Client/browser productivity language (for layout)

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Millions of Designers Struggle With CSS

Berkeley Par Lab

"I need help sorting out the problem with a website I designed which uses DIV tags to allow me to use a background image with layers of editable text over it. What I have works fine in all browsers EXCEPT when the screen resolution changes and/or the browser is resized. Then the text no longer properly or predictably lines up with the background image. [...]"

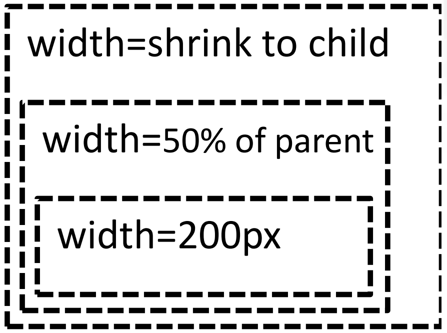
CSS is hard. Why?

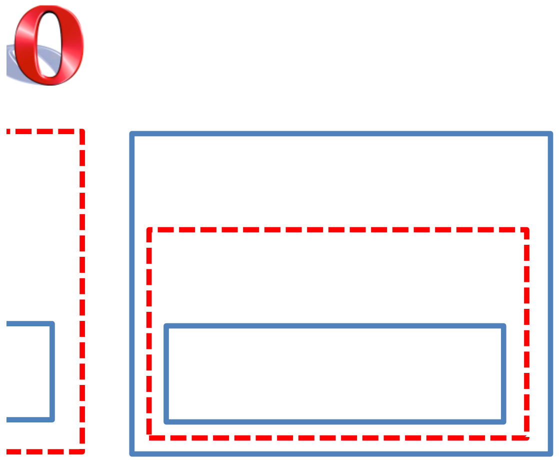
- Is it too large, bloated?
- Or is something missing?
- Do the language concepts map onto how users think?

→ Brokenness by Example

CSS Spec is Contradictory

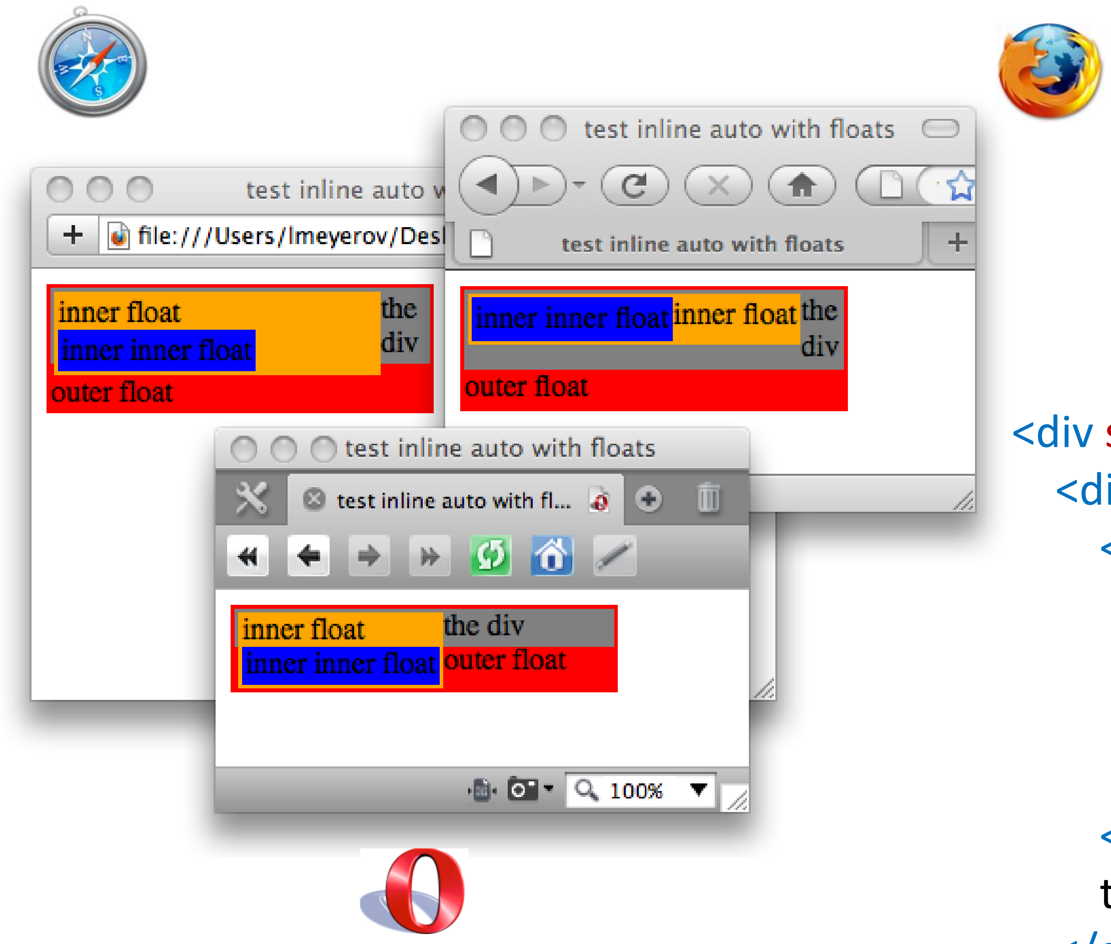
- Browser tries to guess user’s intent
  - Deviate from Spec
- CSS is too lo
  - Does not raints yourself





