

CLIENT SIDE WEB ENGINEERING REACT

REACT

- » Component based library to build composable UIs
- » OpenSourced in 2013
- » Implemented and Maintained by Facebook
- » Learn once, write anywhere
 - » React-Native
 - » React-Native-Desktop
 - » React-Native-Windows

COMPONENTS

“Components let you split the UI into independent, reusable pieces.¹”

- » Main Building block of a React App
- » Describe the look and feel of one section in the UI

¹ example calculator <https://www.calculator.net/>

REACT COMPONENTS

```
const Button = () => {
  return (
    <button type='button'>
      A button
    </button>
  )
}

// Usage
React.renderComponent(<Button />, document.body)
```

REACT CLASS COMPONENTS

» Alternative syntax for components

```
class Button extends React.Component {  
  render() {  
    return (  
      <button type='button'>  
        A button  
      </button>  
    )  
  }  
}  
  
// Usage  
React.renderComponent(<Button />, document.body)
```

JSX

» JavaScript XML

» extension to write XML in JS

» Allows to combine data preparation with render logic

```
const Button = () => {
  return (
    <button type='button'>
      A button
    </button>
  )
}
```

REACT WITHOUT JSX

» React can be used without JSX

```
const Button = () => {
  return React.createElement(
    'button',
    { type: 'button' },
    'A button'
  )
}
```

WHICH COMPONENTS DO YOU SEE

The diagram shows a window titled "Sign In" with a dark header bar. Below the header are three input fields: "Email" (with a placeholder box), "Password" (with a placeholder box), and a large rectangular button labeled "Sign in". At the bottom left of the window is a link labeled "Sign Up". The entire window is set against a light gray background.

WHICH COMPONENTS DO YOU SEE

App

Button

I owe somebody Somebody owes me

User Amount

Select Create

A user 10,40\$ Paid

A user 10,40\$

A user 10,40\$

A user -10,40\$ Paid

A user 10,40\$

BUILDING THE FIRST REACT COMPONENT

EMBEDDING EXPRESSIONS

```
const CurrentTime = () => {
  return (
    <h1>
      {((new Date()).toLocaleDateString())}
    </h1>
  )
}
```

EMBEDDING EXPRESSIONS

```
const FagoMenu = () => {
  return (
    <a href={`/menu/${(new Date()).toLocaleDateString()}`}>
      Go to todays menu
    </a>
  )
}
```

CONDITIONAL RENDERING

```
const CurrentTime = () => {
  // ...
  return (
    <h1>
      {isToday
        ? 'Today'
        : 'Not Today'}
    </h1>
  )
}
```

CONDITIONAL RENDERING

```
const CurrentTime = () => {
  // ...
  return (
    <h1>
      {isToday && 'Today'}
      {!isToday && 'Not today'}
    </h1>
  )
}
```

LOOP OVER ARRAYS

```
const UserList = ({ users }) => {
  return (
    <ul>
      {users.map(user) => {
        return (<li key={user.id}>{user.name}</li>)
      })}
    </ul>
  )
}
```

FRAGMENTS

- » Groups a list of children without adding a dom element

```
const AComponent = () => {
  return (
    <>
      <label>An input</label>
      <input type='text' />
    </>
  )
}
```

KEYED FRAGMENTS

- » Same as fragment but a key can be provided (eg.: definition list)

