

High Performance Web Sites

14 rules for faster pages



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Exceptional Performance

quantify and improve the performance of
all Yahoo! products worldwide

center of expertise

build tools, analyze data

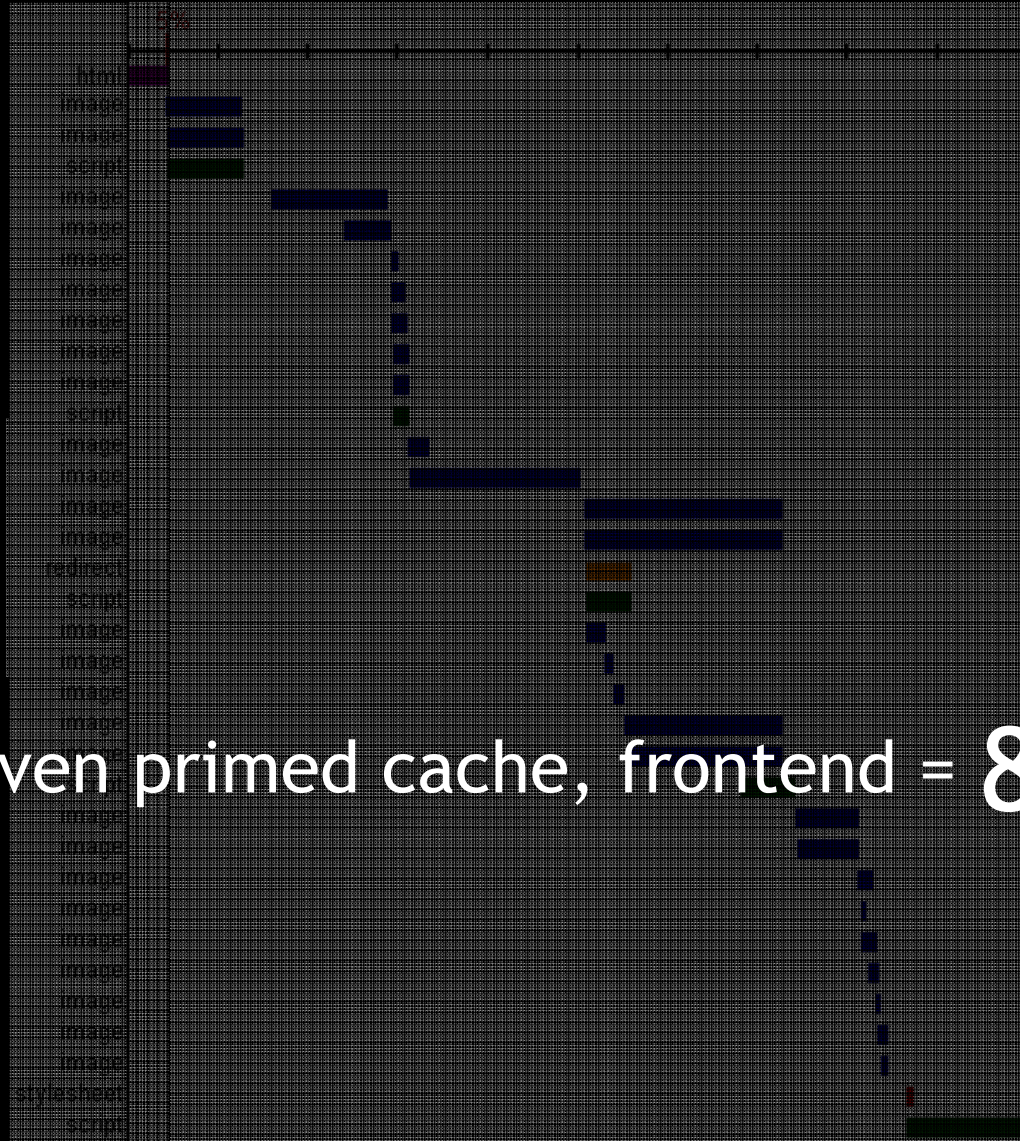
gather, research, and evangelize best
practices

The Importance of Frontend Performance

Backend =
5%

Frontend =
95%

Even primed cache, frontend = 88%



Time Spent on the Frontend

	Empty Cache	Primed Cache
amazon.com	82%	86%
aol.com	94%	86%
cnn.com	81%	92%
ebay.com	98%	92%
google.com	86%	64%
msn.com	97%	95%
myspace.com	96%	86%
wikipedia.org	80%	88%
yahoo.com	95%	88%
youtube.com	97%	95%

The Performance Golden Rule

80-90% of the end-user response time is spent on the frontend. Start there.

