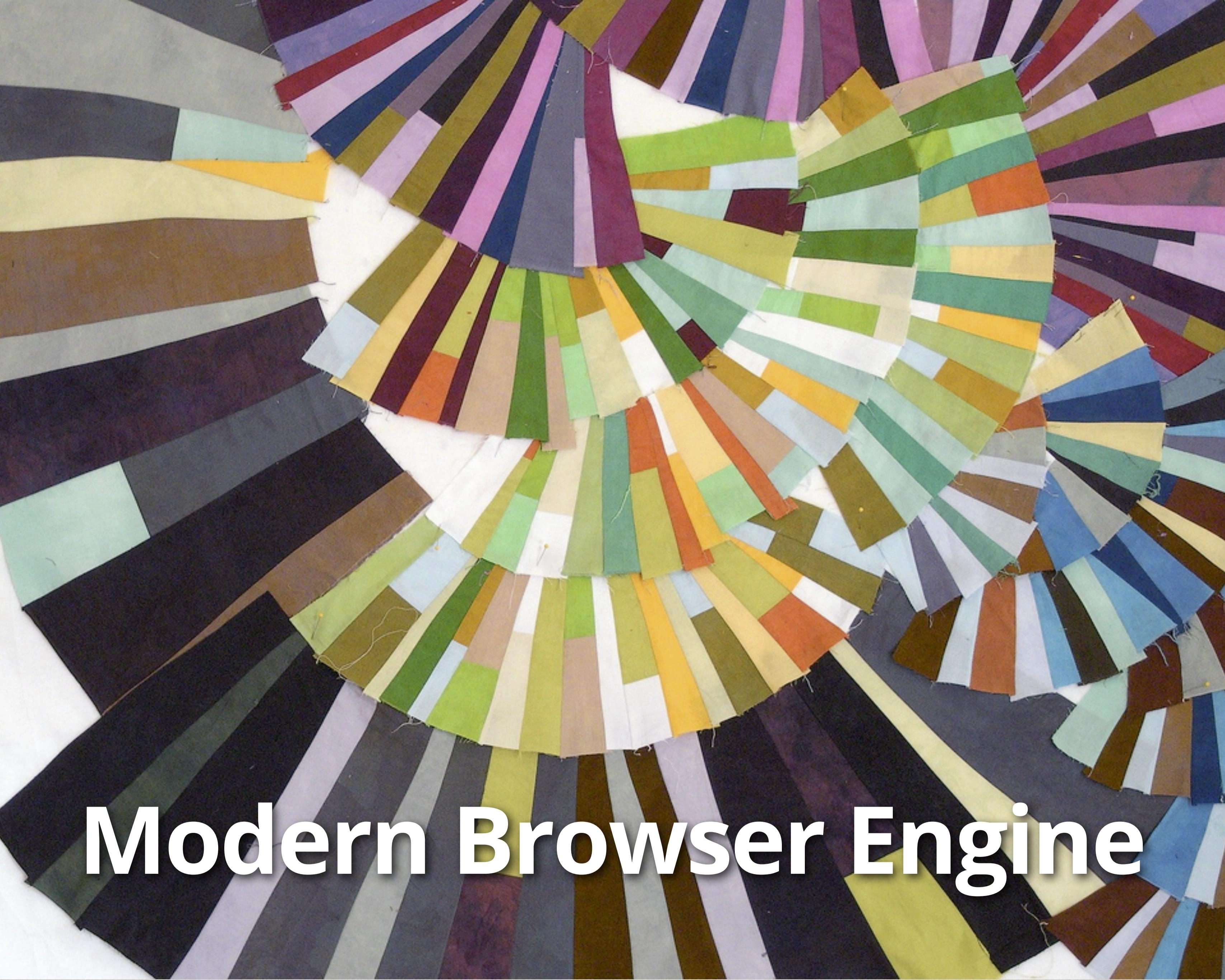




SERVO

Designing and Implementing a
Parallel Browser

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[@metajack](https://twitter.com/metajack)



Modern Browser Engine

The background of the image is a photograph of a lush green grassy hill under a clear blue sky with a few wispy white clouds. The hill slopes gently from the foreground to the horizon.