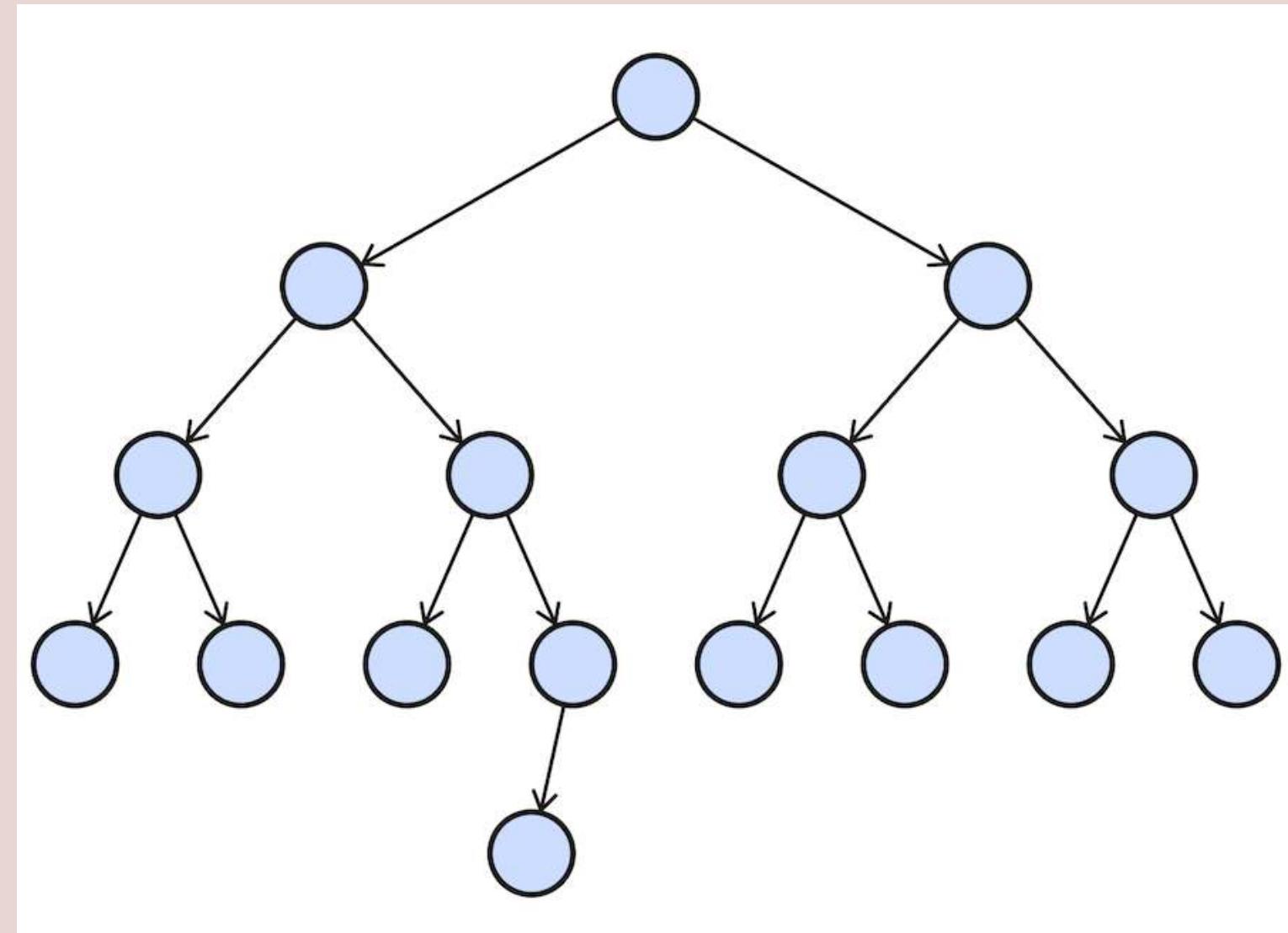
```
const AComponent = ({ items }) => {
  return (
    <dl>
      {items.map(item => (
        // Without the `key`, React will fire a key warning
        <React.Fragment key={item.id}>
          <dt>{item.term}</dt>
          <dd>{item.description}</dd>
        </React.Fragment>
      ))}
    </dl>
  )
}
```

KEY PROPERTY IN LOOPS

- » Is required when interating over lists
- » Helps react to decide if an element needs to be rerendered
- » Video explanation
- » Detailed explanation

COMPONENT COMPOSITION

» Components can be nested and composed together



REACT PROPS

- » Possibility to customize components
- » Can be seen as component configuration
- » Props are passed to the component
- » A component at a lower level of the tree can't modify given props directly

REACT PROPS

```
const Button = ({ children, disabled = false }) => {
  // ^^^^^^
  // props which are passed to the component

  return (
    <button disabled={disabled} className='button'>
      {children}
    </button>
  )
}

const usage = <Button disabled>A button</Button>
// 1) ^^^^^^
// 2) ^^^^^^
// 1) shortcut for disabled={true}
// 2) child components/nodes passed to a component
```

STATE IN REACT

- » What we've seen so far:
 - » Components can render chunks of UI
 - » Components can be nested

STATE IN REACT

“How can we interact with components?”

STATE IN REACT

“The State of a component is an object that holds some information that may change over the lifetime of the component ⁵”

⁵ [geeksforgeeks.com](https://geeksforgeeks.com/reactjs-state-and-props/)

REACT STATE (WITHOUT HOOKS)

```
class ToggleButton extends React.Component {
  state = { backgroundColor: 'red' };
  // define a default value for background color

  toggleBackgroundColor = () => {
    const nextBackgroundColor = backgroundColor === 'red' ? 'blue' : 'red'
    this.setState({ backgroundColor: nextBackgroundColor })
    //      ^^^^^^^^^^
    // setState calls render method with updated state
  }
  render() {
    return (
      <button
        onClick={() => this.toggleBackgroundColor() }
        style={{ backgroundColor: this.state.backgroundColor }}
      >
        {children}
      </button>
    );
  }
}
```

