Make it Declarative with React

@koba04 / JSConf JP 2019

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- @koba04
  Twitter / GitHub
- Web Developer
  2007〜
- Cybozu
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```
ReactVoice.render(
  <>
    <kyoko>こんにちは</kyoko>
    <alex>
        I work as a frontend developer for Cybozu and
        I work as a frontend advisor for SmartHR.
    </alex>
    <alex>My Twitter and GitHub accounts are @koba04, please follow me!</alex>
    <victoria>
        I'm also one of the organizers of React.js meetup in Tokyo and
        a contributor of React.
    </victoria>
    <victoria>I've been working with React for 5years.</victoria>
  </>,
  {}
);
```

Agenda

- Benefits of Declarative Programming for UI
- Custom renderer of React
- Live Demo!

Declarative Programming for UI

Declarative Programming

> In computer science, declarative programming is a programming paradigm—a style of building the structure and elements of computer programs—that expresses **the logic of a computation without describing its control flow**.

> Many languages that apply this style attempt to minimize or eliminate side effects by **describing what the program must accomplish in terms of the problem domain**, rather than describe how to accomplish it as a sequence of the programming language primitives

https://en.wikipedia.org/wiki/Declarative_programming

Declarative in React

> React makes it painless to create interactive UIs. Design simple views for each state in your application, and React will efficiently update and render just the right components when your data changes.

> **Declarative views make your code more predictable and easier to debug**.

https://reactjs.org

SwiftUI

```
import SwiftUI

struct Content: View {
    var body: some View {
        VStack {
            Text("Hello")
                .font(.title)
            Text("World!")
                .font(.body)
        }
    }
}
```

https://developer.apple.com/documentation/swiftui/

SwiftUI

- SwiftUI Essentials
  - https://developer.apple.com/videos/play/wwdc2019/216/
- Data Flow Through SwiftUI
  - https://developer.apple.com/videos/play/wwdc2019/226

Why Declarative?

- What Not How
  - How -> Compiler
- Abstraction layer
  - Optimization in the underlying layer
  - Primitive as domain

> The logic of a computation without describing its control flow

DOM manipulation is based on imperative operations

Imperative

```
const view = document.querySelector('.view');
const addButton = document.querySelector('.add-button');

// You have to implement how to update the view
addButton.addEventListener('click', () => {
    view.appendChild(child)
});
```

Declarative

```
const view = document.querySelector('.view');
const addButton = document.querySelector('.add-button');
const state = [];

addButton.addEventListener('click', () => {
    // update the state impleratively
    state.push(child);
    // describe the view declaratively based on the state
    render(state);
});

// describing what the view should display
const render = state => {
    view.innerHTML = state.map(s => `<span>${s}</span>`).join('');
}
```

Describing what to update the view

Declarative with React

```
const view = document.querySelector('.view');

// describing what the view should display
const App = () => {
    const [items, setItems] = useState([]);
    return (
        <Layout>
            <Header>title</Header>
            <ItemList>
                {items.map(item => <Item key={item.id} item={item} />)}
            </ItemList>
            <AddItem onAddItem={(item) => {
                setItems(items.concat(item));
            }} />
        </Layout>
    );
}

