Browser Internals

- Manasa

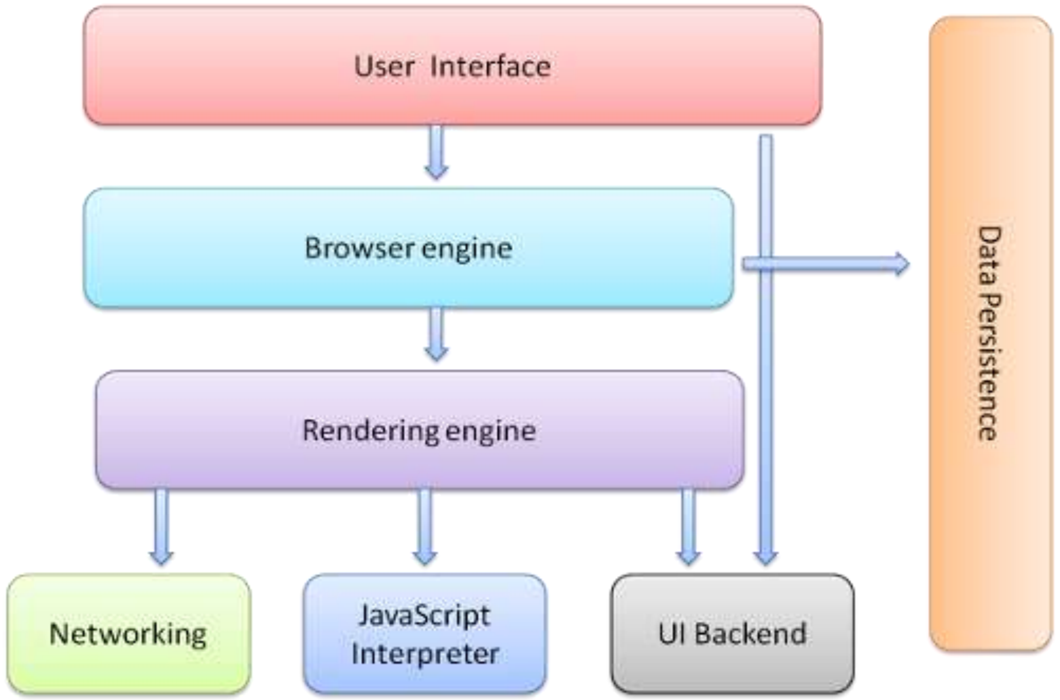
What are we learning today?

- How a HTML page is rendered
- How CSS is attached
- How the page is painted on the screen

Why do we need this?

- Analyze performance
- Make better decisions
- Justifications behind development best practices