Greenfield Project

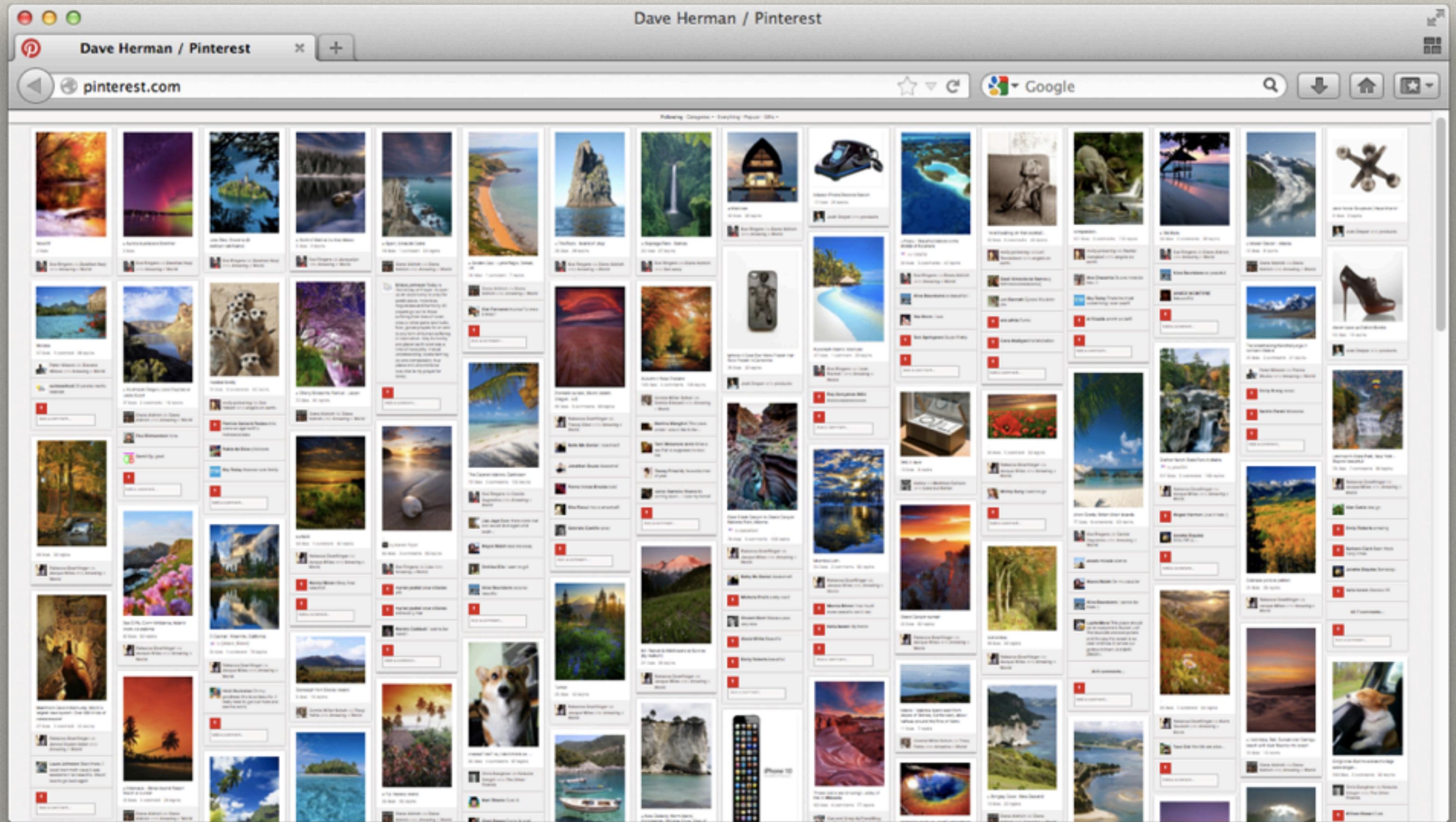


Explore & Experiment

Rust

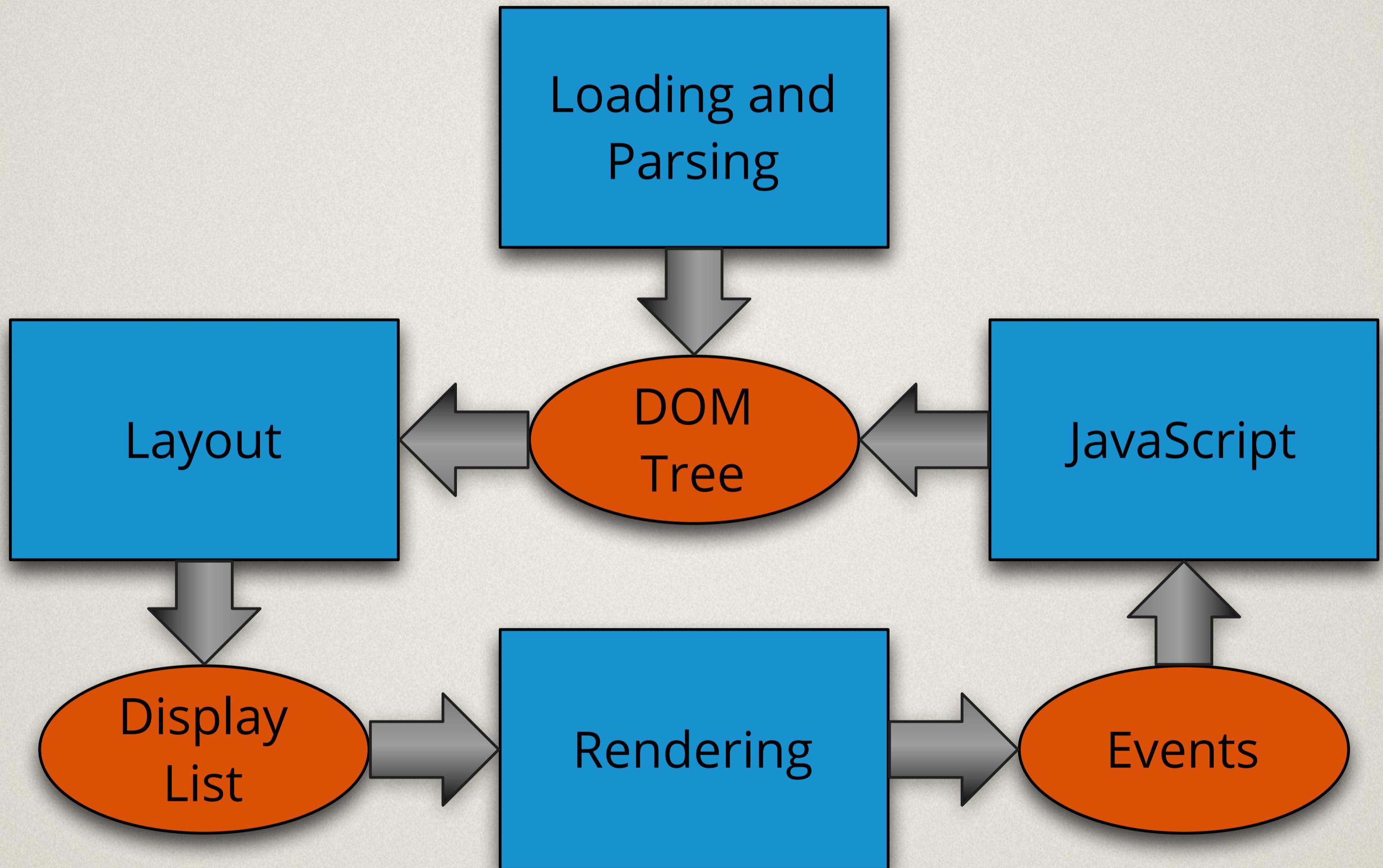


A lot of parallelism exists on the Web, but not in browsers.

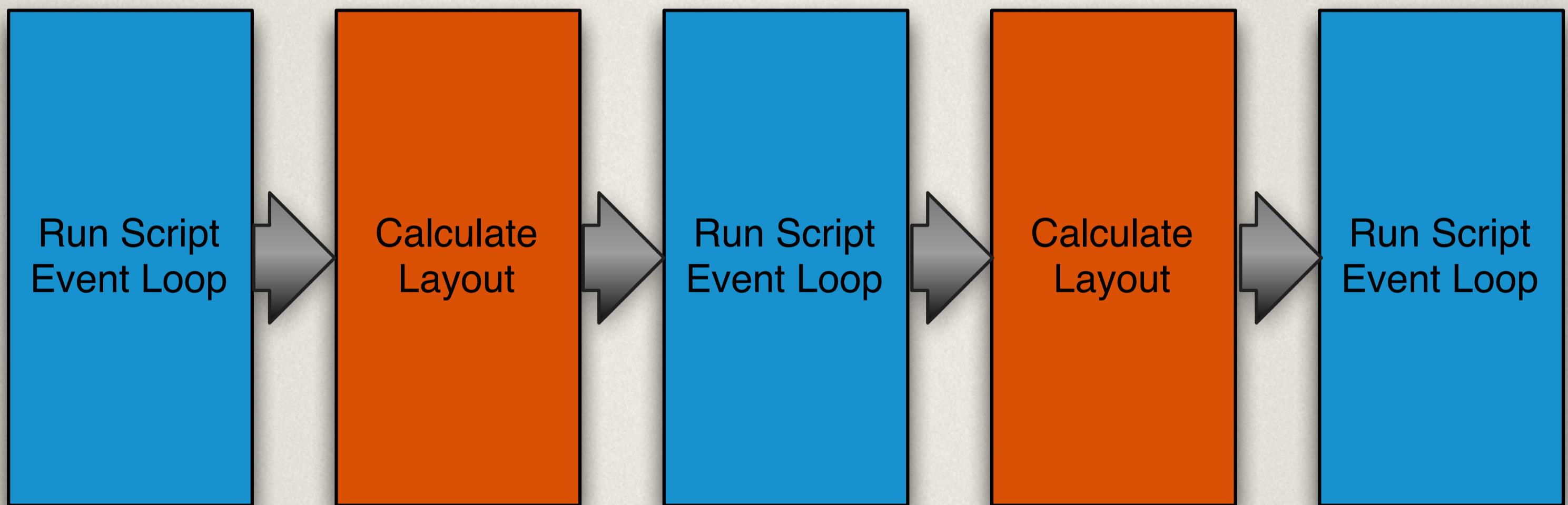


BROWSER ARCHITECTURE

BROWSER ARCHITECTURE



SINGLE THREADED

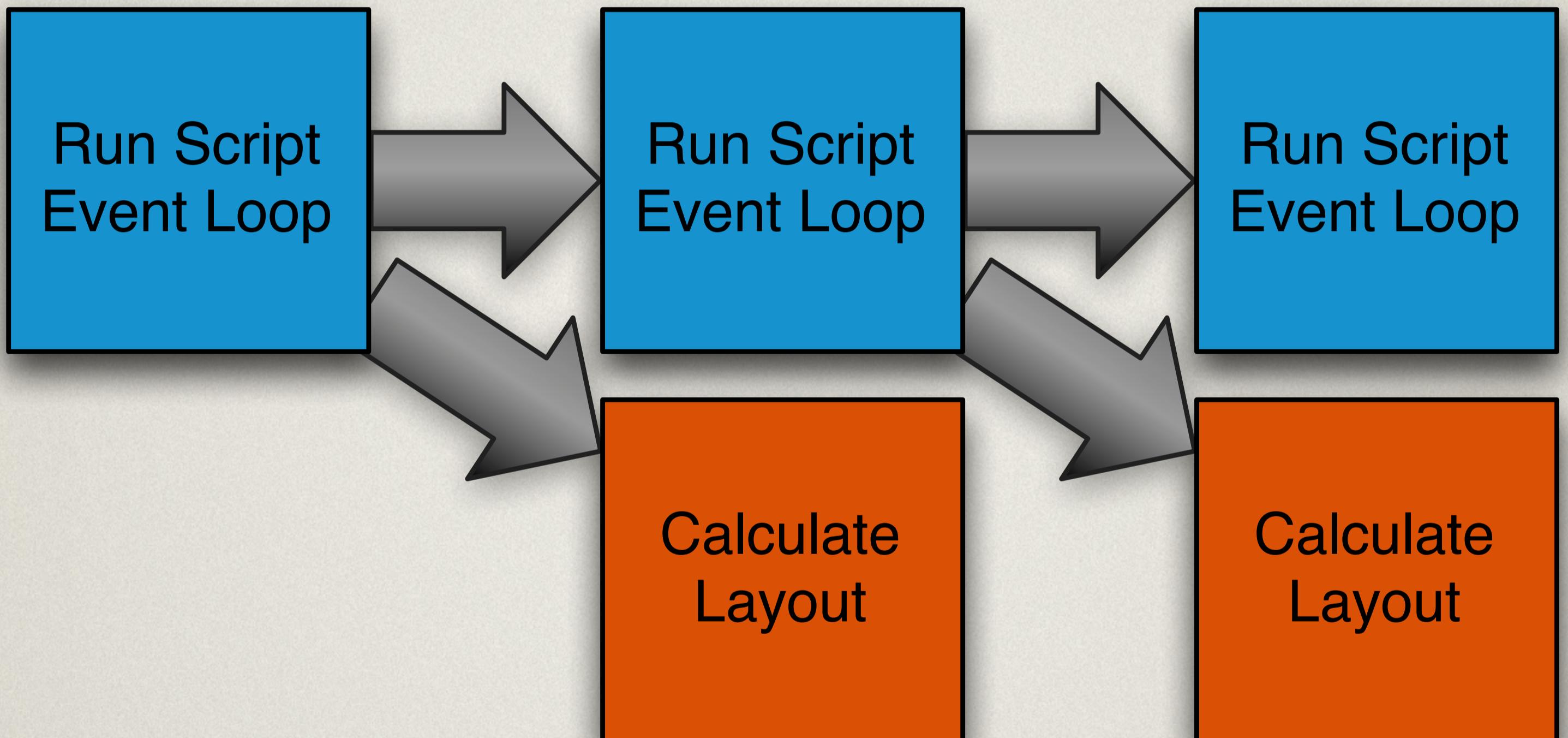


SCRIPT & LAYOUT



AT THE SAME TIME!