ReactDOM.render(<App />, view);
```

 = View(State)

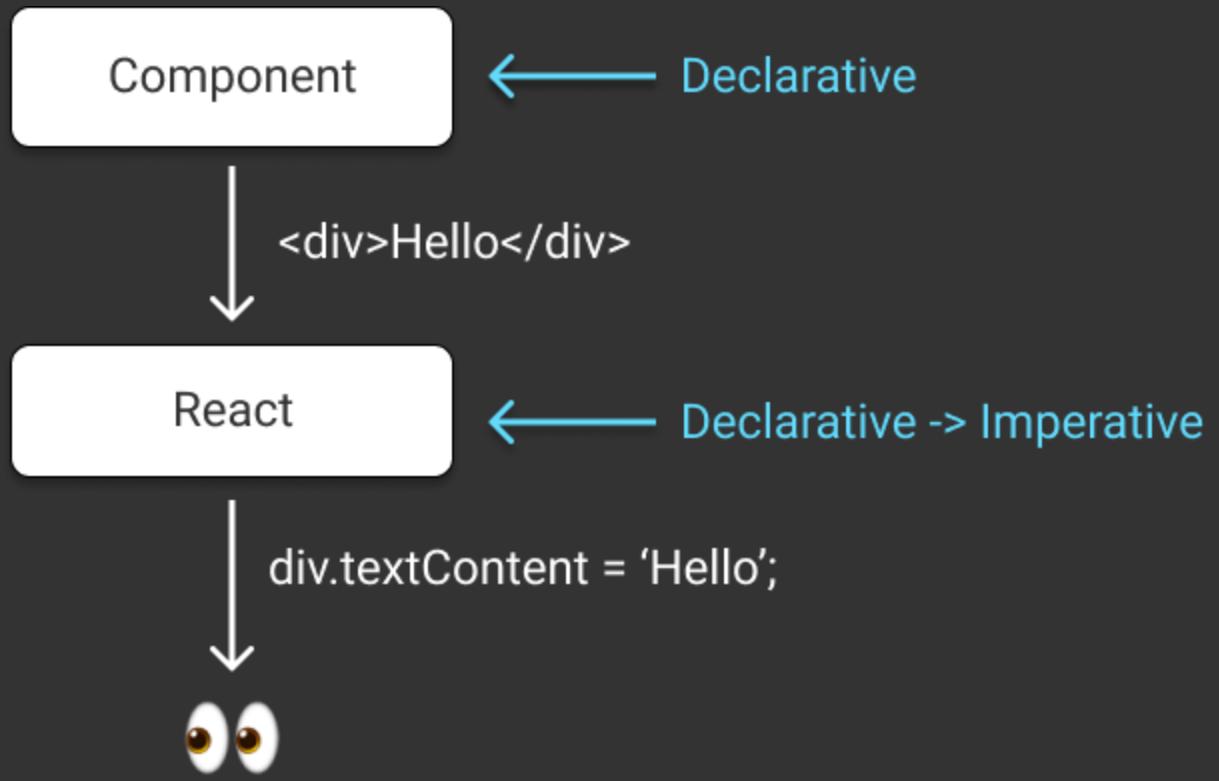
React updates views efficiently

```
let count = 1;
ReactDOM.render(
    <div>
        <Header />
        <p>{count}</p>
    </div>,
    container
);

count = 2;
ReactDOM.render(
    <div>
        <Header />
        <p>{count}</p>
    </div>,
    container
)
// p.textContent = 2; // React updates the DOM
```

Change the index in a list

```
ReactDOM.render(
    <ul>
        <li key="a">a</li>
        <li key="b">b</li>
        <li key="c">c</li>
    </ul>,
    container
);

ReactDOM.render(
    <ul>
        <li key="b">b</li>
        <li key="a">a</li>
        <li key="c">c</li>
    </ul>,
    container
)
// React update the DOM like the following
// li.insertBefore(b, a);
```

ReactDOM Renderer



> Describing what the program must accomplish in terms of the problem domain

Abstract your application components

- DOM is an implementation detail
- React Component is a primitive of your domain.

Build own domain layers with React

```
const view = document.querySelector('.view');

// describing what the view should display
const App = () => {
    const [items, setItems] = useState([]);
    return (
        <Layout>
            <Header>title</Header>
            <ItemList>
                {items.map(item => <Item key={item.id} item={item} />)}
            </ItemList>
            <AddItemButton
                onAddItem={item => setItems(items.concat(item))}
            />
        </Layout>
    );
}


