Web 101:

The critical rendering path

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Content

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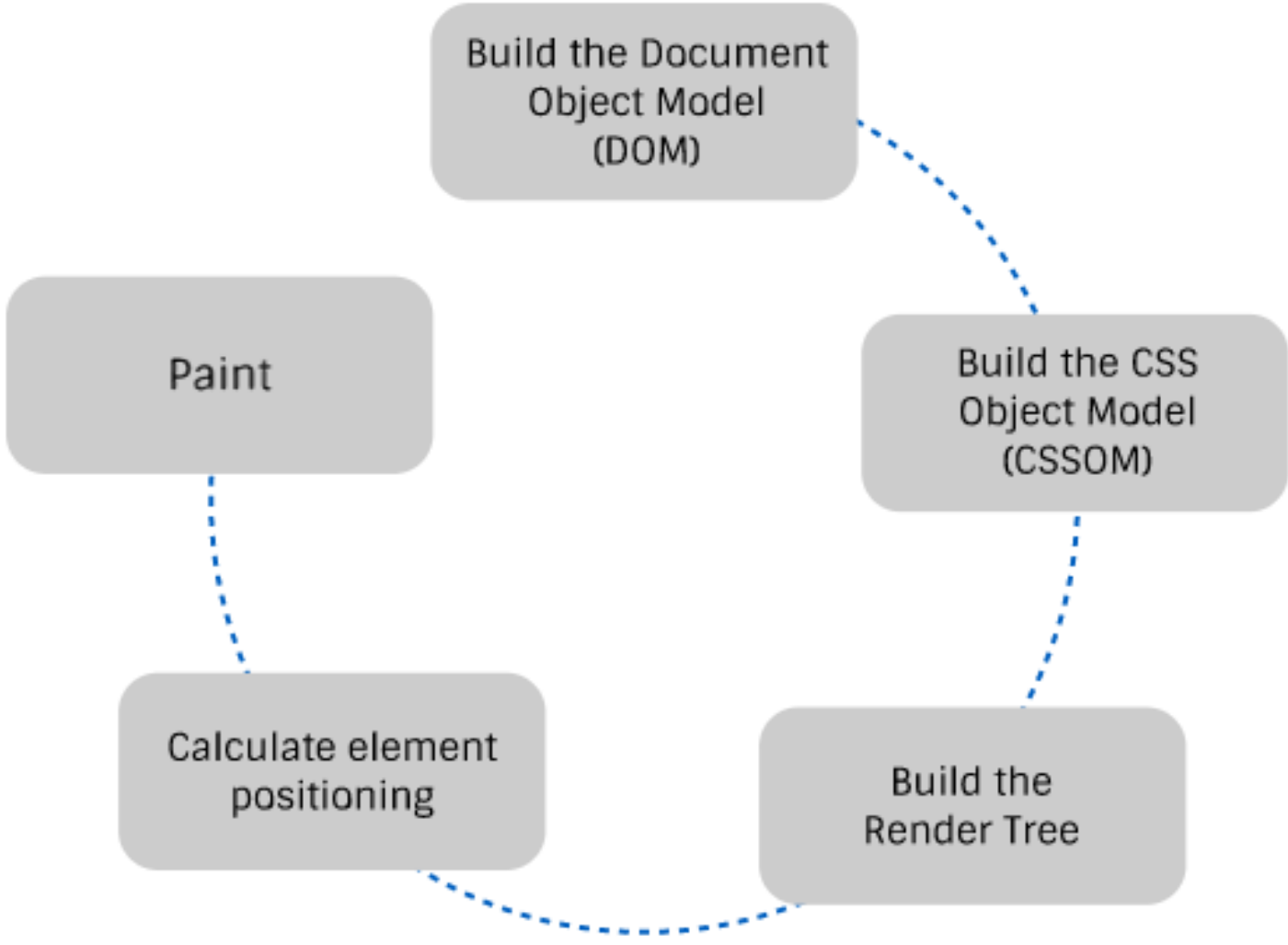
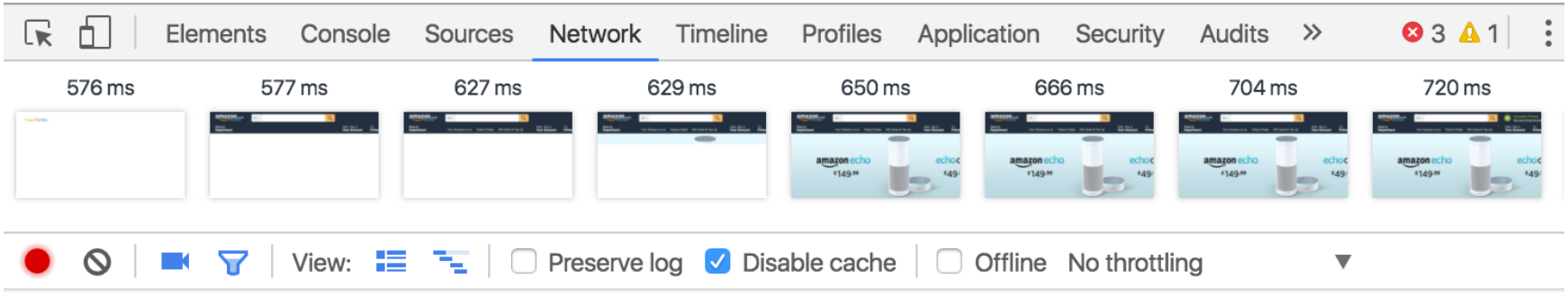
- The critical rendering path
- Optimising the critical rendering path
- Measuring the critical rendering path
- Case study
- Summary