- Greater potential for improvement
- Simpler
- Proven to work



Performance Research

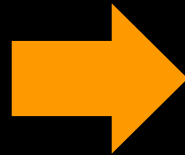
Browser Cache Experiment

Add an image to the page:

Expires: Thu, 15 Apr 2004 20:00:00 GMT

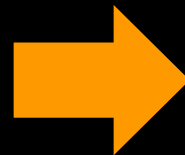
Last-Modified: Wed, 28 Sep 2006 23:49:57 GMT

Percentage of users with
an empty cache?



$$\frac{\text{\# users with at least one
200 response}}{\text{total \# unique users}}$$

Percentage of page
views with an empty
cache?



$$\frac{\text{\# of 200 responses}}{\text{total \# responses}}$$

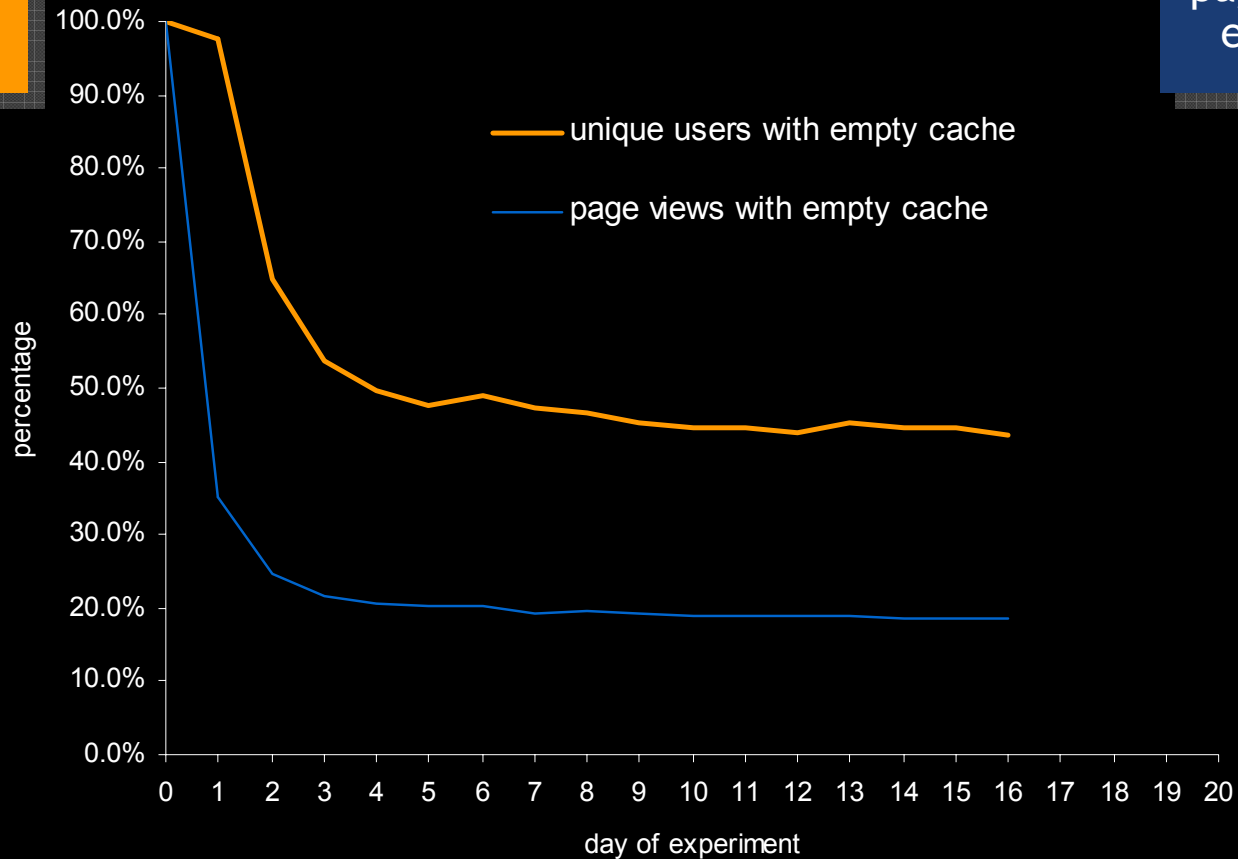
Browser Cache Expt Results

users with empty cache

40-60%

page views with empty cache

~20%



Experiment Takeaways

The empty cache user experience is more prevalent than you think!

Optimize for both primed cache *and* empty cache experience.

14 Rules



**NO ALCOHOLIC
BEVERAGES**



**NO
SMOKING**



**NO GLASS
CONTAINERS**



