React Reconciliation

How ReactJS renders your application

Presented by Jim Sproch

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What is React?

A Javascript library for building user interfaces

The **“V”** in **MVC**

Today’s Topics

React's Design

- Re-render the whole app on every update

Virtual DOM

- An implementation detail / performance hack

Reconciliation

- The "magic" that makes React work

React’s Design

Idempotent functions that take in the current state of your application and return the UI of your application.

React Components

```
function UserBoxComponent(props) {
  return (
    <div>
      <img src={props.user.image} />
      <span>{props.user.name}</span>
    </div>
  );
}
```

React’s Design

React Components

```
function UserBoxComponent(props) {
   return (
      React.createElement(‘div’, {},
         [React.createElement(‘img’,{
            src: props.user.image}),
         React.createElement(‘span’,
            {},props.user.name)]
   ));
}
```

React’s Design

React Components

```
function UserBoxComponent(props) {
  return (
    <div>
      <img src={props.user.image} />
      <span>{props.user.name}</span>
    </div>
  );
}
```

React’s Design

React’s Design

React’s Design

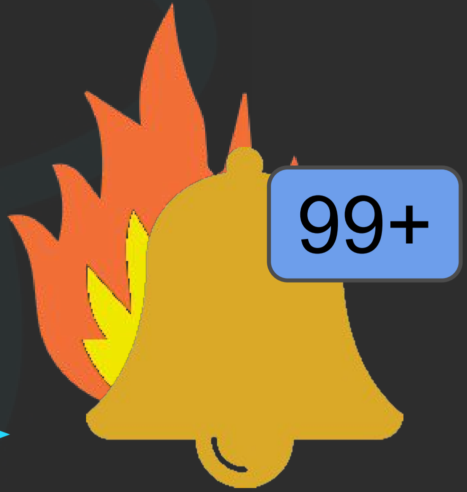
React’s Design

React’s Design

8
Add Badge!
Set badge to 8!
99+

React’s Design

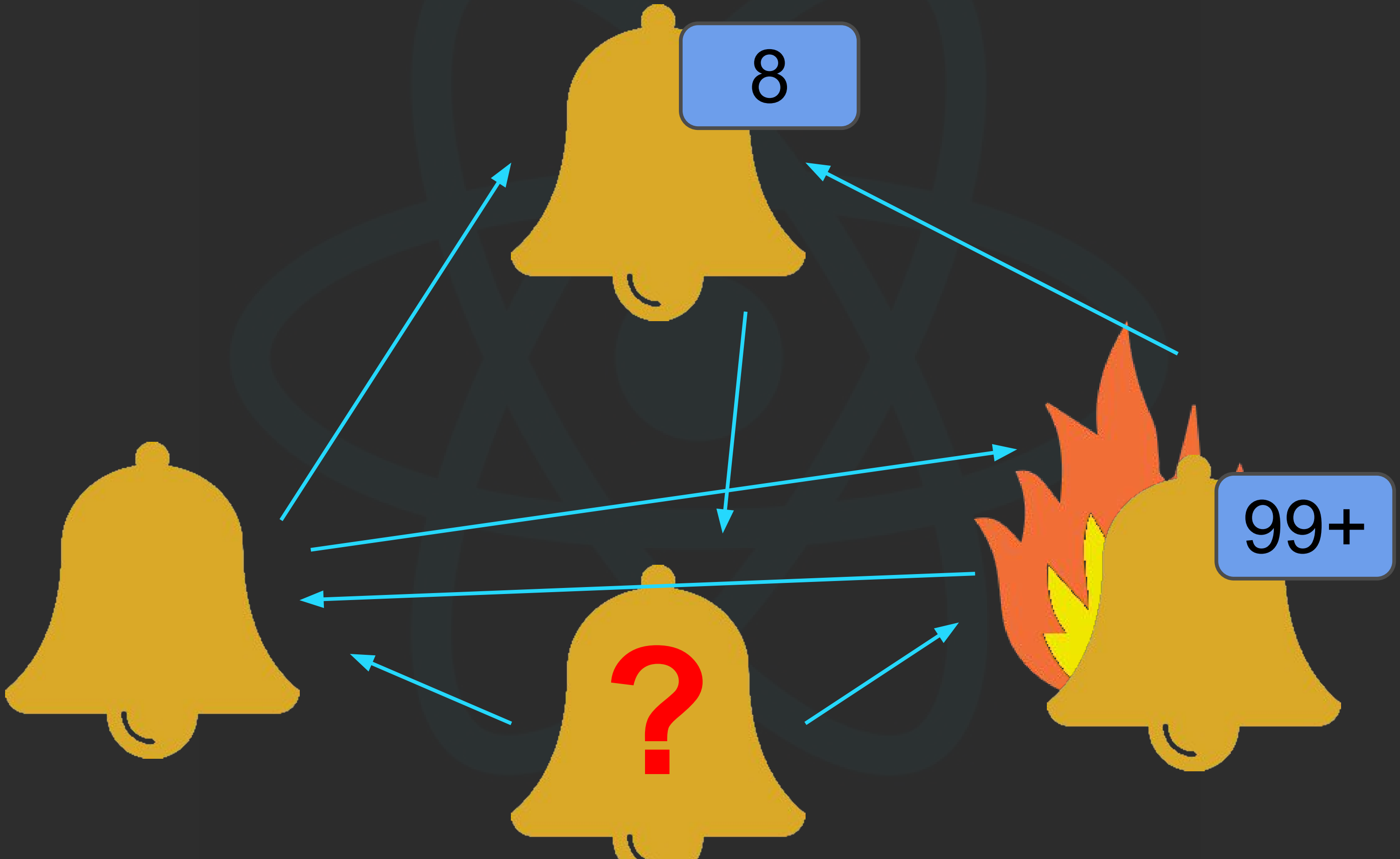
Add Badge!
Add Fire!
Set badge to 99+!



