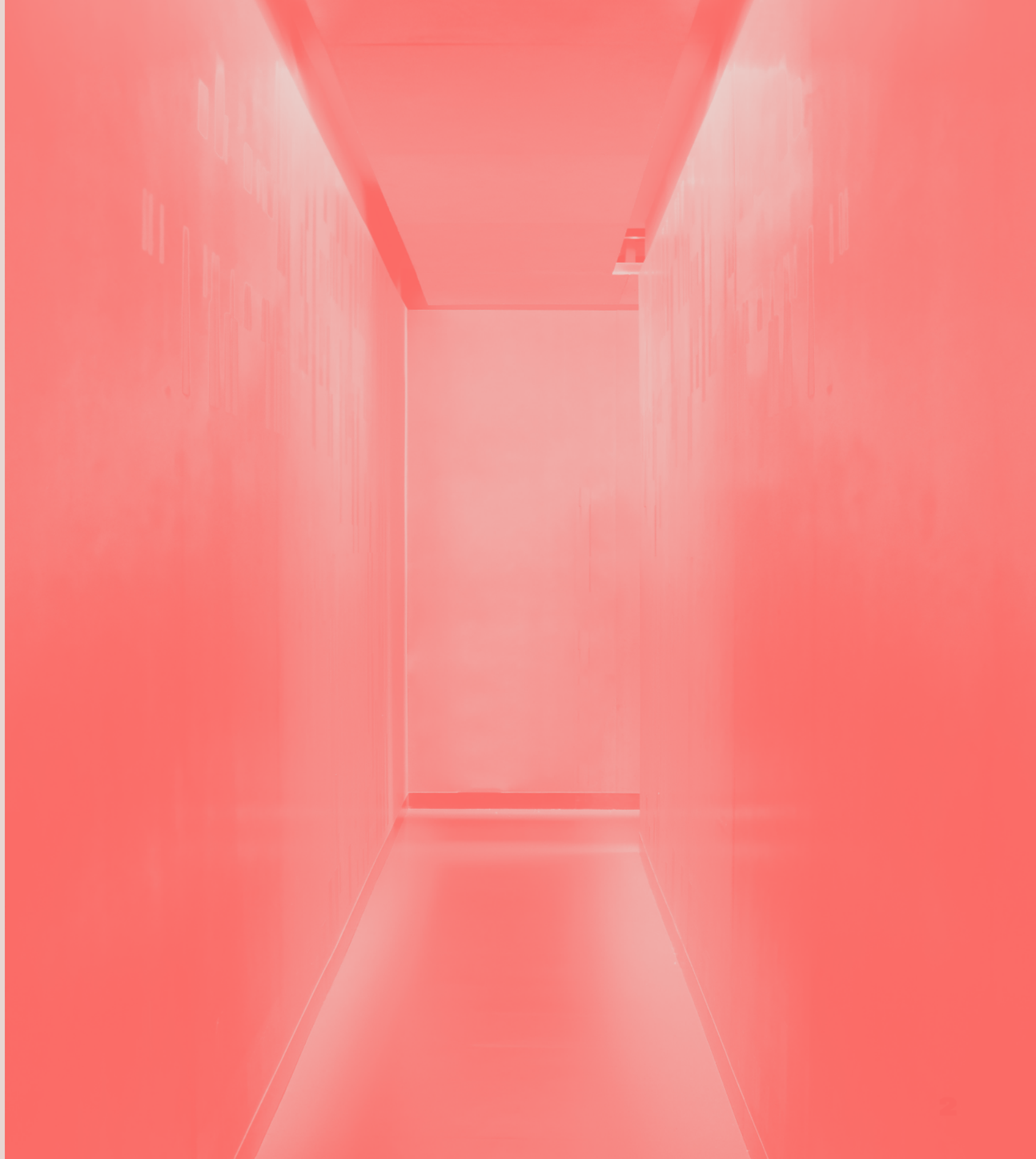
CLIENT SIDE WEB ENGINEERING

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

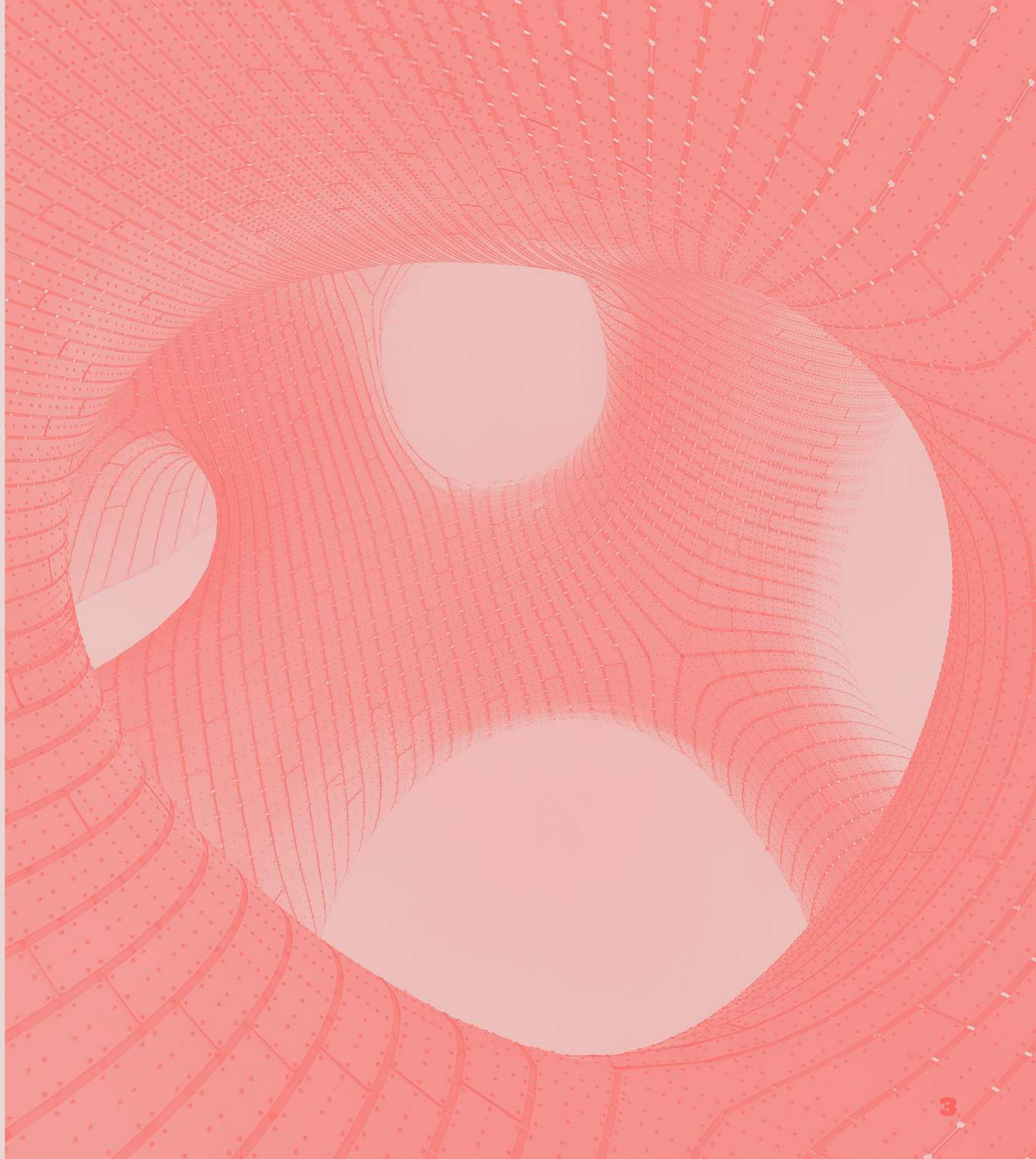


COMPONENTS

“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>
  )
}
```

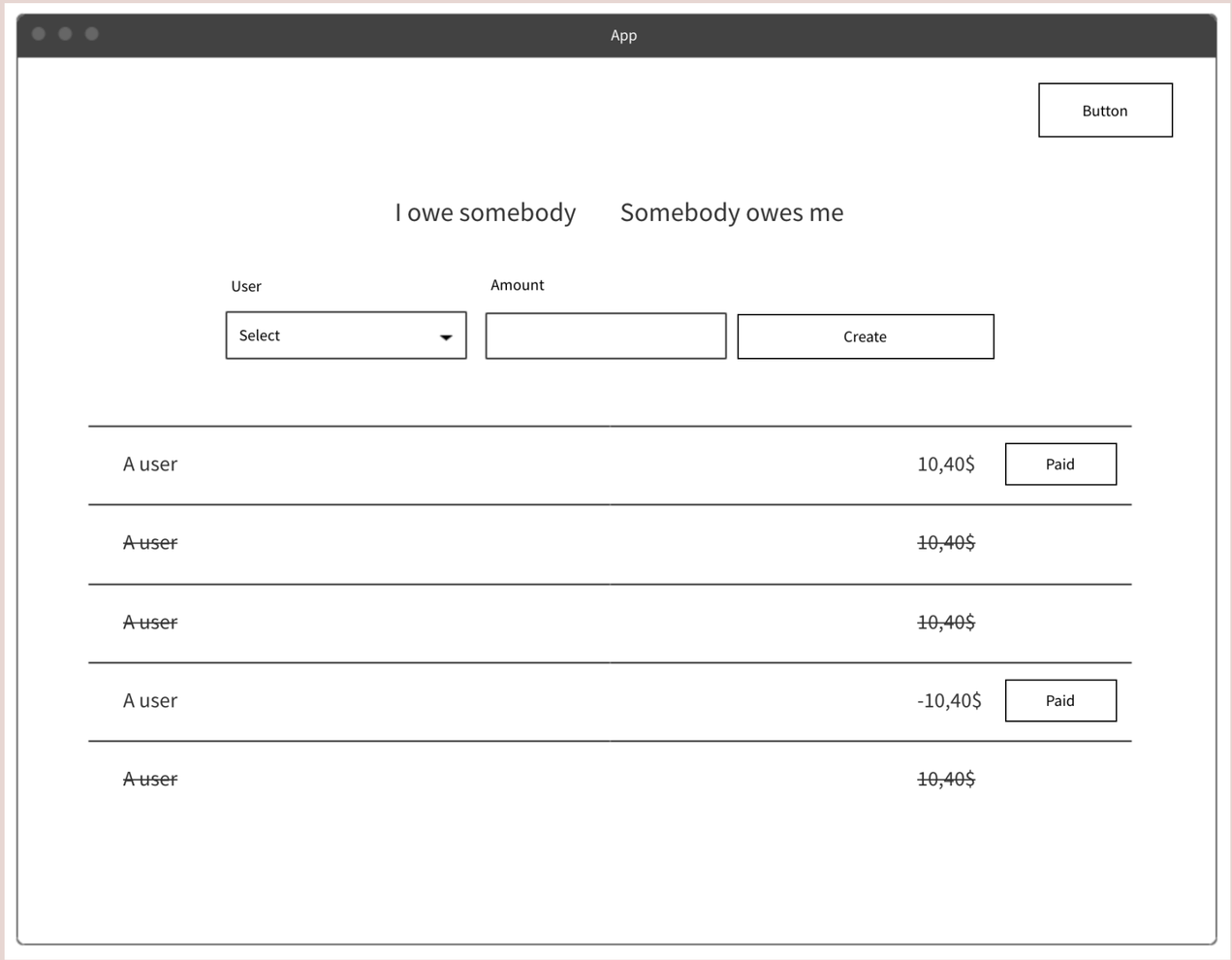
REACT WITHOUT JSX

