Mastering Chrome DevTools v4

February, 2025

About Me

- Jon Kuperman
- TC39
- Source Maps
- Signals
- Builds DevTools @ Bloomberg

This Course

- Code: https://github.com/jkup/mastering-devtools-static
- Slides: https://tinyurl.com/mastering-devtools-4
- Deployed Code: https://masteringdevtools.com/

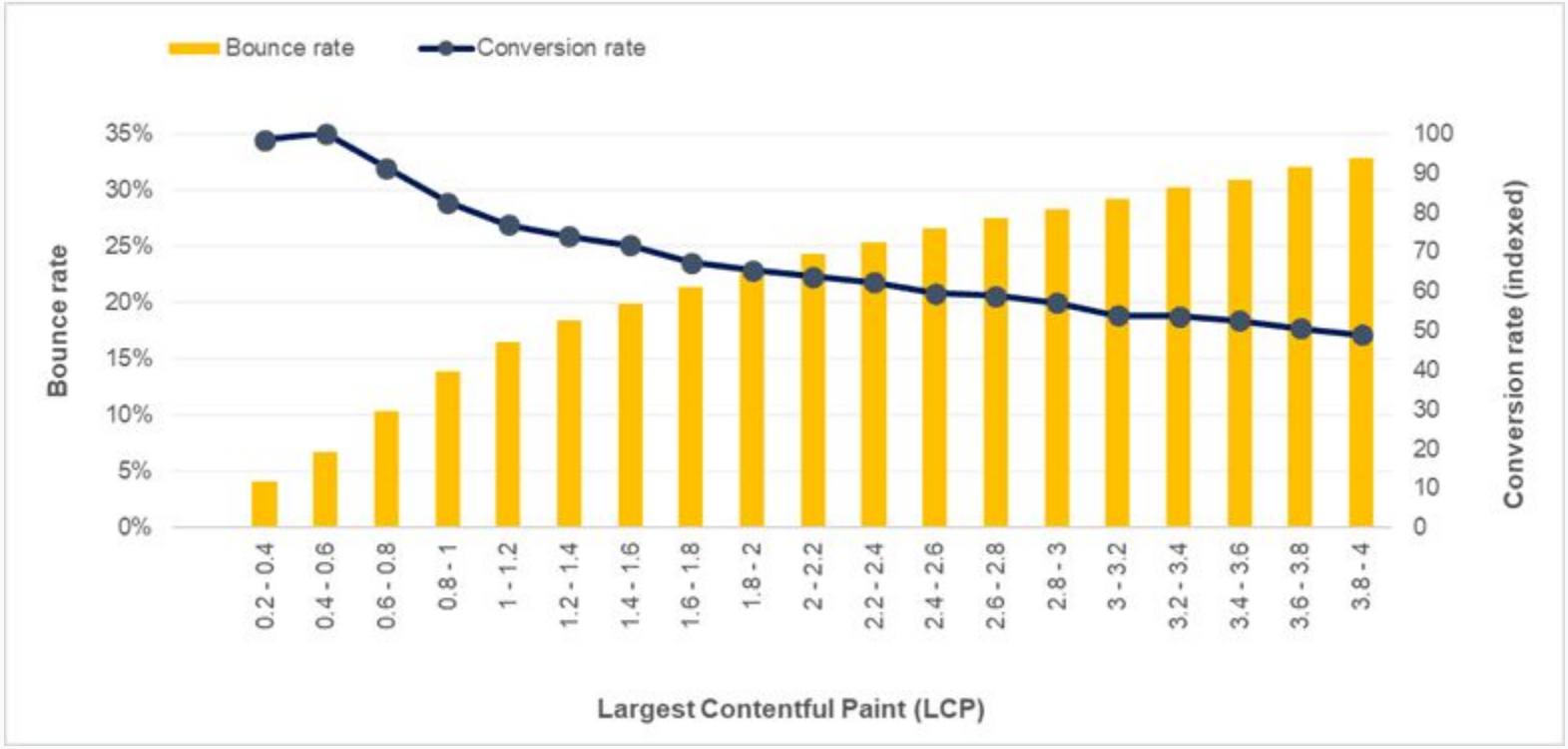
What we do

Building a C++/JS Browser for the Financial Markets

Why master Chrome DevTools?

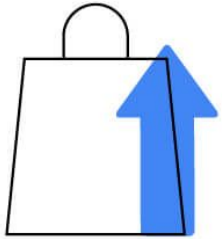
- Become a web performance expert!
- Be the one on your team to fix complicated bugs
- Prototype quickly with live editing

Google Performance Studies



https://web.dev/case-studies/renault

A 0.1 second improvement of mobile site speed increases conversion rates by:

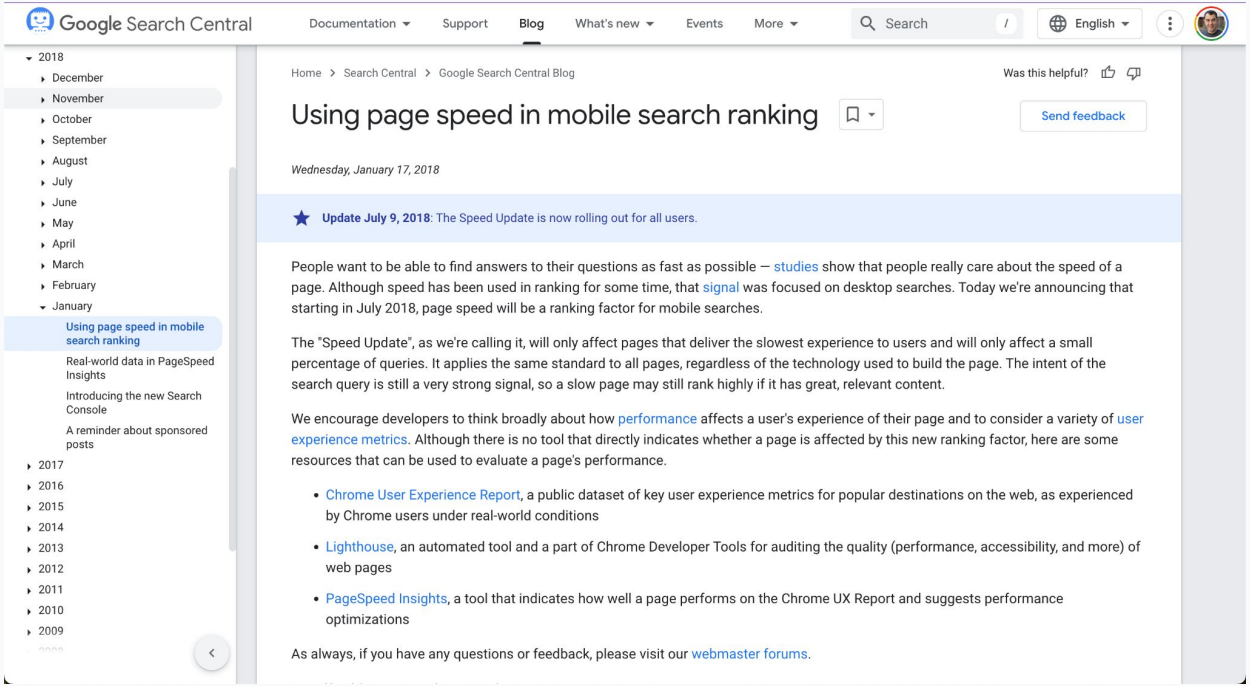


8.4%
for retail sites

10.1%
for travel sites

https://web.dev/case-studies/milliseconds-make-millions

The Speed Update



https://developers.google.com/search/blog/2018/01/using-page-speed-in-mobile-search

How do we measure performance?

Introducing Core Web Vitals

(Loading)

LCP

Largest Contentful Paint

(Interactivity)

INP

Interaction to Next Paint

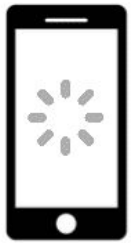
(Visual Stability)

CLS

Cumulative Layout Shift

Bloomberg contributes to Core Vitals!

RAIL



Response | **Animation** | **Idle** | **Load**

Where is everyone coming from with devtools?

To cover in this course

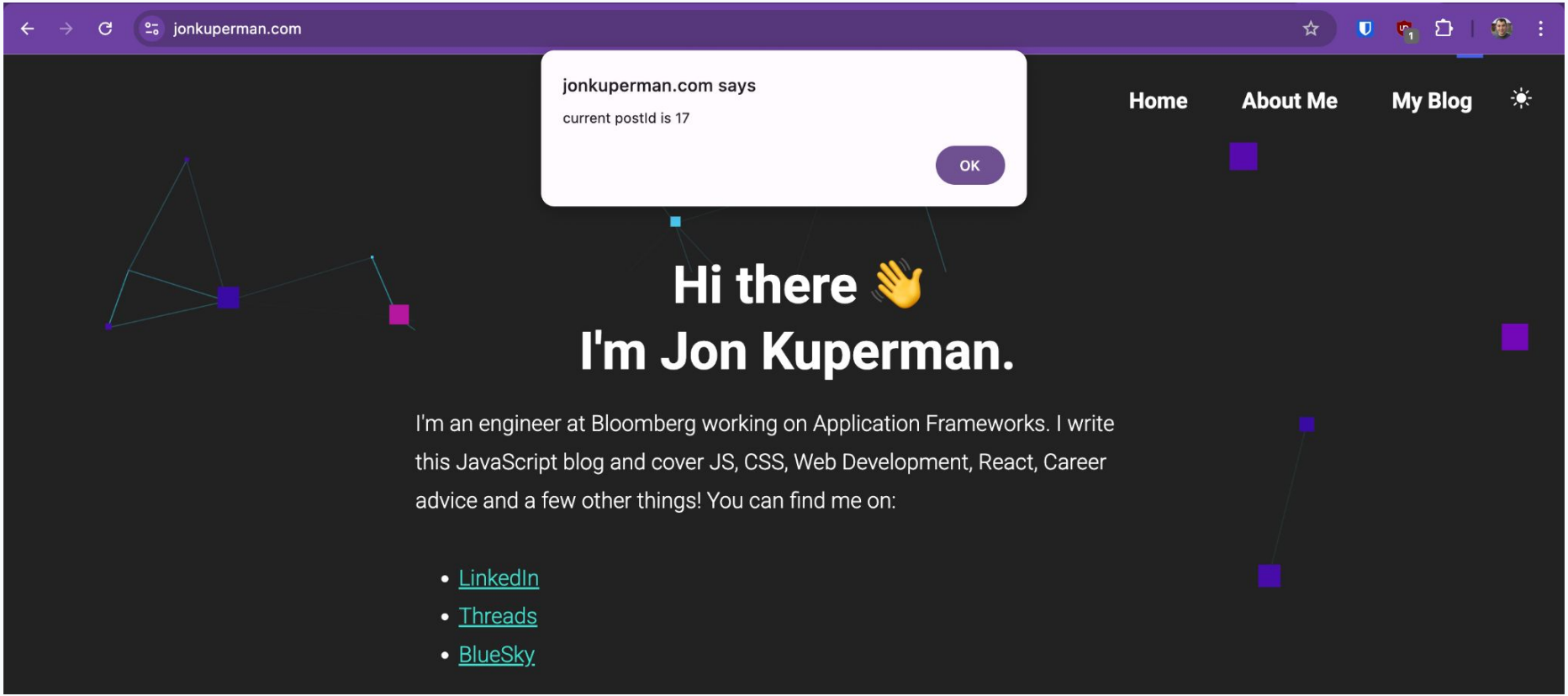
- Essential Chrome DevTools
- Network Optimization
- Lighthouse Audits
- Step-through debugging
- Performance Profiling
- Memory Management

Course Structure

- **Slides** / lecture style
- Interactive **Lessons** (using the DevTools together)
- **Exercises**

Lesson 1: What can Chrome DevTools Do?

Before Chrome DevTools


jonkuperman.com
jonkuperman.com says
current postId is 17
OK
Home
About Me
My Blog
Hi there 👋
I'm Jon Kuperman.
I'm an engineer at Bloomberg working on Application Frameworks. I write this JavaScript blog and cover JS, CSS, Web Development, React, Career advice and a few other things! You can find me on:
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Threads
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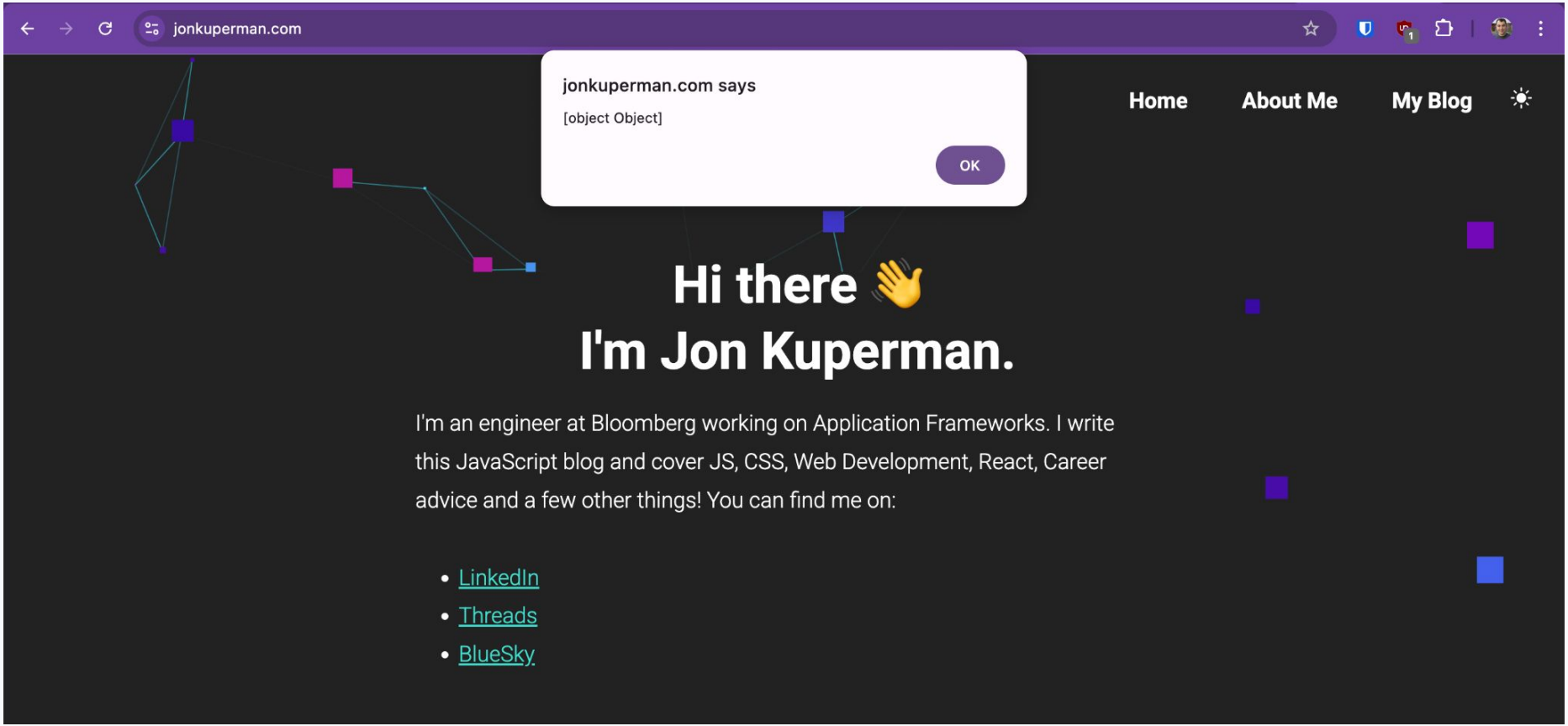

jonkuperman.com
jonkuperman.com says
[object Object]
OK
Home
About Me
My Blog
Hi there 👋
I'm Jon Kuperman.
I'm an engineer at Bloomberg working on Application Frameworks. I write this JavaScript blog and cover JS, CSS, Web Development, React, Career advice and a few other things! You can find me on:
LinkedIn
Threads
BlueSky