→ Silently dropped constraints lead to unpredictability

CSS Spec is Ambiguous



```
<div style="float: left ; width:200px">
   <div>
      <div style="float: left; ">
         inner float
         <div style="float: left;">
            inner inner float
         </div>
      </div>
      the div
   </div>
   outer float
</div>
```

Summary of Motivation

Users are confused

- Limited Expressiveness; results are unpredictable.

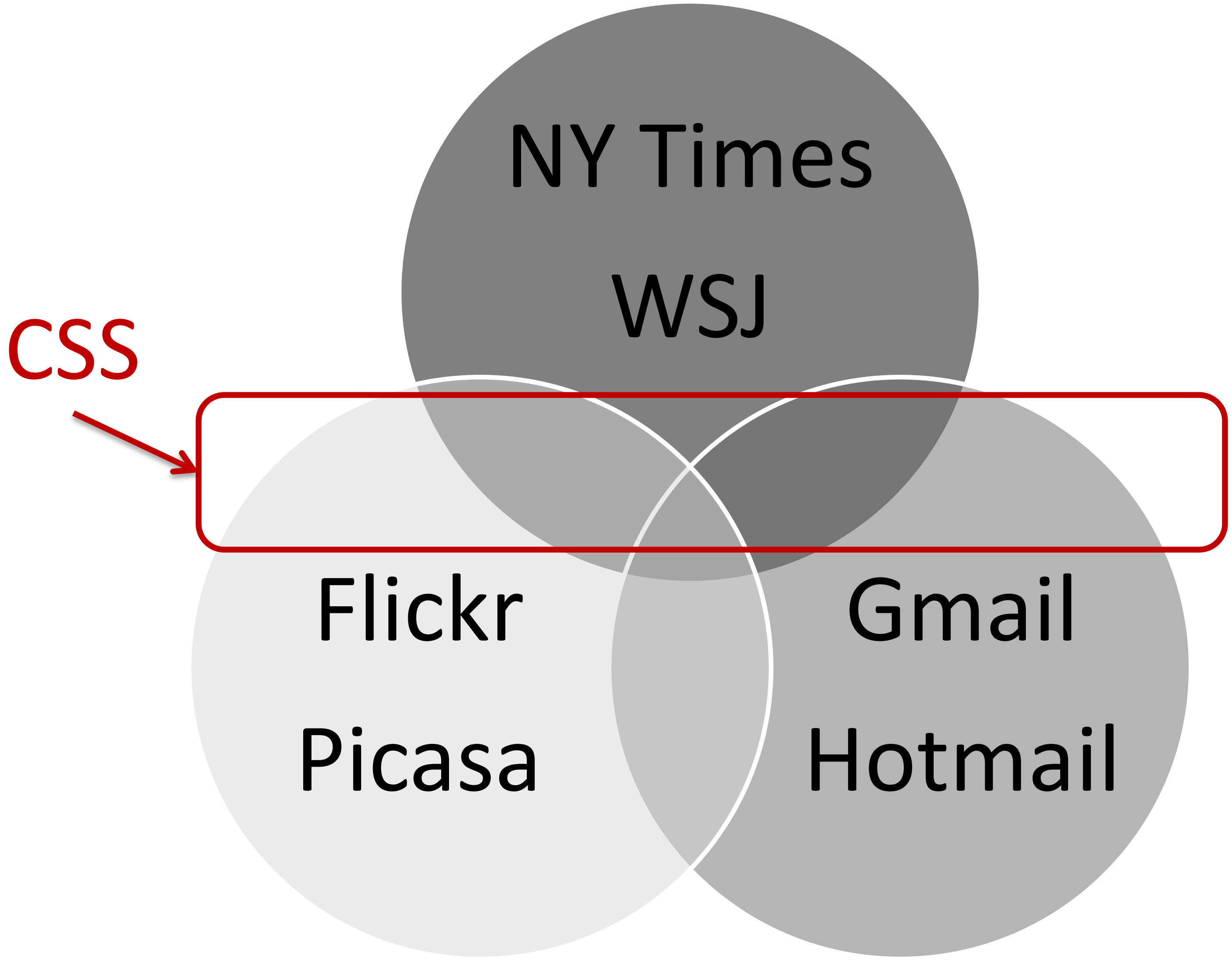
CSS Spec confusing because

- Contradictory, constraints silently dropped
- Ambiguous, diverging browsers
- Complicated, hard to implement

We address these by

- Simpler, domain languages
- Tool support for checking specs
- Tool for generating layout engine