**NO DOGS
OR PETS**



**NO MOTOR
VEHICLES**



**NO
LITTERING**



**NO OPEN
FIRES**



**NO
CAMPING**



14 Rules

1. Make fewer HTTP requests
2. Use a CDN
3. Add an Expires header
4. Gzip components
5. Put stylesheets at the top
6. Move scripts to the bottom
7. Avoid CSS expressions
8. Make JS and CSS external
9. Reduce DNS lookups
10. Minify JS
11. Avoid redirects
12. Remove duplicate scripts
13. Configure ETags
14. Make AJAX cacheable

Rule 1: Make fewer HTTP requests

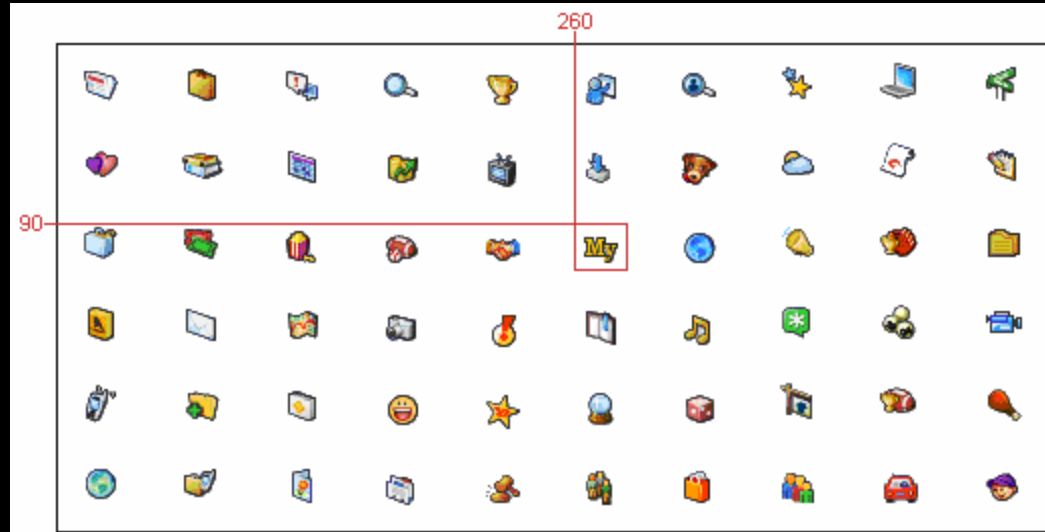
CSS sprites

combined scripts, combined stylesheets

image maps

inline images

CSS Sprites



```
<span style="
  background-image: url('sprites.gif');
  background-position: -260px -90px;">
</span>
```

size of combined image is less

Rule 2: Use a CDN

amazon.com	Akamai
aol.com	Akamai
cnn.com	
ebay.com	Akamai, Mirror Image
google.com	
msn.com	SAVVIS
myspace.com	Akamai, Limelight
wikipedia.org	
yahoo.com	Akamai
youtube.com	

