Who Filters the Filters:
Understanding the Growth, Usefulness and Efficiency of Crowdsourced Ad Blocking

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The talk in a slide…

- Many web and privacy tools use crowdsource lists
  - ABP
  - Uno
  - Adblock
  - Privacy
  - Chrome

- How these lists are maintained is poorly understood
  - Who decides what goes in? What comes out? What exceptions exist? etc…

- Web measurement of EasyList
  - Most popular list
  - Mostly “dead weight”, 90.16% of rules unused
  - 10k website measurement over 2+ months → practical optimizations
  - How do advertisers & trackers respond?
Overview

● Context and Background
  What, why and how of EasyList

● Methodology
  Web scale measurement over two months

● Measurement Results
  Whats used and unused, rule lifecycle, how do trackers respond, etc?

● Applications
  Mobile and extension optimizations

● Discussion and Conclusion
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Context and Background

- EasyList is the most popular list
- Targets ads and tracking from advertisers
- Text format, RegEx-like format
- EasyList is a large project, 15 years of contributions
- Targets English and “global” sites
- Many different rules, acting on different layers
EasyList Types of Rules

- **Network rules**
  \[\ll\text{example.org/ad}\rr\]

- **Element rules**
  \[\\text{site.com##i)frame}\rr\]

- **Exception rules**
  \[\ll\text{example.org/advice}\rr\]

- **Filters**
  \[\ll\text{example.org^script}\rr\]
EasyList Over Time

- 2005: Started by Rick Petnel
- 2009: Moves to GitHub
- 2013: Merges with “Fanboy’s list”
- 2019: Reaches 72,469 rules
- 2020 (May): Shrinks to ~69k
Rule “Life Cycle”

- Measurement of how long a rule stays in the List
- Measured using git commit history
- ~50% rules remain for > ~4 years
Who Contributes To EasyList

- From forum and GitHub
- Five main contributors
  76.87% of commits
- Many small contributors
  65.3% of contributors made <= 100 commits
Also in the Paper…

- How commit history was tracked across project structure changes
- How often commits are made
- How other tools use EasyList
- Tooling details
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Measurement Goals

- **Broad Goal:** Understand how EasyList and the web interact

- **Sub Goals:**
  - How is “rule usefulness” distributed?
  - Relationship between rule age and rule usefulness?
  - How to advertisers respond to being listed?
Methodology

- **Instrument a browser:**
  Record all network requests when visiting a page

- **Representative automated crawl**
  Both popular and unpopular websites

- **Apply EasyList to crawl data:**
  Determine what would be blocked if that day’s EasyList was applied
Browser Instrumentation

- **Stock Chromium:**
  Current stable version of Chromium at time of measurement

- **Puppeteer automation:**
  Record all URLs fetched, along with response type, hash and body size

- **Passive instrumentation:**
  No changes to page loading or resource requesting

- **No measurement of page contents:**
  Omitted measurements of element hiding rules
Representative Automated Crawl

- **Web domain selection:**
  - “Popular”: Alexa 5k
  - “Unpopular”: Random selection from Alexa 5,000-1m

- **Page selection:**
  Measured landing page, and three same-eTLD+1 links

- **Measurement times:**
  - Every day for 74 days
  - Measured each page for 30 seconds

- **Passive measurement:**
  No changes to page loading or resource requesting
https://cnn.com
30 sec

<a href="https://advertiser.com">
<a href="https://cnn.com/page1">
<a href="https://othersite.org">
<a href="https://cnn.com/page3">
<a href="https://neat.advertiser.com">
<a href="https://cnn.com/page2">
<a href="https://youtube.com">
<a href="https://cnn.com/page5">

...
# Applying EasyList to Crawl Data

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                   • … | •  
                   • */ad/*  
                   • ||doubleclick.com|^  
                   •  
                   • … |
On Omitting Element Rules

- **Noted network and exception rules**
  Did not include element (i.e., cosmetic) rules

- **Reasoning**
  - Measurement focus is on privacy and performance
  - Highly variable and dependent on user interaction
  - Many EasyList consuming tools also omit them (e.g., Privoxy, PiHole)
Summary

- Instrumented automated Chromium
- Visited 10k sites (5k popular, 5k unpopular)
- Recorded:
  - Domains visited
  - Subpages visited
  - Resource requests and responses
  - Matching EasyList network rules
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Measurement Results

- **Study period:**
  July 24th → October 5th, 2018

- **Unresponsive domains:**
  400 domains never replied

- **3.74 pages per domain:**
  Difference b/c single page apps, CF CAPTCHA, etc.