How the web browser works

- You visit a web page
- Your web browser asks for a resource from a server
- An HTML file is returned
- Then what?


Build the Document Object Model (DOM)
Build the CSS Object Model (CSSOM)
Build the Render Tree
Calculate element positioning
Paint


Elements
Console
Sources
Network
Timeline
Profiles
Application
Security
Audits
3
1
576 ms
577 ms
627 ms
629 ms
650 ms
666 ms
704 ms
720 ms
View:
Preserve log
Disable cache
Offline
No throttling

How the browser loads resources

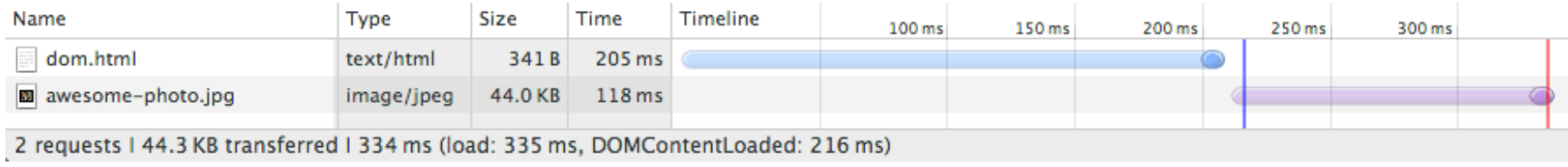
An adaptation on a great Google article

Found here

A very basic web page

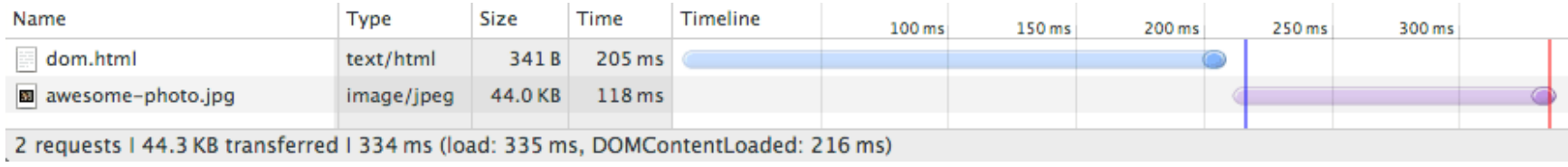
```
<html>
  <head>
    <title>Basic web page</title>
  </head>
  <body>
    <h1>Our web page.</h1>
    <img src="awesome-photo.jpg">
  </body>
</html>
```

DevTools



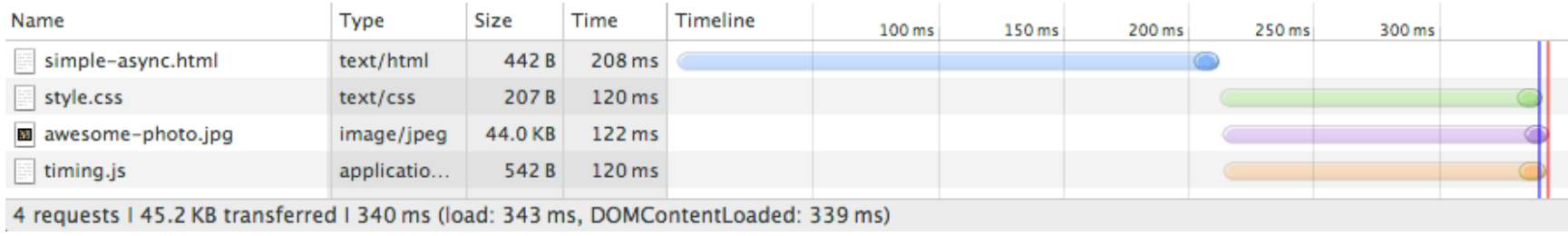
- Events: DOMContentLoaded & OnLoad
- Resource requests