ReactDOM.render(<App />, view);
```

DOM as a Second-class Citizen

Sebastian Markbåge / React Europe 2015

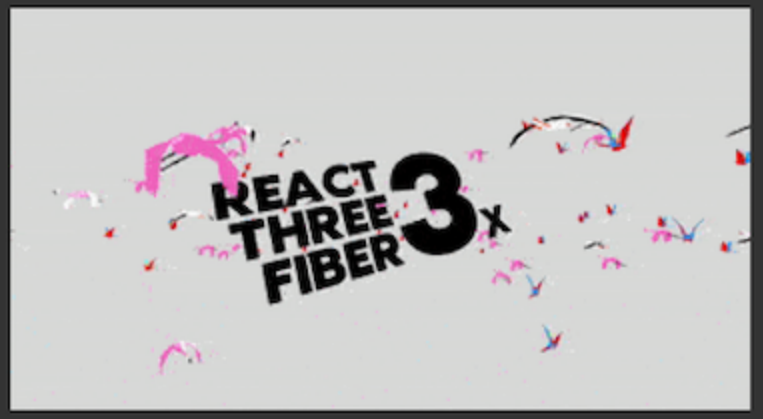
React is not only for DOM

```
YourRenderer.render(
    <Hello>
        <jsconf country="japan">
            <talk
                title="Make it Declative with React"
                speaker="koba04"
            >
                Let's create a your custom renderer!!!
            </talk>
        </jsconf>
    </Hello>
)
```

React Custom Renderer

Renderers


```
$ ts-node index.tsx
Hello world!
✨  Done in 2.48s.
```



Source: https://github.com/react-spring/react-three-fiber

ReactNative

```
<View
    style={{
        flex: 1,
        justifyContent: "center",
        alignItems: "center"
    }}
>
    <Text style={{ fontSize: 50 }}>
        Hello, world!
    </Text>
</View>
```

Ink

```
import React from 'react';
import {render, Box, Color} from 'ink';

render(
  <Box>
      <Color green>Hello world!</Color>
  </Box>
);
```

ReactKonva

```
ReactKonva.render(
    <Stage width={300} height={300}>
      <Layer>
        <Text text="Hello, world!" fontSize={30} />
        <Star
          x={50}
          y={70}
          innerRadius={20}
          outerRadius={40}
          fill="tomato"
        />
      </Layer>
    </Stage>,
    el
);
```

ReactThreeFiber

```
import React, { useRef } from 'react'
import ReactDOM from 'react-dom'
import { Canvas, useFrame } from 'react-three-fiber'