CONCURRENT SCRIPT & LAYOUT

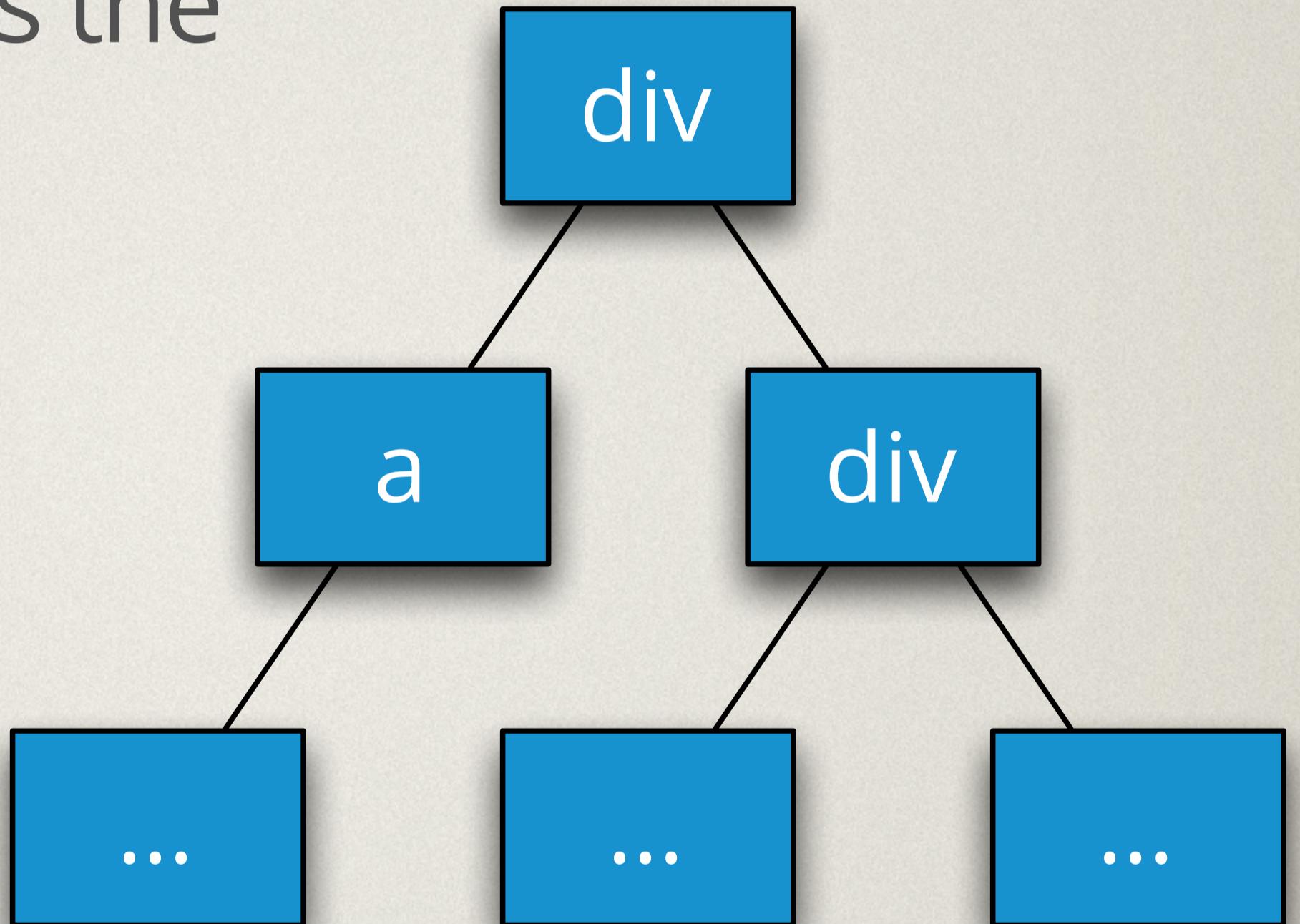


THE PROBLEM

- **Goal:** Run JavaScript code and calculate layout in parallel.
- **Problem:** DOM is shared and mutated by both. Efficiency and safety are critically important.

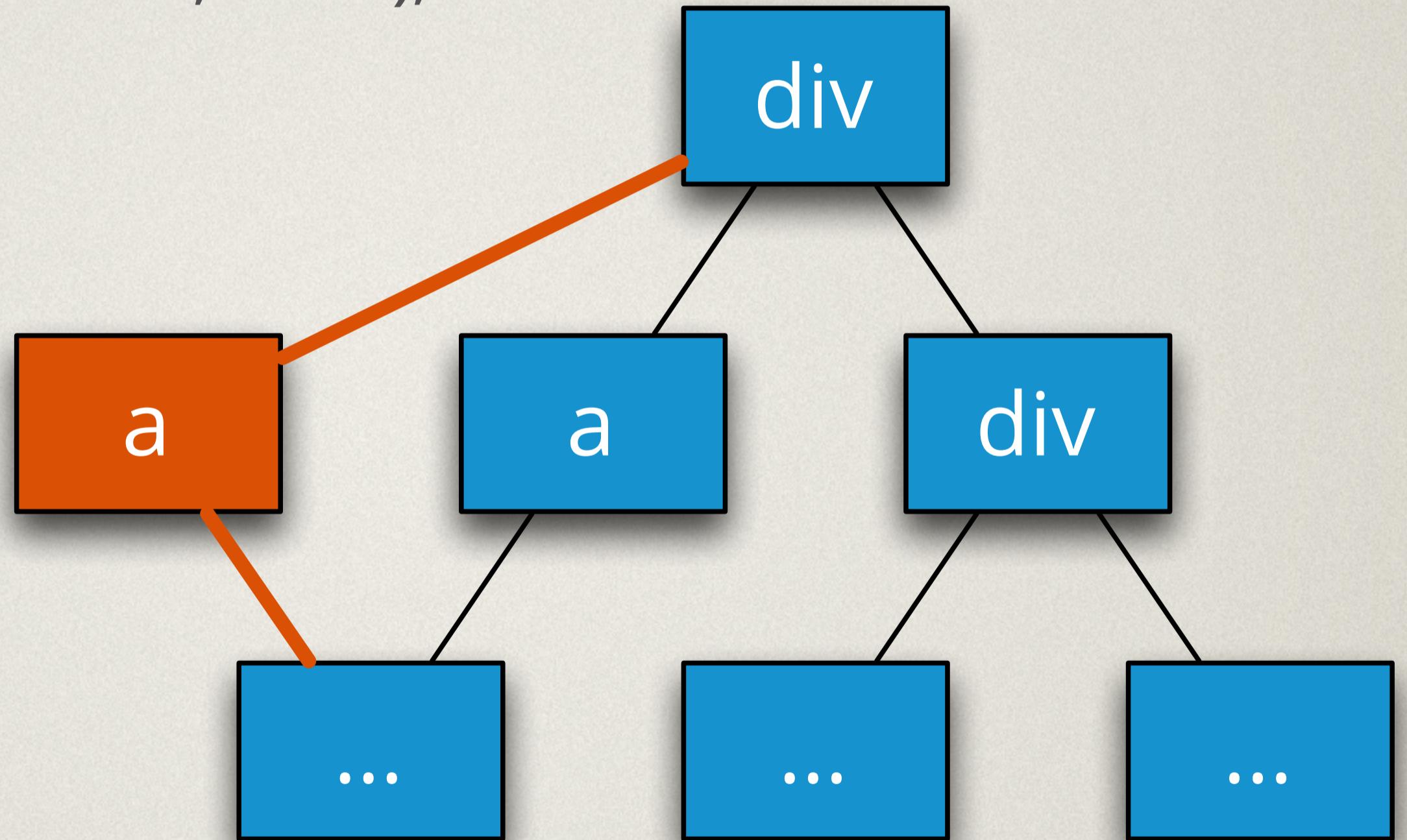
COPY-ON-WRITE DOM

Layout always sees the same tree



COPY-ON-WRITE DOM

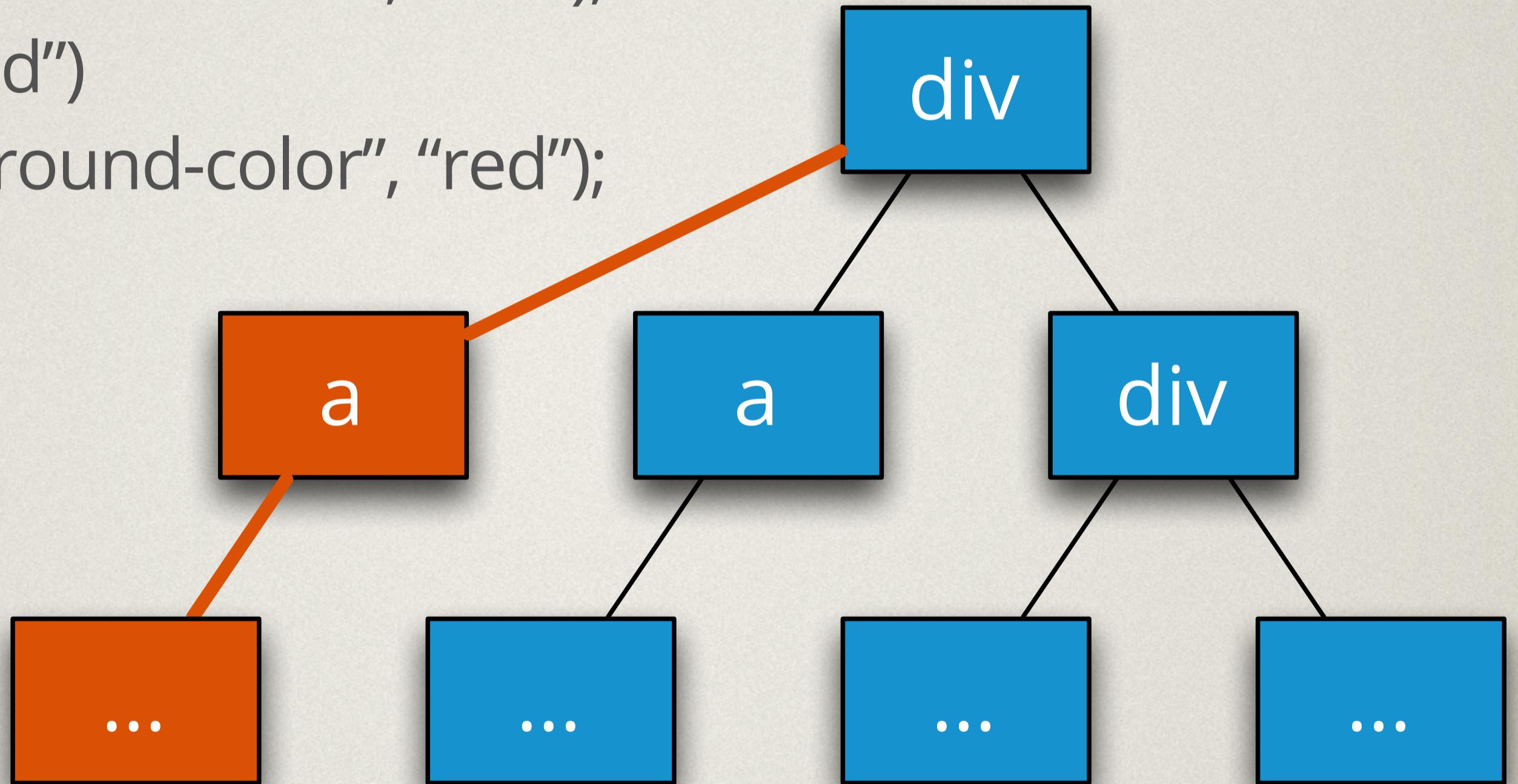
```
$("a")  
.css("background-color", "red");
```