Images:



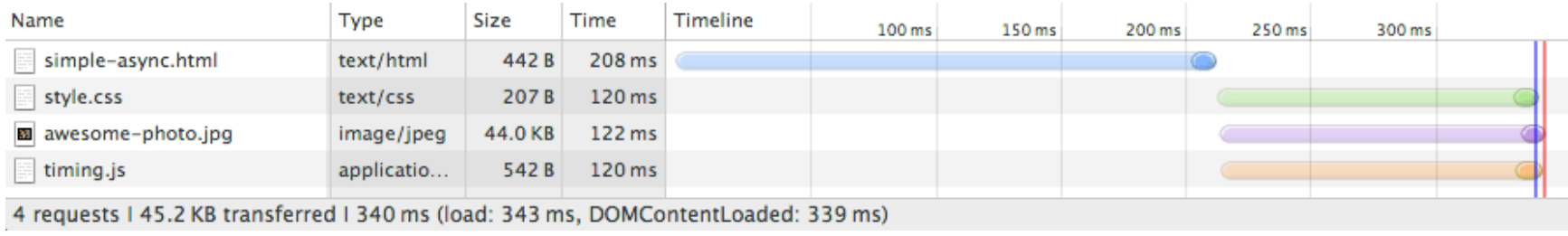
- Non-parser blocking
- Non-render blocking

Javascript:



- Parser & render blocking
- It might change the DOM or query the CSSOM

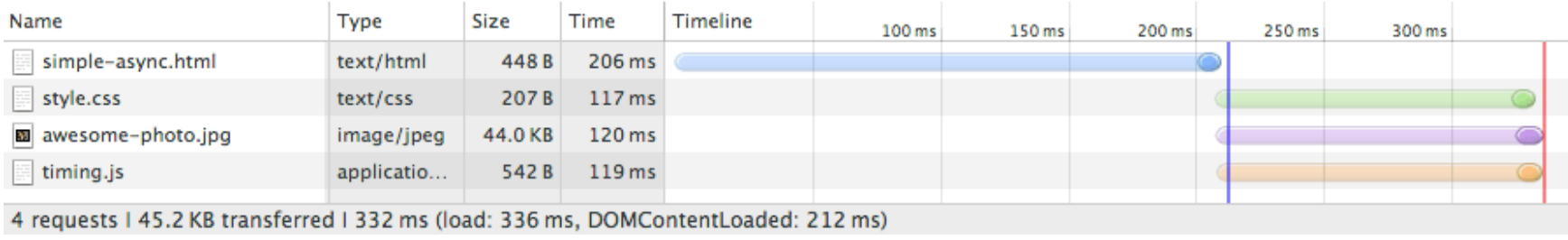
CSS:



- Render blocking
- DOMContentLoaded still blocked due to JS

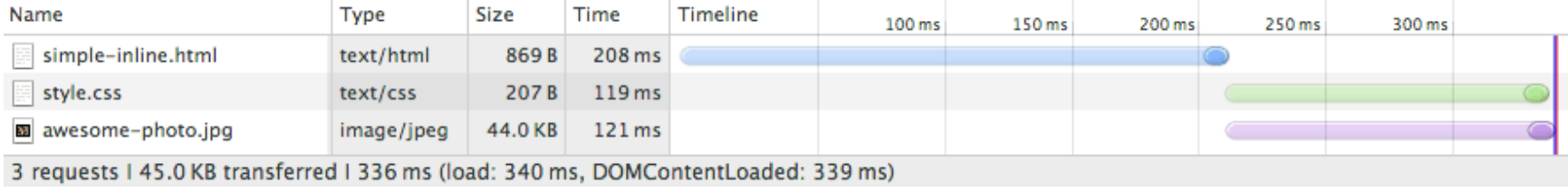
Async/Defer JS:

```
<script src="timing.js" defer></script>
```



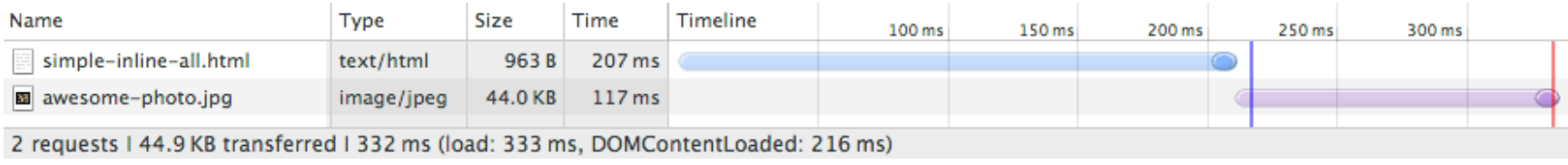
- Not blocking
- Async blocks the parser to execute when it's loaded
- Defer waits for parser to finish before executing

Inline JS



- DOMContentLoaded event fires after `styles.css` is loaded?