distributed your static content before
distributing your dynamic content

Rule 3: Add an Expires header

not just for images

	Images	Stylesheets	Scripts	% with Expires	Median Age
amazon.com	0/62	0/1	0/3	0%	114 days
aol.com	23/43	1/1	6/18	48%	217 days
cnn.com	0/138	0/2	2/11	1%	227 days
ebay.com	16/20	0/2	0/7	55%	140 days
froogle.google.com	1/23	0/1	0/1	4%	454 days
msn.com	32/35	1/1	3/9	80%	34 days
myspace.com	0/18	0/2	0/2	0%	1 day
wikipedia.org	6/8	1/1	2/3	75%	1 day
yahoo.com	23/23	1/1	4/4	100%	n/a
youtube.com	0/32	0/3	0/7	0%	26 days

Rule 4: Gzip components

you can affect users'
download times

90%+ of browsers support
compression

Gzip: not just for HTML

	HTML	Scripts	Stylesheets
amazon.com	x		
aol.com	x	some	some
cnn.com			
ebay.com	x		
froogle.google.com	x	x	x
msn.com	x	deflate	deflate
myspace.com	x	x	x
wikipedia.org	x	x	x
yahoo.com	x	x	x
youtube.com	x	some	some

gzip scripts, stylesheets, XML, JSON (not images, PDF)

Rule 5: Put stylesheets at the top

stylesheets block rendering in IE

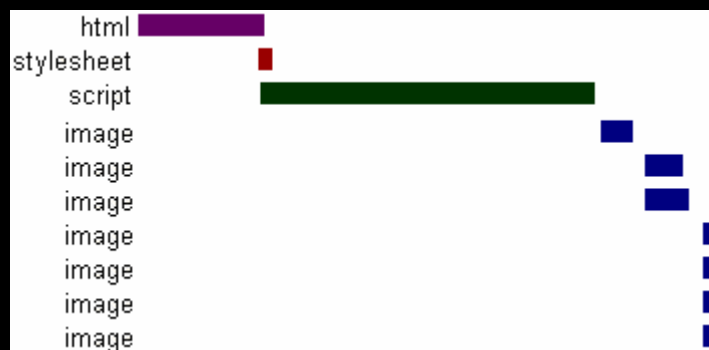
solution: put stylesheets in HEAD (per spec)

avoids Flash of Unstyled Content

use LINK (not @import)

Rule 6: Move scripts to the bottom

scripts block parallel downloads across all hostnames



scripts block rendering of everything below them in the page

`script defer` attribute is not a solution

- blocks rendering and downloads in FF
- slight blocking in IE

Rule 7: Avoid CSS expressions

used to set CSS properties dynamically in IE

```
width: expression(  
    document.body.clientWidth < 600 ?  
    "600px" : "auto" );
```

problem: expressions execute many times

- mouse move, key press, resize, scroll, etc.

alternatives:

- one-time expressions
- event handlers

Rule 8: Make JS and CSS external

inline: HTML document is bigger

external: more HTTP requests, but cached

variables

- page views per user (per session)
- empty vs. primed cache stats
- component re-use