React’s Design

```
if (count > 99) {
  if (!hasFire()) { addFire(); }
} else {
  if (hasFire()) { removeFire(); }}
if (count === 0) {
  if (hasBadge()) { removeBadge(); }
  return;}
if (!hasBadge()) { addBadge(); }
text = count > 99 ? '99+' : count.toString();
getBadge().setText(text);
```

React’s Design

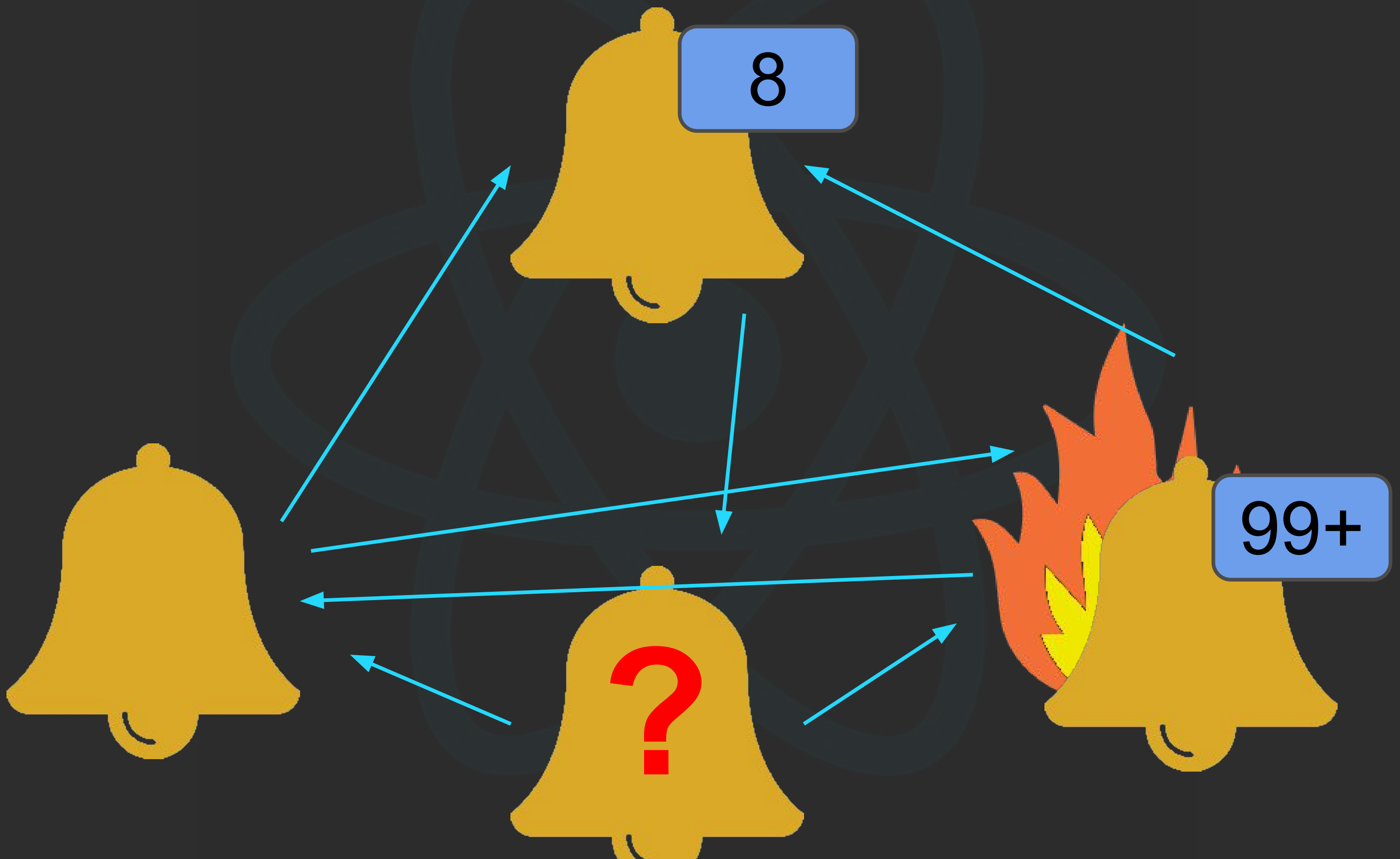


React’s Design

“Controlling complexity is the essence of computer programming.”

— Brian Kernighan

React's Design



React’s Design

State Transition Complexity

$O(N(N-1)) \Rightarrow O(N^2-N)$

React’s Design

Mutation is hard

Let’s not do mutation!

React’s Design

```
text = count > 99 ? '99+'  : count.toString();

<bell>
  <if test={count > 99}>
    <img src=”fire.png” class=”background” />
  </if>
  <if test={count > 0}>
    <badge count={text} class=”foreground” />
  </if>
</bell>
```

React’s Design

Rebuild the whole dom, for every change

Sounds expensive.

```
function SimpleComponent(props) {
   return <button onClick={props.bar} />;
}
```