Script sees
red nodes
and links

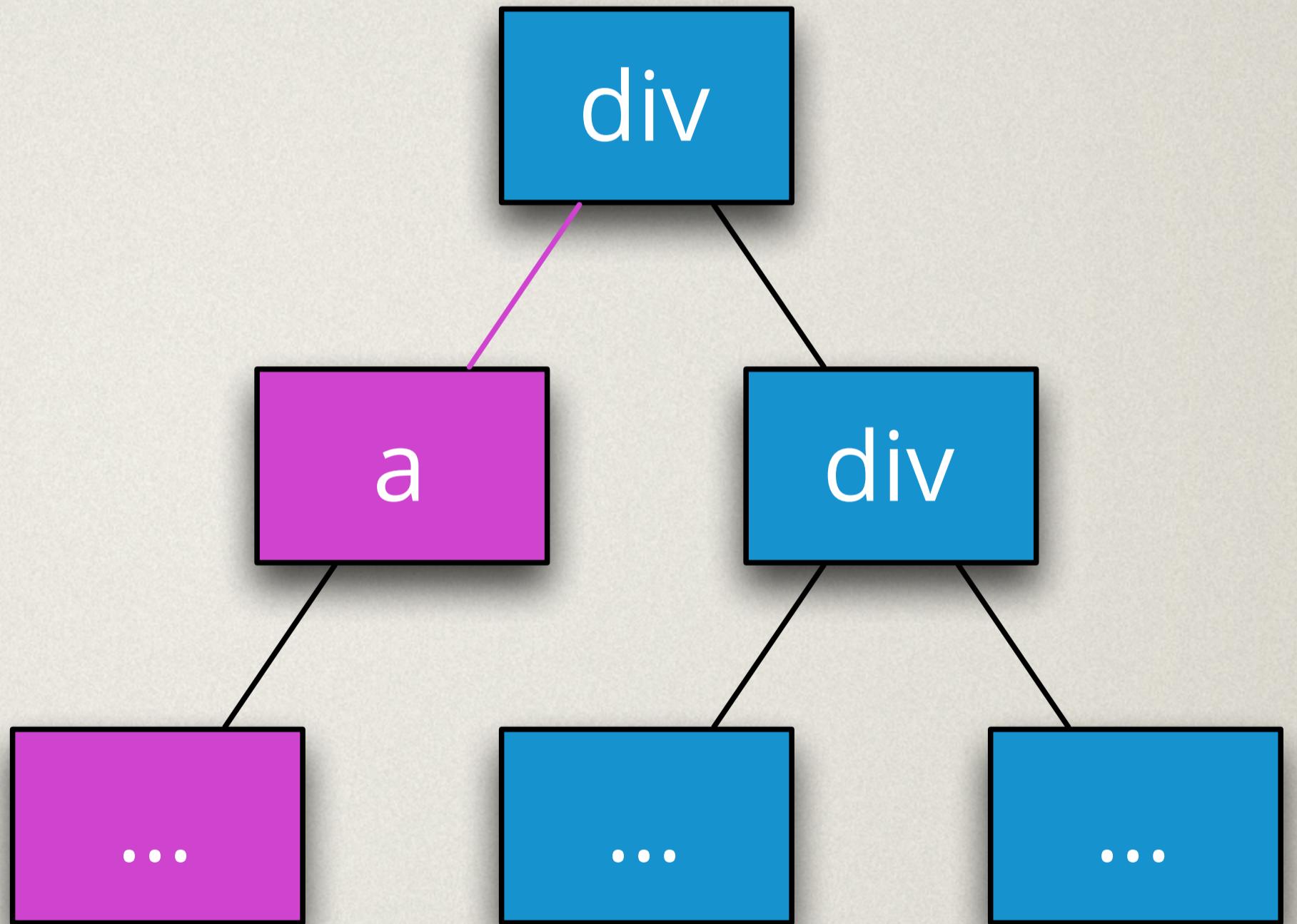
COPY-ON-WRITE DOM

```
$("a")  
.css("background-color", "red");  
$("a:first-child")  
.css("background-color", "red");
```



COPY-ON-WRITE DOM

Layout
finished.

