

Finding All Cross-Site Needles in the DOM Stack: A Comprehensive Methodology for the Automatic XS-Leak Detection in Web Browsers

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Research Challenges

Abstract

Cross-Site Leaks (XS-Leaks) are a class of vulnerabilities that allow a web attacker to infer user state from a target web application cross-origin. Fixing XS-Leaks is a cat-and-mouse game: once a published vulnerability is fixed, a variant is discovered. To end this game, we propose a methodology to find all leak techniques for a given state-dependent resource and a set of inclusion method. We translate a website's DOM at runtime into a directed graph. We execute this translation twice, once for each state. The outputs are two slightly different graphs. We then get the set of all leak techniques by computing these two graphs' differences. The remaining nodes and edges differ between the two states, and the corresponding DOM properties and objects can be observed cross-origin.

We implemented AutoLeak, our open-source solution for automatically detecting known and yet unknown XS-Leaks in web browsers and websites. For our systematic study, we focus on XS-Leak test cases for web browsers with detectable differences induced by HTTP headers. We created and evaluated a total of 151776 test cases in Chrome, Firefox, and Safari. AutoLeak executed them automatically without human interaction and identified up to 8403 leak techniques per test case. On top, AutoLeak's systematic evaluation uncovers 5 novel classes of XS-Leaks based on leak techniques that allow detecting novel HTTP headers cross-origin. We show the applicability of our methodology on 24 web sites in the Tranco Top 50 and uncovered XS-Leaks in 20 of them.

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