» React can be used without JSX

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

WHICH COMPONENTS DO YOU SEE

WHICH COMPONENTS DO YOU SEE



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)

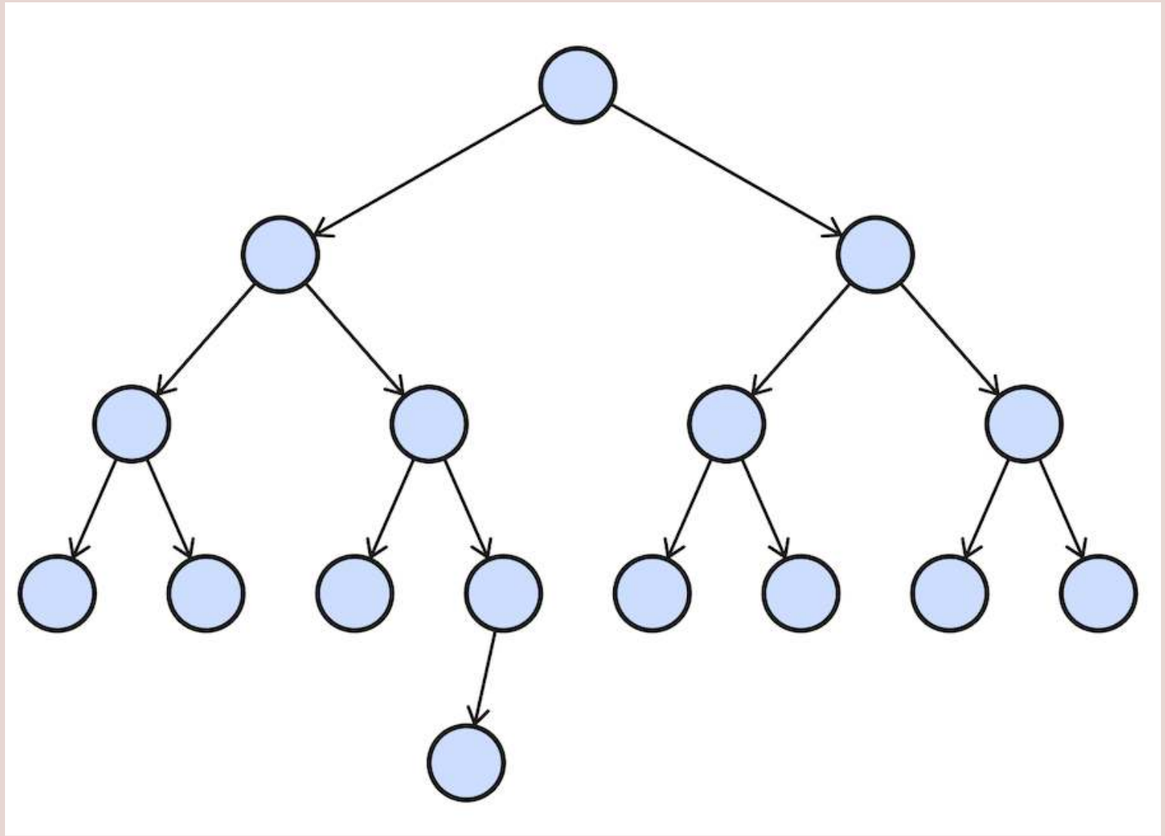
```
const AComponent = ({ items }) => {
  return (
    <dl>
      {items.map(item => (
        // Without the `key`, React will fire a key warning
        <React.Fragment key={item.id}>
          <dt>{item.term}</dt>
          <dd>{item.description}</dd>
        </React.Fragment>
      ))}
    </dl>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