external is typically better

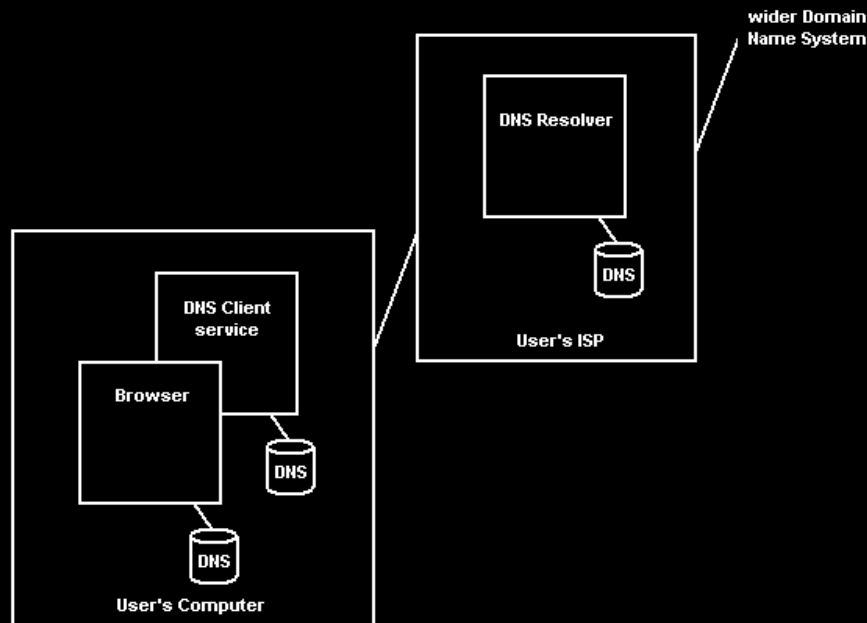
extra credit: post-onload download,
dynamic inlining

Rule 9: Reduce DNS lookups

typically 20-120 ms

block parallel downloads

OS and browser both have DNS caches



Rule 10: Minify JavaScript

	Minify External?	Minify Inline?
www.amazon.com	no	no
www.aol.com	no	no
www.cnn.com	no	no
www.ebay.com	yes	no
froogle.google.com	yes	yes
www.msn.com	yes	yes
www.myspace.com	no	no
www.wikipedia.org	no	no
www.yahoo.com	yes	yes
www.youtube.com	no	no

minify inline scripts, too

Minify vs. Obfuscate

	Original	JSMIn Savings	Dojo Savings
www.amazon.com	204K	31K (15%)	48K (24%)
www.aol.com	44K	4K (10%)	4K (10%)
www.cnn.com	98K	19K (20%)	24K (25%)
www.myspace.com	88K	23K (27%)	24K (28%)
www.wikipedia.org	42K	14K (34%)	16K (38%)
www.youtube.com	34K	8K (22%)	10K (29%)
Average	85K	17K (21%)	21K (25%)

minify - it's safer

not much difference



<http://crockford.com/javascript/jsmin>

<http://dojotoolkit.org/docs/shrinksafe>

Rule 11: Avoid redirects

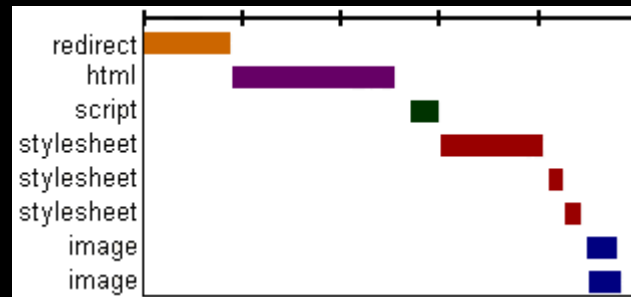
3xx status codes - mostly 301 and 302

HTTP/1.1 301 Moved Permanently

Location: <http://stevesouders.com/newuri>

add Expires headers to cache redirects

worst form of blocking



Rule 12: Remove duplicate scripts

hurts performance

- extra HTTP requests (IE only)
- extra executions

atypical?

- 2 of 10 top sites contain duplicate scripts

team size, # of scripts

Rule 13: Configure ETags

unique identifier returned in response

ETag: "c8897e-ae-4165acf0"

Last-Modified: Thu, 07 Oct 2004 20:54:08 GMT

used in conditional GET requests

If-None-Match: "c8897e-ae-4165acf0"