Different needs -> Different languages



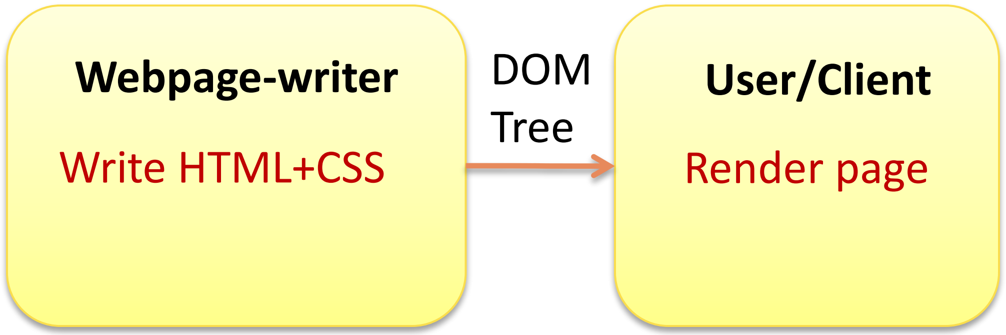
Eventually

Successful if we can embed in our model

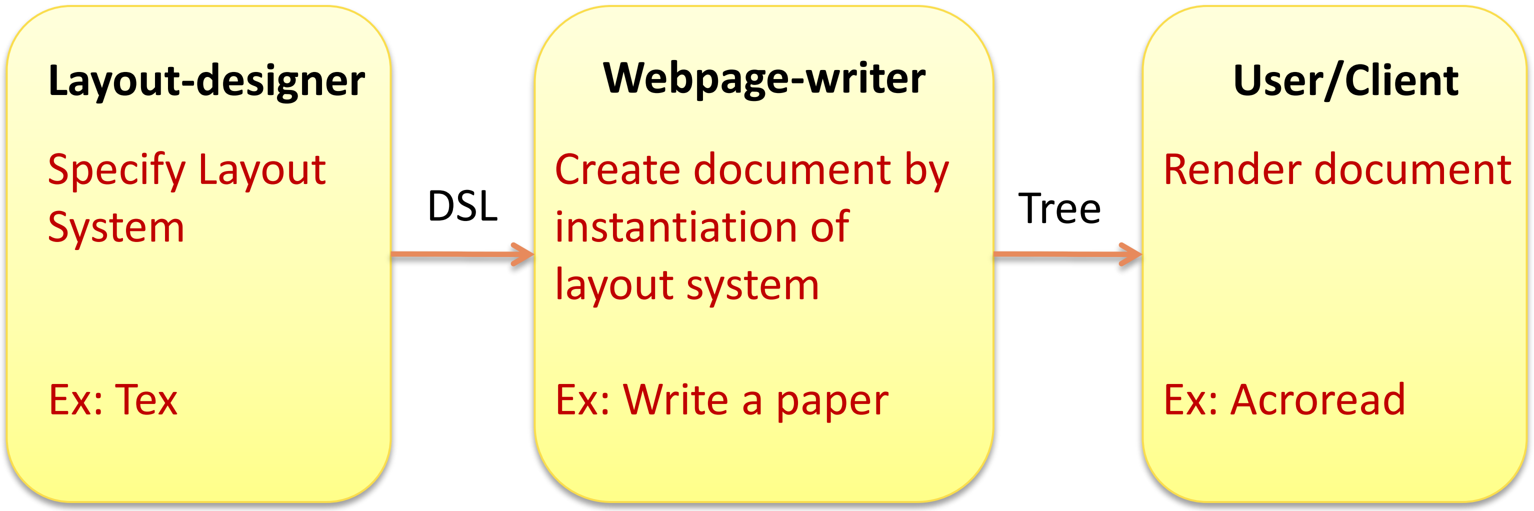
- GUIs: QML, XAML, etc.
- New Grid-Based Layouts
- Core/Subsets CSS [Meyerovich'09]

