexicon-based features

Semantic features

Keyword-based features
Senti4SD

Lexicon-based features

Semantic features

Keyword-based features

Training the model
<table>
<thead>
<tr>
<th>INPUT</th>
<th>OUTPUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweet :) Happy hacking!</td>
<td></td>
</tr>
<tr>
<td>I want them to resize based on the length of the data they're showing.</td>
<td></td>
</tr>
<tr>
<td>Do you have jQuery loaded correctly?</td>
<td></td>
</tr>
<tr>
<td>For Python 3 the following will work.</td>
<td></td>
</tr>
<tr>
<td>If you're really worried about this, Java is not the language for you</td>
<td></td>
</tr>
</tbody>
</table>
Equal proportion of positive/negative e-mail threads

% of e-mail threads by sentiment polarity

- Negative 38%
- Neutral 24%
- Positive 38%
Equal number of positive/negative discussions across releases

- **Graph 1:**
  - X-axis: Releases
  - Y-axis: # of e-mail threads
  - Bars show the number of negative and positive discussions per release.

- **Graph 2:**
  - X-axis: Release phases
  - Y-axis: # of e-mail threads
  - The bar graph shows a comparison of negative and positive discussions across three phases.

- **Details:**
  - The graphs illustrate that there is an equal number of positive and negative discussions across the releases and phases.
Specific events might change the sentiment...

Negative sentiment over month

Positive sentiment over month
Specific events might change the sentiment…

Negative sentiment over month

Positive sentiment over month
The sentiment fluctuates among weeks

Sentiment across weeks in 2017

Sentiment across weeks in 2018
The sentiment fluctuates among weeks

Weeks 31-34: August, 2018
The sentiment fluctuates among weeks

Weeks 31-39: September, 2018
The sentiment fluctuates among weeks

Weeks 40-44: October, 2018
Tuesdays, Wednesdays, and Thursdays have more positive discussions.
The sentiment does not differ between maintainers and non-maintainers.
Challenges and Ongoing Work
Noisy data
Noisy data

Noisy tools
Noisy data

Noisy tools

Target of sentiment?
Noisy data
Noisy tools
Target of sentiment?
How to act on results?
Let’s do a quick survey?

PollEv.com/isabellaferr986
Can you define the sentiment of the following sentences?

When survey is active, respond at PollEv.com/isabellaferr986
What kind of tool support could help the community?
Cregit tracks patches at token level

Links to mailing list reviews generated by email2git

https://cregit.linuxsources.org
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Links to mailing list reviews generated by email2git

https://cregit.linuxsources.org
..., but a Code of Conduct just treats the Symptoms, what is the Root of the Problem?
..., but a Code of Conduct just treats the Symptoms, what is the Root of the Problem?

ci·vil·i·ty
/soʊˈvilɪdə/ (n)

noun
terminology, civility, politeness, courtesy, good manners, gentility, gentility,
courtesy, politeness, good manners, manners, gentility, gentility,
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*“I hope we can treat each other with civility and respect”*

-synonyms: courtesy, courteousness, politeness, good manners, mannerliness, gentlemanliness, chivalry, gallantry, graciousness, consideration, respect, gentility... More

-polite remarks used in formal conversation.

-plural noun; civilities

-she was exchanging civilities with his mother

-synonyms: polite remarks, politeness, courtesy, formality

-she didn’t waste time on civilities

Specific events might change the sentiment...

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/isabellavieira
@isaferreira_57
We need your feedback!

Specific events might change the sentiment...

<table>
<thead>
<tr>
<th>Negative sentiment over month</th>
<th>Positive sentiment over month</th>
</tr>
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</table>

- % of linear trends
- 0 10 20 30 40 50
- 1 2 3 4 5 6 7 8 9 10

- Noisy data
- Noisy tools
- Target of sentiment?
- How to act on results?
We need your feedback!

SEmotion 2019
Fourth International Workshop on Emotion Awareness in Software Engineering
ICSE 2019 Workshop - 28 May 2019 - Montréal, QC, Canada
Ferreira et al. A Longitudinal Study on the Maintainers’ Sentiment of a Large Scale Open Source Ecosystem