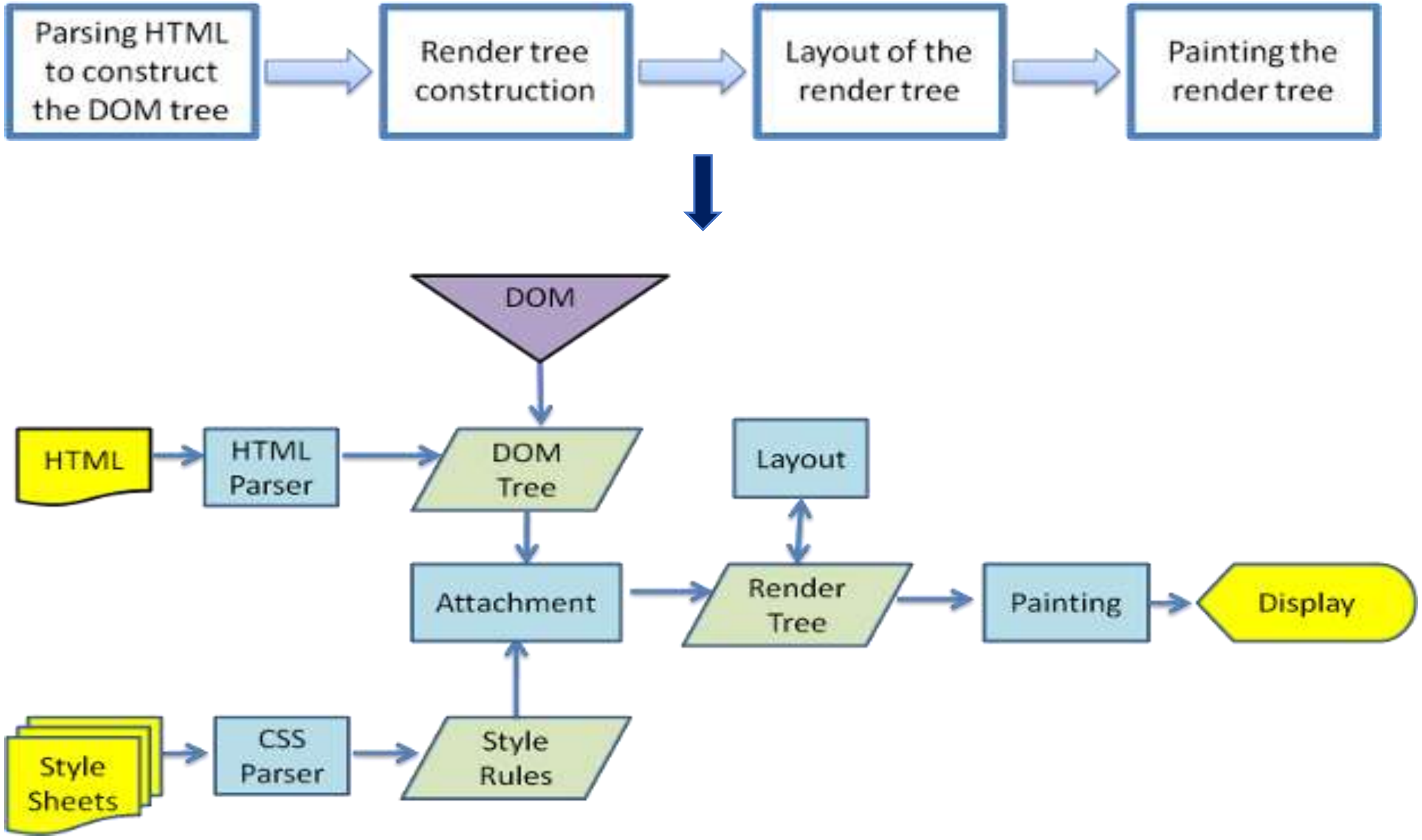
Browser Components



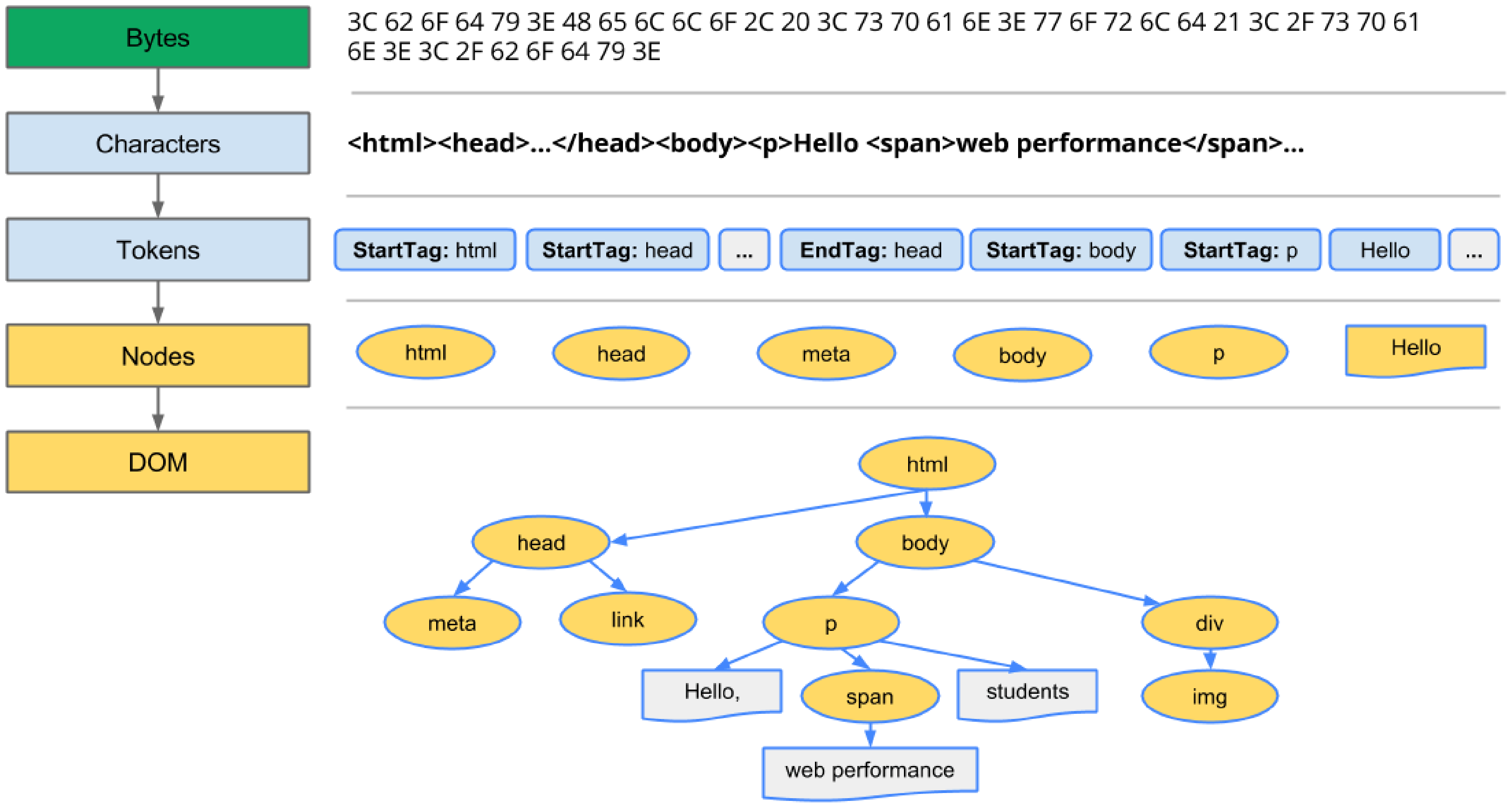
Types of rendering engines

IE	-	Trident
Firefox	-	Gecko
Safari	-	WebKit
Chrome	-	Blink (a fork of WebKit)
Edge	-	Blink (a fork of WebKit)
Opera	-	Blink (a fork of WebKit)

Overview

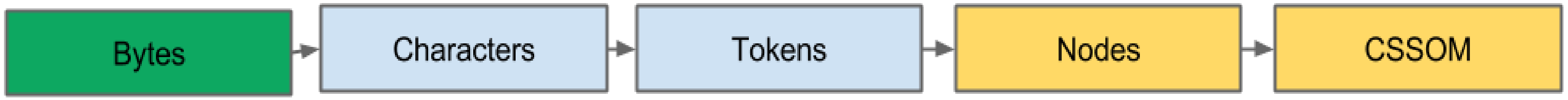

Parsing HTML to construct the DOM tree
Render tree construction
Layout of the render tree
Painting the render tree
DOM
HTML
HTML Parser
DOM Tree
Layout
Attachment
Render Tree
Painting
Display
Style Sheets
CSS Parser
Style Rules