REACT STATE (WITH HOOKS)

» Alternative syntax with hooks

```
const ToggleButton = () => {
  const [backgroundColor, setBackground] = useState('red')
  // 1)                                     ^^^^^^^^^^
  // 2) ^^^^^^^^^^^^^^^^^^^^^^
  // 3)           ^^^^^^^^^^
  // 1) define a state with a default value "red"
  // 2) the current value of the state
  // 3) function to set the state to something else

  return (
    <button
      onClick={() => setBackground(backgroundColor === 'red' ? 'blue' : 'red')}
      style={{ backgroundColor }}
    >
      {children}
    </button>
  )
}
```

REACT HOOKS

“Hooks allow you to reuse stateful logic without changing your component hierarchy. React Docs”

REACT HOOKS

- » Introduced recently to reduce boilerplate
- » Makes it possible to use state in functional components
 - » Previously one had to convert between functional/class components when state introduced
- » hooks are prefixed with use
- » Can't be called inside loops, conditions or nested

USESTATE

```
const App = () => {
  const [count, setCount] = useState(0)
  const handleIncrement = () => setCount(count + 1)

  return (
    <div>
      <div>{count}</div>
      <button onClick={handleIncrement}>Increment by 1</button>
    </div>
  )
}
```

EXTRACT INTO CUSTOM HOOK

```
const useCounter = () => {
  const [count, setCount] => useState(0);
  const handleIncrement = () => setCount(count + 1);
  return { count, handleIncrement };
}

const App = () => {
  const {count,handleIncrement} => useCounter();

  return (
    <div>
      <div>{count}</div>
      <button onClick={handleIncrement}>Increment by 1</button>
    </div>
  );
}
```

STATE VS. PROPS

PROPS

Can get initial value from parent Component?

Can be changed by parent Component?

Can set default values inside Component?*

Can change inside Component?

Can set initial value for child Components?

Can change in child Components?

STATE

Yes

Yes

Yes

No

Yes

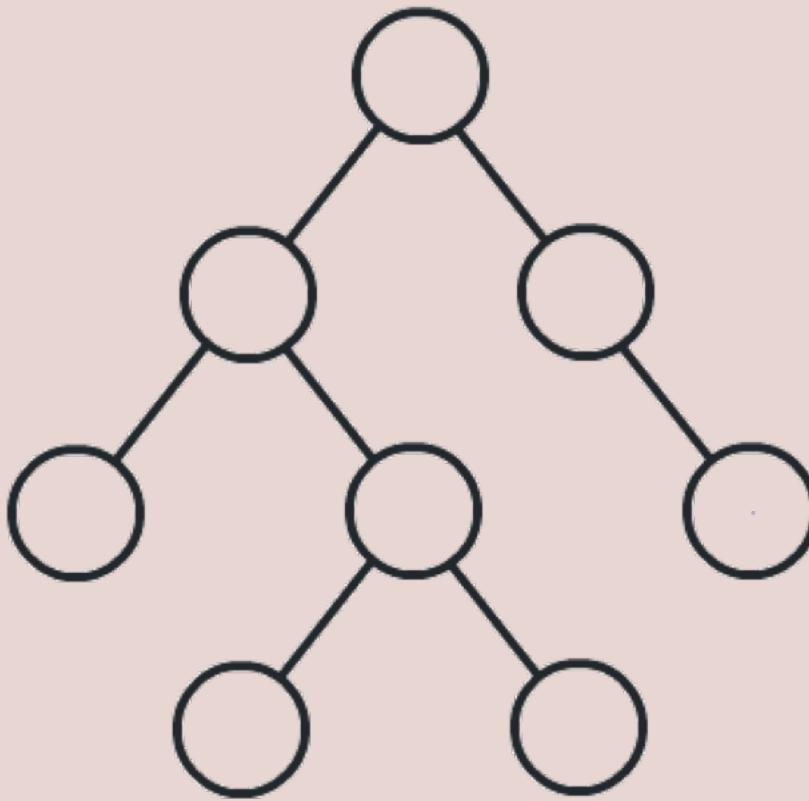
Yes

source

UNIDIRECTIONAL DATAFLOW

- » Props only flow from parent to children
- » Parent is responsible to update data
 - » might provide callbacks to do so
- » set state rerenders all children of component

UNIDIRECTIONAL DATAFLOW



- State change initiated
- State change

“Source”

VIRTUAL DOM

- » makes DOM updates faster
- » after `setState` subtree is rerendered in memory
- » compares DOM to in memory representation
- » applies DOM changes when needed