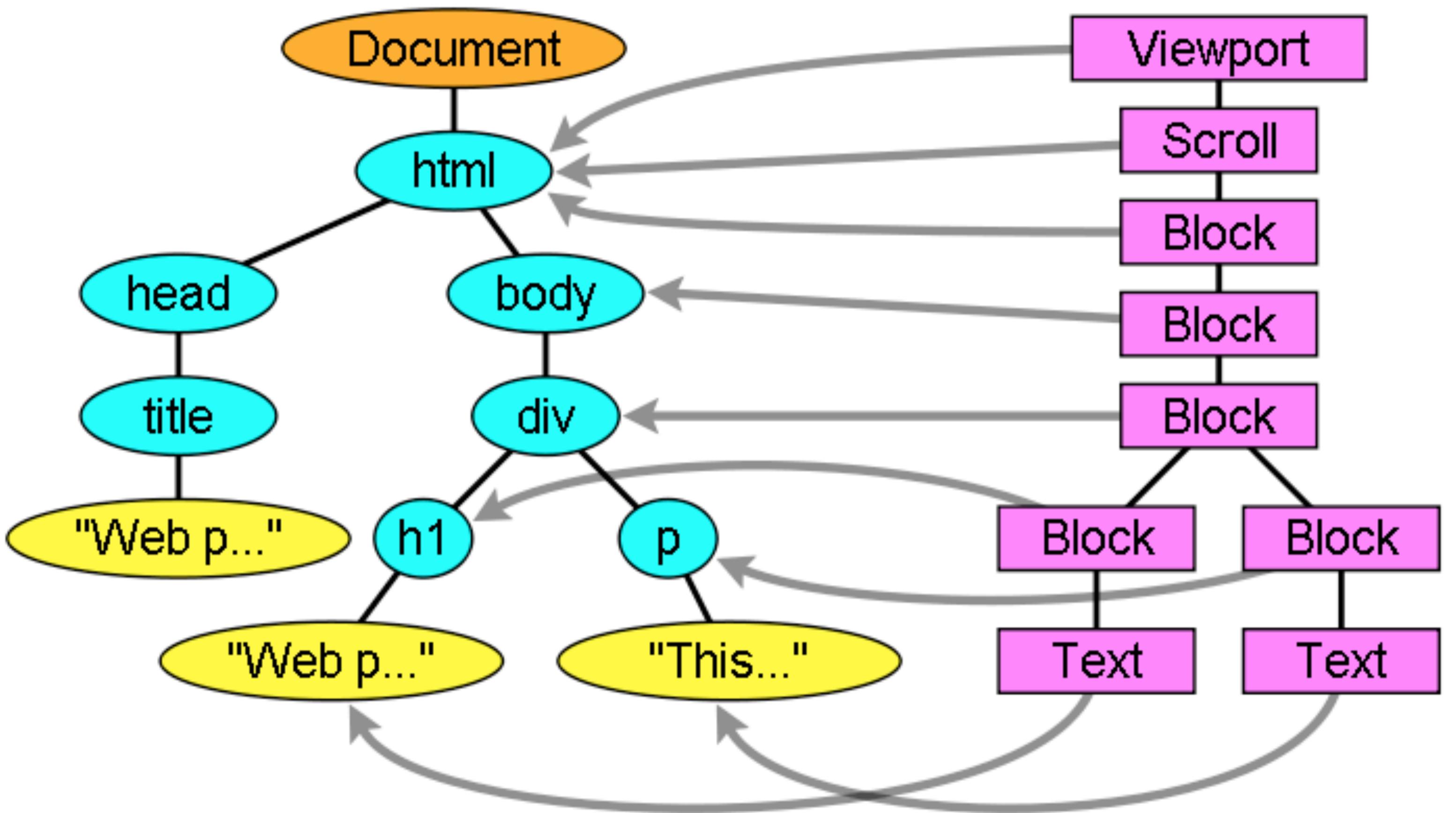


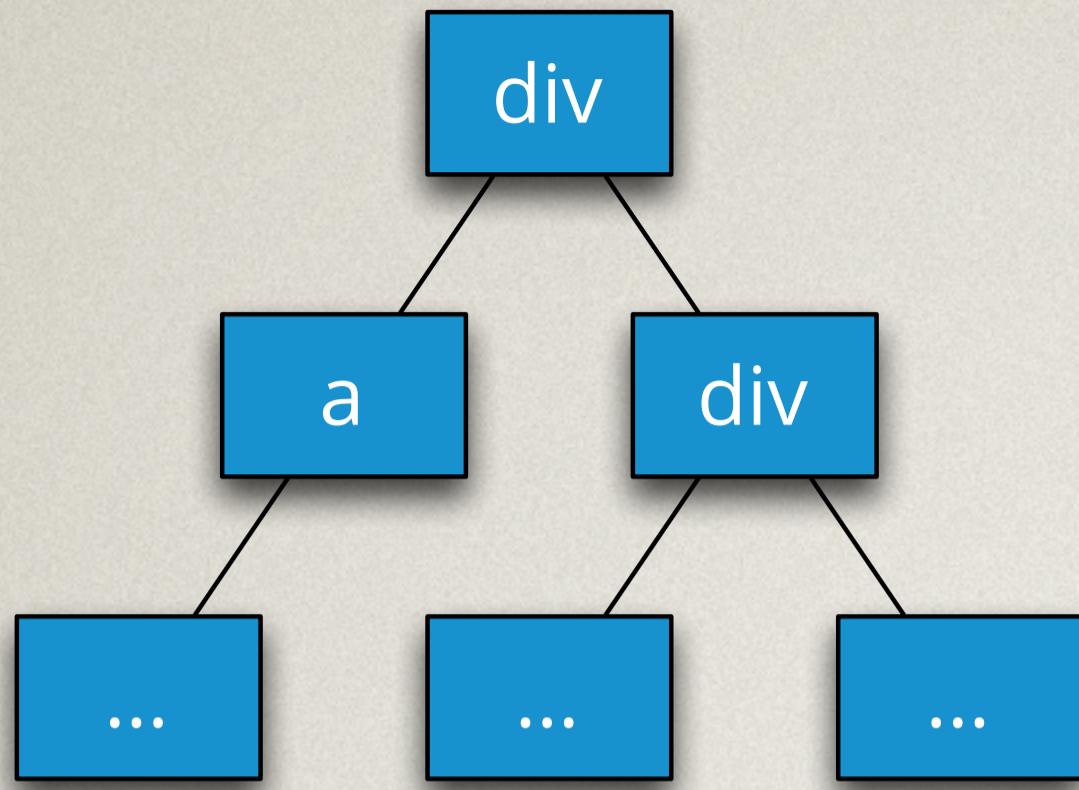
C.O.W. DOM SAFETY

- Rust type system enforces safety
- Layout and script tasks see different types for the DOM tree and both types have distinct implementations
- Leaks are not allowed; nodes can't escape.