DOM

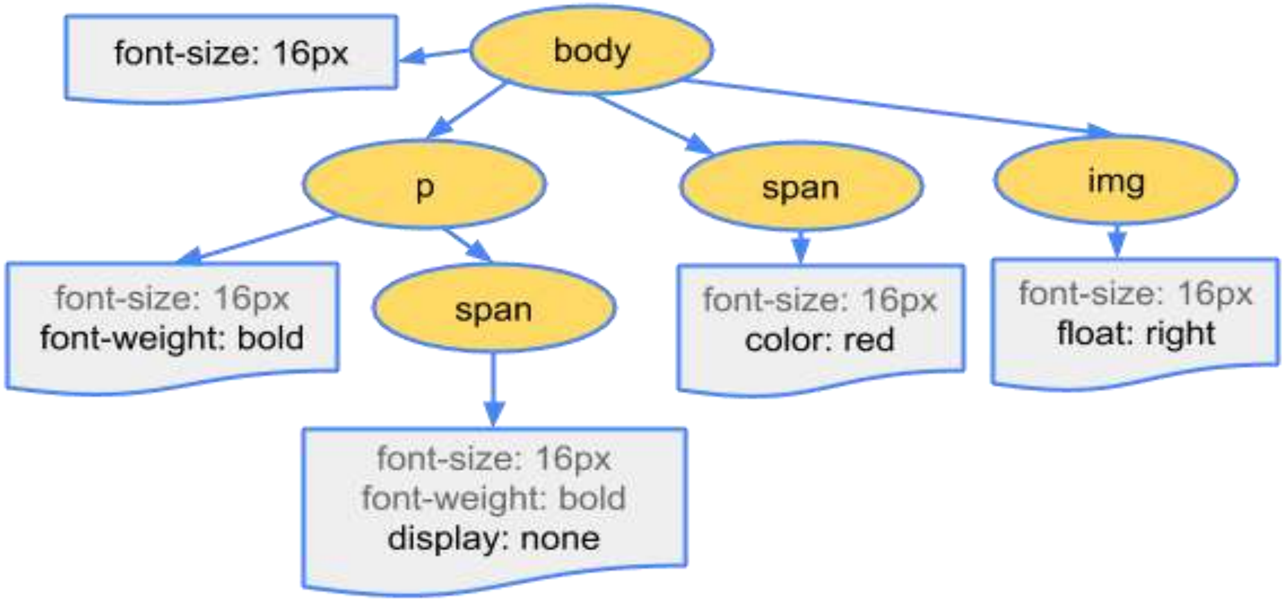


Bytes
Characters
Tokens
Nodes
DOM
3C 62 6F 64 79 3E 48 65 6C 6C 6F 2C 20 3C 73 70 61 6E 3E 77 6F 72 6C 64 21 3C 2F 73 70 61 6E 3E 3C 2F 62 6F 64 79 3E
<html><head>...</head><body><p>Hello <span>web performance</span>...
StartTag: html
StartTag: head
...
EndTag: head
StartTag: body
StartTag: p
Hello
...
html
head
meta
body
p
Hello
html
head
body
meta
link
p
div
Hello,
span
students
img
web performance

CSSOM



Example:



Processing CSS

Cascading Order :

- Browser Defaults
- External Style Sheets (Linked or Imported)
- Internal Style Sheets (Embedded)
- Inline Styles
- Important declarations (!important)

Specificity :

a: Score one for inline styles

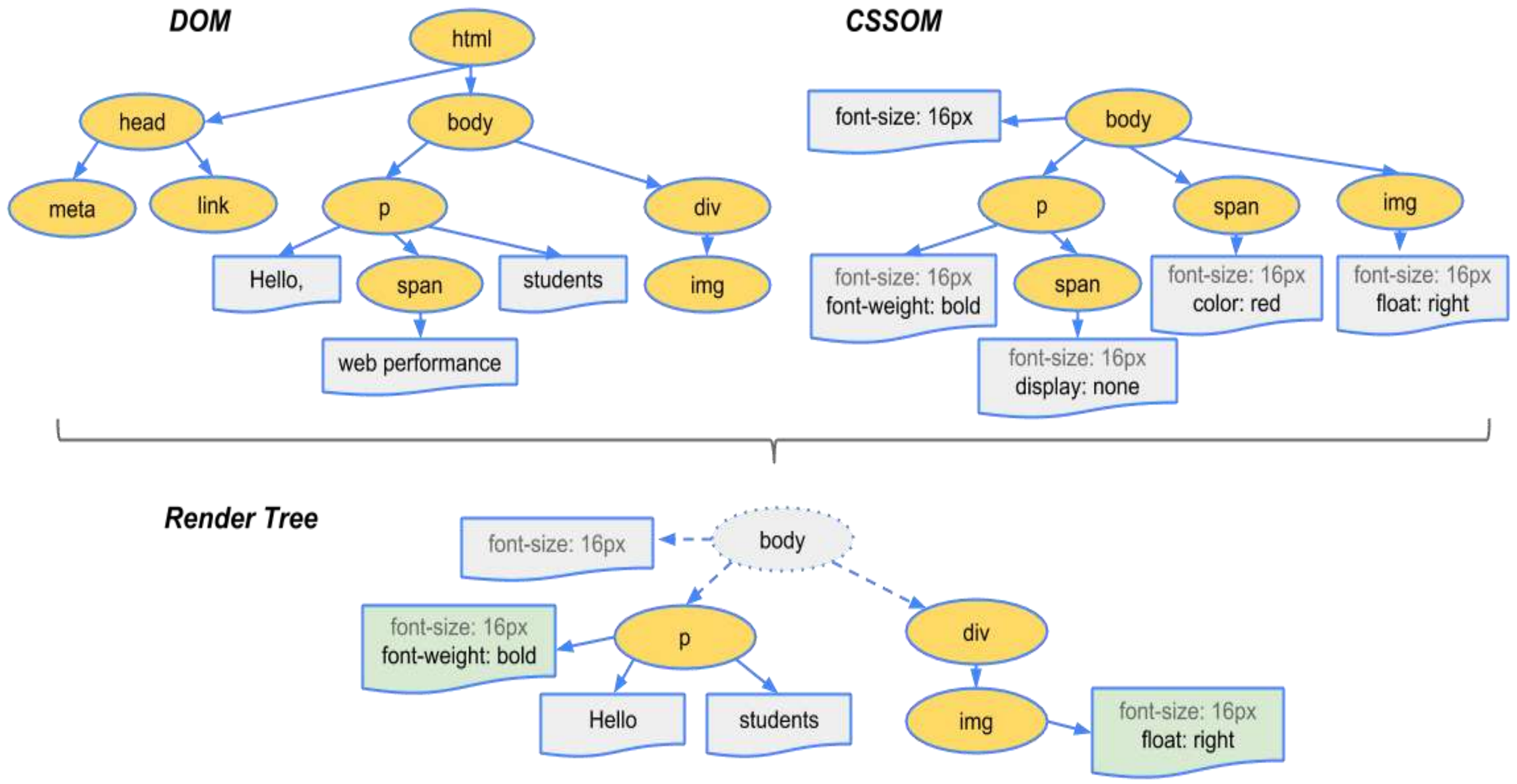
b: Score one for each ID selector contained inside overall selector