FORMS WITH REACT HOOKS

```
const App = () => {
  const [username, setUsername] => useState('');
  //                                     ^^^^^^^^^^
  // define a new state with an initial value of empty string

  return (
    <div>
      <input onChange={(evt) => setUsername(evt.target.value)} value={username}>
      { /*                                         ^^^^^^^^^^ */
      { /* set the state of the username */
        <button onClick={() => console.log({ username })}>Submit form</button>
      }
    </div>
  );
}
```

EXERCISE 2/2 (20 MINUTES)

» Bonus: extract a useForm hook

```
const [values, setValue] =  
useForm({  
  
  username: '',  
  
  password: ''  
  
})  
  
return <Input  
onChange={setValue('username')} />
```

OTHER HOOKS



USEEFFECT⁴

```
// Executed on every rerender  
useEffect(() => {})  
  
// Executed when component rendered initially  
useEffect(() => {}, [])  
  
// Executed when component rendered initially  
// and when variable changes.  
useEffect(() => {}, [variable])  
  
// Cleanup when component unmounts (eg. eventHandlers, setInterval/setTimeout)  
useEffect(() => {  
  // do something fancy  
  return () => { console.log('cleanup') }  
}, [variable])
```

⁴ this will be covered in more detail in the side effect lecture

PREVIOUS EXAMPLE

```
const useCounter = () => {
  const [count, setCount] => useState(0);
  const handleIncrement = () => setCount(count + 1);
  return { count, handleIncrement };
}

const App = () => {
  const {count,handleIncrement} => useCounter();

  return (
    <div>
      <div>{count}</div>
      <button onClick={handleIncrement}>Increment by 1</button>
    </div>
  );
}
```

UPDATE TITLE WITH COUNTER

```
const useCounter = () => {
  const [count, setCount] => useState(0);
  const handleIncrement = () => setCount(count + 1);
  return { count, handleIncrement };
}

const App = () => {
  const {count, handleIncrement} => useCounter();

  // Is executed when component is rendered for the first time
  // And when the counter variable changes.
  useEffect(() => {
    document.title = `Counter clicked ${count} times`;
  }, [count]);

  return (
    <div>
      <div>{count}</div>
      <button onClick={handleIncrement}>Increment by 1</button>
    </div>
  );
}
```

EXTRACT TO CUSTOM HOOK

```
const useCounter = () => {
  const [count, setCount] => useState(0);
  const handleIncrement = () => setCount(count + 1);
  useEffect(() => {
    document.title = `Counter clicked ${count} times`;
  }, [count]);
  // ^^^^^^ moved to hook

  return { count, handleIncrement };
}

const App = () => {
  const {count, handleIncrement} => useCounter();

  return (
    <div>
      <div>{count}</div>
      <button onClick={handleIncrement}>Increment by 1</button>
    </div>
  );
}
```