A brief history of DevTools for the web

- **1993**: The web launched with View Source and alert().
- **1999**: console.log is introduced in Netscape's JavaScript Console.
- **2006**: Firefox releases Firebug with DOM inspection, console output, and network monitoring.
- **2008**: Google Chrome launches with built-in Chrome DevTools.
- **2011**: Source maps are introduced, allowing developers to debug minified or transpiled code.
- **2013**: Performance panel debuts in Chrome DevTools, enabling detailed profiling of rendering and JavaScript execution.
- **2017**: Firefox Quantum reimagines its developer tools with modern features like grid layout inspection and performance analysis.
- **2020**: Microsoft Edge adopts Chromium, aligning its developer tools with Chrome's and consolidating devtools standards across browsers.

A history of DevTools for the web

- **1993**: The web launched with View Source and alert().
- **1999**: console.log is introduced in Netscape's JavaScript Console.
- **2002**: Venkman debugger launches with Firefox support.
- **2002**: Charles Proxy launches allowing you to debug HTTP traffic.
- **2003**: DOMi (DOM Inspector) launches as part of the Mozilla Application Suite.
- **2006**: Firebug launches with support for Firefox. It offers DOM inspection, console output, and network monitoring.
- **2008**: Google Chrome launches with built-in Chrome DevTools.
- **2011**: Source maps are introduced, allowing developers to debug minified or transpiled code.
- **2013**: Performance panel debuts in Chrome DevTools, enabling detailed profiling of rendering and JavaScript execution.
- **2017**: Firefox Quantum reimagines its developer tools with modern features like grid layout inspection and performance analysis.
- **2020**: Microsoft Edge adopts Chromium, aligning its developer tools with Chrome's and consolidating devtools standards across browsers.

A robust history of DevTools for the web

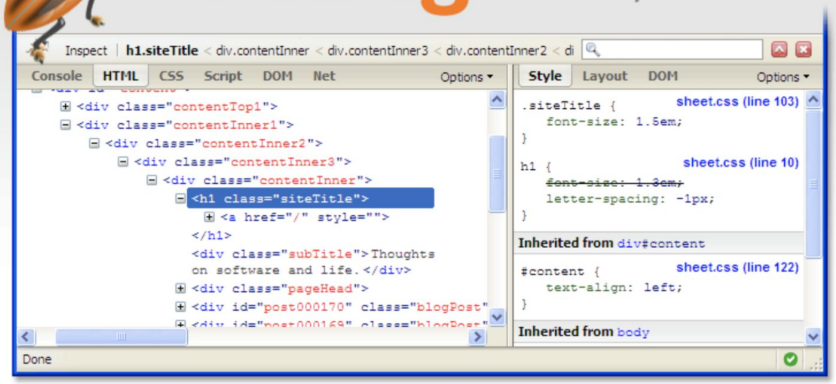
- **1990**: The web launches with `View Source`.
- **1995**: JavaScript launches with `window.alert`.
- **1998**: Microsoft launches Microsoft Script Debugger
- **1999**: console.log is introduced in Netscape's JavaScript Console.
- **2002**: Venkman debugger launches with Firefox support.
- **2002**: Charles Proxy launches allowing you to debug HTTP traffic.
- **2003**: DOMi (DOM Inspector) launches as part of the Mozilla Application Suite.
- **2003**: The Web Developer Toolbar is launched for Firefox.
- **2006**: Firebug launches with support for Firefox. It offers DOM inspection, console output, and network monitoring.
- **2006**: YSlow launches the first page performance analyzer.
- **2006**: Webkit releases their Web Inspector.

A robust history of DevTools for the web

- **2008**: Google Chrome launches with built-in Chrome DevTools.
- **2009**: Dynatrace launches Dynatrace Ajax Edition.
- **2009**: Google introduces it's Pagespeed performance analyzer.
- **2011**: Source maps are introduced, allowing developers to debug minified or transpiled code.
- **2013**: Performance panel debuts in Chrome DevTools, enabling detailed profiling of rendering and JavaScript execution.
- **2016**: Google launches Lighthouse for validating Progressive Web Apps.
- **2017**: Firefox Quantum reimagines its developer tools with modern features like grid layout inspection and performance analysis.
- **2018**: Visibug launches as "Firebug for web design".
- **2018**: Developer browsers like Sizzy and Polypane launch.
- **2020**: Microsoft Edge adopts Chromium, aligning its developer tools with Chrome's and consolidating devtools standards across browsers.

Firebug

web development evolved



(Click the tabs above to see screenshots of each.)

Firebug integrates with Firefox to put a wealth of development tools at your fingertips while you browse. You can edit, debug, and monitor CSS, HTML, and JavaScript live in any web page.

Just the way you like it

Firebug is always just a keystroke away, but it never gets in your way. You can open Firebug in a separate window, or as a bar at the bottom of your browser. Firebug also gives you fine-grained control over which websites you want to enable it for.

Learn more

Release Notes

Firebug is free and open source. Please support the project by donating.

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Henri Helvetica 🐵🇭🇹
@henrihelvetica.bsky.social

🎂 Today, the legendary web debugging tool FIREBUG would have celebrated an 18th bday today. 🎉
If you're super curious, there's footage of the 1.0 launch at a Yahoo Eng meetup on YouTube, but you an also read the blog post from Jan 24th, 2007. Enjoy!
📝: bit.ly/firebug-v1
📹: youtu.be/k4IgewBsxmY?...