c: Score one for other attributes and pseudo-classes in the selector

d: Score one for each element names and pseudo-elements in the selector

=>abcd would be the specificity

Render Tree


DOM
html
head
body
meta
link
p
div
Hello,
span
students
img
web performance
CSSOM
font-size: 16px
body
p
span
img
font-size: 16px
font-weight: bold
span
font-size: 16px
color: red
font-size: 16px
float: right
font-size: 16px
display: none
Render Tree
font-size: 16px
body
font-size: 16px
font-weight: bold
p
div
Hello
students
img
font-size: 16px
float: right

Layout

→ Parent renderer determines its own width

→ Parent goes over children and:

  Place the child renderer (sets its x and y)

  Calls child layout if needed – they are dirty – which calculates the child’s height

→ Parent uses children's accumulative heights and the heights of margins and padding to set its own height – this will be used by the parent renderer's parent

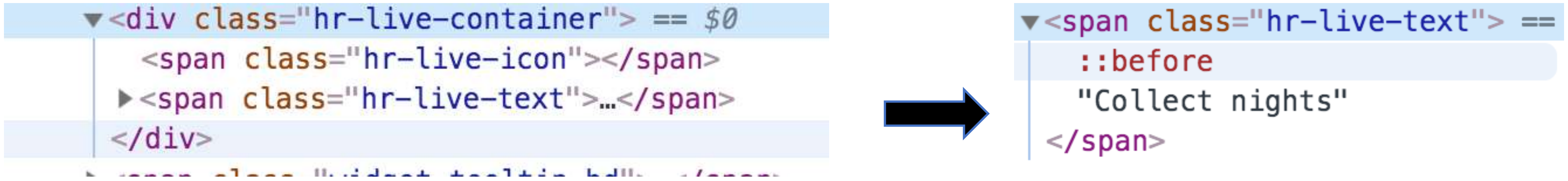
→ Sets its dirty bit to false

Painting

- background color
- background image
- border
- children
- outline

Performance

- Avoid extra HTML tags whenever necessary.

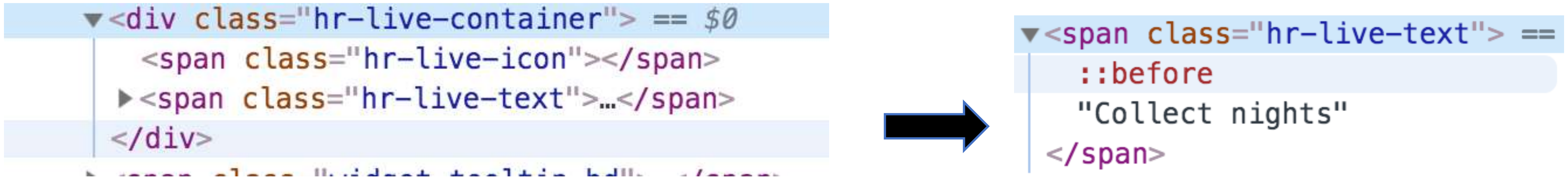


```
▼<div class="hr-live-container"> == $0
    <span class="hr-live-icon"></span>
  ▶<span class="hr-live-text">…</span>
  </div>
 ▶<span class="widget-tooltip-bd">…</span>
```

```
▼<span class="hr-live-text"> ==
    ::before
    "Collect nights"
  </span>
```

Performance

- Avoid extra HTML tags whenever necessary.