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Counts</th>
</tr>
</thead>
<tbody>
<tr>
<td># days</td>
<td>74</td>
</tr>
<tr>
<td># domains</td>
<td>10,000</td>
</tr>
<tr>
<td># non-responsive domains</td>
<td>400</td>
</tr>
<tr>
<td>Avg # pages per day</td>
<td>29,776</td>
</tr>
<tr>
<td>Avg # pages per domain per day</td>
<td>3.74</td>
</tr>
<tr>
<td>Total # pages measured</td>
<td>3,260,479</td>
</tr>
</tbody>
</table>
Proportion of EasyList Rules Used

- **Measurement**
  % of rules used at least once during the entire experiment

- **Most rules were not used**
  90.16% never applied
  5.39% used >= 100 times

- **Domain popularity not sig**
Relationship of Rule Age and Usefulness

- **Measurement:** Are newer rules more useful?

- **Answer:** Mixed, but mostly no

- New and old rules are used at least once equally

- Most blocking is done by old rules

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<tr>
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<th>Added during experiment</th>
<th>Added before experiment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absolute #</td>
<td>2,002</td>
<td>37,826</td>
</tr>
<tr>
<td>% used at least once</td>
<td>9.45%</td>
<td>9.84%</td>
</tr>
<tr>
<td>Use frequency (of those used at least once)</td>
<td>0.65 per day</td>
<td>6.14 per day</td>
</tr>
</tbody>
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Advertiser Reactions

● **Methodology:**
  • Same resource, multiple URLs, only some blocked
  • Non-blocked URLs occurred after relevant rule
  • Compare URLs to observe why not blocked
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<tr>
<td>a.com/ad-script.js</td>
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<tr>
<td>a</td>
<td>a.com/ad-script.js</td>
<td>New Rule: /ad-script.js</td>
<td>a.com/ad-script.js</td>
</tr>
<tr>
<td>b</td>
<td>b.com/ad-script.js</td>
<td></td>
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</tr>
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| v.s. | c.com/sneaky.js |
Advertiser Reactions

- **Changing domain:**
  
  tracker.com/script.js → benign.com/script.js

- **Move to 1st party:**
  
  google-analytics.com/ga.js → cnn.com/ga.js

- **Remove “ad” keyword:**
  
  example.org/ads/shoes.png → example.org/images/shoes.png

- **Remove dimensions:**
  
  example.org/shoes-320x240.png → example.org/shoes-standard.png
Advertiser Reactions

Number of evasions detected

Evasion strategies

- Change domain
- Move to 1st party
- Remove "ad" keyword
- Remove dimensions

0 200 400 600 800 1000 1200 1400 1600

- Change domain (1600)
- Move to 1st party
- Remove "ad" keyword
- Remove dimensions
Also in the Paper…

- How quickly advertisers respond to new rules?
  Most don’t…

- Statistical correlation between rule age and use frequency
  Significant positive correlation

- Specific examples of filter list evasions
  We name names…
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Applications

- **Mobile content blocking**
  Fitting filter lists in mobile devices, performantly

- **Improving performance of extensions**
  Left for the paper
Applications

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Mobile Content Blocking

• Two related problems
  • iOS limits to 50k rules
  • Compiling rules is slow on first load

• Its not only EasyList...
  • EasyPrivacy
  • Regional lists

• Solution
  • Use crawl data to identify likely useful rules
  • Only load those rules on iOS
  • “Slim List”
Mobile Content Blocking

![Graph showing average compilation time for different devices with varying number of rules to compile. The graph includes three devices: iPhone X, iPad 10.5, and iPhone 6s.](image-url)

- **iPhone X**: Blue bars
- **iPad 10.5**: Orange bars
- **iPhone 6s**: Green bars

The x-axis represents the number of rules to compile, ranging from 1,000 to 40,000. The y-axis represents the average compilation time in seconds, ranging from 0 to 12 seconds. The graph shows a generally increasing trend as the number of rules increases.
Mobile Content Blocking

"Useful" subset

Number of rules to compile

Average compilation time (second)

- iPhone X
- iPad 10.5
- iPhone 6s

Full EasyList
Mobile Content Blocking

![Bar chart showing the average compilation time for different numbers of rules to compile for iPhone X, iPad 10.5, and iPhone 6s. The y-axis represents the average compilation time in seconds, and the x-axis represents the number of rules to compile. The chart indicates that the compilation time increases with the number of rules, and there is a noticeable difference between the devices.]

Full EasyList
Applications

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  Fitting filter lists in mobile devices, performantly

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Limitations And Future Work

● **Web site selection generalizability**
  We assume interactivity isn’t vital
  We assume “shallow” pages are similar to “deep” pages

● **Web region and language generalizability**
  We assume measuring from US IP generalizes
  We assume good division between English / global EasyList and regional lists

● **Varying resource blocking importance**
  We assume all blocking is equally useful
  We assume vital, security level protections are dealt with through other means
Summary

● First measurement of how EasyList affects the web

● Broadly used, maintained by five people

● >90% of EasyList provides little benefit

● Quantified taxonomy of filter list evasion

● Measurement allows for use on mobile
Summary and Thank You!

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