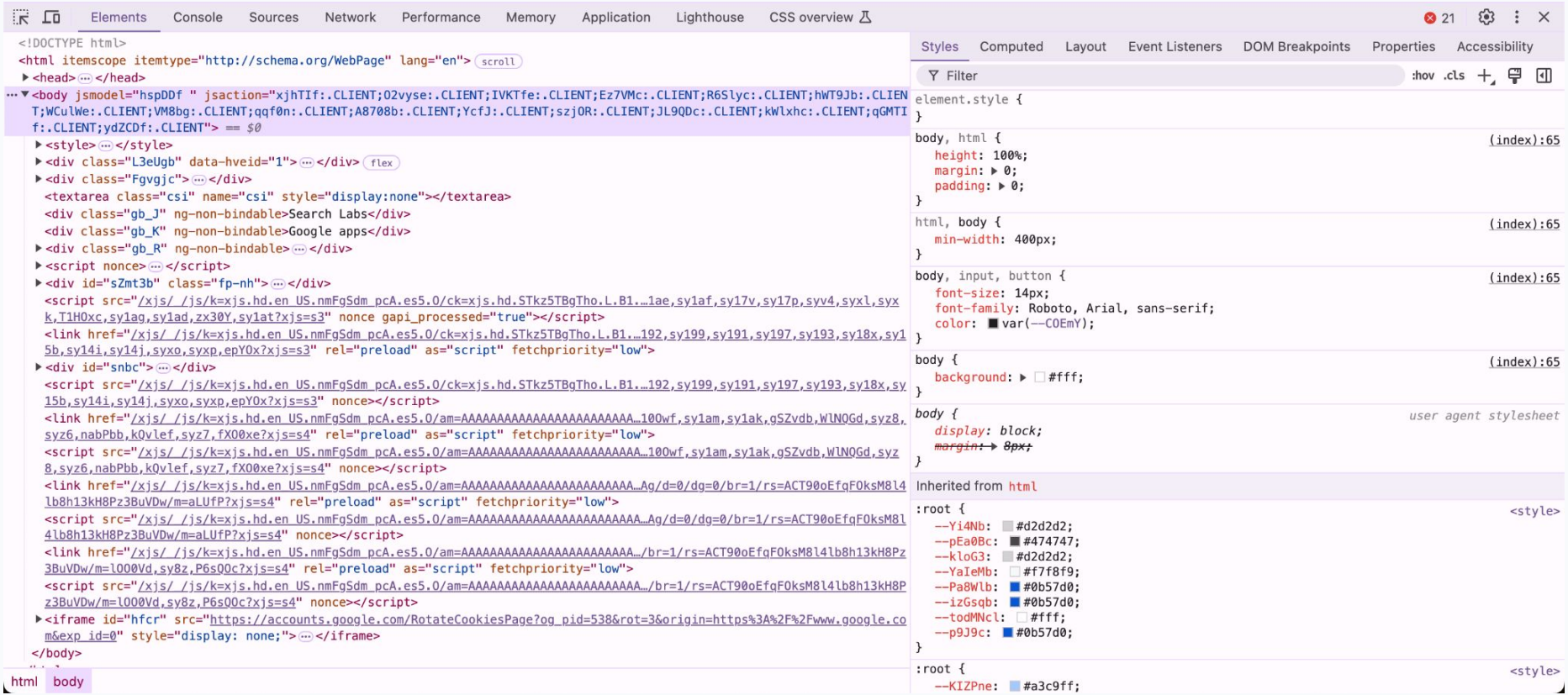
Essential Chrome DevTools

- Elements
- Console
- Sources

Line wrap

```
<!doctype html><html itemscope="" itemtype="http://schema.org/WebPage" lang="en"><head><meta charset="UTF-8"><meta content="origin" name="referrer"><meta content="/images/branding/
var g=this||self;function k(){return window.google&&window.google.kOPI||null};var l,m=[];function n(a){for(var b;a&&(!a.getAttribute||!(b=a.getAttribute("eid")));)a=a.parentNode;re
function r(a,b,d,c,h){var e="";b.search("&ei=")===-1&&(e="&ei="+n(c),b.search("&lei=")===-1&&(c=p(c))&&(e+="&lei="+c));var f=b.search("&cshid=")===-1&&a!=="slh";c="&zx="+Date.now()
document.documentElement.addEventListener("submit",function(b){var a;if(a=b.target){var c=a.getAttribute("data-submitfalse");a=c==="1"||c==="q"&&!a.elements.q.value?!0:!1}else a=!
var p=this||self;window.google=window.google||{};var r=window.performance&&window.performance.timing&&"navigationStart"in window.performance.timing,aa=google.stvsc&&google.stvsc.ns
function ea(a,b,c){a:{for(var d=a;d&&d!==b;d=d.parentElement)if(d.style.overflow==="hidden"||d.tagName==="G-EXPANDABLE-CONTENT"&&getComputedStyle(d).getPropertyValue("overflow")===
function da(a){return a.style.display==="none"?!0:document.defaultView&&document.defaultView.getComputedStyle?(a=document.defaultView.getComputedStyle(a),!!a&&(a.visibility==="hid
function ha(a,b,c,d,e){var h=e(a),k=h.left+(c?0:window.pageXOffset),m=h.top+(c?0:window.pageYOffset),n=h.width,f=h.height,g=0;if(!b&&f<=0&&n<=0)return g;b=window.innerHeight||docum
a!==null?a==="1":b||this.g.complete);this.A=b;x||this.A||this.i||D(this);w&&!c&&B()&&E(this)},D=function(a){google.rll(a.g,!0,function(){F(a,Date.now())})},E=function(a){if(a.C===
function I(a){for(var b=document.getElementsByTagName("img"),c=0,d=b.length;c<d;++c)a(H(b[c]))};function ta(a){if(a&&(a=a.target,a.tagName==="IMG")){var b=Date.now();F(H(a,void 0,
window.performance&&performance.mark&&performance.mark("SearchAFTStart",{startTime:K.wsrt});google.c.b("xe","load");var N;if((N=google.stvsc)==null?0:N.start)google.timers.load.t.
function T(a){var b=google.timers.load,c=b.m;if(!c||!c.prs){c=window._csc==="agsa"&&window._cshid;var d=R()||c?0:S("qsubts");d>0&&(c=S("fbts"),c>0&&(b.t.start=Math.max(d,c)));var e
p._cshid);(g=window.google&&window.google.kOPI||null)&&(f+="&opi="+g);a+=f;(f=google.stvsc)&&(a+="&ssr=1");if(f?f.isBF:R()===2)a+="&bb=1";R()===1&&(a+="&r=1");"gsasrt"in c&&(c=S("
"function"?navigator.sendBeacon(c,""):google.log("","",c)}};function U(a){a&&google.tick("load","cbs",a);google.tick("load","cbt");T("cap")};var ya=function(a){var b=xa;b.g=a;b.g&&
"function"?Object.assign:function(a,b){for(var c=1;c<arguments.length;c++){var d=arguments[c];if(d)for(var e in d)Object.prototype.hasOwnProperty.call(d,e)&&(a[e]=d[e])}return a};
var t=this||self;var u="click focusin focusout auxclick change copy dblclick beforeinput input keyup keydown keypress mousedown mouseenter mouseleave mouseout mouseover mouseup pas
var v=["focus","blur","error","load","toggle"];function w(a){return a==="mouseenter"?"mouseover":a==="mouseleave"?"mouseout":a==="pointerenter"?"pointerover":a==="pointerleave"?"po
function I(a,b){if(a===b)return!1;for(;a!==b&&b.parentNode;)b=b.parentNode;return a===b};var x=new D;a:{for(var E=x,B=window.document.documentElement,J=0;J<E.g.length;J++)if(B===E.
var g=this||self;var k,l=(k=g.mei)!=null?k:1,n,p=(n=g.sdo)!=null?n:!0,q=0,r,t=google.erd,v=t.jsr;google.ml=function(a,b,d,m,e){e=e===void 0?2:e;b&&(r=a&&a.message);d===void 0&&(d=
"&bver="+b(t.bv);t.dpf&&(c+="&dpf="+b(t.dpf));var f=a.lineNumber;f!==void 0&&(c+="&line="+f);var h=a.fileName;h&&(h.indexOf("-extension:/")>0&&(e=3),c+="&script="+b(h),f&&h===windo
try{
_._F_toggles_initialize=function(a){(typeof globalThis!=="undefined"?globalThis:typeof self!=="undefined"?self:this)._F_toggles=a||[]};(0,_._F_toggles_initialize)([]);
/*

 Copyright The Closure Library Authors.
 SPDX-License-Identifier: Apache-2.0
*/
var ca,ja,ka,oa,qa,ra,Aa,Ba,Da,Ea,Fa,Ia,Ya,Xa,ab,cb,bb,db,eb,hb,ib,mb,pb,jb,ob,nb,lb,kb,qb,rb,yb,Cb,Db,Eb,Fb;_.aa=function(a,b){if(Error.captureStackTrace)Error.captureStackTrace(
_.da=function(a){_.t.setTimeout(()=>{throw a;},0)};_.fa=function(){var a=_.t.navigator;return a&&(a=a.userAgent)?a:""};ja=function(a){return ha?ia?ia.brands.some(({brand:b})=>b&&b
_.pa=function(){return _.u("Safari")&&!(oa()||(ka()?0:_.u("Coast")))||_.la()||(ka()?0:_.u("Edge"))||(ka()?ja("Microsoft Edge"):_.u("Edg/"))||(ka()?ja("Opera"):_.u("OPR"))||_.na()||
_.ta=function(){return qa()?ia.platform==="macOS":_.u("Macintosh")};_.va=function(a,b){return _.ua(a,b)>=0};_.wa=function(a){let b="",c=0;const d=a.length-10240;for(;c<d;)b+=String
Ba=function(a,b){b[_.v]=(a|34)&-30941};Da=function(a){return!(!a||typeof a!=="object"||a.i!==Ca)};Ea=function(a){return a!==null&&typeof a==="object"&&!Array.isArray(a)&&a.construc
_.La=function(a,b,c,d){var e;d=(e=d)!=null?e:0;a==null&&(a=Ja);Ja=void 0;if(a==null)e=96,c?(a=[c],e|=512):a=[],b&&(e=e&-33521665|(b&1023)<<15);else{if(!Array.isArray(a))throw Erro
e=c&-33521665|(b&1023)<<15}else e=c}}a[_.v]=e;return a};_.Na=function(){const a=Error();Ma(a,"incident");_.da(a)};_.Oa=function(a){a=Error(a);Ma(a,"warning");return a};_.Qa=functio
_.Ua=function(a){return a==null||typeof a==="string"?a:void 0};_.Wa=function(a,b,c){if(a!=null&&typeof a==="object"&&a.Gd===_.Va)return a;if(Array.isArray(a)){var d=a[_.v]|0,e=d;e=
Xa=function(a){switch(typeof a){case "number":return isFinite(a)?a:String(a);case "bigint":return(0,_.Za)(a)?Number(a):String(a);case "boolean":return a?1:0;case "object":if(a)if(
cb=function(a,b,c,d,e){if(a!=null){if(Array.isArray(a))a=Fa(a)?void 0:e&&(a[_.v]|0)&2?a:bb(a,b,c,d!==void 0,e);else if(Ea(a)){const f={};for(let g in a)f[g]=cb(a[g],b,c,d,e);a=f}e
eb=function(a,b,c=Ba){if(a!=null){if(a instanceof Uint8Array)return b?a:new Uint8Array(a);if(Array.isArray(a)){var d=a[_.v]|0;if(d&2)return a;b&&(b=d===0||!!(d&32)&&!(d&64||!(d&16
_.gb=function(a){const b=a.ha,c=b[_.v];return c&2?_.Ka(a.constructor,_.fb(b,c,!1)):a};hb=function(a){return a};ib=function(a){return a};mb=function(a,b,c,d){return jb(a,b,c,d,kb,l
jb=function(a,b,c,d,e,f){if(!c.length&&!d)return 0;var g=0;let h=0,k=0;var l=0;let m=0;for(var p=c.length-1;p>=0;p--){var r=c[p];d&&p===c.length-1&&r===d||(l++,r!=null&&k++)}if(d)
+D,isNaN(d)||d>=1024||(p--,q++,x-=D.length,g=e(d,q)+f(p,r,x),g<l&&(a=1+d,l=g))}return a};ob=function(a,b,c){return c+a*3+(a>1?a-1:0)};nb=function(a,b){return(a>1?a-1:0)+(a-b)*4};l
rb=function(a,b,c,d){b=d+(+!!(b&512)-1);if(!(b<0||b>=a.length||b>=c))return a[b]};_.sb=function(a,b,c,d){const e=b>>15&1023||536870912;if(c>=e){let f,g=b;if(b&256)f=a[a.length-1];e
_.vb=function(a,b){return a!=null?a:b};
yb=function(a){var b=wb?a.ha:bb(a.ha,db,void 0,void 0,!1);var c=!wb,d=(c?a.ha:b)[_.v];if(a=b.length){var e=b[a-1],f=Ea(e);f?a--:e=void 0;var g=+!!(d&512)-1,h=a-g;d=!!xb&&!(d&512);v
((H=r)!=null?H:r={})[D]=p[D]}else if(l=p[D],Array.isArray(l)&&(Fa(l)||Da(l)&&l.size===0)&&(l=null),l==null&&(f=!0),h&&x<k){f=!0;l=x+g;for(q=m.length;q<=l;q++)m.push(void 0);m[l]=p
d}return b};_.zb=function(){const a=class{constructor(){throw Error();}};Object.setPrototypeOf(a,a.prototype);return a};_.w=function(a,b){return a!=null?!!a:!!b};_.y=function(a,b)
Db=function(a){a=["object"==typeof globalThis&&globalThis,a,"object"==typeof window&&window,"object"==typeof self&&self,"object"==typeof global&&global];for(var b=0;b<a.length;++b
Fb("Symbol.dispose",function(a){return a?a:Symbol("b")});Fb("globalThis",function(a){return a||Eb});Fb("Promise.prototype.finally",function(a){return a?a:function(b){return this.th
Mb=function(a,b,c){return a.call.apply(a.bind,arguments)};_.z=function(a,b,c){_.z=Mb;return _.z.apply(null,arguments)};_.Nb=function(a,b){var c=Array.prototype.slice.call(arguments
_.C=function(a,b){function c(){}c.prototype=b.prototype;a.W=b.prototype;a.prototype=new c;a.prototype.constructor=a;a.Bj=function(d,e,f){for(var g=Array(arguments.length-2),h=2;h<
a:{let a="";const b=function(){const c=_.fa();if(_.lc)return/rv:([^\);]+)(\)|;)/.exec(c);if(_.kc)return/Edge\/([\d\.]+)/.exec(c);if(_.jc)return/\b(?:MSIE|rv)[: ]([^\);]+)(\)|;)/.ex
```


Elements
Console
Sources
Network
Performance
Memory
Application
Lighthouse
CSS overview
21
<!DOCTYPE html>
<html itemscope itemtype="http://schema.org/WebPage" lang="en">
<head>
<body jsmodel="hspDDf " jsaction="xjhTIf:.CLIENT;O2vyse:.CLIENT;IVKTfe:.CLIENT;Ez7VMc:.CLIENT;R6Slyc:.CLIENT;hWT9Jb:.CLIENT;WCulWe:.CLIENT;VM8bg:.CLIENT;qqf0n:.CLIENT;A8708b:.CLIENT;YcfJ:.CLIENT;szjOR:.CLIENT;JL9QDc:.CLIENT;kWlxhc:.CLIENT;qGMTIf:.CLIENT;ydZCDf:.CLIENT"> == $0
<style>

<textarea class="csi" name="csi" style="display:none"></textarea>
<div class="gb_J" ng-non-bindable>Search Labs
<div class="gb_K" ng-non-bindable>Google apps
<div class="gb_R" ng-non-bindable>
<script nonce>

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<link href="/xjs/_/js/k=xjs.hd.en_US.nmFgSdm_pcA.es5.O/ck=xjs.hd.STkz5TBgTho.L.B1.…192,sy199,sy191,sy197,sy193,sy18x,sy15b,sy14i,sy14j,syxo,syxp,epYOx?xjs=s3" rel="preload" as="script" fetchpriority="low">

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<link href="/xjs/_/js/k=xjs.hd.en_US.nmFgSdm_pcA.es5.O/am=AAAAAAAAAAAAAAAAAAAAAA…10Owf,sy1am,sy1ak,gSZvdb,WlNQGd,syz8,syz6,nabPbb,kQvlef,syz7,fXO0xe?xjs=s4" rel="preload" as="script" fetchpriority="low">
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<link href="/xjs/_/js/k=xjs.hd.en_US.nmFgSdm_pcA.es5.O/am=AAAAAAAAAAAAAAAAAAAAAA…Ag/d=0/dg=0/br=1/rs=ACT90oEfqFOksM8l4lb8h13kH8Pz3BuVDw/m=aLUfP?xjs=s4" rel="preload" as="script" fetchpriority="low">
<script src="/xjs/_/js/k=xjs.hd.en_US.nmFgSdm_pcA.es5.O/am=AAAAAAAAAAAAAAAAAAAAAA…Ag/d=0/dg=0/br=1/rs=ACT90oEfqFOksM8l4lb8h13kH8Pz3BuVDw/m=aLUfP?xjs=s4" nonce></script>
<link href="/xjs/_/js/k=xjs.hd.en_US.nmFgSdm_pcA.es5.O/am=AAAAAAAAAAAAAAAAAAAAAA…/br=1/rs=ACT90oEfqFOksM8l4lb8h13kH8Pz3BuVDw/m=lOO0Vd,sy8z,P6sQOc?xjs=s4" rel="preload" as="script" fetchpriority="low">
<script src="/xjs/_/js/k=xjs.hd.en_US.nmFgSdm_pcA.es5.O/am=AAAAAAAAAAAAAAAAAAAAAA…/br=1/rs=ACT90oEfqFOksM8l4lb8h13kH8Pz3BuVDw/m=lOO0Vd,sy8z,P6sQOc?xjs=s4" nonce></script>
<iframe id="hfcr" src="https://accounts.google.com/RotateCookiesPage?og_pid=538&rot=3&origin=https%3A%2F%2Fwww.google.com&exp_id=0" style="display: none;">
</body>
html
body
Styles
Computed
Layout
Event Listeners
DOM Breakpoints
Properties
Accessibility
Filter
:hov
.cls
element.style {
}
body, html {
(index):65
height: 100%;
margin: 0;
padding: 0;
}
html, body {
(index):65
min-width: 400px;
}
body, input, button {
(index):65
font-size: 14px;
font-family: Roboto, Arial, sans-serif;
color: var(--COEmY);
}
body {
(index):65
background: #fff;
}
body {
user agent stylesheet
display: block;
margin: 8px;
}
Inherited from html
:root {
<style>
--Yi4Nb: #d2d2d2;
--pEa0Bc: #474747;
--kloG3: #d2d2d2;
--YaIeMb: #f7f8f9;
--Pa8Wlb: #0b57d0;
--izGsqb: #0b57d0;
--todMNcl: #fff;
--p9J9c: #0b57d0;
}
:root {
<style>
--KIZPne: #a3c9ff;

What do we mean DOM?