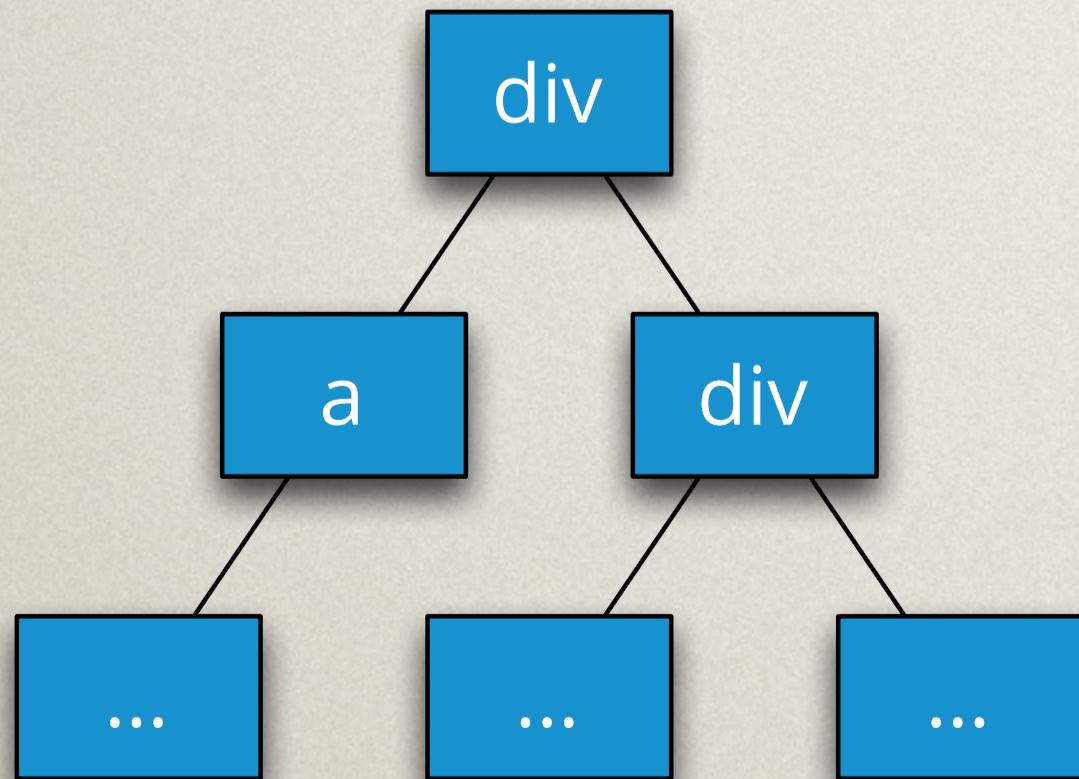
PARALLEL LAYOUT

GECKO'S LAYOUT

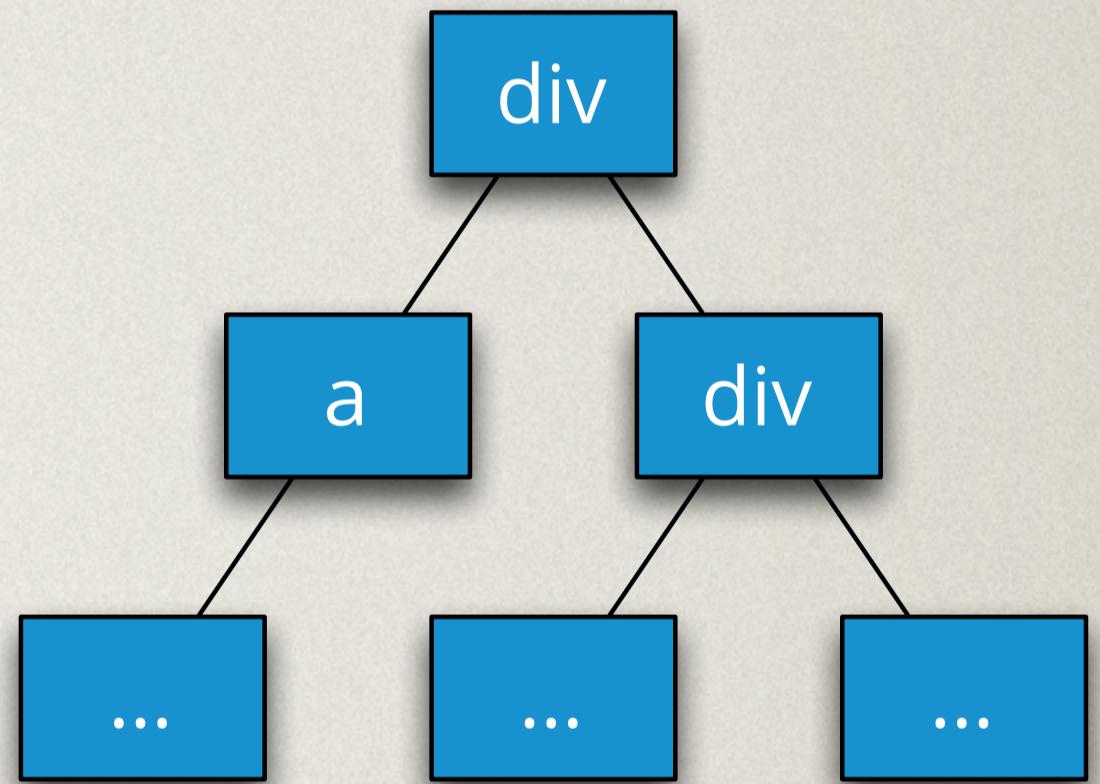




Bubble Widths



Assign Heights

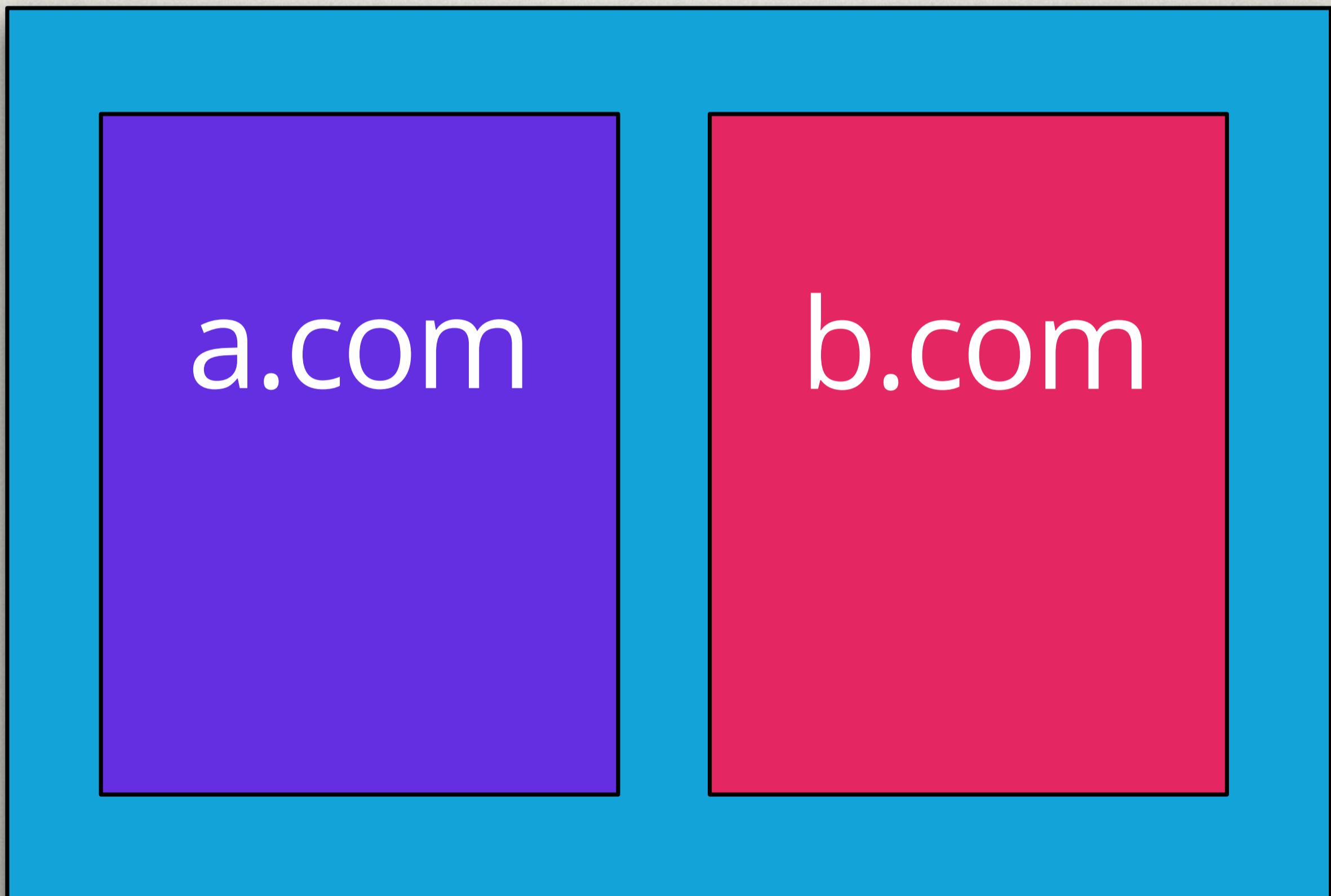


PARALLEL IFRAMES

SAME-ORIGIN IFRAMES



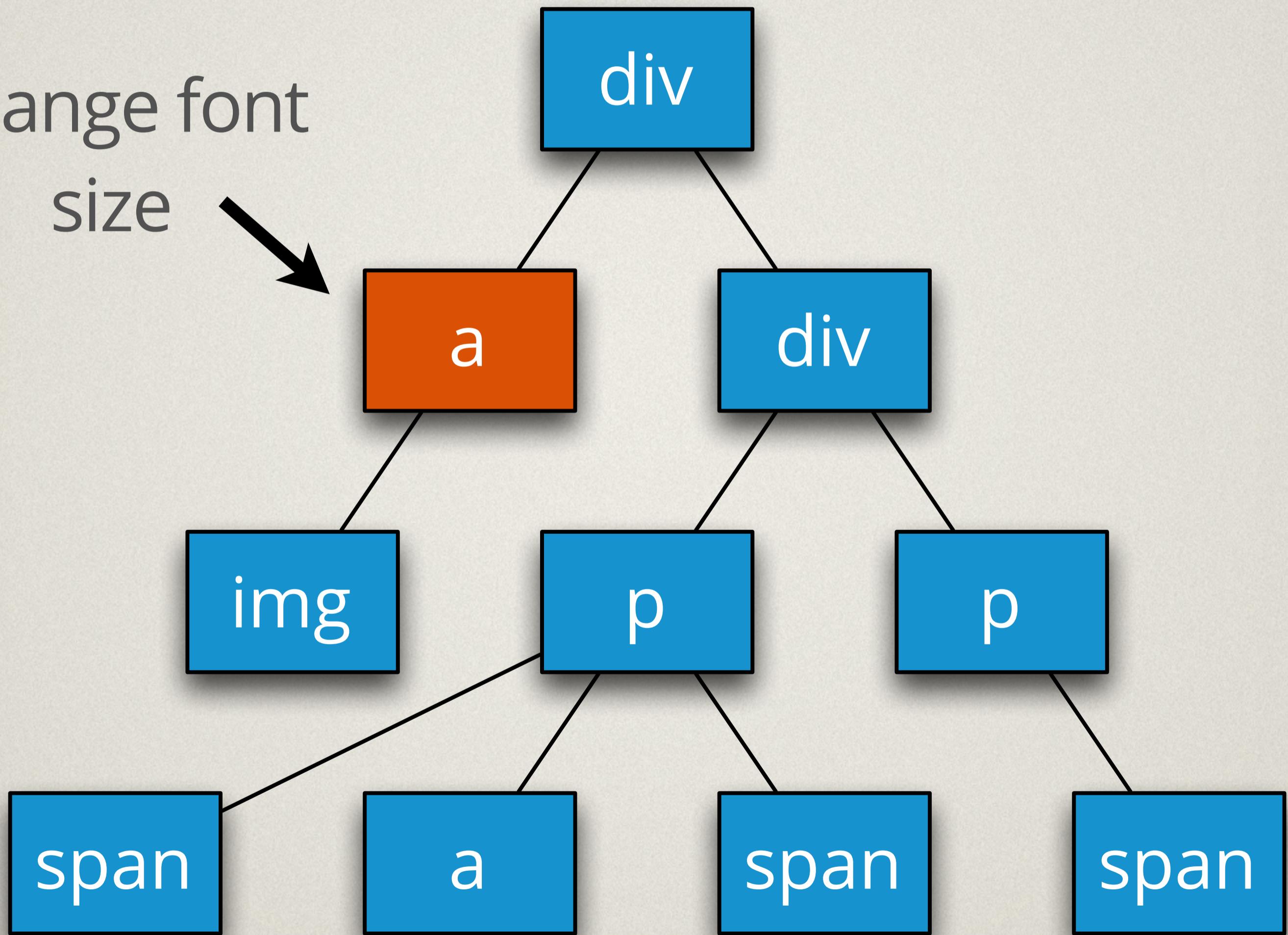
CROSS-ORIGIN IFRAMES



PARTIAL LAYOUT

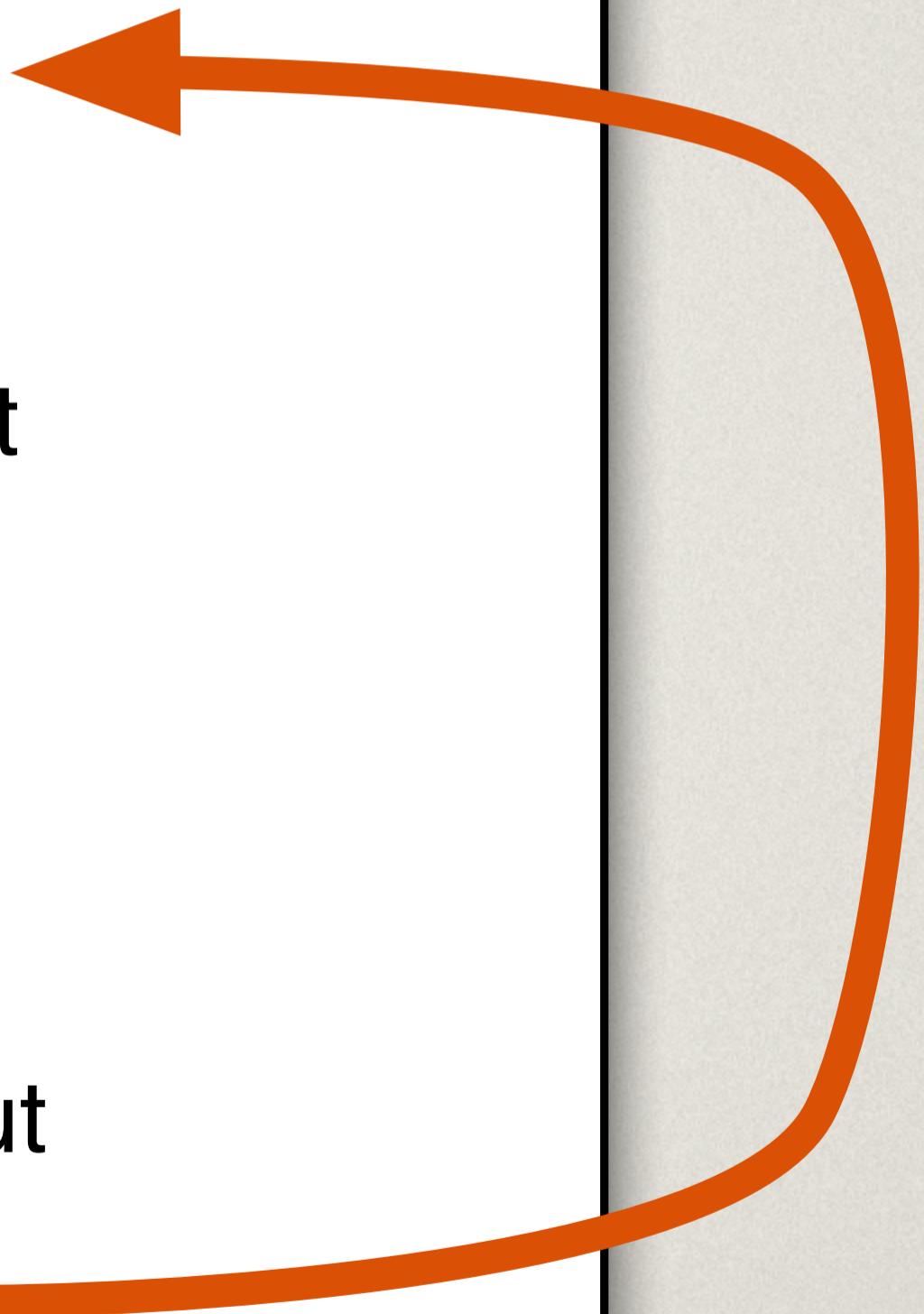
PARTIAL LAYOUT

Change font
size