Inline JS and CSS



- Still render and parser blocking
- Fewer network requests & less load time

Common performance considerations:

- Place all CSS at the top of your page
- Async JS if possible
- If not, place JS at the bottom of your page
- Bundle CSS, JS, image files (sprites) for fewer network requests
- Inline JS/CSS where possibly, again fewer network calls
- Optimise images
- Minify and Gzip all files

But this isn't enough!

Web pages are getting heavier: richer media, more features

Users are more demanding

> Usability studies show that after one second with no response, there's a mental context switch in our brains

Introducing the critical rendering path (CRP)

The path/time taken to first render content to a user

Not the whole page just the content above the browser fold

aka 'First meaningful paint'

Why I like it

It's a user-centred approach to measuring page performance

CRP speed is important!

- **Users love it**
  The perceived page load is lightening fast meaning higher engagement, more pages viewed, improved conversion

- **SEO favours it**
  Google's Speed Index metric uses it for boosting

Optimising the critical rendering path

In 4 steps:

1.) Minimise number of critical resources

- Separate the JS and CSS needed to render the above above-the-fold content
- Async or defer the remaining JS and CSS
- Leverage Media types and media queries to make CSS non-render blocking

```
<head>
  <link href="styles.css">
  <link href="print.css" media="print" >
</head>
```

- Async/defer webfonts
- Utilise client-side caching

2.) Optimise the number of critical bytes

- Keep your HTML under 14kb

  Due to TCP behaviour the server can send up to 14KB (first roundtrip) before it waits for the client to acknowledge to deliver more.

- Defer extra HTML content using JS
- Use image progressive rendering
- Inline critical CSS and JS needed for first render

3.) Optimise the order in which the remaining critical resources are loaded

- Download all critical assets as early as possible to shorten the critical path length.

4.) Optimise infrastructure

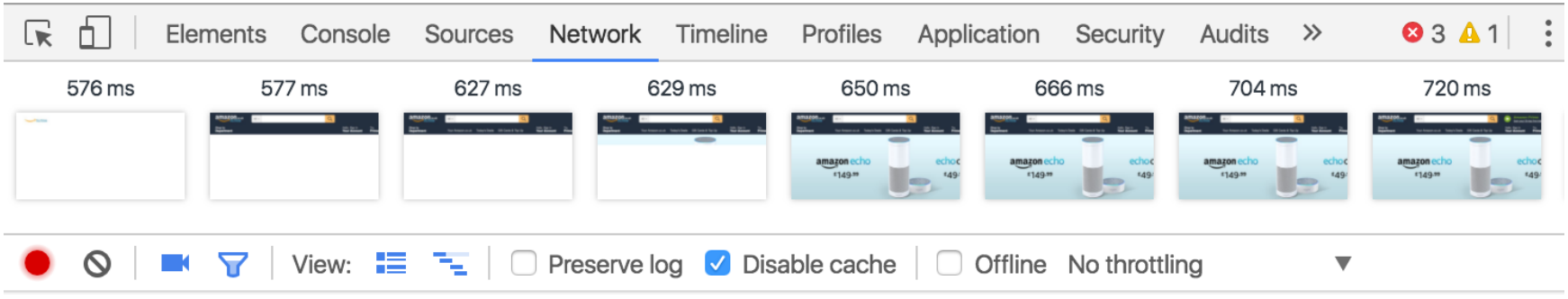
- Use low-latency web hosting
- Put resources on a CDN
- Optimise caching

Measuring

- It's hard to know when exactly all above-the fold only content has loaded
- Tools good for measuring the critical rendering path:
- Lighthouse - Chrome extension
- WebPagetest - browser based tool

Measuring part II

Eyeball it using Chrome Devtools:



Although Google's own docs state:

> DevTools is currently not well-suited for CRP analysis

Measuring part III

What counts as above-the-fold?

What do you consider critical?