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

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

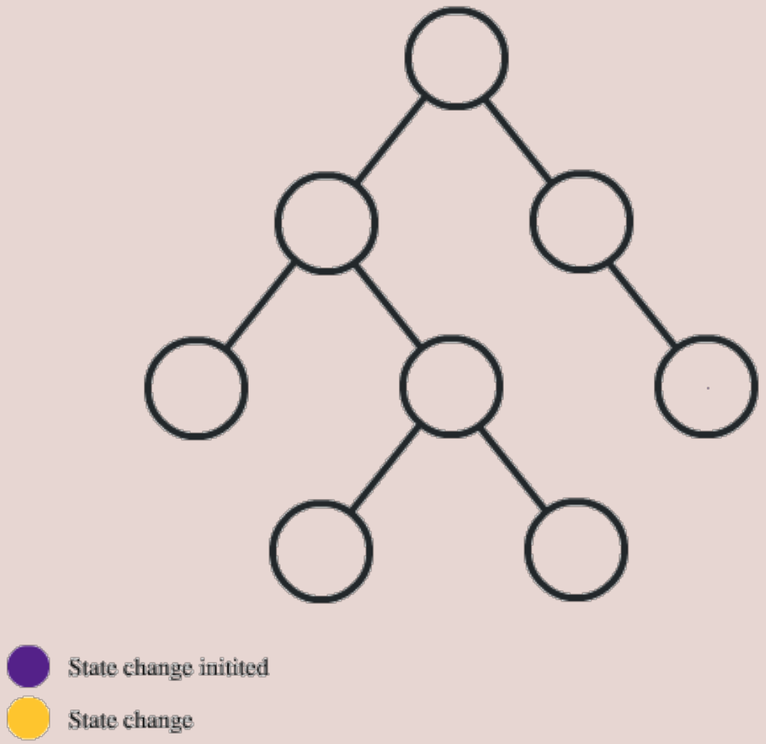
PROPS	STATE
Can get initial value from parent Component?	Yes
Can be changed by parent Component?	Yes
Can set default values inside Component?*	Yes
Can change inside Component?	No
Can set initial value for child Components?	Yes
Can change in child Components?	Yes