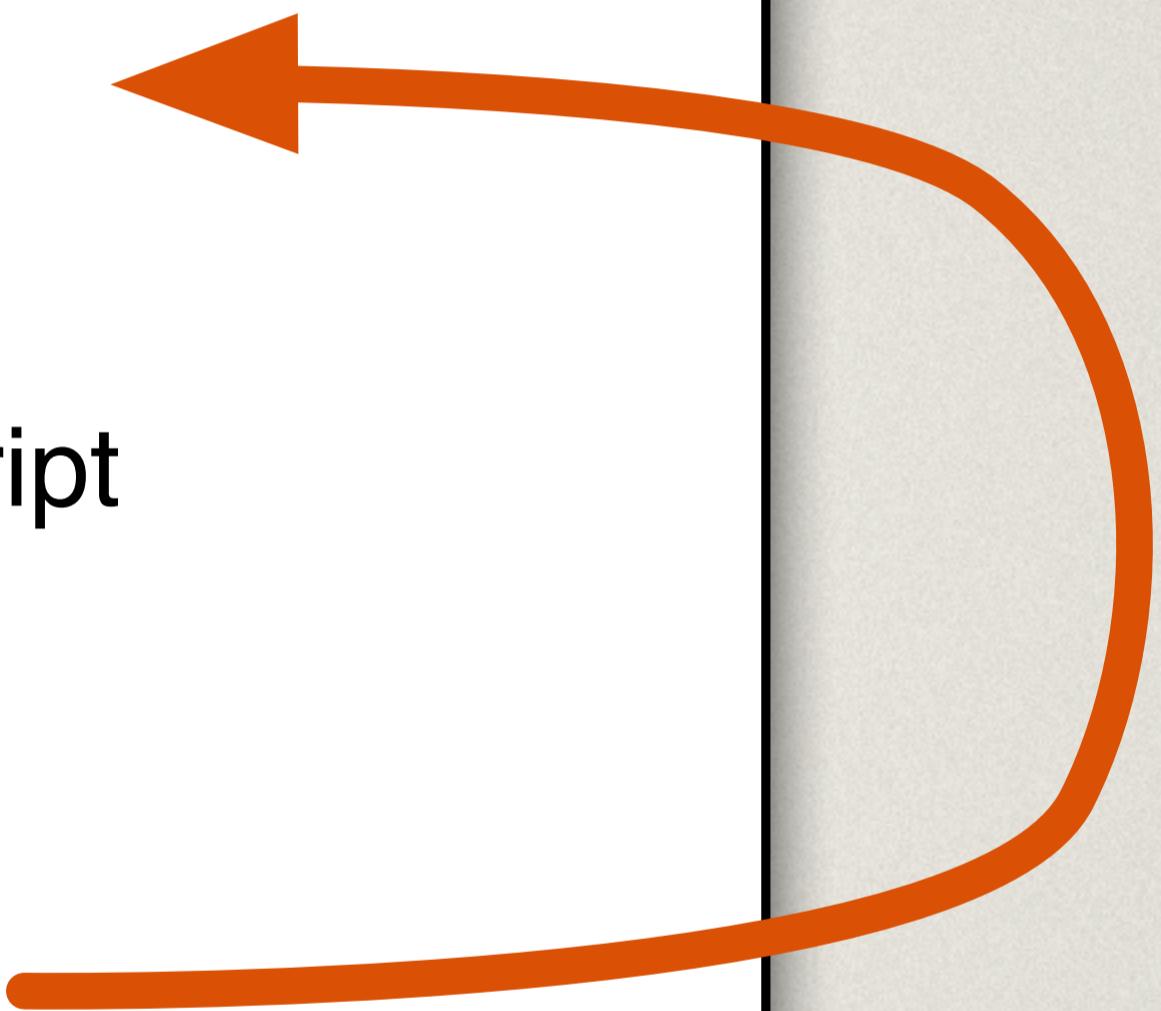
NORMAL LAYOUT (SERIAL)

```
{  
  // script  
  ...  
  
  // more script  
  ...  
  
  // layout  
  ...  
  
  // more layout  
  ...  
}
```

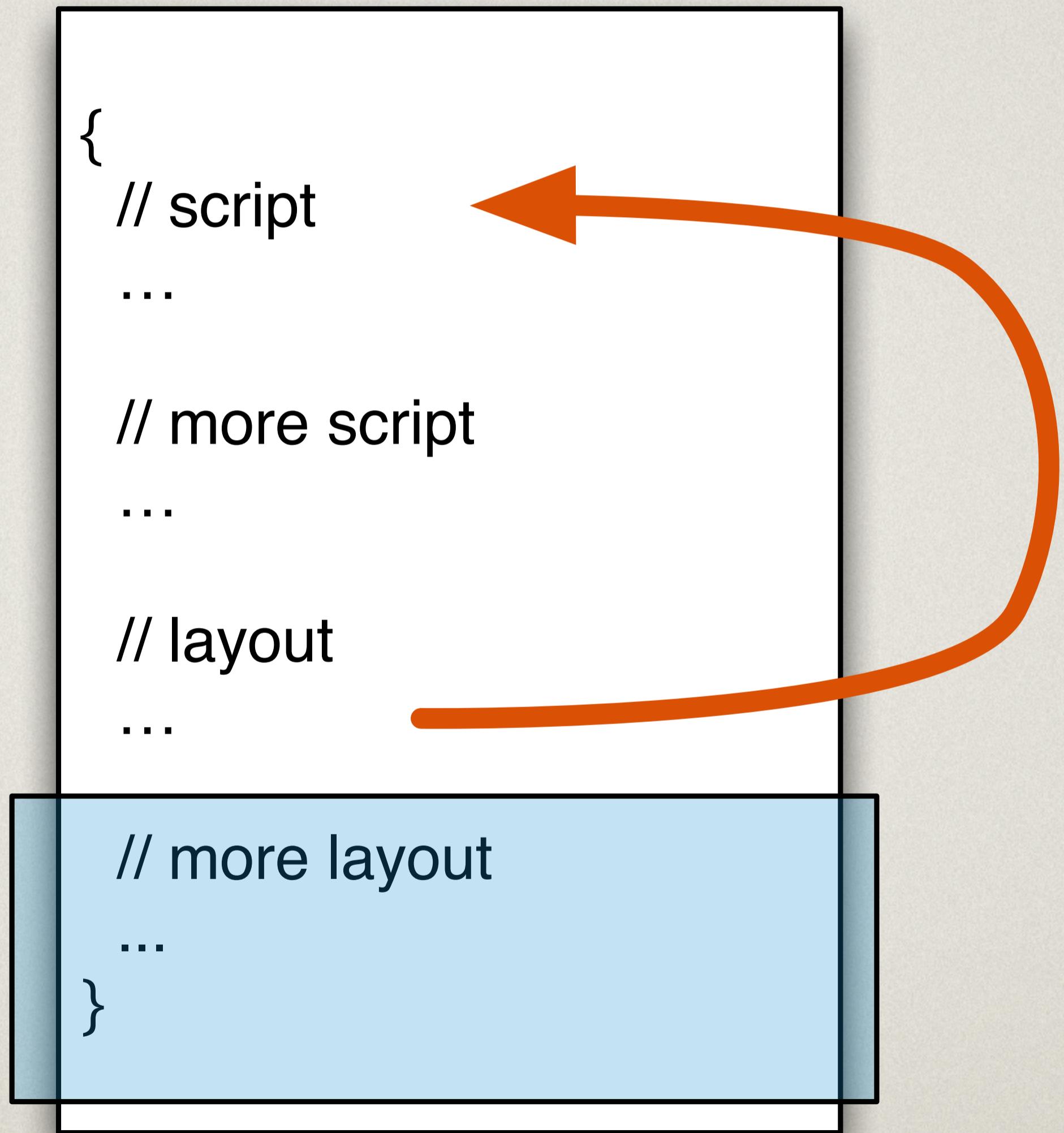


PARTIAL LAYOUT (SERIAL)

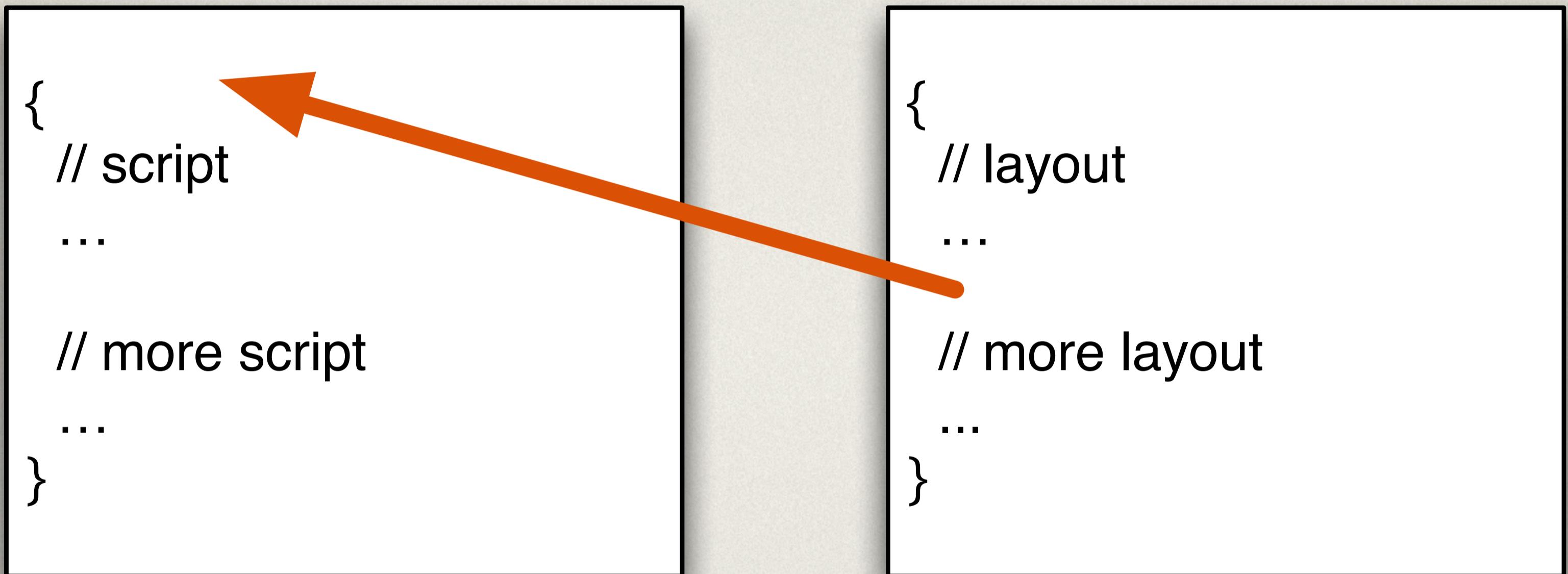
```
{  
  // script  
  ...  
  
  // more script  
  ...  
  
  // layout  
  ...  
  
  // more layout  
  ...  
}
```