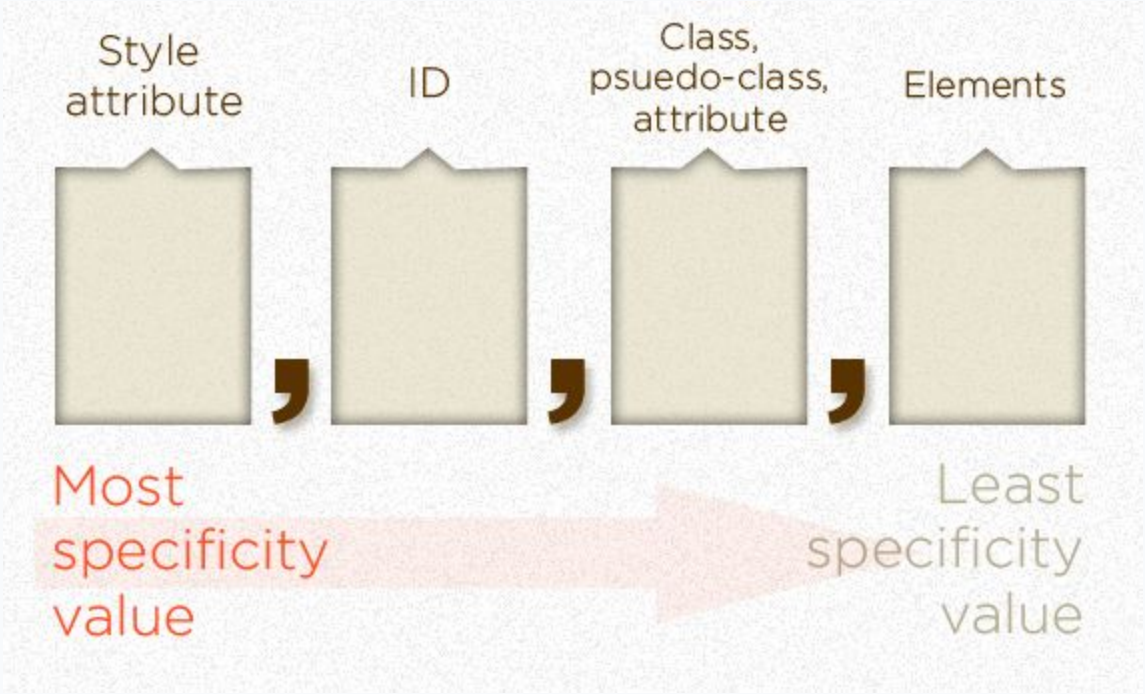
Markup to test (permalink, save, upload, download, hide):

```
<!DOCTYPE html>
<html>
  <head>
    <style>
      h1{
        font-size: 30px;
      }
    </style>
  </head>
  <body>
    <h1 class="foo">Hello</h1>
  </body>
</html>
```

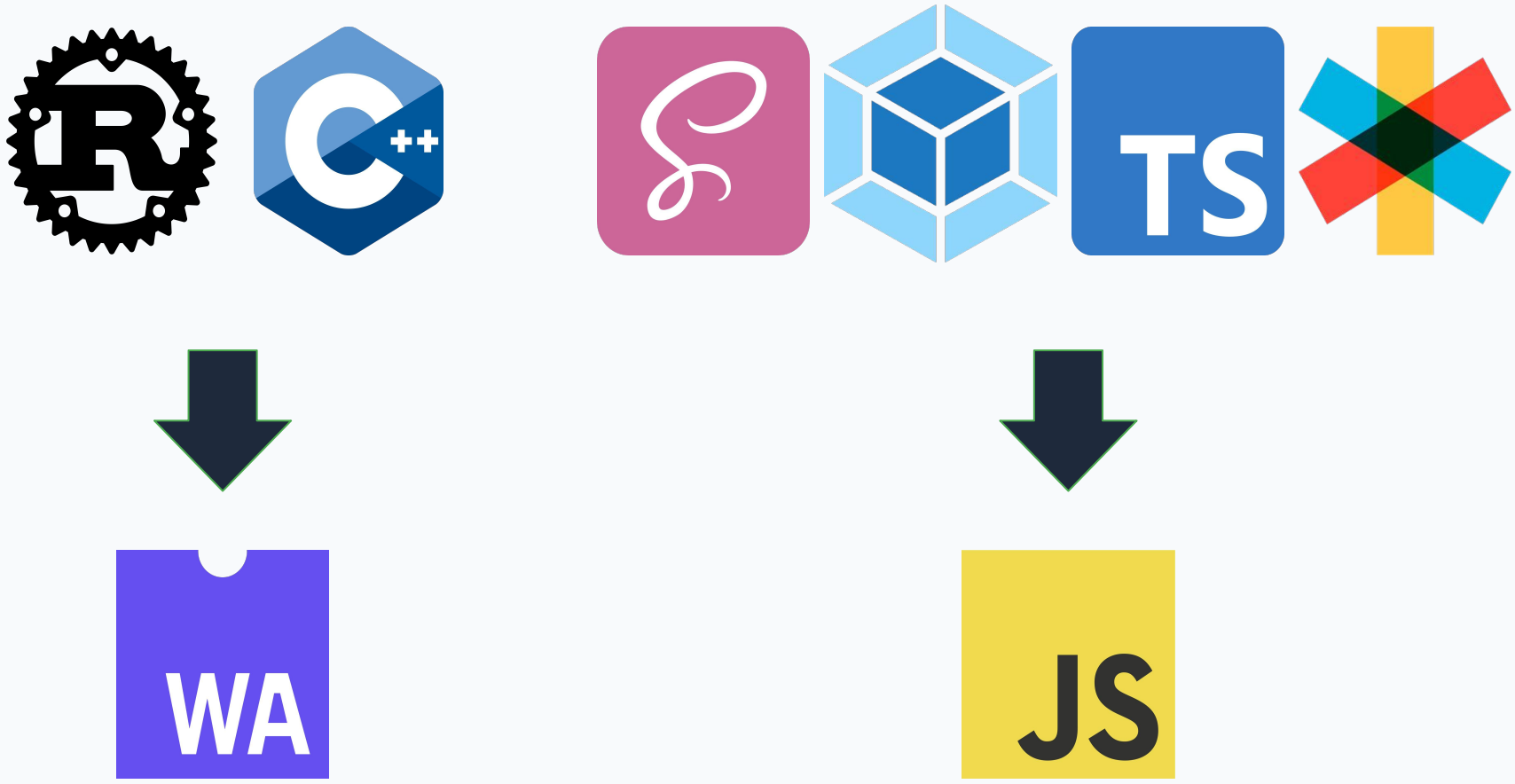
DOM view (hide, refresh):

```
├DOCTYPE: html
└HTML
  ├HEAD
  │ ├#text:
  │ ├STYLE
  │ │ └#text: h1{ font-size: 30px; }
  │ └#text:
  ├#text:
  └BODY
    ├#text:
    ├H1 class="foo"
    │ └#text: Hello
    └#text:
```

Why am I seeing this CSS applied?

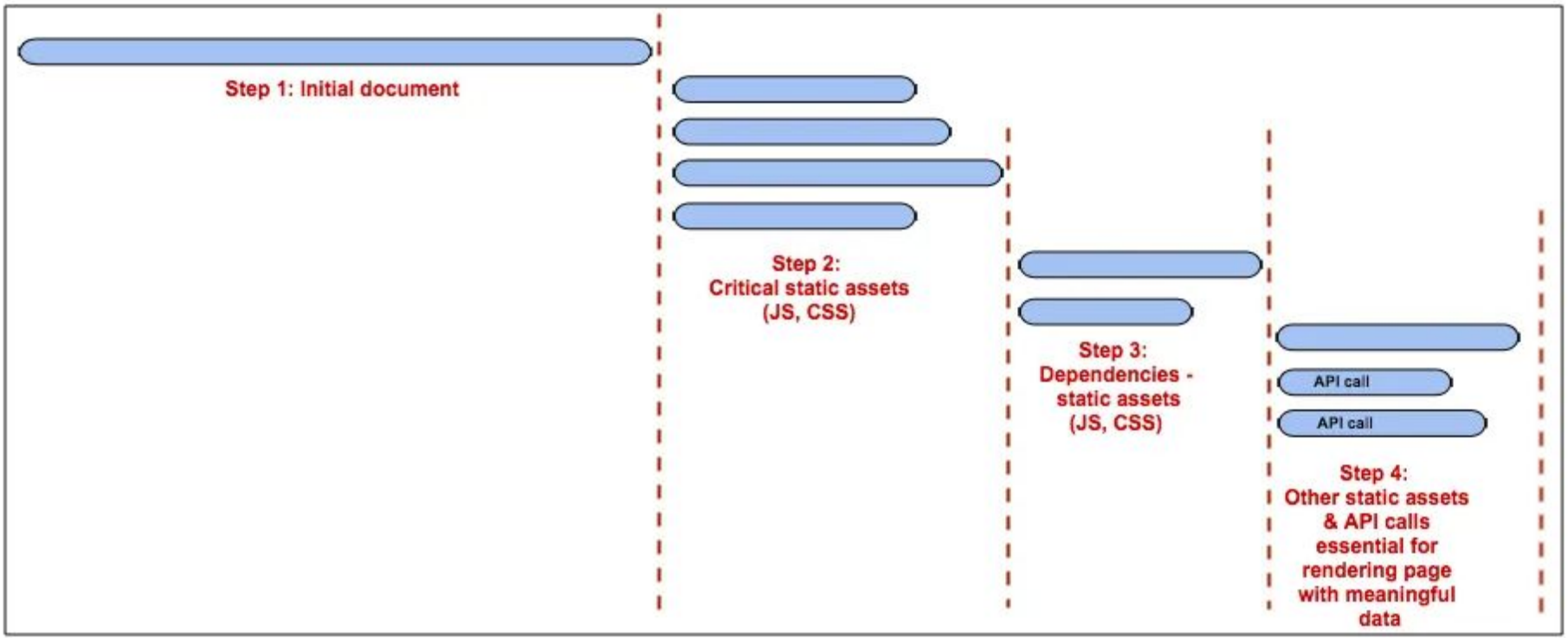

Style attribute
ID
Class, psuedo-class, attribute
Elements
,
,
,
Most specificity value
Least specificity value