Roles

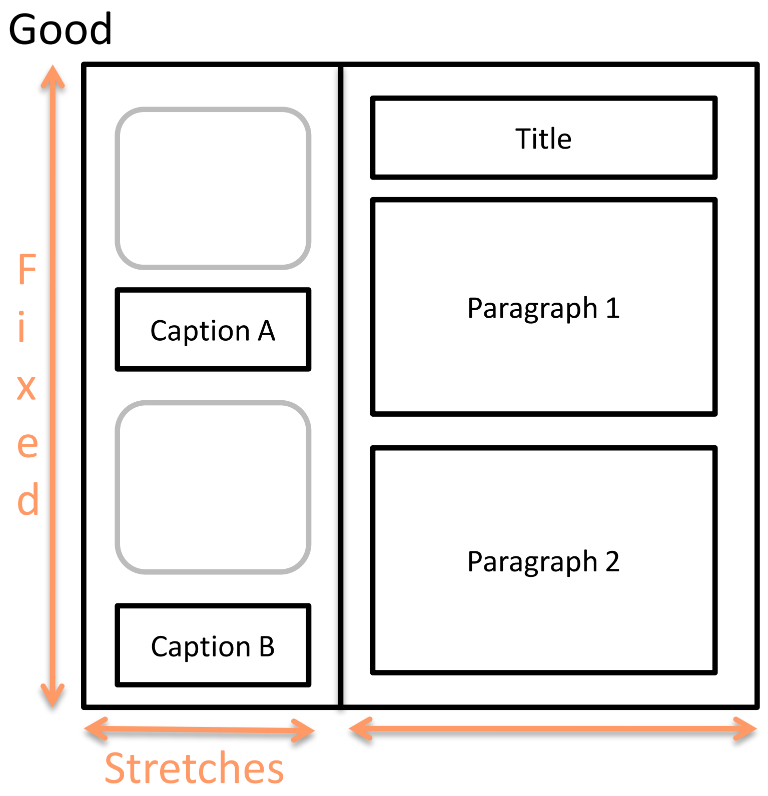
Today

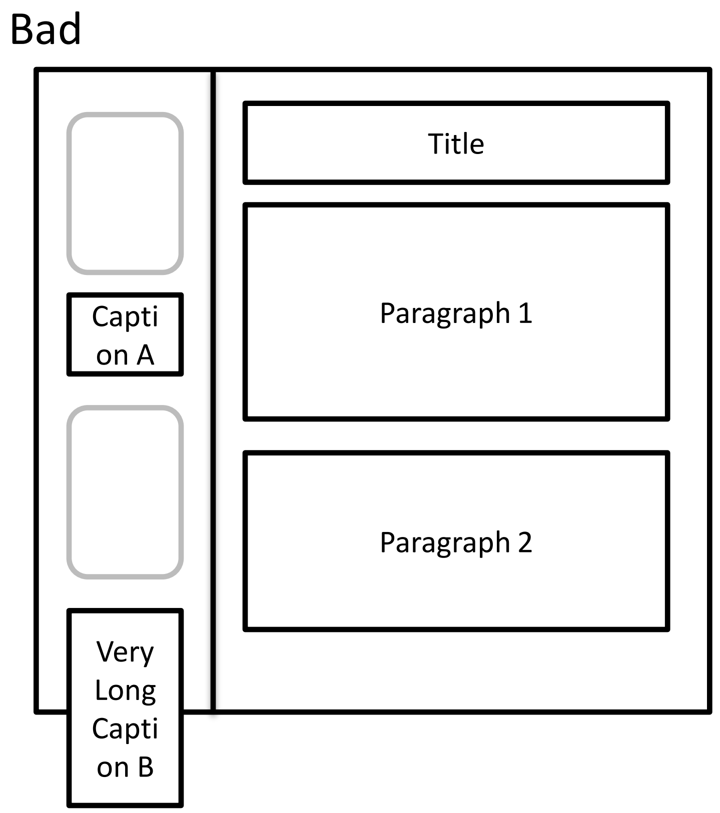


Tomorrow



Example





Designer Intent: Pictures + Captions all on first page.

Computation: Left: width := F(height)

Right : height := G(width)

Free The Constraints

Let the designer express declaratively his intent via constraints.