If-Modified-Since: Thu, 07 Oct 2004 20:54:08 GMT

if ETag doesn't match, can't send 304

ETag format

- Apache: inode-size-timestamp
- IIS: Filetimestamp: ChangeNumber

Remove them

- Apache: FileETag none
- IIS: <http://support.microsoft.com/kb/922703/>

Rule 14: Make AJAX cacheable

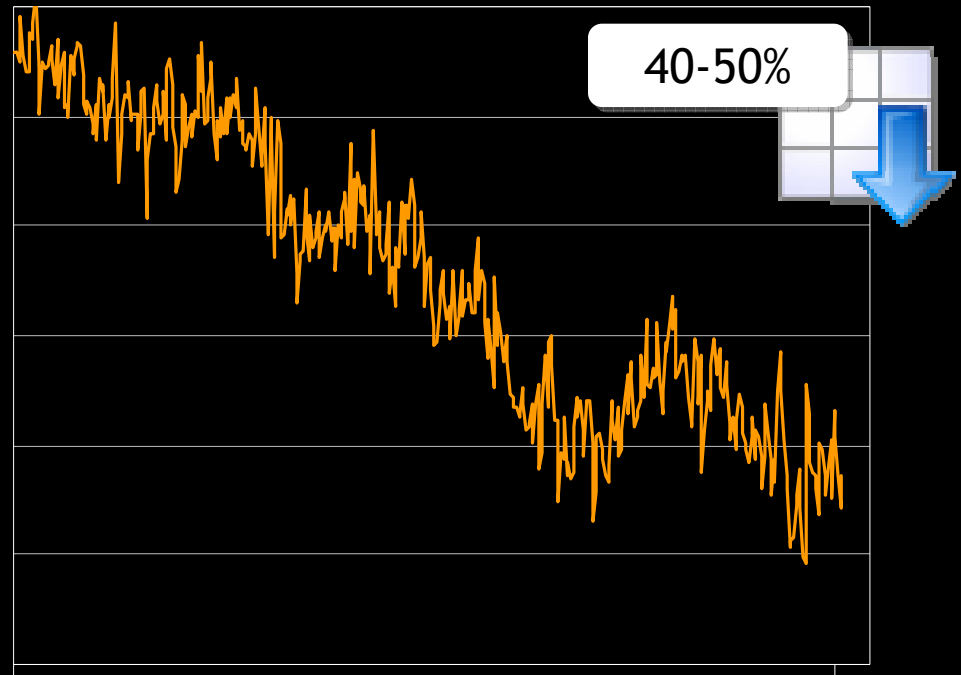
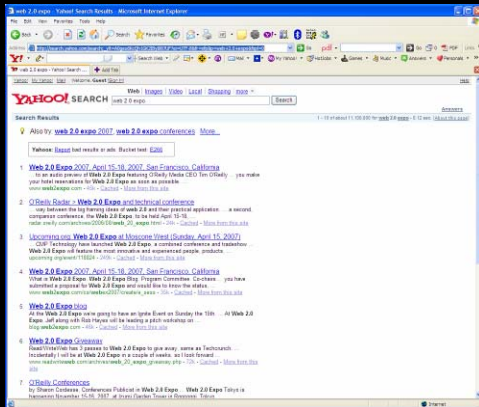
XHR, JSON, iframe, dynamic scripts can still be cached (and minified, and gzipped)

a personalized response should still be cacheable for that person

A close-up photograph of a brown leather suitcase handle. The handle is made of smooth, tan-colored leather and is secured with a metal latch mechanism. The latch consists of two metal prongs that hold the handle in place. The background is blurred, showing a dark surface and a small green object. The text "Case Studies" is overlaid in the center of the image in a white, sans-serif font.

Case Studies

Case Study:



- move JS to onload
- remove bottom tabs
- avoid redirects
- images sprites
- host JS on CDN
- combine JS files