Source Maps

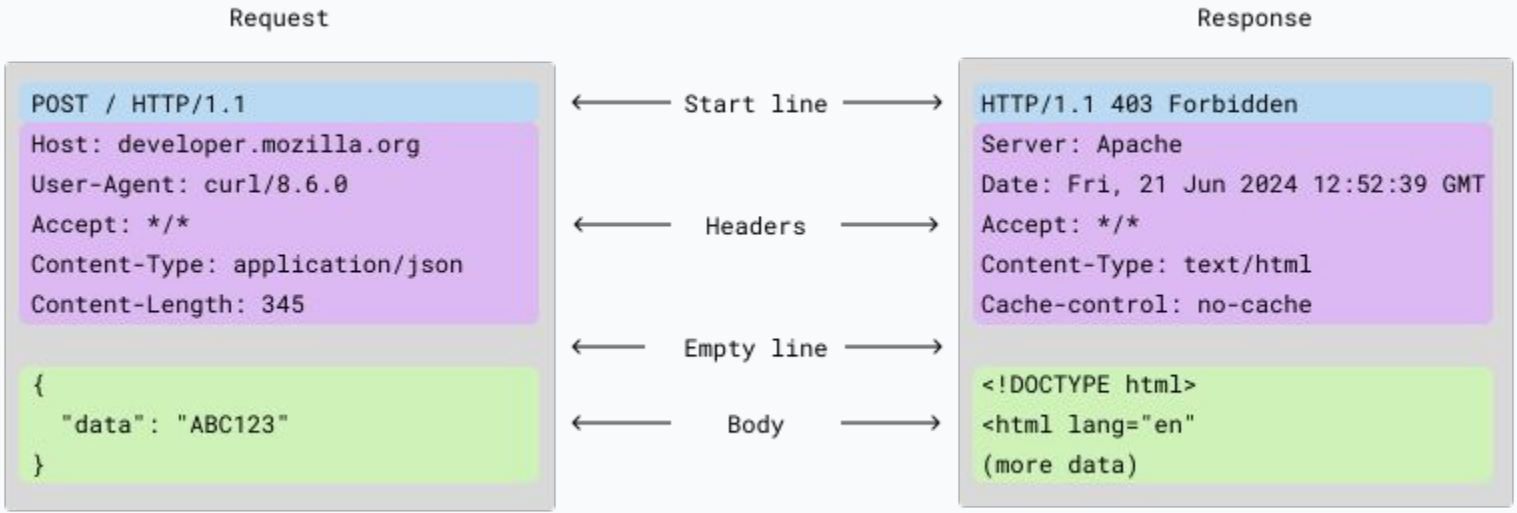


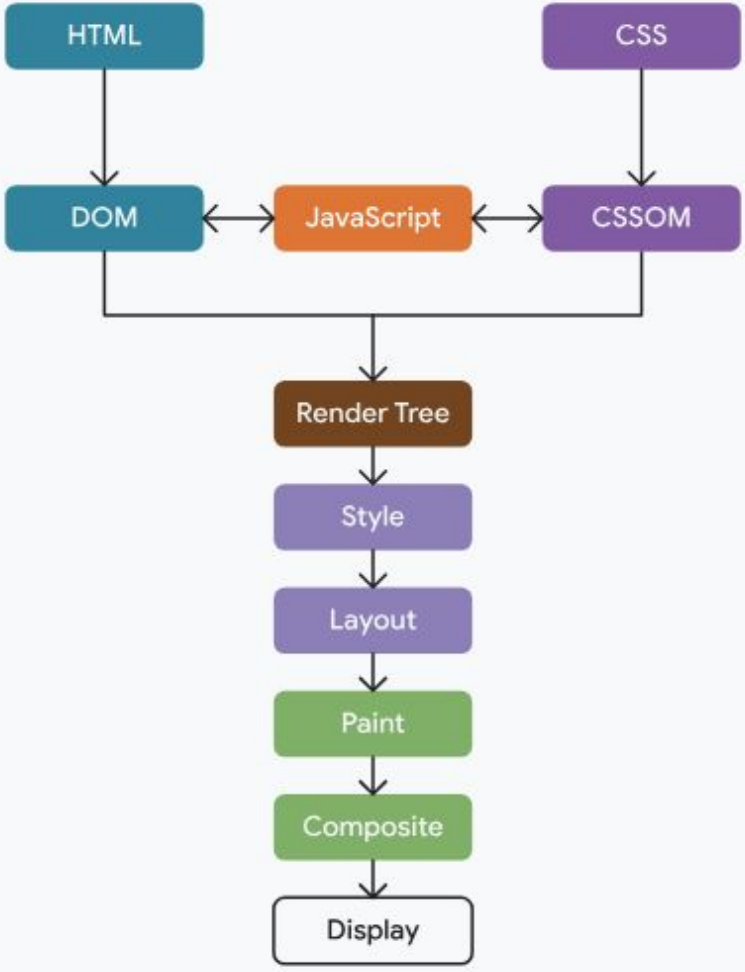
Lesson: Essential Chrome DevTools

Network Optimization

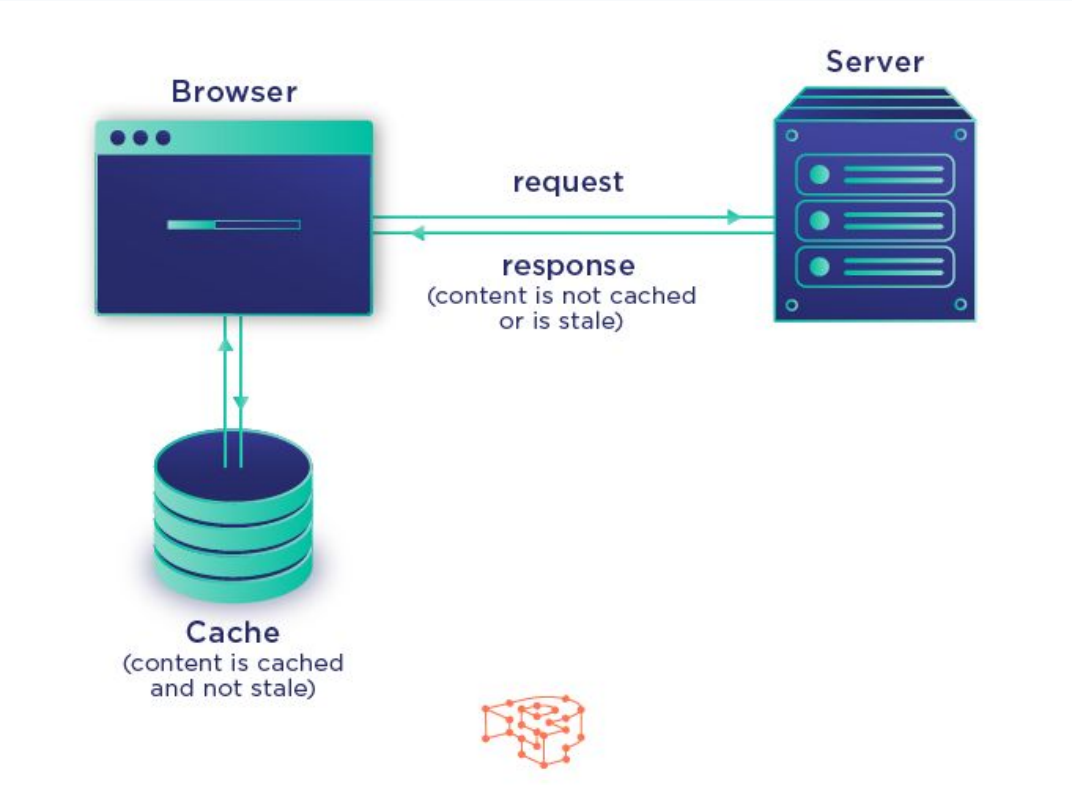

Step 1: Initial document
Step 2:
Critical static assets
(JS, CSS)
Step 3:
Dependencies -
static assets
(JS, CSS)
API call
API call
Step 4:
Other static assets
& API calls
essential for
rendering page
with meaningful
data

Network Optimization

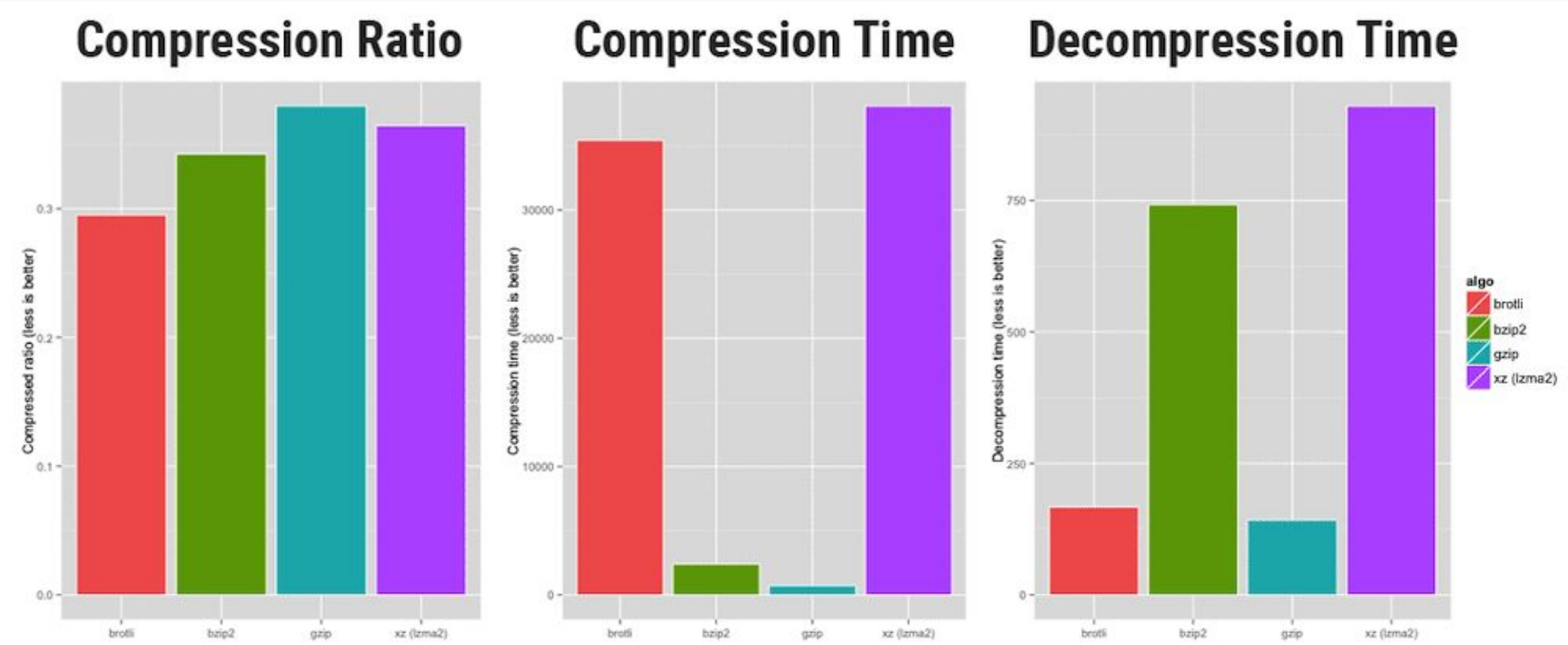



HTML
CSS
DOM
JavaScript
CSSOM
Render Tree
Style
Layout
Paint
Composite
Display

Browser cache



Gzip vs Brotli

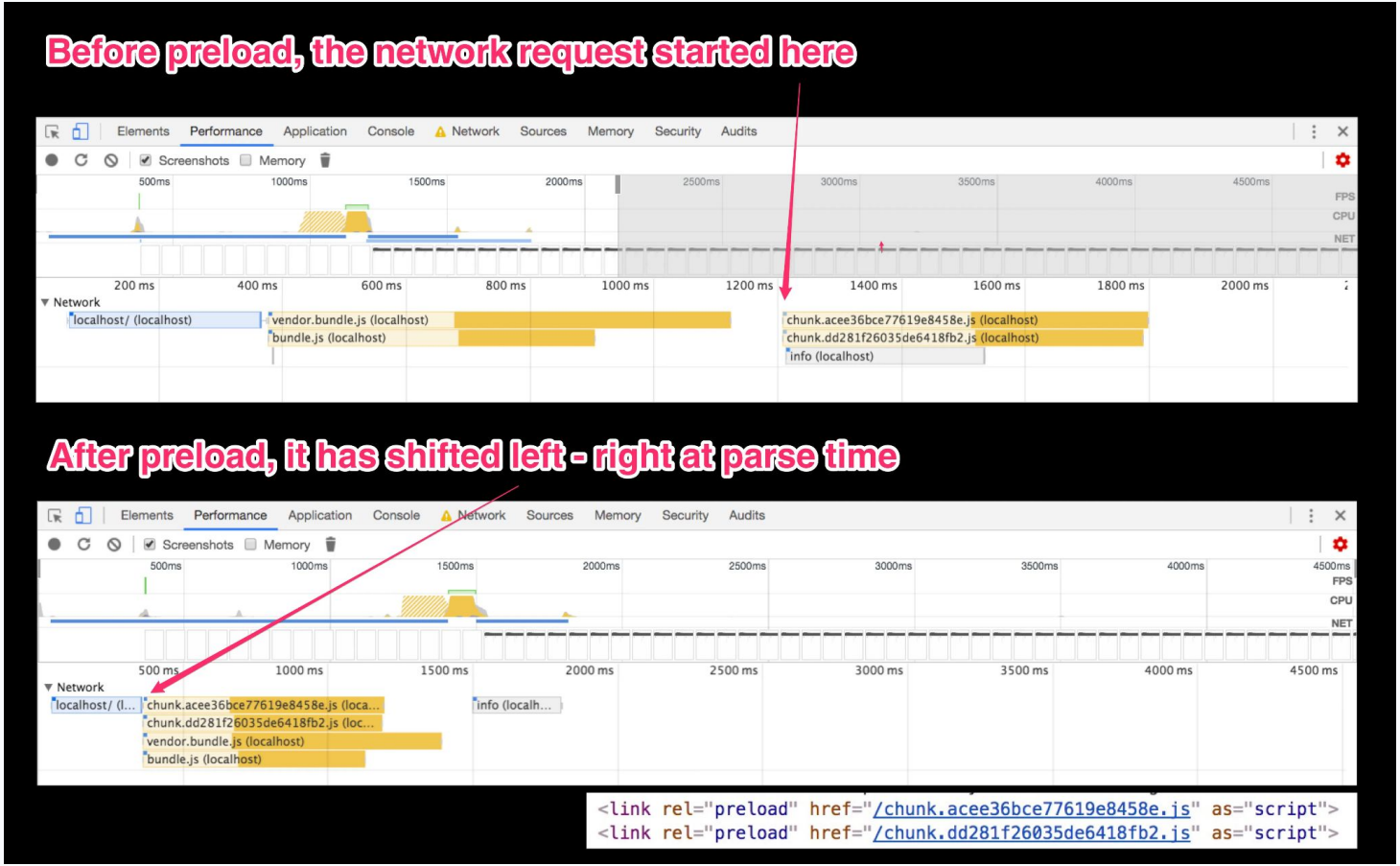


Browser priority

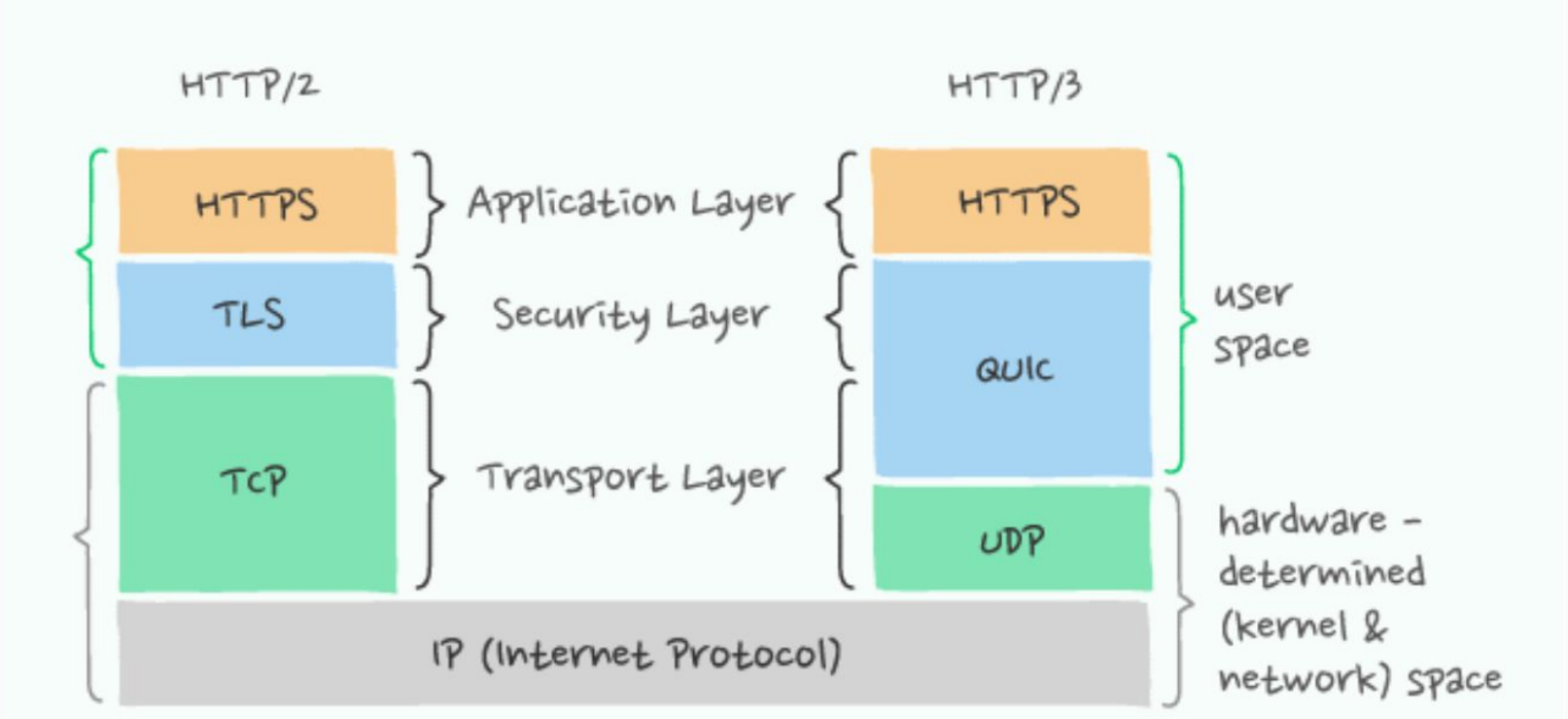
Name	Status	Type	Initiator ▲	Size	Time	Priority
ea8FacM9Wef3EJPWRr…	200	font	css?family=Googl…	15.2 kB	11 ms	Highest
ieVl2ZhZI2eCN5jzbjEETS…	200	font	css?family=Robot…	(disk cache)	3 ms	Highest
BBCReithSans_W_Bd.w…	200	font	world-asia-587846…	60.6 kB	146 ms	Highest
BBCReithSerif_W_Md.w…	200	font	world-asia-587846…	80.0 kB	167 ms	Highest
BBCReithSerif_W_Rg.wo…	200	font	world-asia-587846…	80.7 kB	181 ms	Highest
BBCReithSans_W_Rg.w…	200	font	world-asia-587846…	(memory …	1 ms	Highest
BBCReithSans_W_Rg.w…	200	font	Other	(disk cache)	4 ms	Highest
bdb6447d-6e06-4b98-87…	200	font	Other	58.1 kB	41 ms	Highest
e07f1fb2-93c9-407f-b8ff…	200	font	Other	64.1 kB	33 ms	Highest
fa16d116-7ca3-4afc-83c…	200	font	Other	75.2 kB	41 ms	Highest

Name ▲	Status	Type	Initiator	Size	Time	Priority
4817?ers=3	200	script	pubads_impl_202…	25.6 kB	45 ms	Low
?orig=video&taboola_hm…	200	script	getuid	230 B	64 ms	High
?orig=video&taboola_hm…	200	script	getuid	230 B	60 ms	High
?url=https%3A%2F%2F…	200	script	dotcom-bootstrap…	923 B	322 ms	Low
a05f1579543550f3e2793…	200	script	container.html:12	11.8 kB	59 ms	Low
abg_lite_fy2019.js	200	script	container.html:12	8.1 kB	32 ms	High

Preload vs prefetch



HTTP/2 vs. HTTP/3



Lesson: Network Optimization

Lighthouse web audits

Fork me on GitHub

YSlow

YSlow analyzes web pages and why they're slow based on Yahoo!'s rules for high performance web sites

Install YSlow for Chrome

En Español | Source | Issues | FAQ | Help

Feature highlights

- Grades web page based on one of three predefined ruleset or a user-defined ruleset;
- It offers suggestions for improving the page's performance;
- Summarizes the page's components;
- Displays statistics about the page;
- Provides tools for performance analysis, including Smush.it™ and JSLint.