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



"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

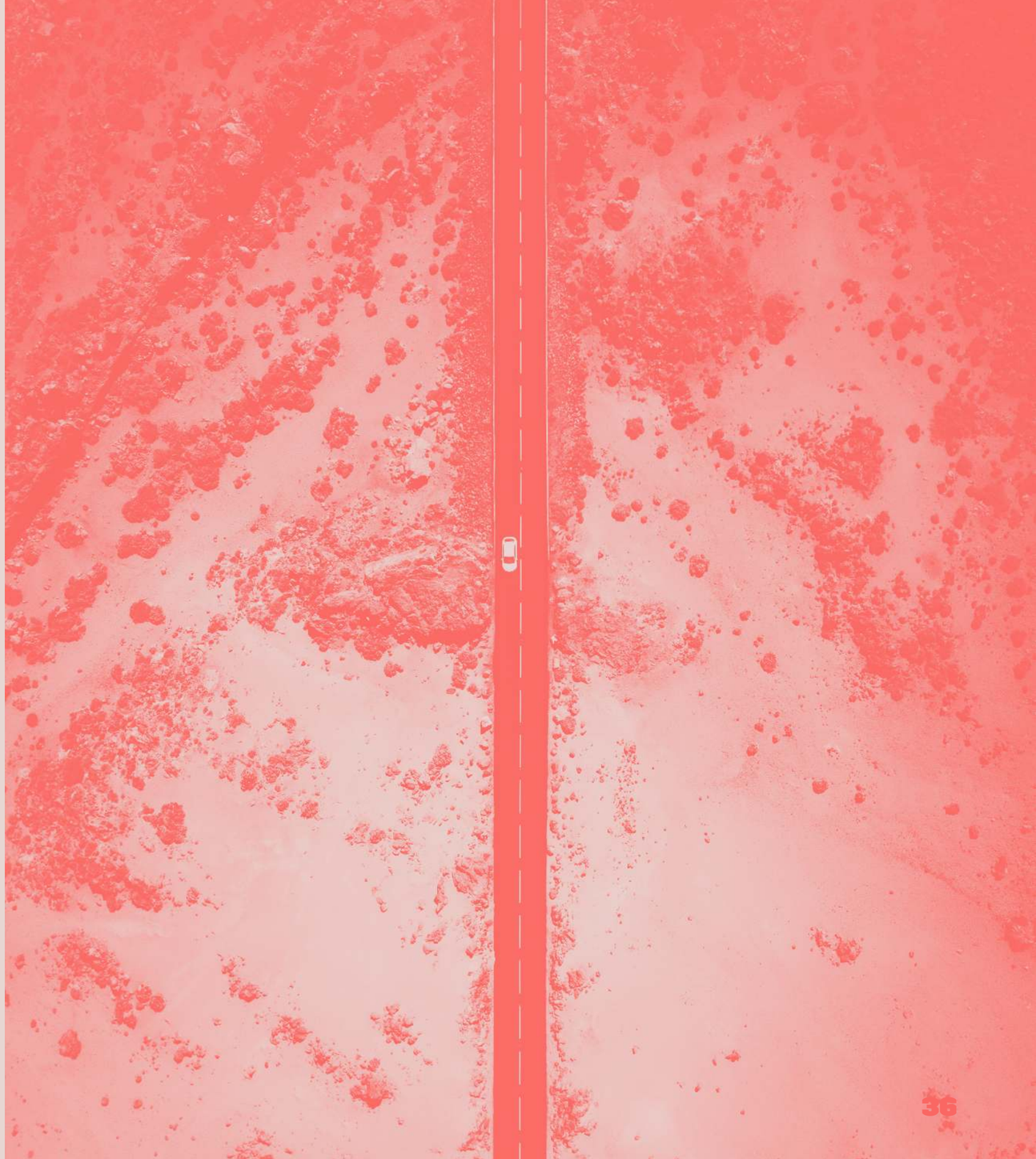
FORMS WITH REACT HOOKS

```
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 1/2 (30 MINUTES)

- Build a sign in form
  - with username
  - with password
  - with a submit button
- extract an input component
- connect these components with hooks
- on submit the form values should be logged to the

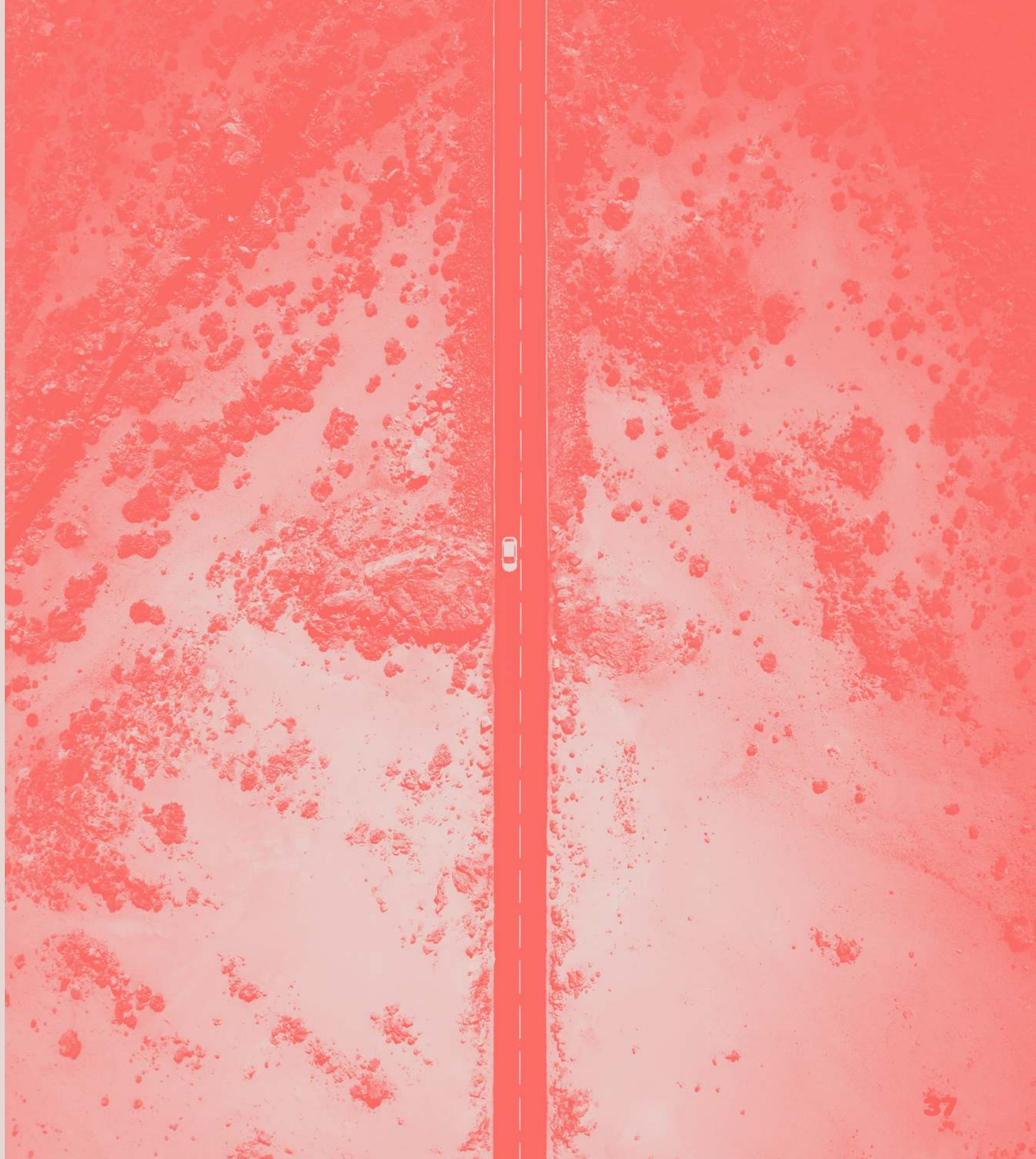


EXERCISE 2/2 (30 MINUTES)

» Bonus: extract a useForm hook