Case study

How we optimised the CRP of Notonthehighstreet's Homepage

Objective:

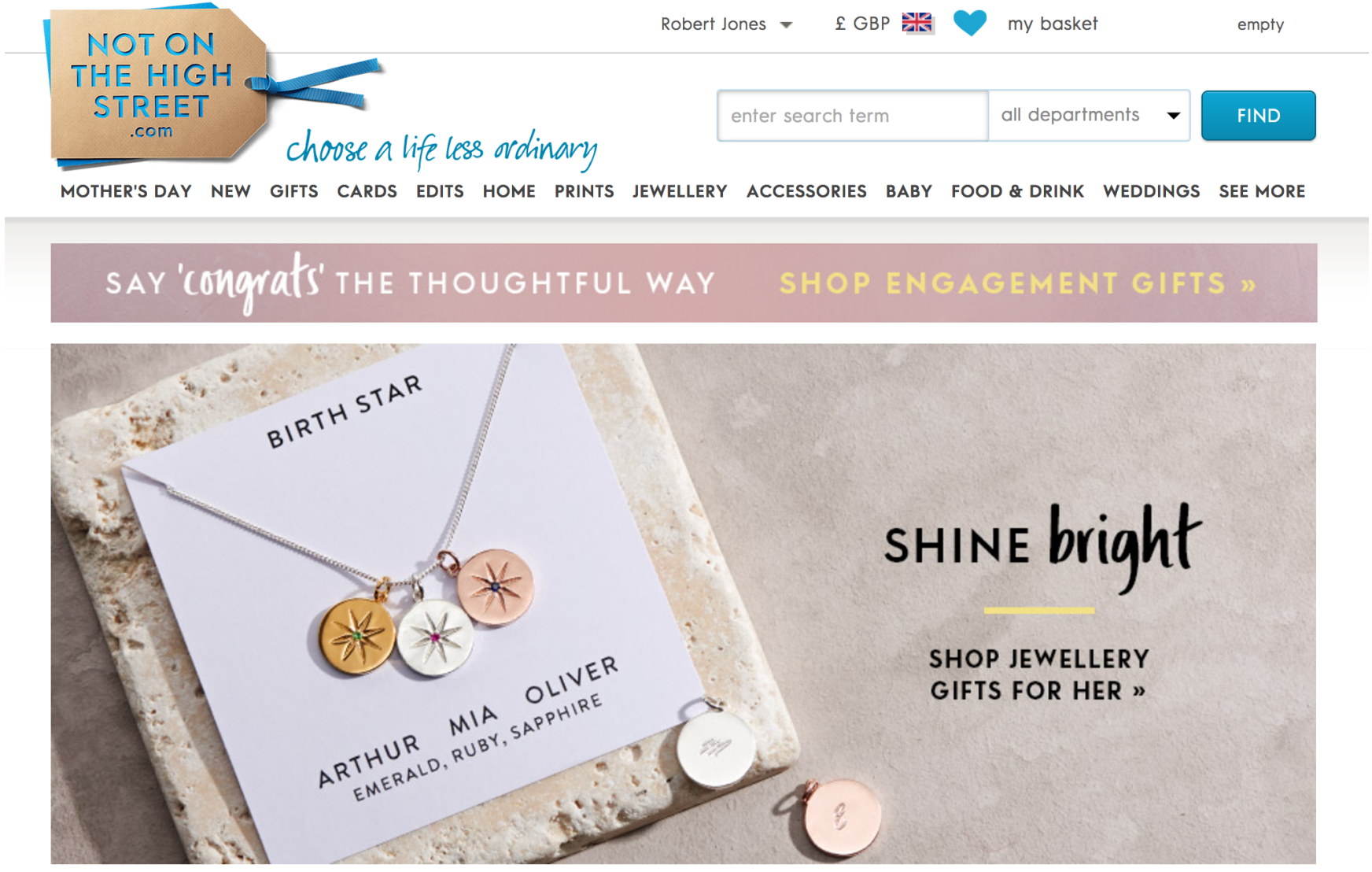
noths.com to load all above-the-fold content

in ~1 second

Currently sits between 1.6 - 1.8 seconds

on 3G

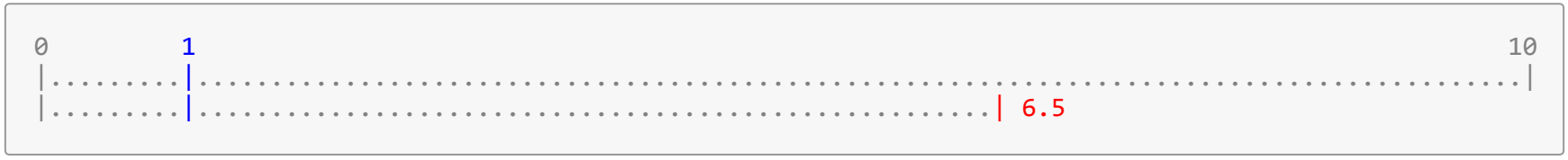
What we measured



Things to consider:

- Homepage only
- 3G throttling
- On desktop
- No feature loss
- Measured using screen captures
- Running in Dev
    - No initial network latency for HTML considered
    - No initial server time or database reads
    - No caching
    - Similar to if the page were cached or on CDN?
- Simply: how will client-side tweaks affect CRP?

The base metric

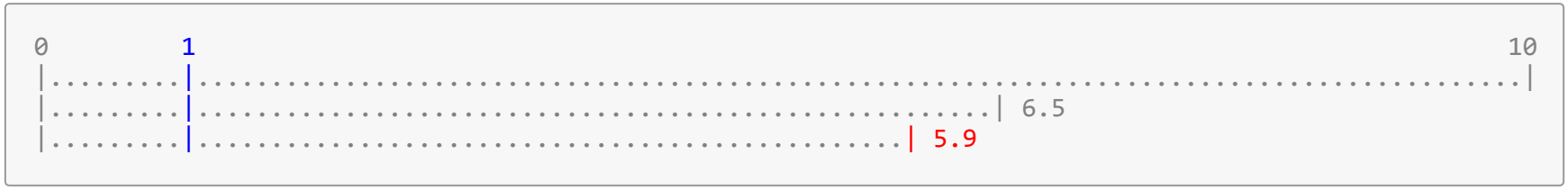


6.5 seconds

Amazon, Notonthehighstreet, Etsy: 8.0 - 10.0 seconds (production)

Move all JS

- Move non-critical JS below CRP (In our case, all JS)
- 6 inline scripts and 4 external JS resources

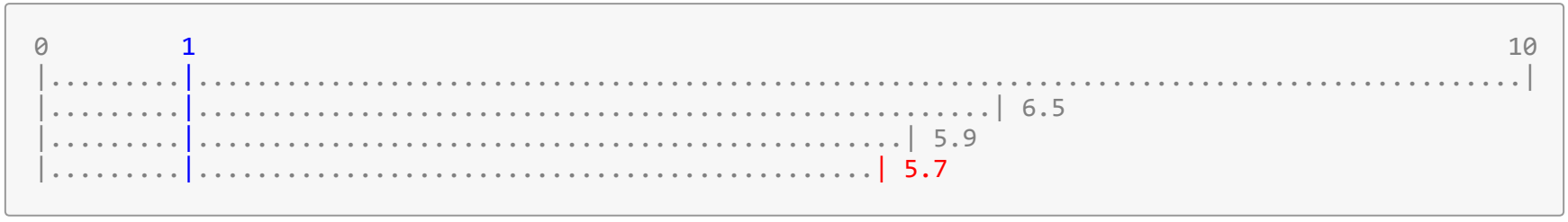


5.9

This Included: error tracking and analytics
which were deferred until above-fold-content was rendered