Availability

 Firefox

 Chrome

 Mobile/Bookmarklet

 Opera

 Safari

 Command Line (HAR)

 PhantomJS

 Node.js Server

 Source Code

 [» View YSlow Ruleset Limitations] (ruleset-limitations/) across several browsers/platforms. ## Web Performance Best Practices and Rules Yahoo!'s Exceptional Performance team has identified 34 rules that affect web

Posts from @yslow

Nothing to see here - yet

When they post, their posts will show up here.

View on X

PageSpeed Insights

Docs

Enter a web page URL

Analyze

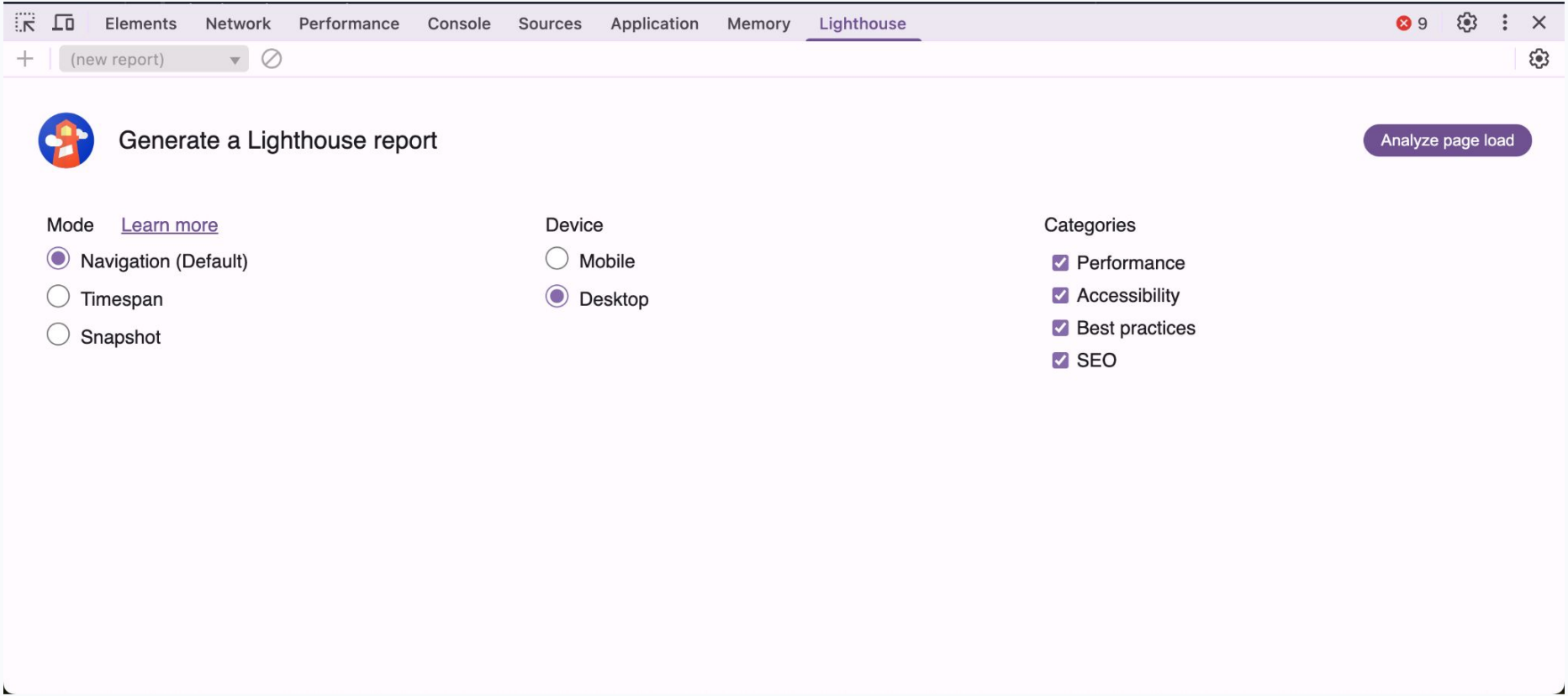
Make your web pages fast on all devices

CHECK OUT

What's new

Documentation

Learn about Web Performance


Elements
Network
Performance
Console
Sources
Application
Memory
Lighthouse
9
(new report)
Generate a Lighthouse report
Analyze page load
Mode
Learn more
Navigation (Default)
Timespan
Snapshot
Device
Mobile
Desktop
Categories
Performance
Accessibility
Best practices
SEO

Lighthouse web audits

- Performance
- Accessibility
- Best Practices
- SEO

Performance

- Page load speed and responsiveness.
- Resource usage (e.g., JavaScript, images, fonts).
- Metrics:
  - First Contentful Paint (FCP): Time to first visible content.
  - Largest Contentful Paint (LCP): Time to load the largest visible element.
  - Cumulative Layout Shift (CLS): Visual stability during loading.
  - Time to Interactive (TTI): Time until the page is fully usable.
  - Total Blocking Time (TBT): Delays caused by scripts.

Accessibility

- Check out the Frontend Masters course (shameless plug!)
- Compatibility with assistive technologies (e.g., screen readers).
- Semantic HTML structure and correct use of ARIA roles.
- Key focus areas:
  - Text contrast ratio.
  - Keyboard navigation support.
  - Alt attributes on images.
  - Labels on forms and interactive elements.

Best Practices

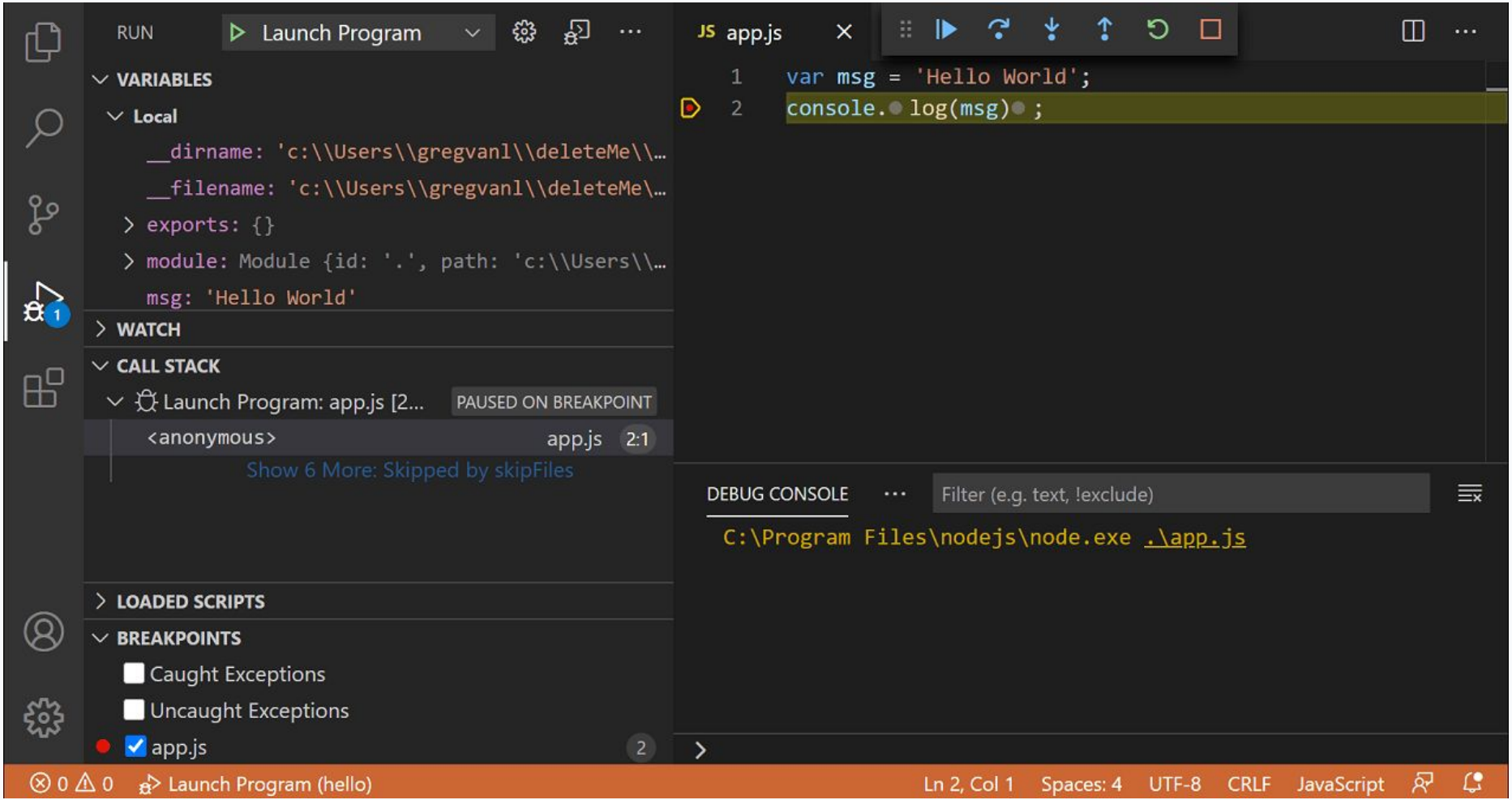
- Code quality and security practices.
- Key areas:
  - Secure HTTPS connections.
  - Avoiding deprecated APIs.
  - No inline styles or JavaScript (avoids XSS risks).
  - Efficient use of browser features (e.g., modern image formats like WebP).

SEO

- Basic search engine optimization for discoverability.
- Key areas:
  - Meta tags.
  - Page can be crawled by SEO bots.
  - Mobile-friendliness.
  - Correct use of HTTP status codes.

Lesson: Lighthouse Audit

Step-through Debugging

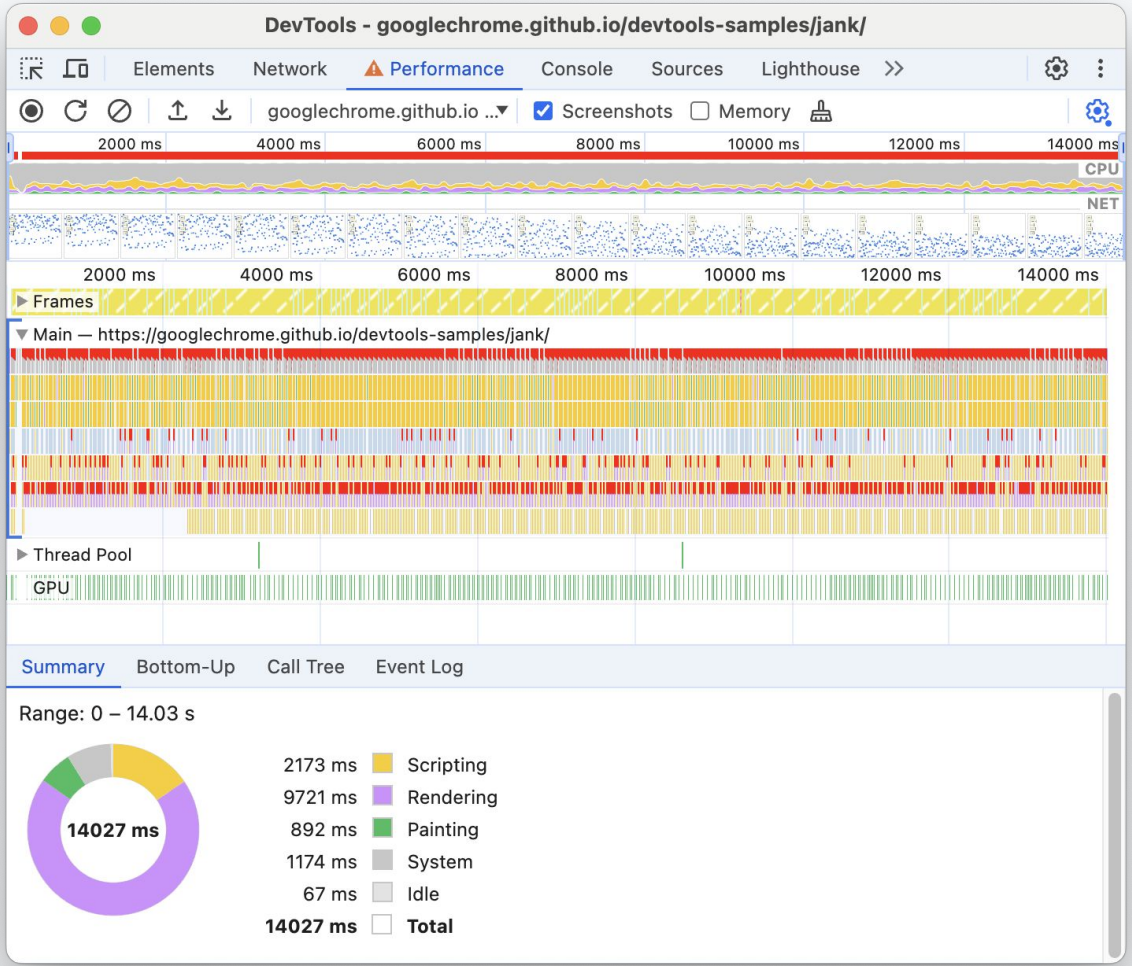

RUN
Launch Program
VARIABLES
Local
__dirname: 'c:\\Users\\gregvanl\\deleteMe\\...
__filename: 'c:\\Users\\gregvanl\\deleteMe\...
exports: {}
module: Module {id: '.', path: 'c:\\Users\\...
msg: 'Hello World'
WATCH
CALL STACK
Launch Program: app.js [2...
PAUSED ON BREAKPOINT
<anonymous>
app.js
2:1
Show 6 More: Skipped by skipFiles
LOADED SCRIPTS
BREAKPOINTS
Caught Exceptions
Uncaught Exceptions
app.js
2
app.js
1 var msg = 'Hello World';
2 console.log(msg);
DEBUG CONSOLE
Filter (e.g. text, !exclude)
C:\Program Files\nodejs\node.exe .\app.js
0 0
Launch Program (hello)
Ln 2, Col 1
Spaces: 4
UTF-8
CRLF
JavaScript

Core Concepts

- Stop / Start
- Step Into
- Step Over
- Step
- Not time traveling!