Virtual DOM

Virtual DOM ≠ Shadow DOM

Virtual DOM

Fast / Light-Weight Nodes

- Created and thrown away with every render

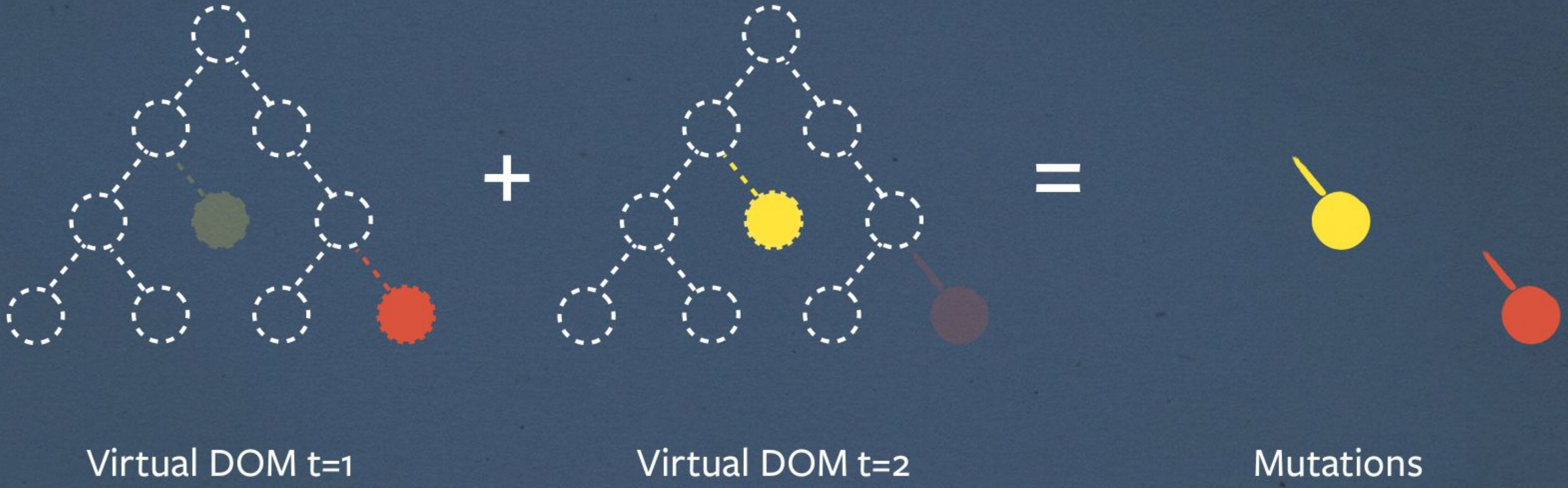
Avoid Layout Thrash

- Reading from the DOM can force a reflow

Queue Updates

- Executed after reconciliation