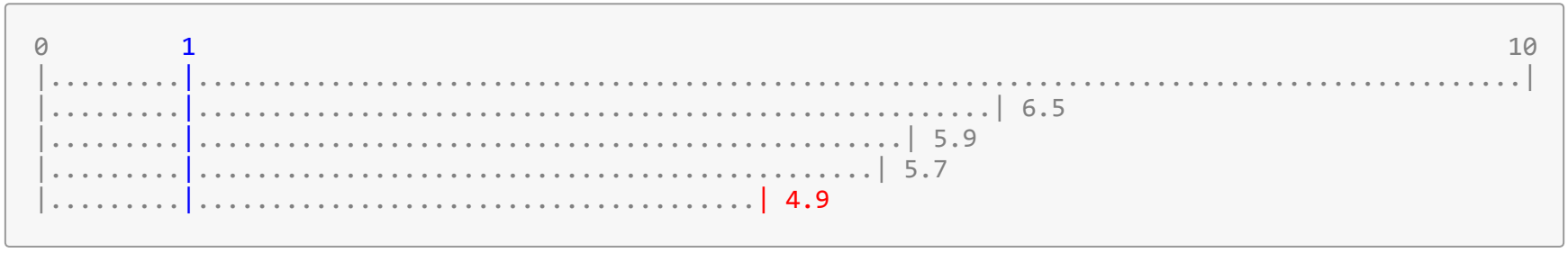
Remove repeated mobile only HTML

- Design our layouts better



5.7

Remove lazy loading from images above fold

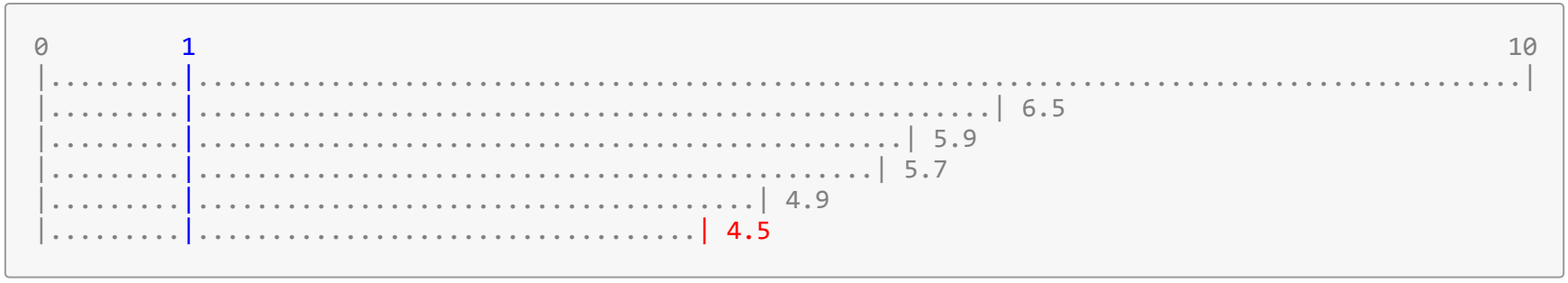


4.9

Note: gains here also due to moving JS

Move fonts below critical rendering path

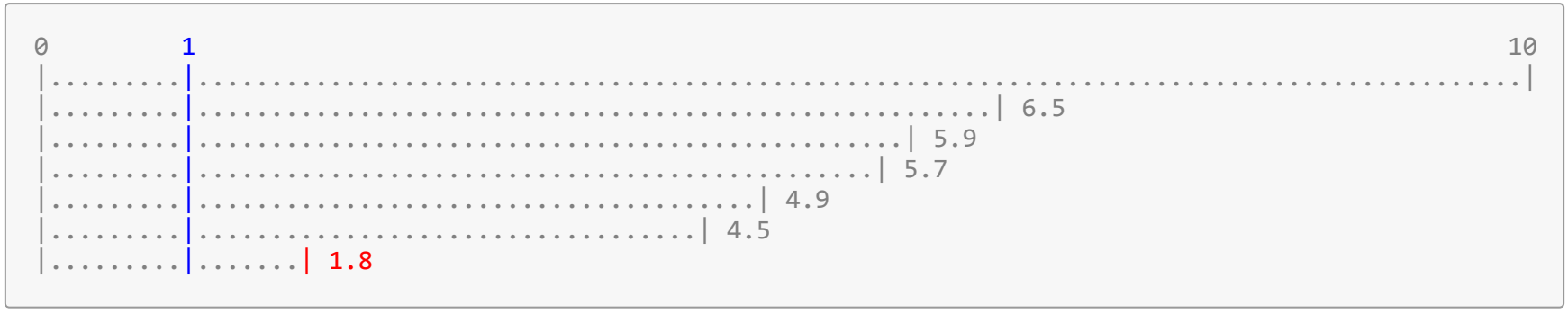
- 3 fonts
- Progressive enhancement
- Good use case for client-side caching



4.5

Move non-critical CSS

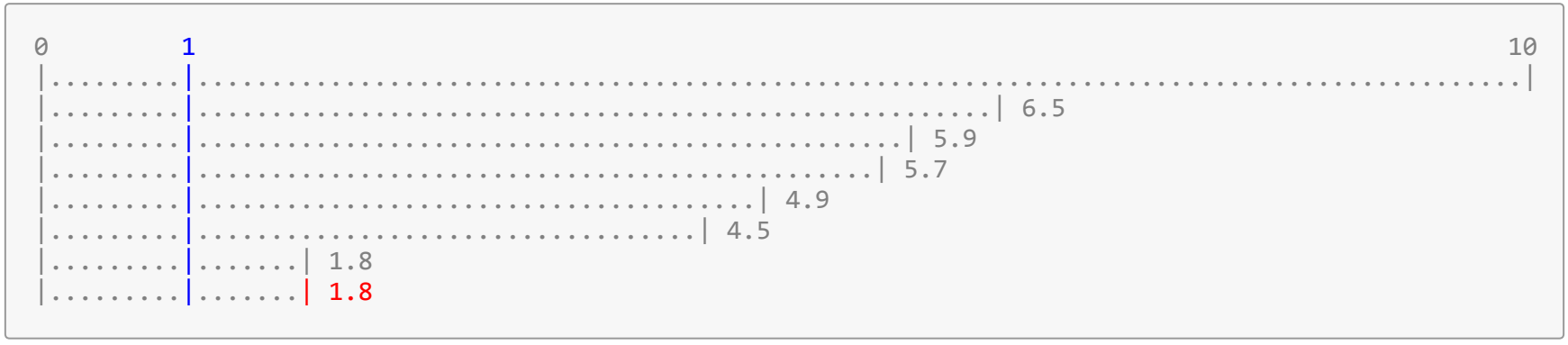
- Inline critical CSS from 3 files
- Defer loading the rest of the CSS