box.width == box.height

Bi-directional constraints:

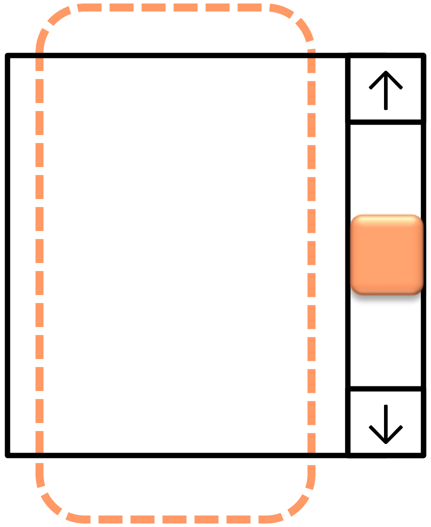
- Conciseness
- Split specified behavior and computation
  - You specify, We Solve

Bi-directional Constraints

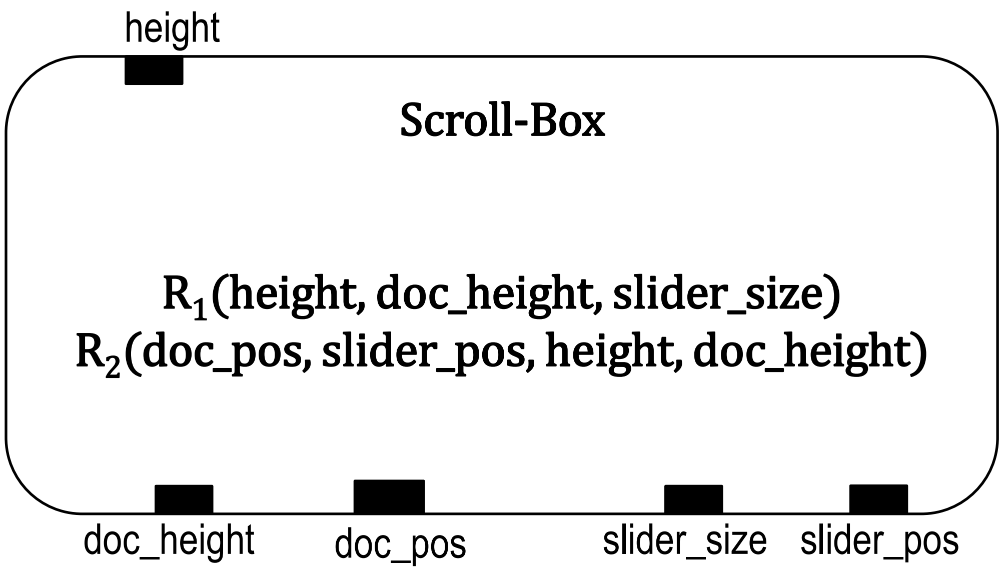
Redundancy in GUI:

Multiple knobs/indicator for a single variable.