Lesson: Step-through debugging

Performance profiling


DevTools - googlechrome.github.io/devtools-samples/jank/
Elements
Network
Performance
Console
Sources
Lighthouse
googlechrome.github.io ...
Screenshots
Memory
2000 ms
4000 ms
6000 ms
8000 ms
10000 ms
12000 ms
14000 ms
CPU
NET
Frames
Main — https://googlechrome.github.io/devtools-samples/jank/
Thread Pool
GPU
Summary
Bottom-Up
Call Tree
Event Log
Range: 0 – 14.03 s
14027 ms
2173 ms Scripting
9721 ms Rendering
892 ms Painting
1174 ms System
67 ms Idle
14027 ms Total

https://web.dev/articles/rail

https://web.dev/articles/rail

0 to 16 ms Users are exceptionally good at tracking motion, and they dislike it when animations aren't smooth. They perceive animations as smooth so long as 60 new frames are rendered every second. That's 16 ms per frame, including the time it takes for the browser to paint the new frame to the screen, leaving an app about 10 ms to produce a frame.

https://web.dev/articles/rail

0 to 100 ms Respond to user actions within this time window and users feel like the result is immediate. Any longer, and the connection between action and reaction is broken.

https://web.dev/articles/rail

100 to 1000 ms Within this window, things feel part of a natural and continuous progression of tasks. For most users on the web, loading pages or changing views represents a task.

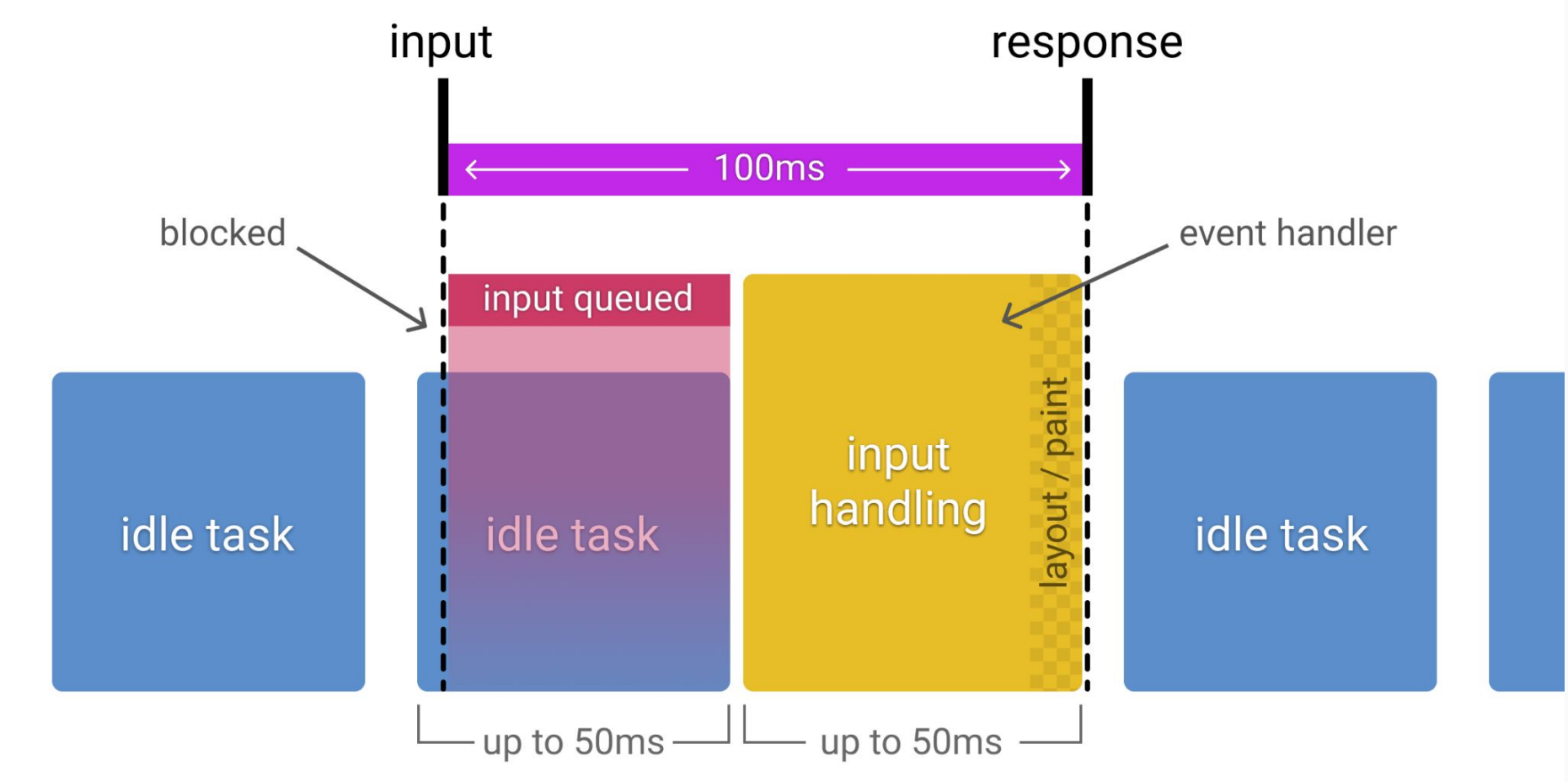
https://web.dev/articles/rail

1000 ms or more Beyond 1000 milliseconds (1 second), users lose focus on the task they are performing.

https://web.dev/articles/rail

10000 ms or more Beyond 10000 milliseconds (10 seconds), users are frustrated and are likely to abandon tasks. They may or may not come back later.

https://web.dev/articles/rail



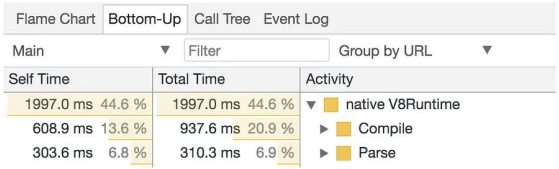
Performance Profiling

JavaScript bytes !== JPEG bytes

~170KB ~170KB

Network Transmission

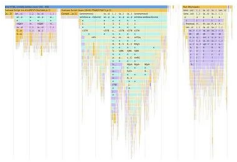
Resource Processing



~2s in Parse/Compile

0.064s in Image Decode

~1.5s in Execution



0.028s in Rasterize Paint

@addyosmani - 170KB of (compressed) JS vs. JPEG bytes over a slow 3G network on a Moto G4. JS needing parsed is even larger once decompressed.

Page Jank

Most devices today refresh their screens 60 times a second. The browser needs to match the device’s refresh rate and put up 1 new picture, or frame, for each of those screen refreshes.

Page Jank

Each of those frames has a budget of just over 16ms (1 second / 60 = 16.66ms). In reality, however, the browser has housekeeping work to do, so all of your work needs to be completed inside 10ms.

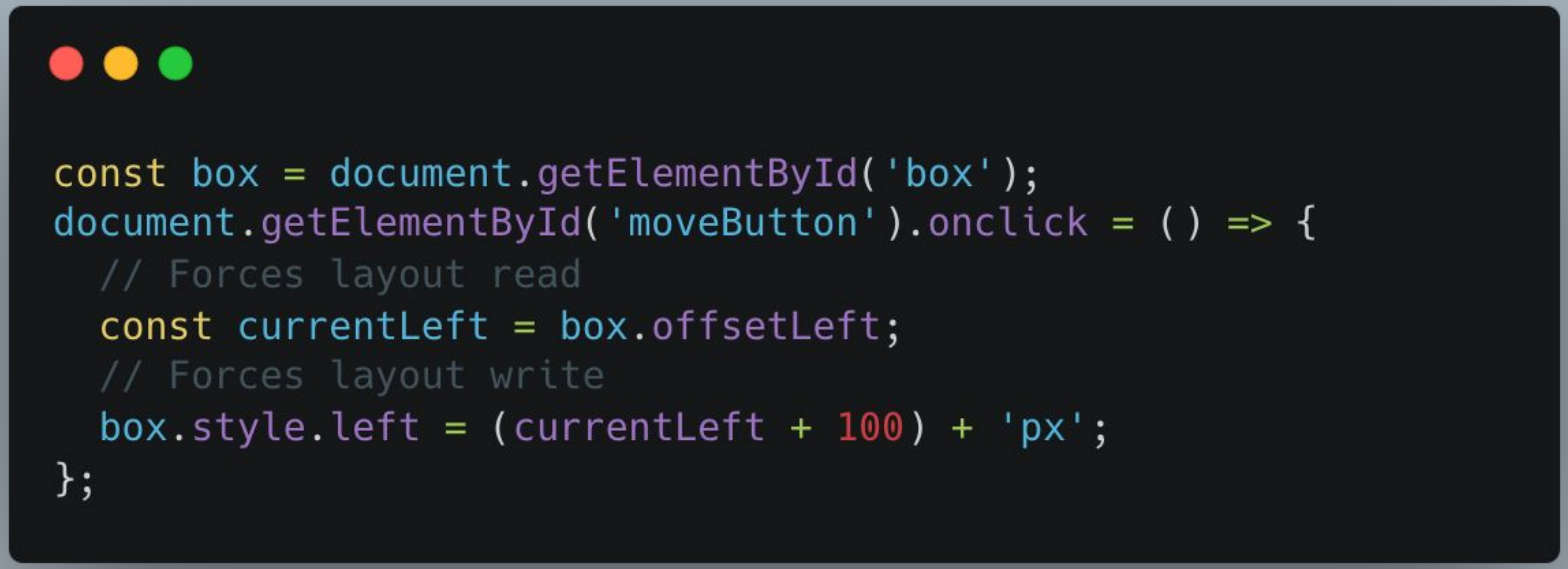
requestAnimationFrame

```
function badUpdate() {
  const box = document.getElementById('box');
  box.style.width = box.offsetWidth + 1 + 'px';  // Read then write
  box.style.height = box.offsetHeight + 1 + 'px'; // Read then write
}gain

setInterval(badUpdate, 16);
```

requestAnimationFrame

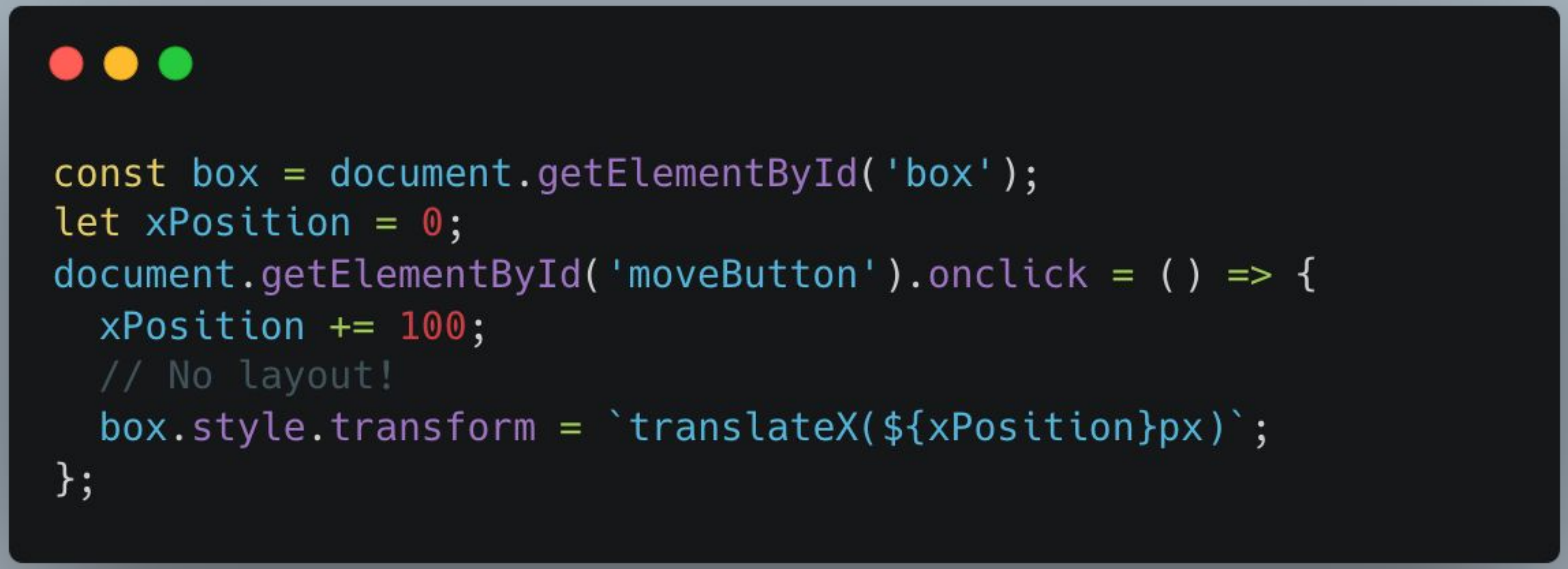
```
function goodUpdate() {
  const box = document.getElementById('box');
  // Read everything first
  const width = box.offsetWidth;
  const height = box.offsetHeight;

  requestAnimationFrame(() => {
    // Then do all writes together
    box.style.width = width + 1 + 'px';
    box.style.height = height + 1 + 'px';
  });
}

requestAnimationFrame(goodUpdate);
```