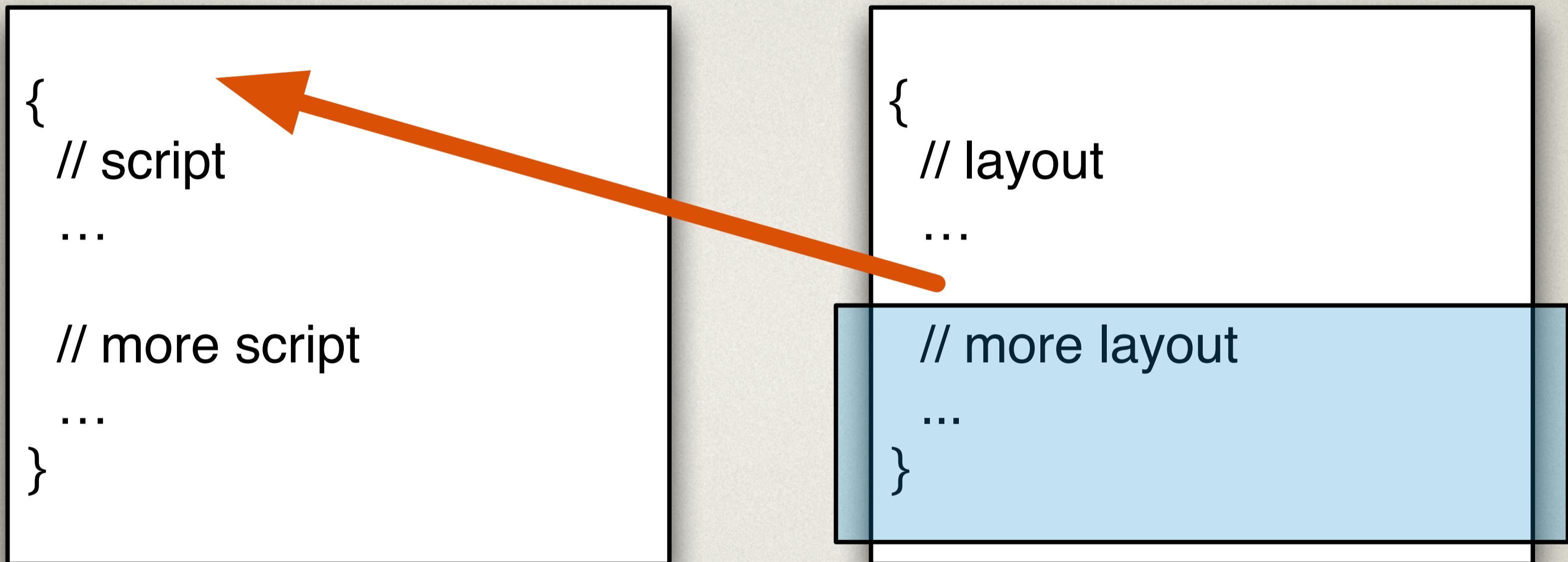
PARTIAL LAYOUT (SERIAL)



PARTIAL LAYOUT (CONCURRENT)



PARTIAL LAYOUT (CONCURRENT)



WHERE'S THE PARALLELISM?

- Rendering, compositing, & animation (GPU)
- CSS selector matching
- Box model solving
- Text shaping
- Media handling (parsing, decode, etc)
- Speculation (parsing, execution, etc)
- Garbage collection

DEMO

WHERE WE ARE &
WHERE WE'RE GOING

toggle

the way

the world ends
bang
whimper

i grow old

pluot?

bar maids,

sing to me, erbarme
dich

This is a nonsensical document, but syntactically valid HTML 4.0. All 100%-conformant CSS1 agents should be able to render the document elements above this paragraph indistinguishably (to the pixel) from this [reference rendering](#), (except font rasterization and form widgets). All discrepancies should be traceable to CSS1 implementation shortcomings. Once you have finished evaluating this test, you can return to the [parent page](#).

tragedy

the misery

the world ends
bang ●
whimper ●
whimper

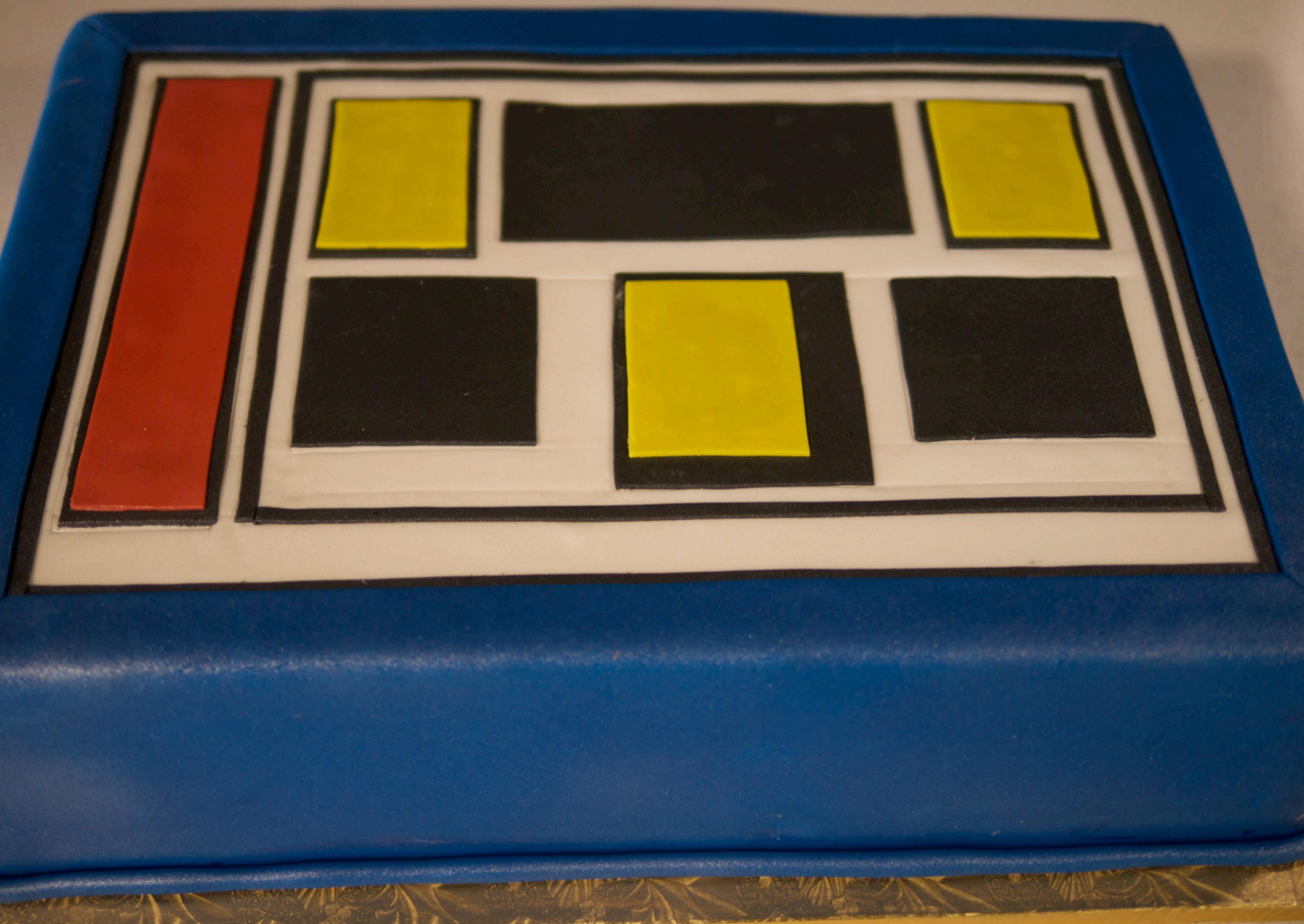
I grow old
old

plus?

but maids,
maids,

single me, extreme
dich
erbarme dich

This is a non-functional document for testing CSS1 agents. It is not intended to be valid HTML. It is 100% conformance CSS1 agents should be able to render. This document should be able to render with the address bar (or the shell) from the reference rendering (except font substitution and form widgets). All discrepancies should be above this paragraph indistinguishably (to the pixel) from this reference rendering, except for CSS1 implementation shortcomings. Once you find a discrepancy, take a screenshot, and post it to the bug, you can file a bug against the implementation.



SERVO TODAY

- Script and layout concurrently
- Parallel iframes
- GPU rendering and compositing
- Quad-tree based tiled rendering, zooming & scrolling
- Basic navigation
- Basic DOM APIs like setAttribute, createElement & appendChild.
- Linux, Mac & Android

SERVO IN THE FUTURE

- Parallel layout
- Incremental layout
- Embeddable
- JS-managed DOM
- New style system
- Benchmarks and conformance tests

SERVO NEEDS YOU!

GitHub: <https://github.com.mozilla/servo>

IRC: **#servo** on irc.mozilla.org

List: <https://lists.mozilla.org/listinfo/dev-servo>

email: jack@metajack.im

twitter: [@metajack](https://twitter.com/metajack)

IMAGE CREDITS

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