TASK

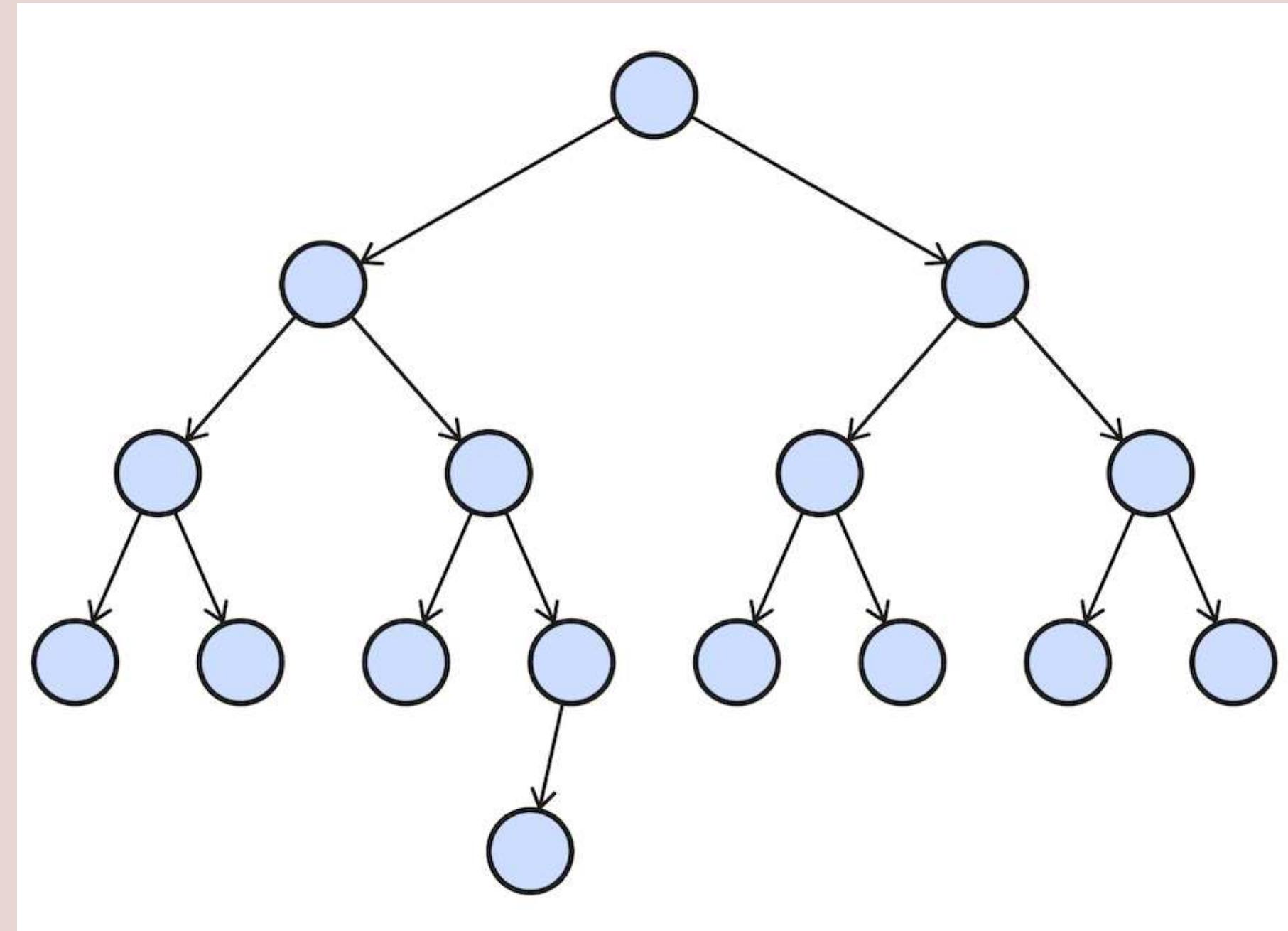
- » Fork/clone the following <https://github.com/webpapaya/fhs-react-redux-starter-kit>
- » npm install
- » npm run start:storybook
- » build a clock component
 - » component displays current time in seconds
 - » automatically updates itself

REACT.MEMO

“Memoizing a function makes it faster by trading space for time. It does this