Thus, many ways to update it.



With bi-directional constraints:


height
Scroll-Box
R_1(height, doc_height, slider_size)
R_2(doc_pos, slider_pos, height, doc_height)
doc_height
doc_pos
slider_size
slider_pos

Summary of Design Choices

Our proposed solution is

- Domain-specific Layout Languages (DSLL).
- Bi-directional constraints exposed to the document writer.

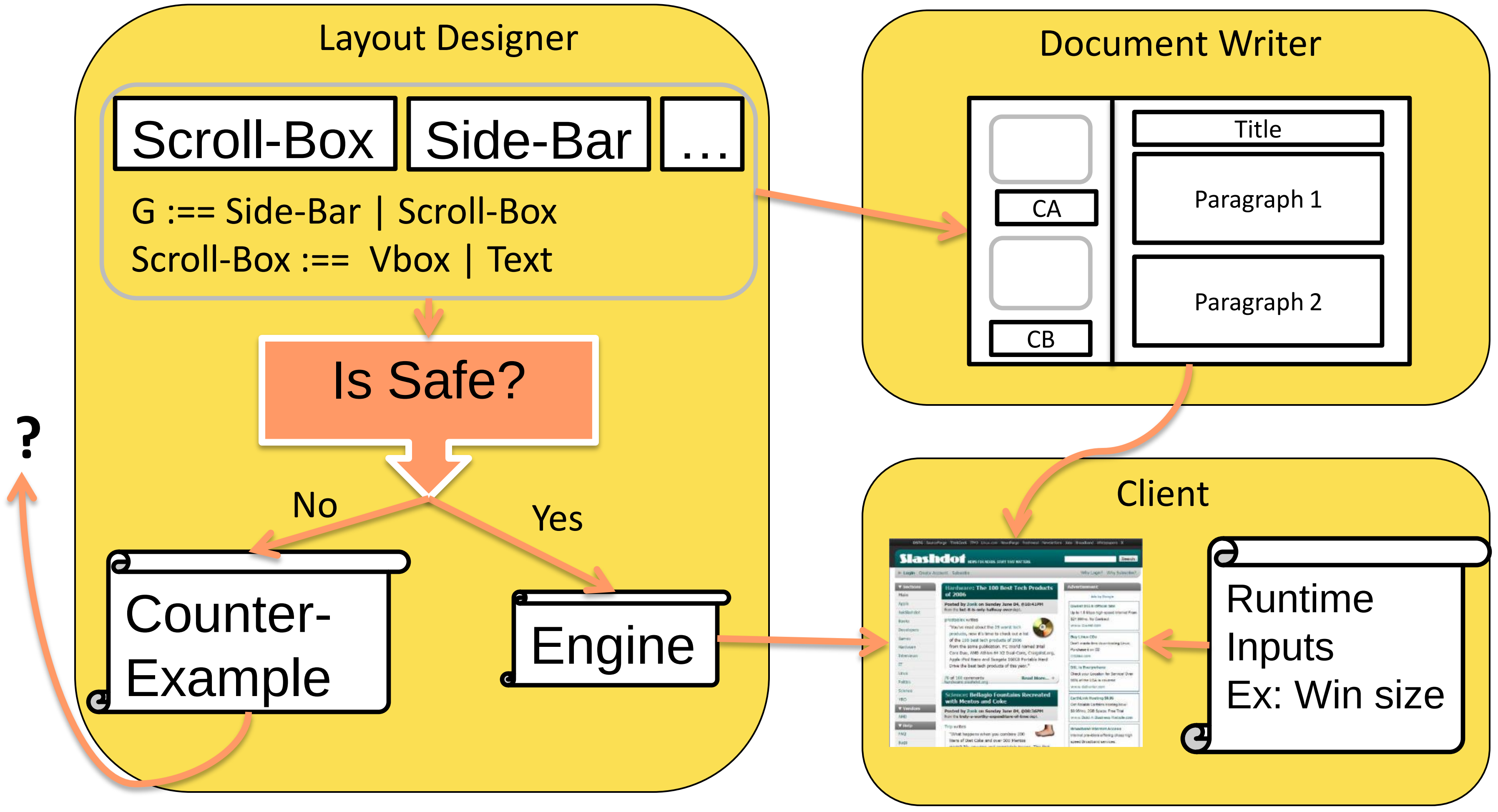
We want all documents in a DSLL to be

- Fast to solve.
- Always well defined: Can always layout.

We need to

- Generate efficient solver (layout engine).
- Check DSLL is "Good"
  - Compilation to tree traversals (AGs)
    - With synthesis of local evaluation rules.

3-Stage Architecture



Safe: Forall Tree in G, Forall Input in Tree, Tree(input) is Satisfiable and the solution can be found with propagation only.

Related Work On Solving

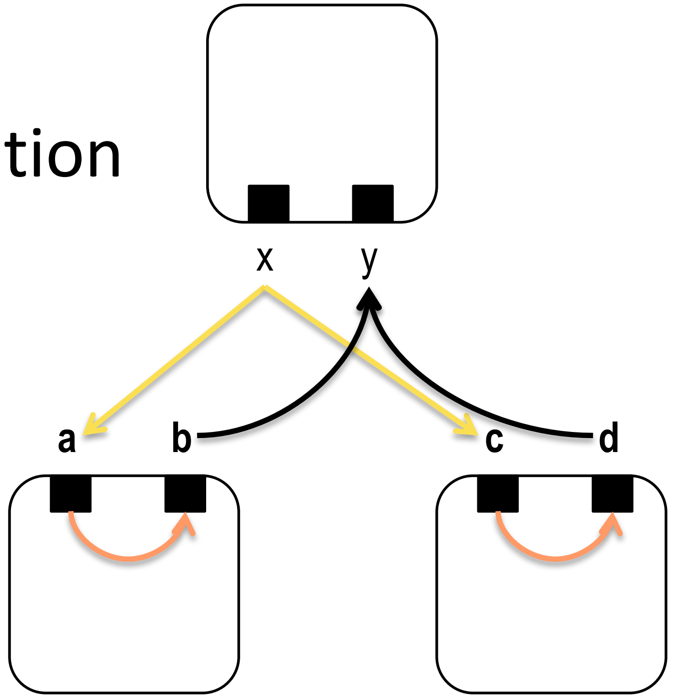
- What would you do?
- Use a generic solver
  - Cassowary [Badros]: Analyze documents online and figures out layout.
- For performance, we want
  - Reduce runtime work by doing offline pre-computation.
  - Modular & Specialized solver.

On Solving

What is the fastest solver ?

- Set of traversals on Tree
- This is given by scheduling an AG
    - Can do parallel traversal
    - Can do incremental evaluation
    - …

  [Leo & Adam]



Example

Relations (input)

```
Hbox ::= Box1 Box2          Box1.x + Box2.x == Hbox.x
                            Box1.x == Box2.x
                            Box1.y == Box2.y == Hbox.y
```

Functions

Box1.x := Hbox.x / 2   ~~Box2.x := Hbox.x / 2~~
~~Hbox.y := Box1.y~~   ~~Hbox.y := Box2.y~~
Box1.y := Box2.y   Box2.y := Box1.y

[Leo & Adam]

Tree Traversals

```
Hbox .visit() {
        Box1.y = this.y;
        Box1.visit();
        Box2.y = this.y;
        Box2.visit();
        thix.x = Box1.x + Box2.x
}
```