Eva

Book

High Performance We

Conferences

Yahoo! F2E Summit

Web 2.0 Expo

Rich Web Experience

Blogs

YUI Blog: <http://yuiblog.com>

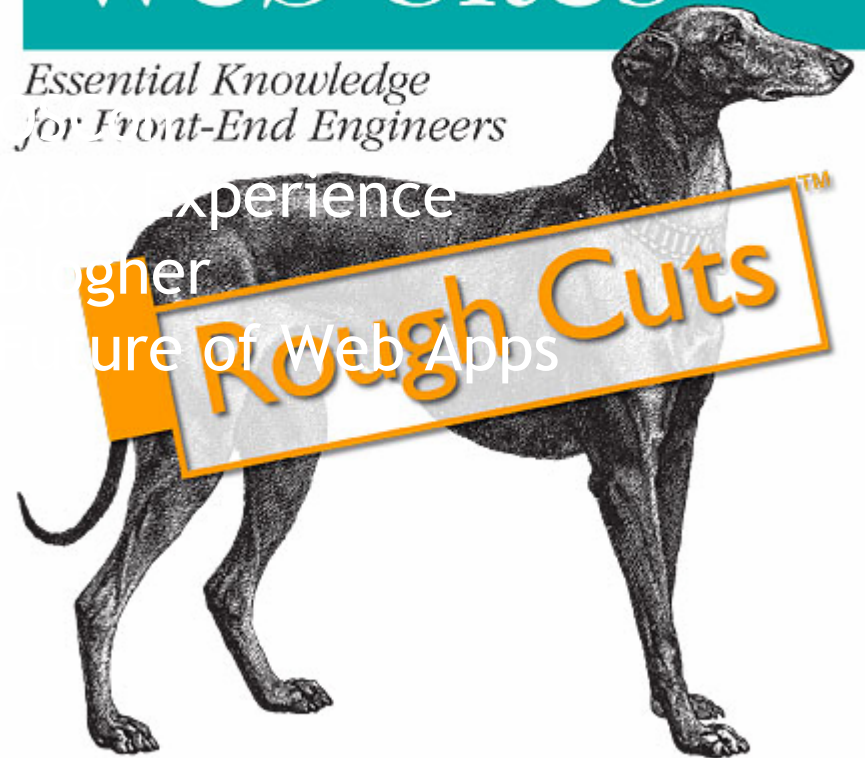
YDN Blog: <http://developer.yahoo.com>

Open Source YSlow

14 Steps to Faster-Loading Web Sites

High Performance Web Sites

*Essential Knowledge
for Front-End Engineers*



Experience
Higher
Quality of Web Apps
Rough Cuts™

O'REILLY®

Steve Souders

YSlow

performance lint tool

grades web pages for each rule

Firefox add-on integrated with Firebug

released this week on YDN!

open source license

Make Y! your home page

No Fee Mortgage PLUS from Bank of America.



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My Yahoo!

My Mail

Web | Images | Video | Local | Shopping | more ▾

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Page Options ▾

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Performance Grade: **B (86)**

Expand All Collapse All

B 1. Make fewer HTTP requests ▾

A 2. Use a CDN ▾

C 3. Add an Expires header ▾

These components do not have a far future Expires header:

- (7/25/2007) <http://us.i1.yimg.com/us.yimg.com/i/ww/sp/updated.gif>
- (7/25/2007) <http://ml.2mdn.net/viewad/551711/23-1x1.gif>