by caching the return values of the function in a table.⁷”

⁷ <https://metacpan.org/pod/Memoize>

REACT.MEMO



REACT.MEMO

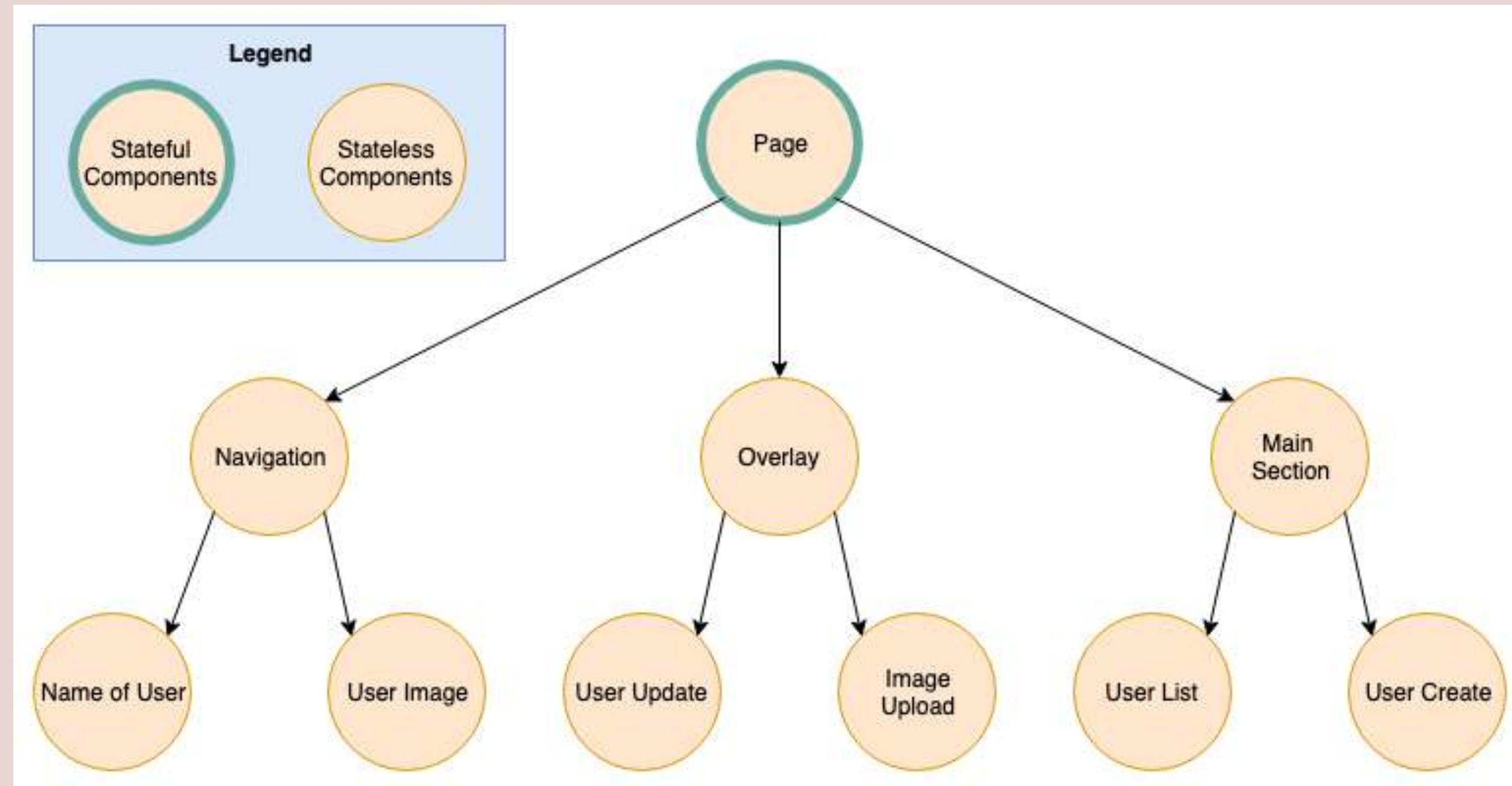
- » Caches the rendered component
- » Only rerenders when one of the props changes
 - » shallow comparison

```
const MyComponent = React.memo(function MyComponent(props) {  
  /* render using props */  
});
```