1.8

Defer loading of non-visible HTML

- Use JS to load above-the-fold non-visible HTML
- Mega-drop-down & departments drop down



1.8

```
<html>
  <head>...</head>
  <body>
    <style>All our inline styles needed for CRP</style>
    <div>All our above-fold content</div>

    <link href="styles.css">
    <div>Rest of our HTML</div>
  </body>
</html>
```

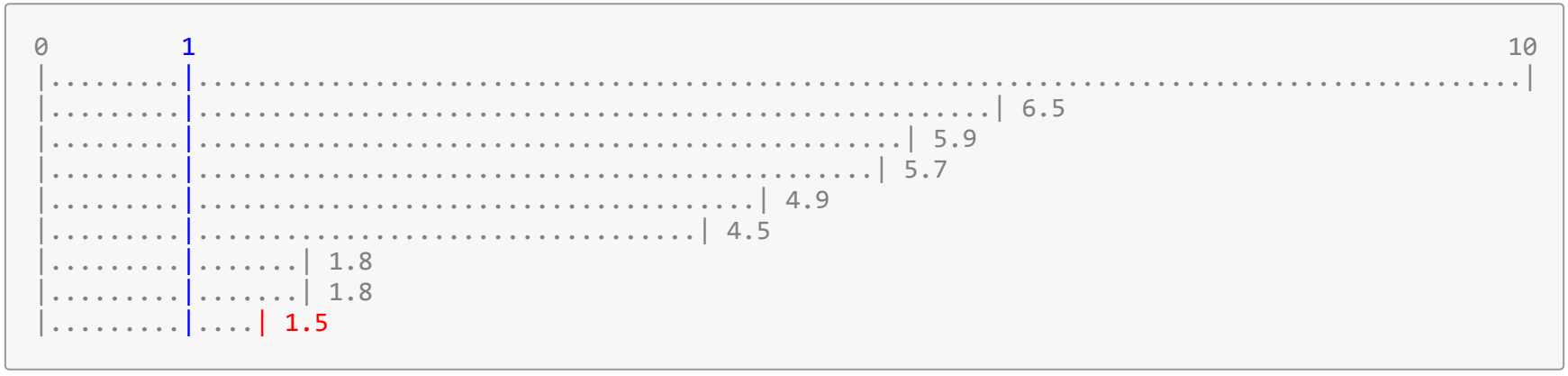
```
<html>
  <head>...</head>
  <body>
    <style>All our inline styles needed for CRP</style>
    <div>All our above-fold content</div>

    <!-- OnLoad fetch JS that builds rest of DOM -->
    <!-- fetch all other resources -->
    <script src="script.js" defer></script>
  </body>
</html>
```

Defer all non-critical resources

- CSS and JS
- Images and fonts
- We also minified our HTML to get the packet size down to 13kb

Did it work...

...no!



1.5 seconds

4G

0.8 seconds

From 5.0

No throttling

0.7 seconds

From 1.7

3G results:

6.5 => 1.5 seconds

-77%

Summary

- CRP has to be designed upfront
- Above-the-fold driven design
- Evaluate your sites above-the-fold content
- Making performance gains is addictive

Look for the big winners

- Split CSS & JS into critical and non-critical
- Defer loading of all other resources
- Optimise or progressively enhance images

Other considerations

- JS frameworks like react
- css pre-processors like Less or Sass
- Bundling managers like webpack
- http://jonathancreamer.com/advanced-webpack-part-2-code-splitting/

What's next for CRP

- HTTP2 - multiplexing
- Service workers - super fast offline cache

Want to know more?

CRP explained in depth

Page rendering in 1 second

10 things I learned making the fastest site in the world

RAIL performance model

Speculative loading