```
const [values, setValue] = useForm({
  username: '',
  password: ''
})

return <Input onChange={setValue('username')} />
```



OTHER HOOKS

USEEFFECT [4]

```
// 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

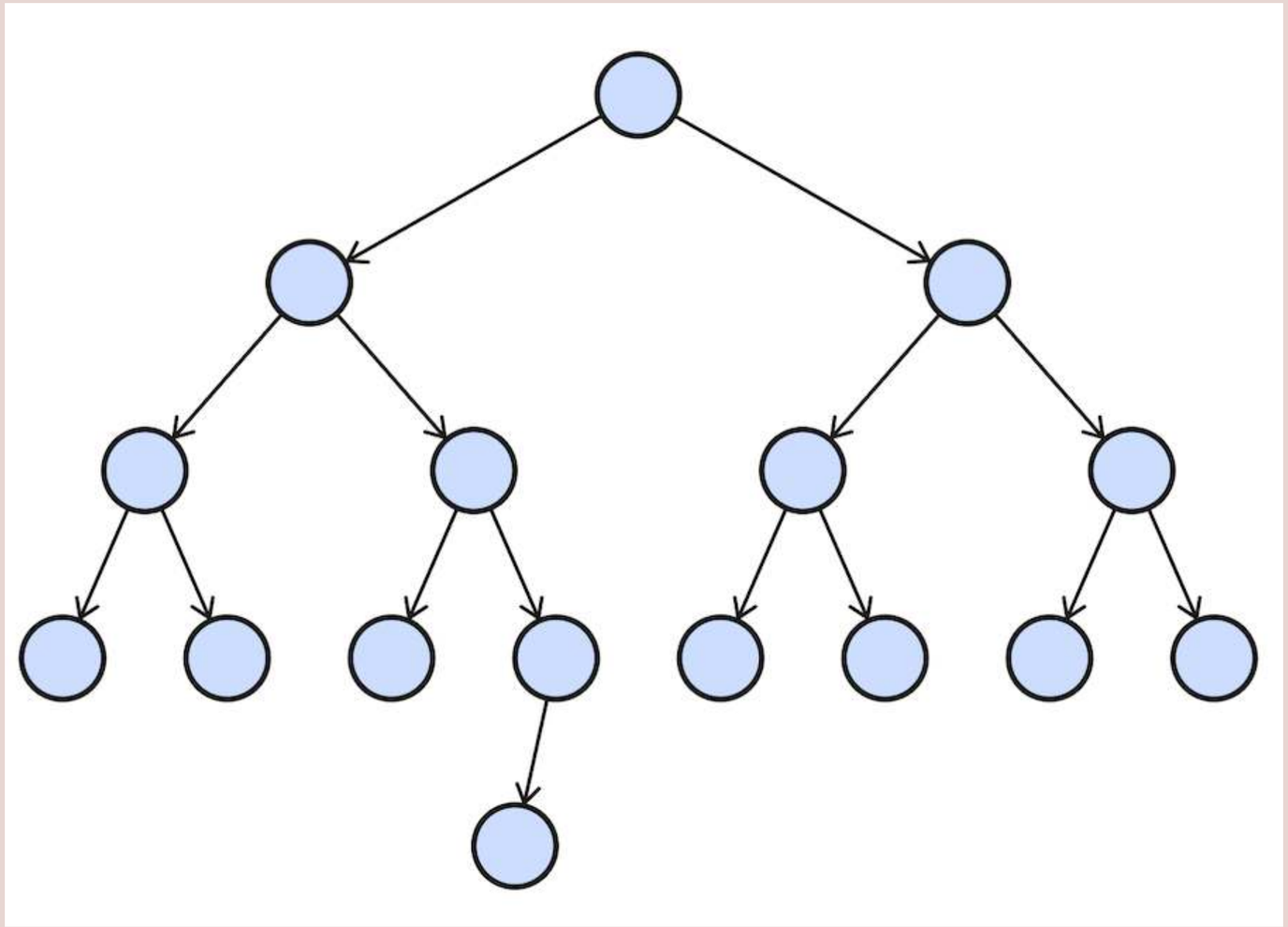
  » automatically updates itself

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 rerenderes when one of the props changes