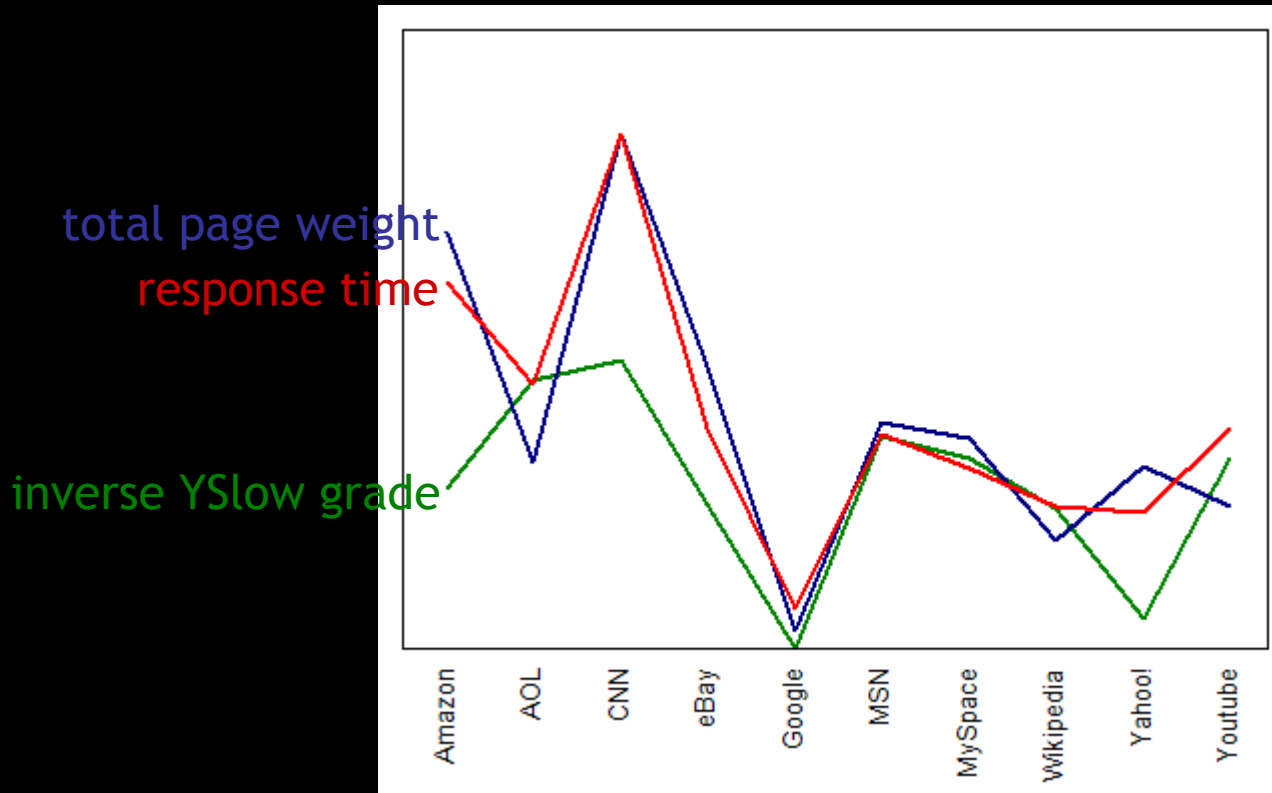
D 4. Gzip components ▾

B 5. Put CSS at the top ▾

Ten Top U.S Web Sites

	Page Weight	Response Time	YSlow Grade
www.amazon.com	405K	15.9 sec	D
www.aol.com	182K	11.5 sec	F
www.cnn.com	502K	22.4 sec	F
www.ebay.com	275K	9.6 sec	C
froogle.google.com	18K	1.7 sec	A
www.msn.com	221K	9.3 sec	F
www.myspace.com	205K	7.8 sec	D
www.wikipedia.org	106K	6.2 sec	C
www.yahoo.com	178K	5.9 sec	A
www.youtube.com	139K	9.6 sec	D

Strong Correlation



correlation(resp time, page weight) = 0.94

correlation(inverse YSlow, resp time) = 0.76

correlation(inverse YSlow, page weight) = 0.59

A vibrant concert scene with a DJ at a booth and a crowd with hands raised in the air, illuminated by colorful stage lights. The text "Live Analysis" is overlaid in the center.

Live Analysis

Ajax Effects

the rules still apply

more Ajax rules are in the works

JS execution is a bigger factor

user expectations are higher

need to start off on the right foot

YSlow will be extended to track XHR,
JSON

Takeaways

focus on the frontend

harvest the low-hanging fruit

you do control user response times

small investment up front keeps on giving

LOFNO - be an advocate for your users



THANK
YOU

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<http://www.flickr.com/photos/marinacvinhal/379111290/>

"Max speed 15kmh" by [xxxtoff](#):

<http://www.flickr.com/photos/xxxtoff/219781763/>

"maybe" by [Tal Bright](#):

<http://www.flickr.com/photos/bright/118197469/>

"takeout" by [dotpolka](#) :

<http://www.flickr.com/photos/dotpolka/249129144/>

"Absolutely Nothing is Allowed Here" by [Vicki & Chuck Rogers](#):

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"new briefcase" by [dcJohn](#):

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