Virtual DOM



The diff algorithm generates a list of DOM mutations, the same way version controls output text mutations

Reconciliation

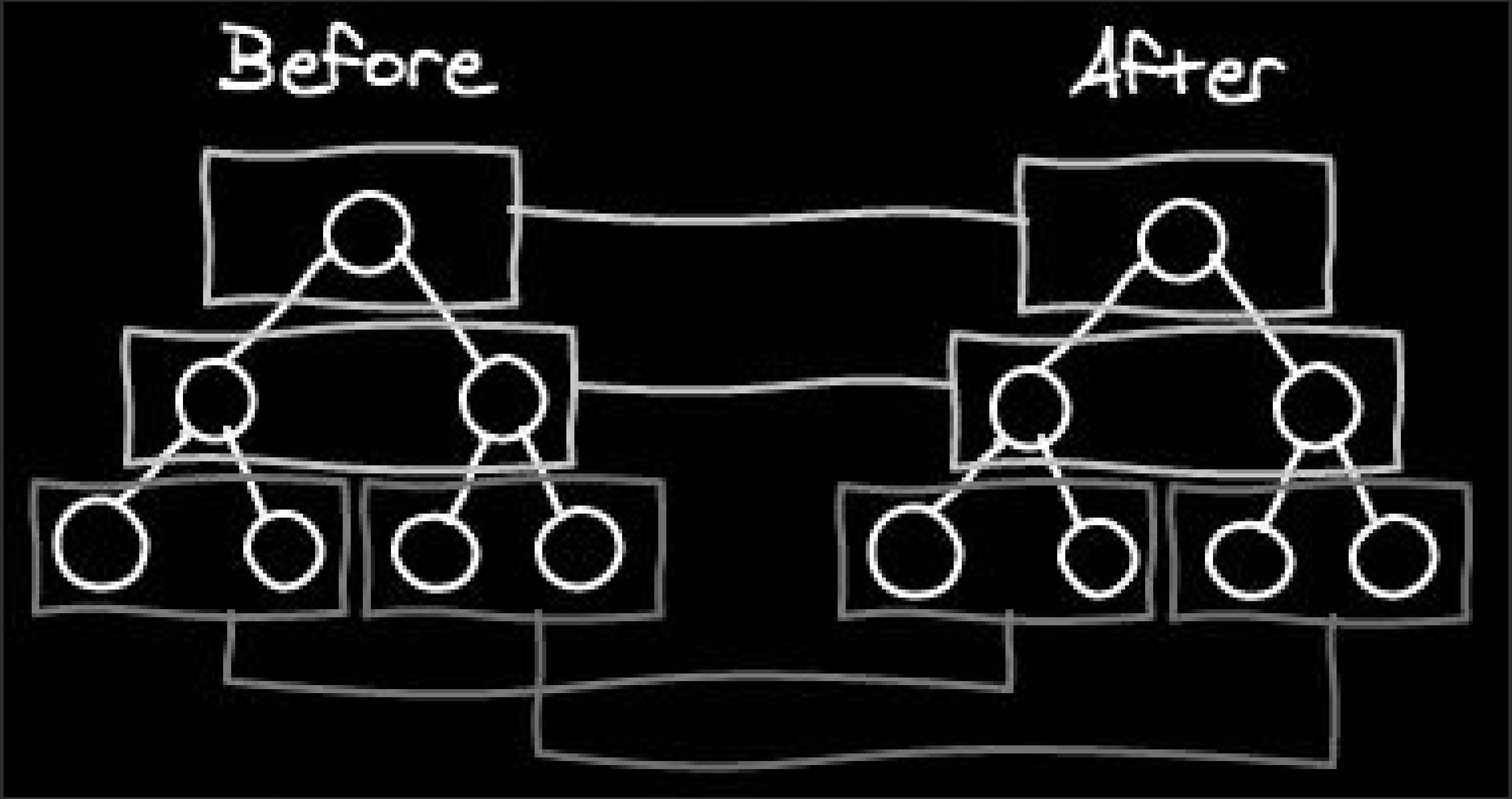
The process of **updating** your **UI** to match your **application state**