  » shallow comparison

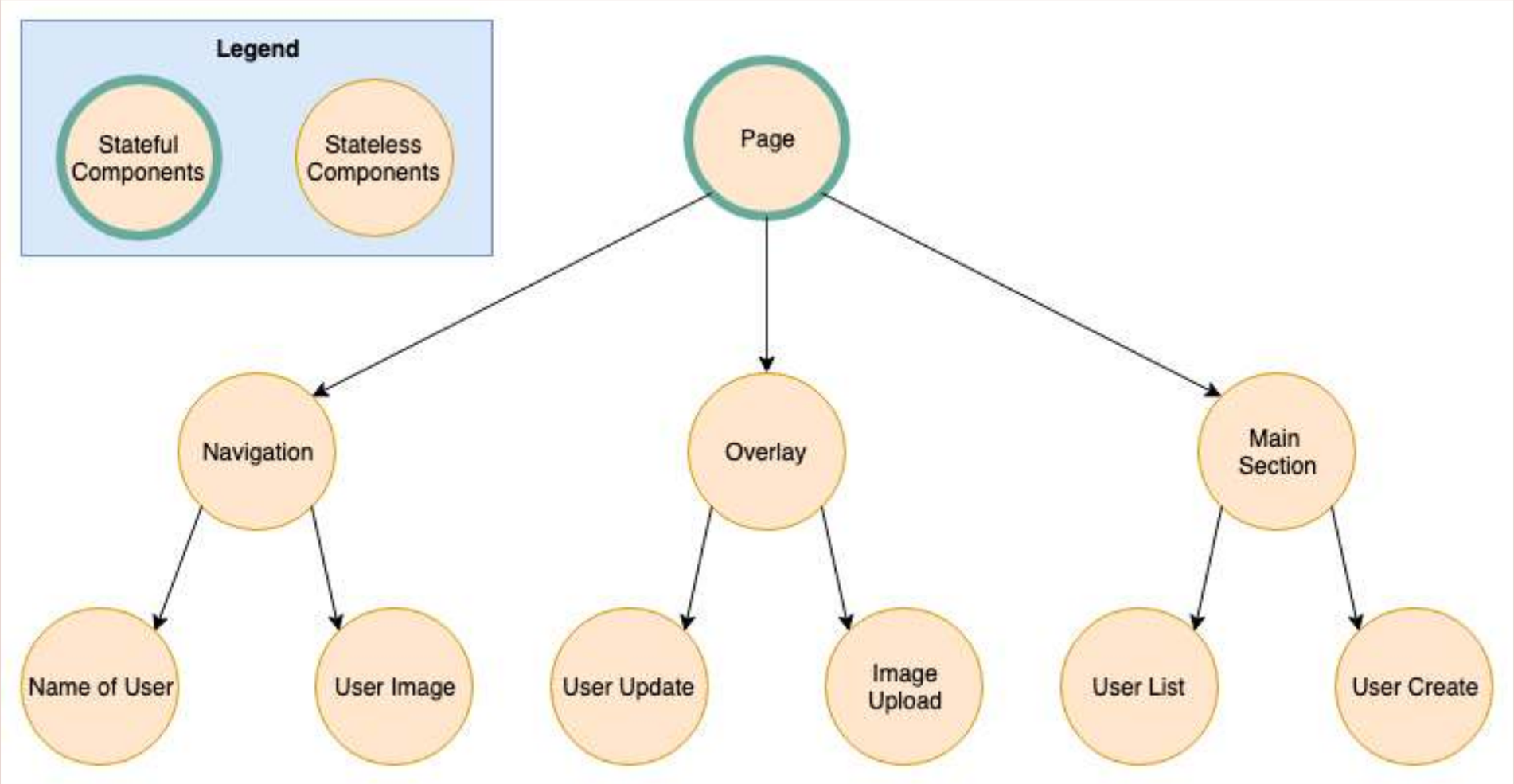
```
const MyComponent = React.memo(function MyComponent(props) {
  /* render using props */
});
```