REACT CONTEXT API

- » Available since the beginning of React
- » Prevent "prop drilling"

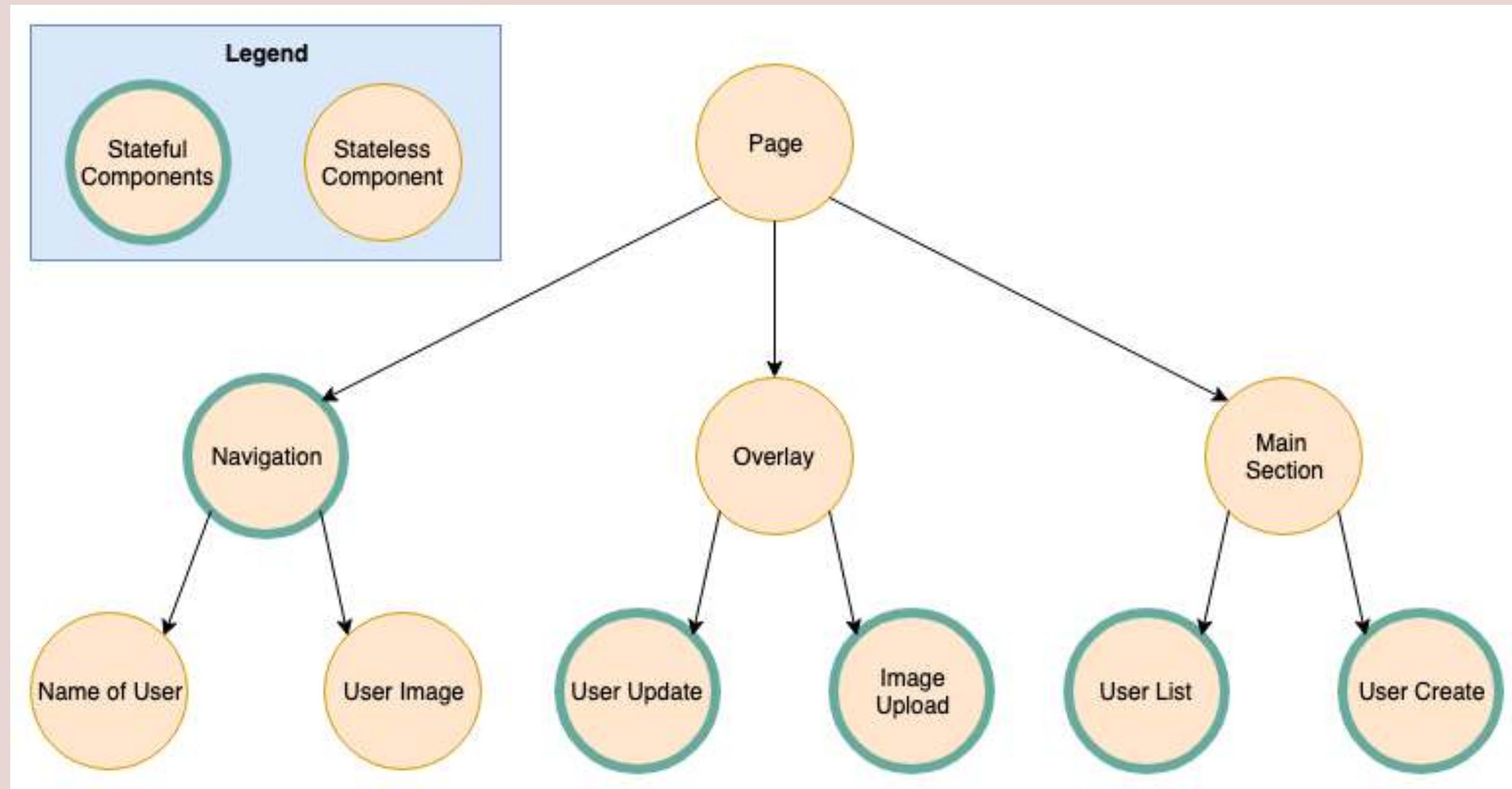
REACT CONTEXT API



REACT CONTEXT API

```
▼ <div>
  ▼ <View pointerEvents="box-none" style={281}>
    ▼ <div className="css-1dbjc4n r-13awgt0 r-12vffkv">
      ▼ <View key="1" pointerEvents="box-none" style={281}>
        ▼ <div className="css-1dbjc4n r-13awgt0 r-12vffkv">
          ▼ <t isNightMode={false}>
            ▼ <t>
              ▼ <r>
                ▼ <Context.Consumer>
                  ▼ <Context.Provider>
                    ▼ <Connect(t)>
                      ▼ <t language="de" loggedInUserId="253431163">
                        ▼ <t>
                          ▼ <Router.Consumer.Provider>
                            ▼ <withRouter(n)>
                              ▼ <t>
                                ▼ <Router.Consumer.Consumer>
                                  ▼ <Router.Consumer.Provider>
                                    ▼ <n>
                                      ▼ <t>
                                        ▼ <Router.Consumer.Consumer>
                                          ▼ <t>
                                            ▼ <Router.Consumer.Consumer>
                                              ▼ <Router.Consumer.Provider>
                                                ▼ <Unknown>
                                                  ▼ <t>
                                                    ▼ <withRouter(t)>
                                                      ▼ <t>
                                                        ▼ <Router.Consumer.Consumer>
                                                          ▼ <Router.Consumer.Provider>
                                                            ▼ <t>
                                                              ▼ <Connect(t)>
                                                                ▼ <t scale="normal">
                                                                  ▼ <t>
                                                                    ▼ <t showReload={true}>
                                                                      ▶ <SideEffect(t) title="Twitter">...</SideEffect(t)>
                                                                      ▶ <withRouter(Connect(t))>...</withRouter(Connect(t))>
                                                                      ▶ <t zIndex={1}>...</t>
                                                                    ▼ <View>
                                                                      ▼ <div className="css-1dbjc4n r-1pi2tsx r-sa2ff0 r-13qz1uu r-417010">
                                                                        ▶ <withRouter(Connect(i))>...</withRouter(Connect(i))>
                                                                      ▼ <@twitter/Responsive>
                                                                        ▼ <View accessibilityRole="main" style={245}>
                                                                          ▼ <main role="main" className="css-1dbjc4n r-16y2uox r-1wbh5a2">
                                                                            ▼ <View style={248}>
```