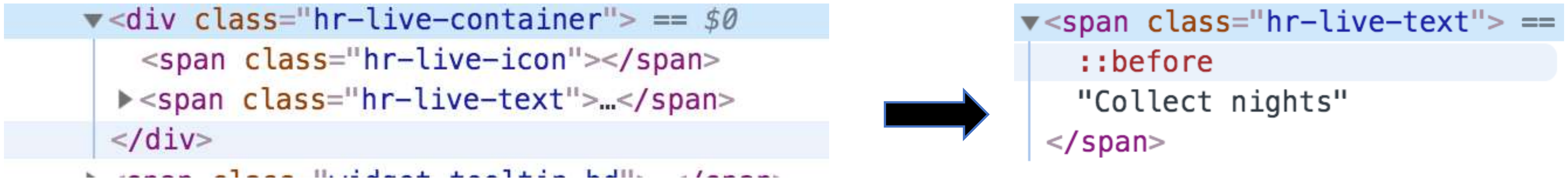
```
▼<div class="hr-live-container"> == $0
    <span class="hr-live-icon"></span>
   ▶<span class="hr-live-text">…</span>
  </div>
```

```
▼<span class="hr-live-text"> ==
    ::before
    "Collect nights"
  </span>
```

- CSS is render blocking. Download the CSS as soon as possible.
- Avoid unnecessary CSS processing by using media tags.
  screen -- width, height, orientation
  type -- screen, print, speech

Performance

- Avoid extra HTML tags whenever necessary.



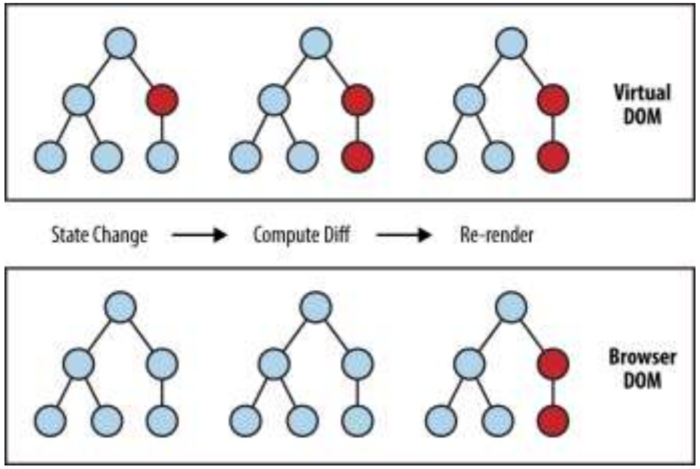
```
▼<div class="hr-live-container"> == $0
    <span class="hr-live-icon"></span>
   ▶<span class="hr-live-text">…</span>
  </div>
```

```
▼<span class="hr-live-text"> ==
    ::before
    "Collect nights"
  </span>
```

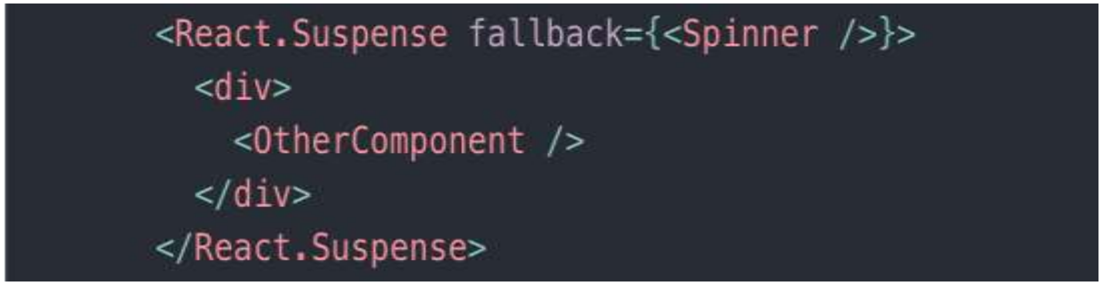
- CSS is render blocking. Download the CSS as soon as possible.
- Avoid unnecessary CSS processing by using media tags.
  screen -- width, height, orientation
  type -- screen, print, speech
- When the browser encounters a script tag, DOM construction pauses until it finishes executing.
- Adding the async keyword to the script tag tells the browser not to block DOM construction.

The React way

Virtual DOM



React Suspense



```
<React.Suspense fallback={<Spinner />}>
  <div>
    <OtherComponent />
  </div>
</React.Suspense>
```

Thank You