const Cube = () => {
    const ref = useRef()
    useFrame(() => (ref.current.rotation.x = ref.current.rotation.y += 0.01))
    return (
        <mesh ref={ref}>
            <boxBufferGeometry attach="geometry" args={[1, 1, 1]} />
            <meshNormalMaterial attach="material" />
        </mesh>
    )
}
ReactDOM.render(<Canvas><Cube /></Canvas>, el);
```

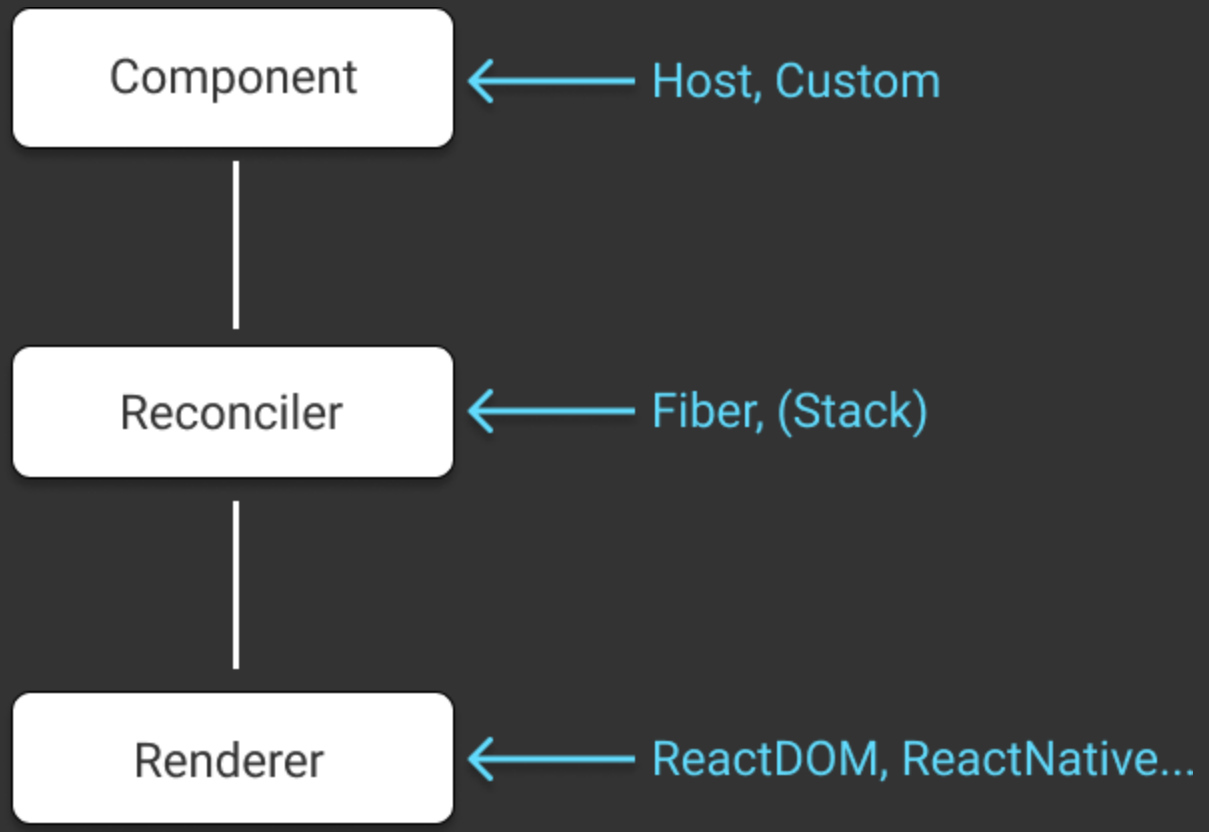
ReactAST

```
import React from 'react';
import {
    renderAst,
    Code,
    ClassDeclaration,
    FunctionDeclaration
} from 'react-ast';

const ast = renderAst(
    <ClassDeclaration name="Hello" superClassName="Array">
        <Code>const hello = 'world'</Code>
        <FunctionDeclaration name="foo">
            <Code>return 'bar'</Code>
        </FunctionDeclaration>
    </ClassDeclaration>
);

console.log(ast);
```

Building a Custom React DOM Renderer

- https://github.com/jquense/react-dom-lite
- https://conf.reactjs.org/event.html?sophiebits

Architecture of React



Algorithms in React

- https://speakerdeck.com/koba04/algorithms-in-react

react-reconciler

```
npm install react-reconciler
```

packages/react-reconciler

How to use

```
import Reconciler from "react-reconciler";

const renderer = Reconciler(hostconfig);