REACT CONTEXT API



CREATING A CONTEXT

```
const DEFAULT_VALUE = 1
const MyContext = React.createContext(DEFAULT_VALUE)

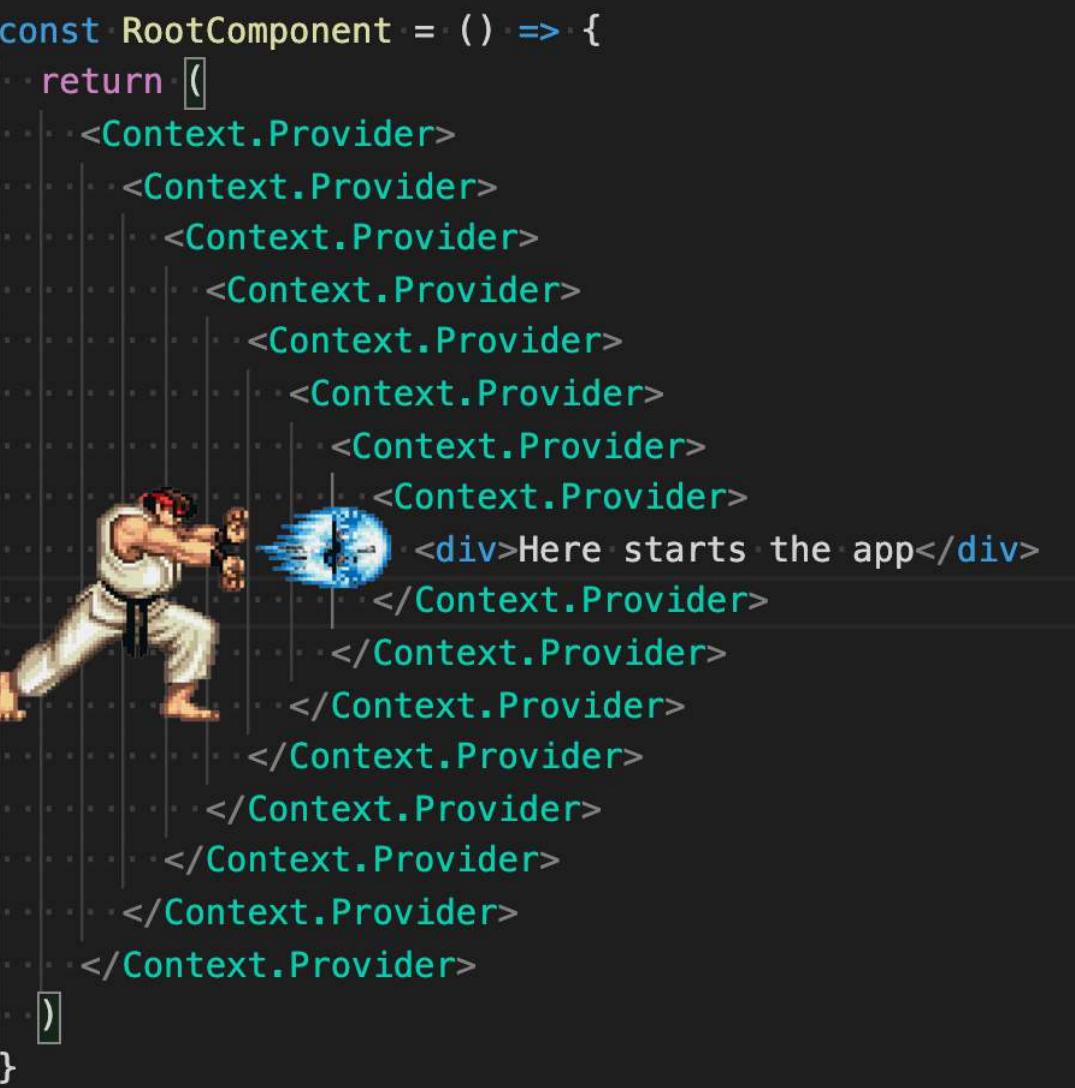
const RootComponent = () => {
  return (
    <MyContext.Provider value={2}>
      <ANestedComponent />
    </MyContext.Provider>
  )
}

const ANestedComponent = () => {
  const value = useContext(MyContext)
  return (
    <h1>The value from context is {value}</h1>
  )
}
```

PITFALLS 1

» fine granular context

```
const RootComponent = () => {
  return (
    <Context.Provider>
      <Context.Provider>
        <Context.Provider>
          <Context.Provider>
            <Context.Provider>
              <Context.Provider>
                <Context.Provider>
                  <Context.Provider>
                    <div>Here starts the app</div>
                  </Context.Provider>
                </Context.Provider>
              </Context.Provider>
            </Context.Provider>
          </Context.Provider>
        </Context.Provider>
      </Context.Provider>
    </Context.Provider>
  )
}
```



PITFALLS/TIPS

- » Prefer passing props down to components
 - » prefer explicit (pass down) vs implicit (context)
- » only use when multiple components need to access same data
 - » if possible pass data down
- » don't overuse

OTHER HOOKS

- » API Reference
- » useReducer
- » useCallback
- » useMemo
- » useRef
- » useImperativeHandle
- » useLayoutEffect

HOMEWORK

- » Build an online integer calculator in react ¹
- » Implement the following arithmetic operations
 - » addition
 - » subtraction
 - » multiplication
- » Use JS BigInt datatype

¹ example calculator <https://www.calculator.net/>

FEEDBACK

- » Questions: tmayrhofer.lba@fh-salzburg.ac.at
- » <https://s.surveyplanet.com/xlibwm85>