Which Functions Do We Choose

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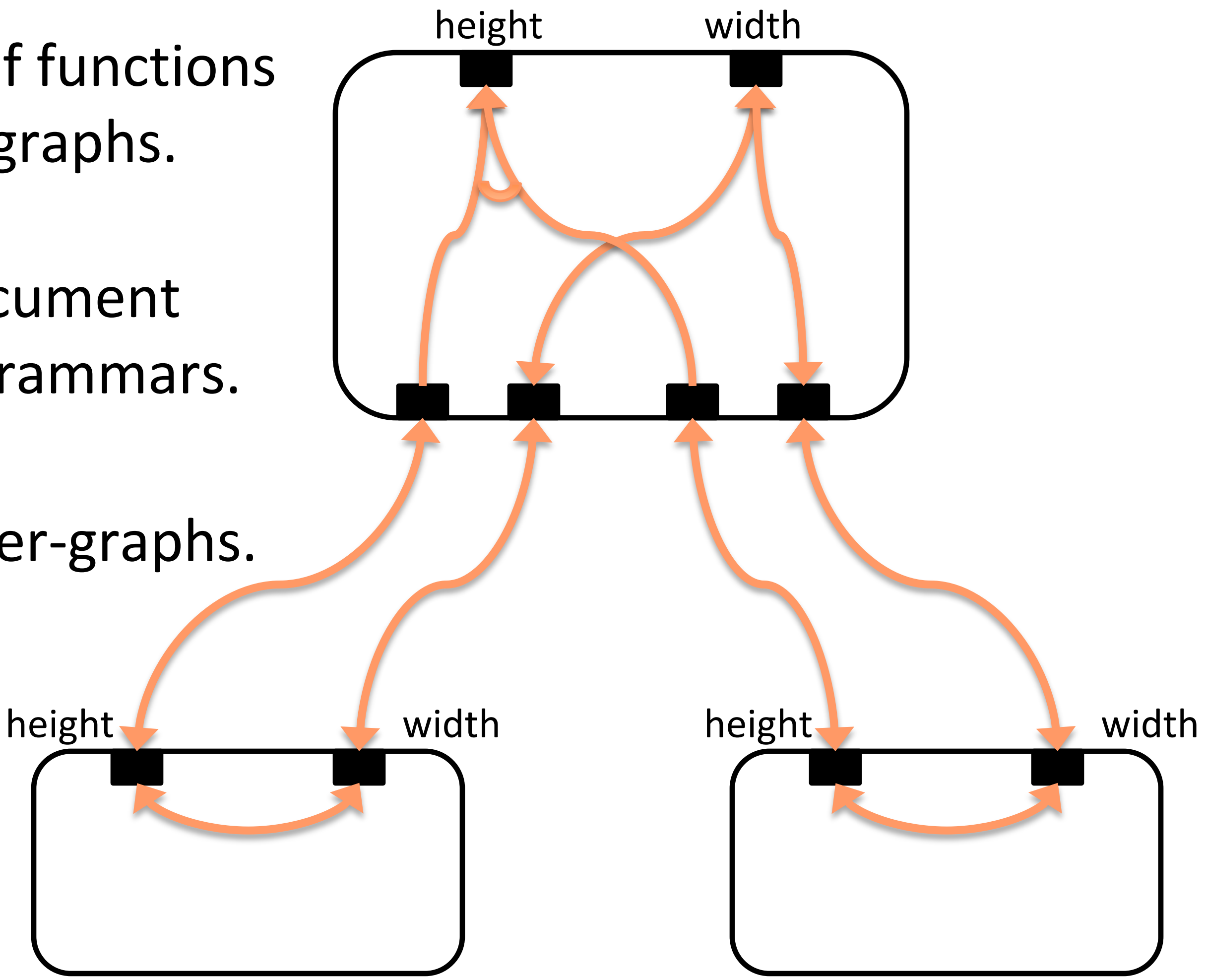
- Picks some subset of functions to cover the whole graphs.
- Here on a single document but generalizes to grammars.

→ Reachability on hyper-graphs.



Future Work

- Events
  - Web-pages are dynamic (AJAX)
  - We are actively working on reactive semantics, ask me about it!
- Programming by demonstrations
  - Best paradigm for designer.
  - From a set of documents, infer the layout.
- Richer layout
  - Expressiveness vs. Speed trade-offs.

That is it!