export const YourReact = {
  render(
    element: React.ReactNode,
    rootContainer: RootContainer,
    callback = () => {}
  ) {
    if (!rootContainer.container) {
      rootContainer.container = {}
      rootContainer.container.fiberRoot = renderer.createContainer(
        container,
        false,
        false
      );
    }
    renderer.updateContainer(element, container.fiberRoot, null, callback);
  }
}
```

HostConfig Interface #1

getPublicInstance, getRootHostContext, getChildHostContext, prepareForCommit, resetAfterCommit, createInstance, appendInitialChild, finalizeInitialChildren, prepareUpdate, shouldSetTextContent, shouldDeprioritizeSubtree, createTextInstance scheduleDeferredCallback, cancelDeferredCallback, setTimeout, clearTimeout, noTimeout, now, isPrimaryRenderer supportsMutation, supportsPersistence, supportsHydration

Mutation(optional)

appendChild, appendChildToContainer, commitTextUpdate, commitMount, commitUpdate, insertBefore, insertInContainerBefore, removeChild, removeChildFromContainer, resetTextContent

HostConfig Interface #2

Persistence(optional)

cloneInstance, createContainerChildSet, appendChildToContainerChildSet, finalizeContainerChildren, replaceContainerChildren

Hydration(optional)

canHydrateInstance, canHydrateTextInstance, getNextHydratableSibling, getFirstHydratableChild, hydrateInstance hydrateTextInstance,didNotMatchHydratedContainerTextInstance, didNotMatchHydratedTextInstance, didNotHydrateContainerInstance, didNotHydrateInstance,didNotFindHydratableContainerInstance, didNotFindHydratableContainerTextInstance, didNotFindHydratableInstance, didNotFindHydratableTextInstance

from @types/react-reconciler

HostConfig of renderers

- ReactDOM
  - packages/react-dom/src/client/ReactDOMHostConfig.js
- ReactNative
  - packages/react-native-renderer/src/ReactNativeHostConfig.js
  - packages/react-native-renderer/src/ReactFabricHostConfig.js
- ReactTestRenderer
  - packages/react-test-renderer/src/ReactTestHostConfig.js
- Ink
  - vadimdemedes/ink/blob/master/src/reconciler.js
- ReactKonva
  - konvajs/react-konva/blob/master/src/ReactKonvaHostConfig.js

HostConfig?

- Side effects for a Host environment
- Define instances
- Define the mode for a renderer
- Hydration logic (if you need)

Side effects for a Host environment

Change the index in a list

```
ReactDOM.render(
    <ul>
        <li key="a">a</li>
        <li key="b">b</li>
        <li key="c">c</li>
    </ul>,
    container
);

ReactDOM.render(
    <ul>
        <li key="b">b</li>
        <li key="a">a</li>
        <li key="c">c</li>
    </ul>,
    container
)
// React update the DOM like the following
// li.insertBefore(b, a);
```

insertBefore

```
export function insertBefore(
  parentInstance: Instance,
  child: Instance | TextInstance,
  beforeChild: Instance | TextInstance
): void {
  // we have to remove a current instance at first
  const index = parentInstance.children.indexOf(child);
  if (index !== -1) {
    parentInstance.children.splice(index, 1);
  }
  // And then, we insert the instance into a new index
  const beforeIndex = parentInstance.children.indexOf(beforeChild);
  parentInstance.children.splice(beforeIndex, 0, child);
}
```

Others

- appendChild, appendInitialChild, appendChildToContainer
- commitTextUpdate, commitMount, commitUpdate
- insertBefore, insertInContainerBefore
- removeChild, removeChildFromContainer, resetTextContent

Define public instance

createInstance, createTextInstance

```
export function createInstance(
  type: Type,
  props: Props,
  rootContainerInstance: Container,
  hostContext: HostContext,
  internalInstanceHandle: OpaqueHandle
): Instance {
  return createYourHostInstance(type, props);
}

export function createTextInstance(
  text: string,
  rootContainerInstance: Container,
  hostContext: HostContext,
  internalInstanceHandle: OpaqueHandle
): TextInstance {
  return createYourTextInstacne(text);
}
```

getPublicInstance

```
export function getPublicInstance(
  instance: Instance | TextInstance
): PublicInstance {
  return convertToPublicInstance(instance);
  // react-dom
  // return instance;
}
```

Define the mode for a renderer

```
export const isPrimaryRenderer = true;
export const supportsMutation = true;
export const supportsPersistence = false;
export const supportsHydration = false;
```

Type Definition for custom host config

```
declare namespace JSX {
  interface IntrinsicElements {
    text: {
      color: string;
      children?: React.ReactNode;
    };
  }
}
```

https://www.typescriptlang.org/docs/handbook/jsx.html#intrinsic-elements

Live Coding

Let's create a tiny custom renderer!

Thank you!!!