Reconciliation

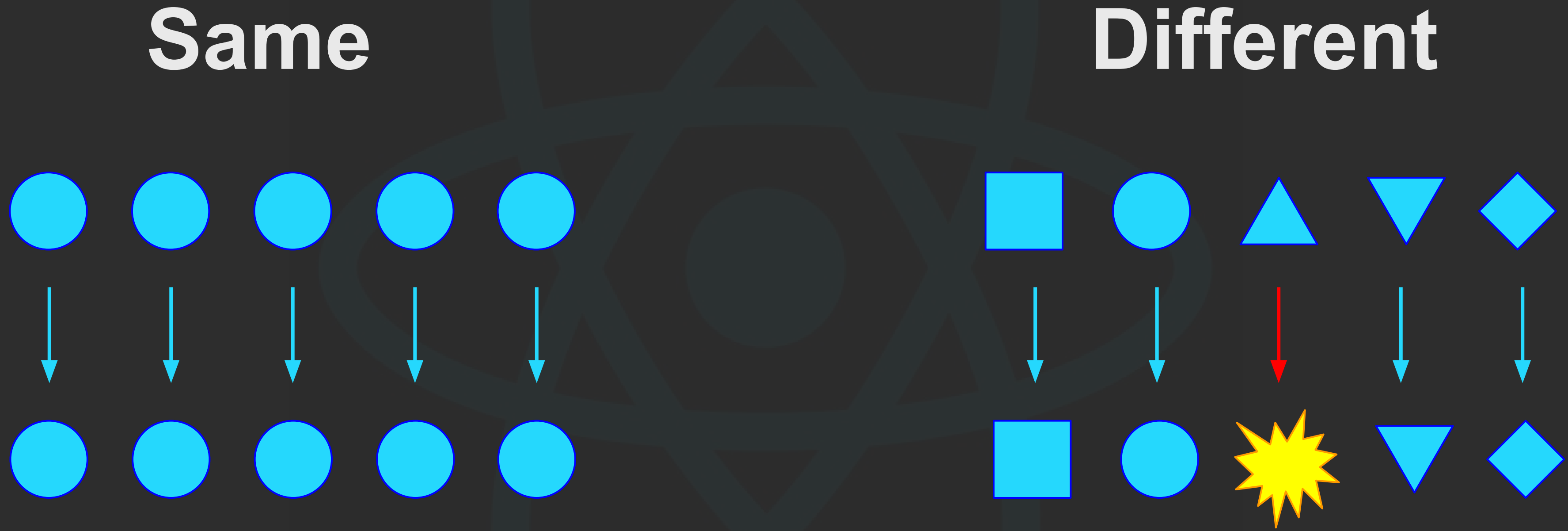
Truly Minimal Diff: $O(N^3)$

React Diff: $O(N)$

Reconciliation



Reconciliation

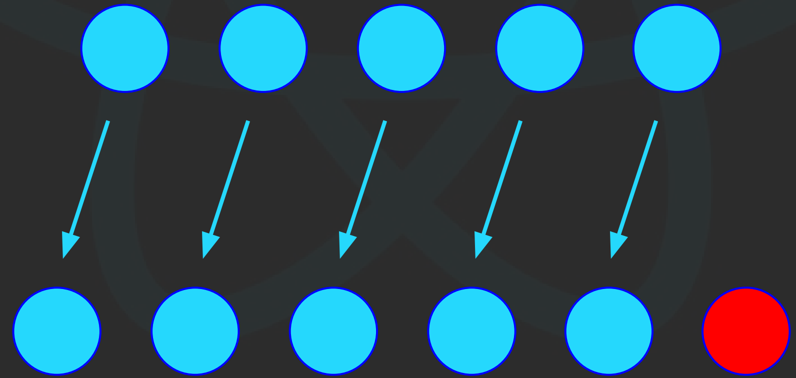


Reconciliation

```
<Circle />
<Circle />
<Circle />
<Circle />
<Circle />
```

→

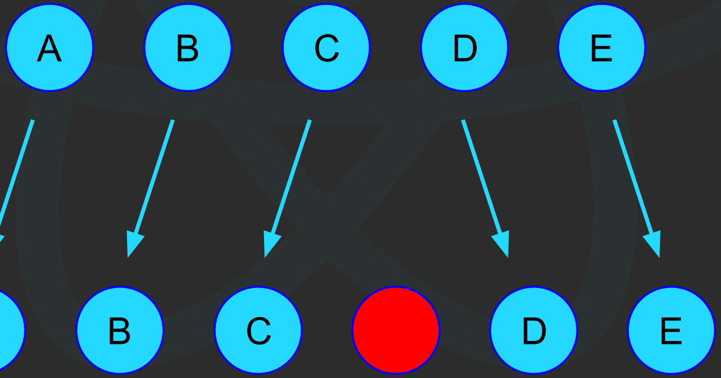
```
<Circle />
<Circle />
<Circle />
<Circle />
<Circle />
<Circle />
```



Reconciliation

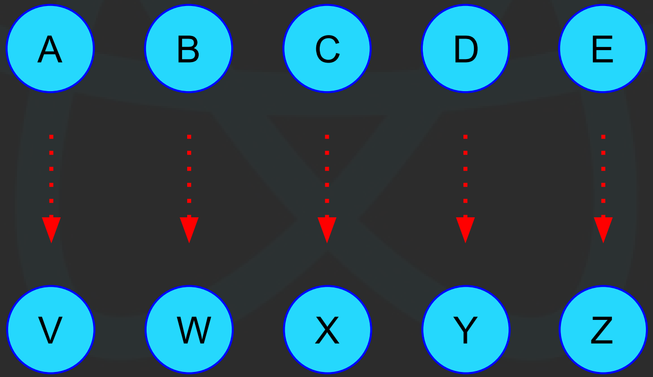
```
<Circle key="A" />
<Circle key="B" />
<Circle key="C" />
<Circle key="D" />
<Circle key="E" />
```

```
<Circle key="A" />
<Circle key="B" />
<Circle key="C" />
<Circle key="XX" />
<Circle key="D" />
<Circle key="E" />
```



Reconciliation

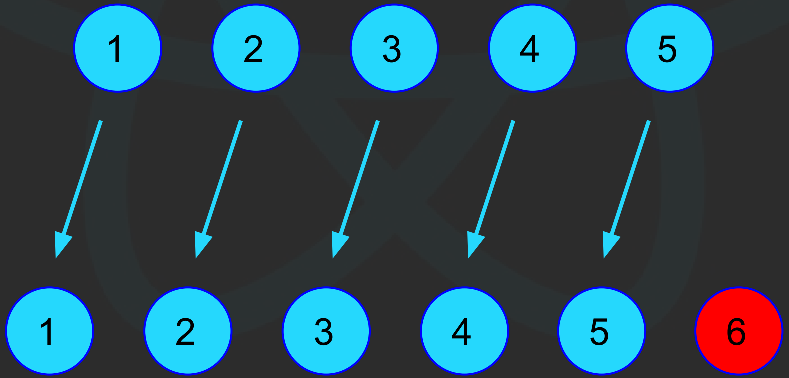
```
<Circle key="A" />        <Circle key="V" />
<Circle key="B" />        <Circle key="W" />
<Circle key="C" />   →    <Circle key="X" />
<Circle key="D" />        <Circle key="Y" />
<Circle key="E" />        <Circle key="Z" />
```



Reconciliation

```
<Circle key="1" />
<Circle key="2" />
<Circle key="3" />
<Circle key="4" />
<Circle key="5" />
```

```
<Circle key="1" />
<Circle key="2" />
<Circle key="3" />
<Circle key="4" />
<Circle key="5" />
<Circle key="6" />
```



Reconciliation

Keys are about identity
(in addition to performance)

Reconciliation

Sub-tree Rendering

- setState

Selective Sub-tree Rendering

- shouldComponentUpdate

Batched Updates

- unstable_batchedUpdates

Today’s Topics

React's Design

- Simple component model for rendering the view layer
- Conceptually re-render the whole app on every update
- Avoid $O(N^2-N)$ state transition complexity (avoid writing transitions)

Virtual DOM

- Light-weight descriptors which specify the desired render tree

Reconciliation

- Calculates a minimal set of changes to apply to the DOM

Thank you

facebook.github.io/react

Jim Sproch (@jimfb)