CSS Transforms



```
const box = document.getElementById('box');
document.getElementById('moveButton').onclick = () => {
  // Forces layout read
  const currentLeft = box.offsetLeft;
  // Forces layout write
  box.style.left = (currentLeft + 100) + 'px';
};
```

CSS Transforms

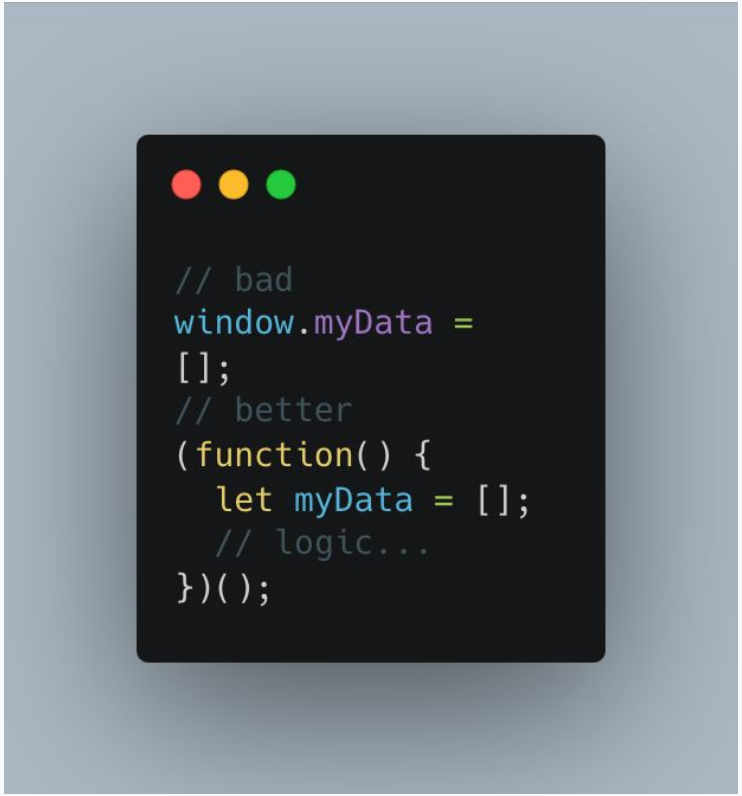


```
const box = document.getElementById('box');
let xPosition = 0;
document.getElementById('moveButton').onclick = () => {
  xPosition += 100;
  // No layout!
  box.style.transform = `translateX(${xPosition}px)`;
};
```

Lesson: Performance Profiling

Memory

Memory Leak 1 - Global Variables



Memory Leak 2 - Closures

Memory Leak 3 - Zombie event listeners

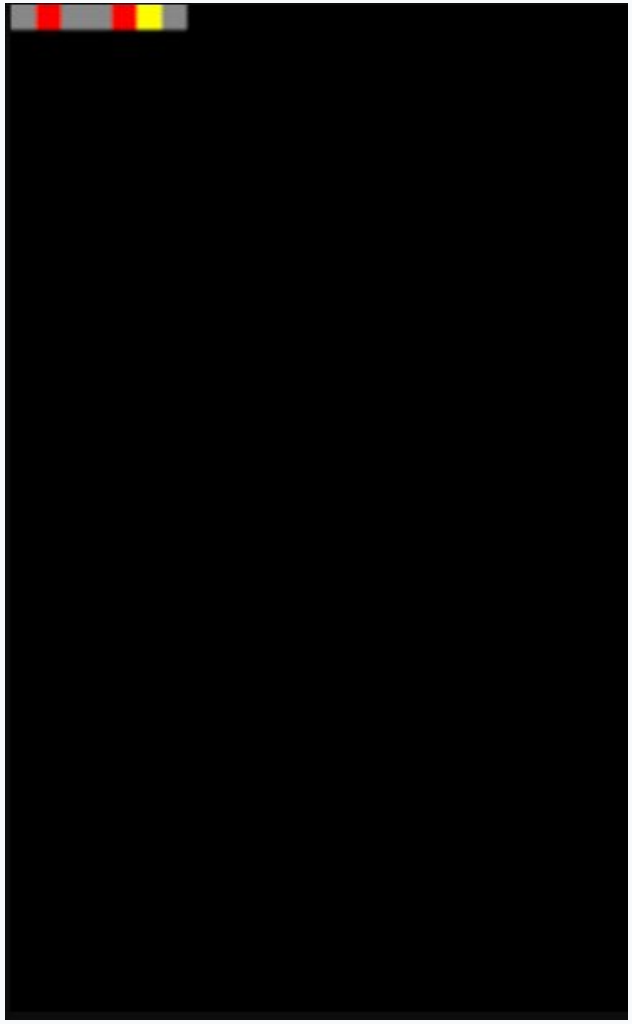
```
// bad
const button = document.getElementById('myButton');
function handleClick() {
  console.log('clicked');
}
button.addEventListener('click', handleClick);

// if we never remove it, 'button' and 'handleClick' remain in memory
```

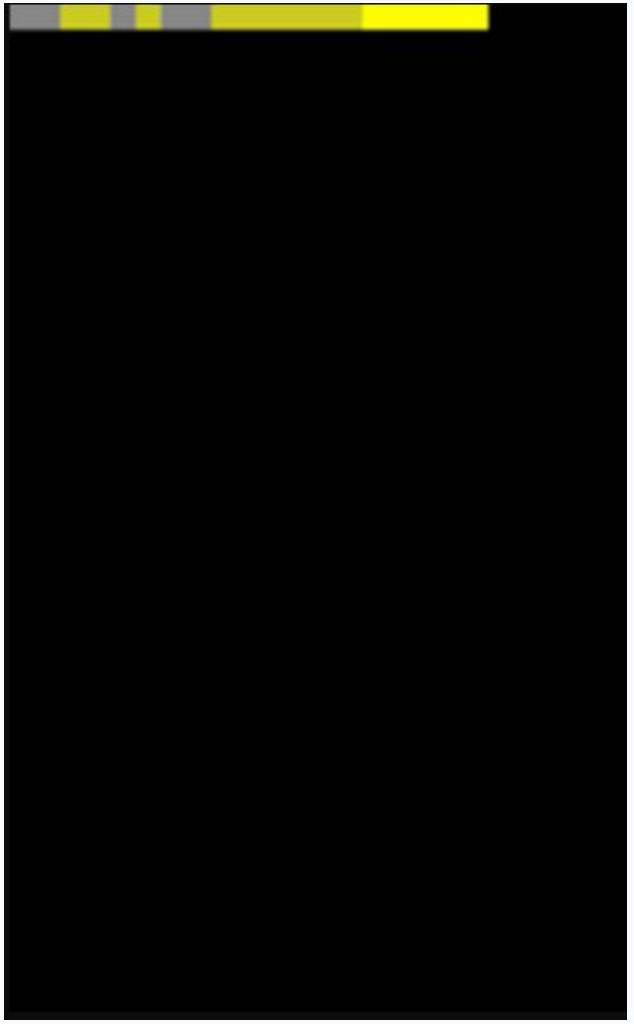
Memory Leak 4 - Never Cleared Intervals

```
// bad
const timer = setInterval(() => {
  // do something
}, 1000);

// if we never call 'clearInterval(timer)', memory accumulates
```

Memory Leak 5 - Detached DOM Nodes

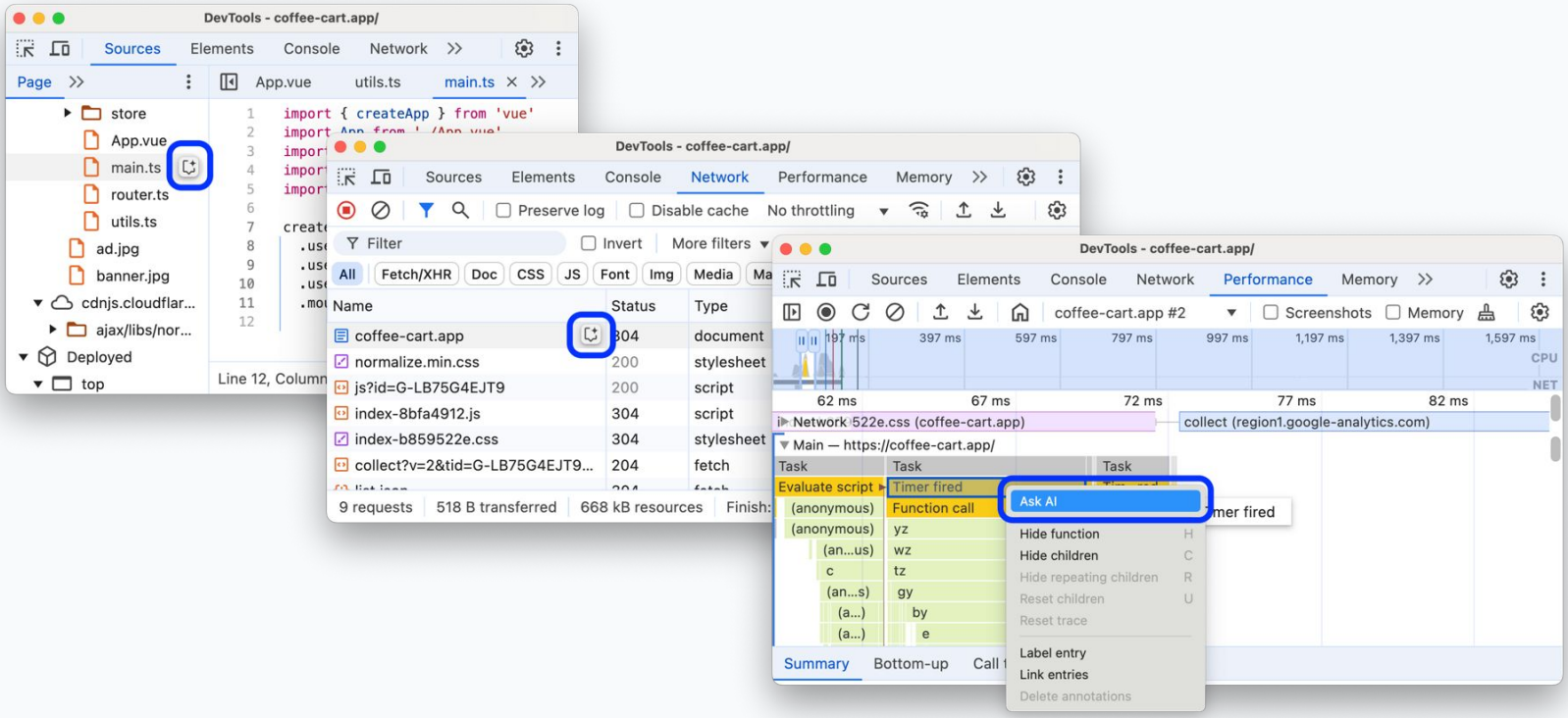
```
// bad
let detachedDiv;

function createDomLeak() {
  const div = document.createElement('div');
  document.body.appendChild(div);
  document.body.removeChild(div);

  // this keeps 'div' in memory even though it's no longer in the
dodetachedDiv = div;
}
```





Lesson: Memory

AI


DevTools - coffee-cart.app/
Sources
Elements
Console
Network
Page
App.vue
utils.ts
main.ts
store
App.vue
main.ts
router.ts
utils.ts
ad.jpg
banner.jpg
cdnjs.cloudflar...
ajax/libs/nor...
Deployed
top
Line 12, Column
DevTools - coffee-cart.app/
Sources
Elements
Console
Network
Performance
Memory
Preserve log
Disable cache
No throttling
Filter
Invert
More filters
All
Fetch/XHR
Doc
CSS
JS
Font
Img
Media
Name
Status
Type
coffee-cart.app
304
document
normalize.min.css
200
stylesheet
js?id=G-LB75G4EJT9
200
script
index-8bfa4912.js
304
script
index-b859522e.css
304
stylesheet
collect?v=2&tid=G-LB75G4EJT9...
204
fetch
9 requests
518 B transferred
668 kB resources
DevTools - coffee-cart.app/
Sources
Elements
Console
Network
Performance
Memory
coffee-cart.app #2
Screenshots
Memory
197 ms
397 ms
597 ms
797 ms
997 ms
1,197 ms
1,397 ms
1,597 ms
CPU
NET
62 ms
67 ms
72 ms
77 ms
82 ms
Network 522e.css (coffee-cart.app)
collect (region1.google-analytics.com)
Main — https://coffee-cart.app/
Task
Task
Task
Evaluate script
Timer fired
(anonymous)
Function call
(anonymous)
yz
(an...us)
wz
c
tz
(an...s)
gy
(a...)
by
(a...)
e
Ask AI
Hide function
H
Hide children
C
Hide repeating children
R
Reset children
U
Reset trace
Label entry
Link entries
Delete annotations
Summary
Bottom-up

Thanks!