REACT CONTEXT API

» Available since the beginning of React

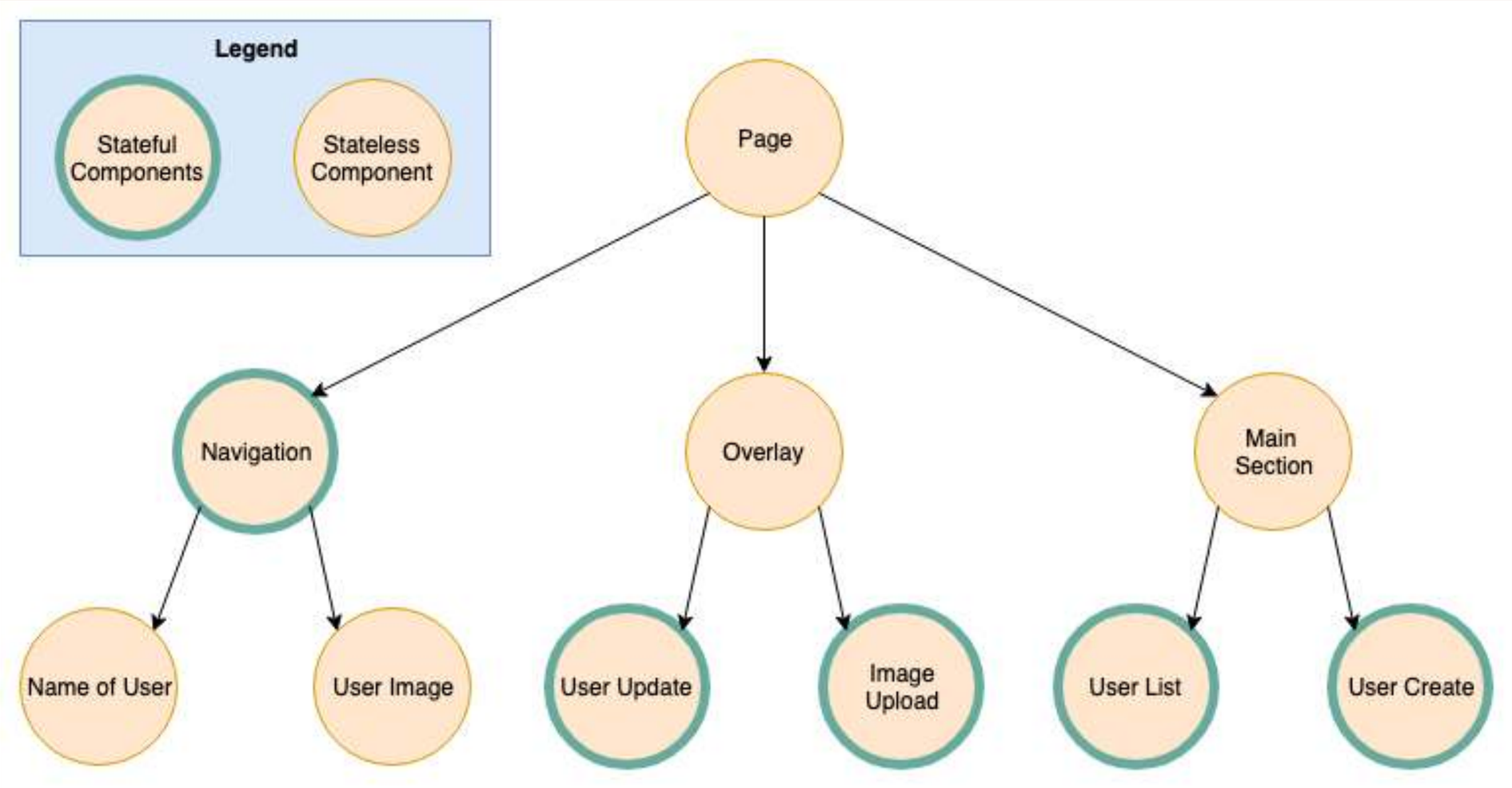
» Prevent "prop drilling"

REACT CONTEXT API



REACT CONTEXT API

REACT CONTEXT API



CREATING A CONTEXT

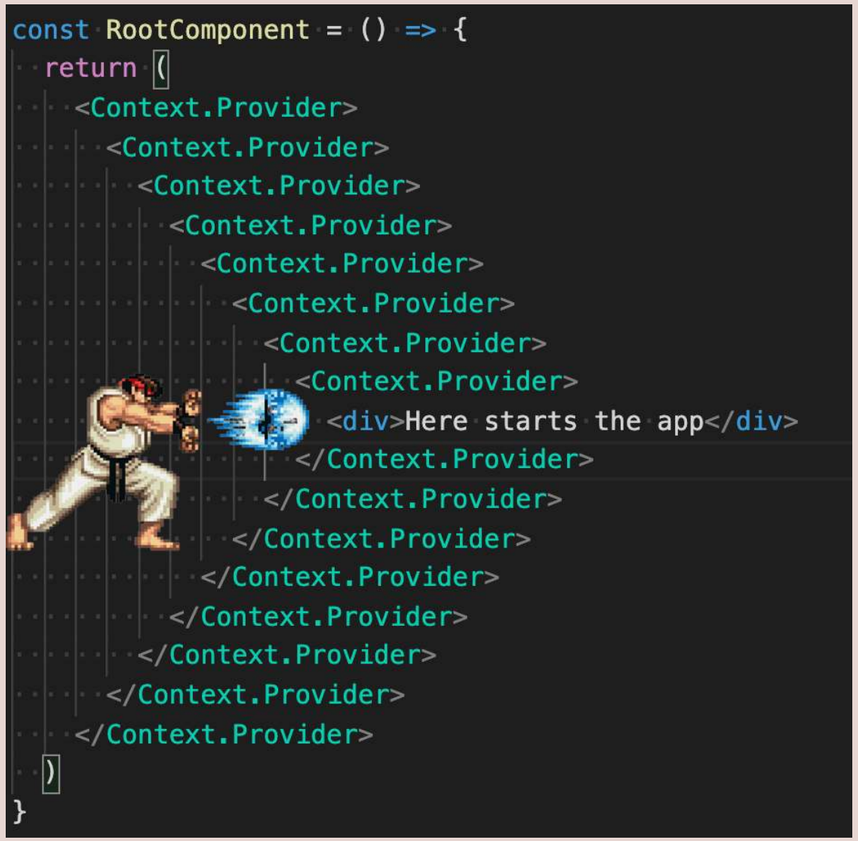
```
const DEFAULT_VALUE = 1
const MyContext = React.createContext(DEFAULT_VALUE)

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



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/x1ibwm85