FUNCTIONAL PROGRAMMING AND STATE MANAGMENT IN REACT

FUNCTIONAL PROGRAMMING

FUNCTIONAL PROGRAMMING

WHAT IS FUNCTIONAL PROGRAMMING

“Applications developed in a functional style use side-effect free functions as their main building blocks. (Made up definition by myself)”

Functional Programming

FP vs. OOP

“Object-oriented programming makes code understandable by encapsulating moving parts. Functional programming makes code understandable by minimizing moving parts. (Michael Feathers)”

Functional Programming
Why Functional Programming

- More testable
  - pure functions simplify testing
- Declarative APIs which are easier to reason about
- Easy concurrency because of statelessness and immutability
  - State is pushed out of the application core to the boundaries

Functional Programming

Immutability

“An immutable data structure is an object that doesn't allow us to change its value. (Remo H. Jansen)”

Functional Programming
Immutable Objects in JS

```
const immutableObject = Object.freeze({ test: 1 })
immutableObject.test = 10
console.log(immutableObject) // => { test: 1 }
```

Functional Programming
Changing an immutable value

```
const immutableObject = Object.freeze({ a: 1, b: 2 })
const updatedObject = Object.freeze({ ...immutableObject, a: 2 })
console.log(updatedObject) // => { a: 2, b: 2 }
```

Functional Programming
Unfreeze an object

```
const immutableObject = Object.freeze({ test: 1 })
const unfrozenCopy = { ...immutableObject }
```

Functional Programming

Object.freeze is mutable

```
const object = { test: 1 }
Object.freeze(object)
object.test = 10
console.log(object) // => { test: 1 }
```

Functional Programming
Why Immutability

- race conditions impossible
- state of the application is easier to reason about
- easier to test

Functional Programming

Mutable Bug

```
const users = []
const loadUsers = async () => {
  const result = await fetchUsers('/users')
  users.push(...result)
  return users
}

loadUsers()
loadUsers()
```

Functional Programming
Immutable version

```
const loadUsers = () => {
  return fetchUsers('/users');
}

const result1 = await loadUsers();
const result2 = await loadUsers();
```

Functional Programming
Higher Order Functions

"A higher order function is a function that returns a function."

Functional Programming
Higher Order Functions

```
const buildCreateUser = (dbAdapter) => {
  return (user) => {
    if (!isValid(user)) { throw new Error('User Invalid') }
    return dbAdapter.create(user)
  }
}
const createUserInPG = buildCreateUser(postgresAdapter)
const createUserInMemory = buildCreateUser(inMemoryAdapter)
```

GLOBAL STATE MANAGEMENT

APPLICATION STATE
WHAT IS APPLICATION STATE

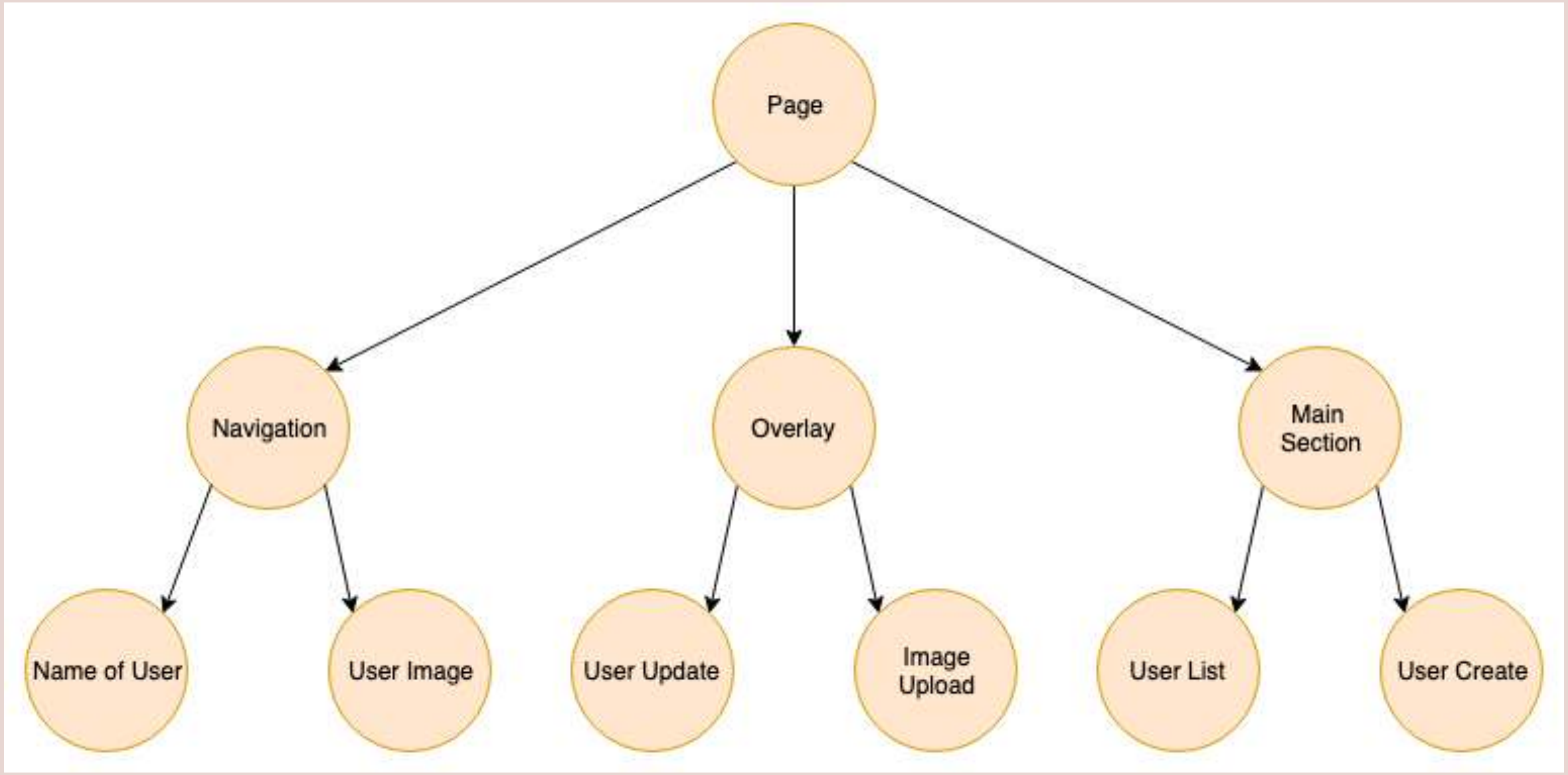
“An application's state is roughly the entire contents of its memory. (sarnold)”

Application State

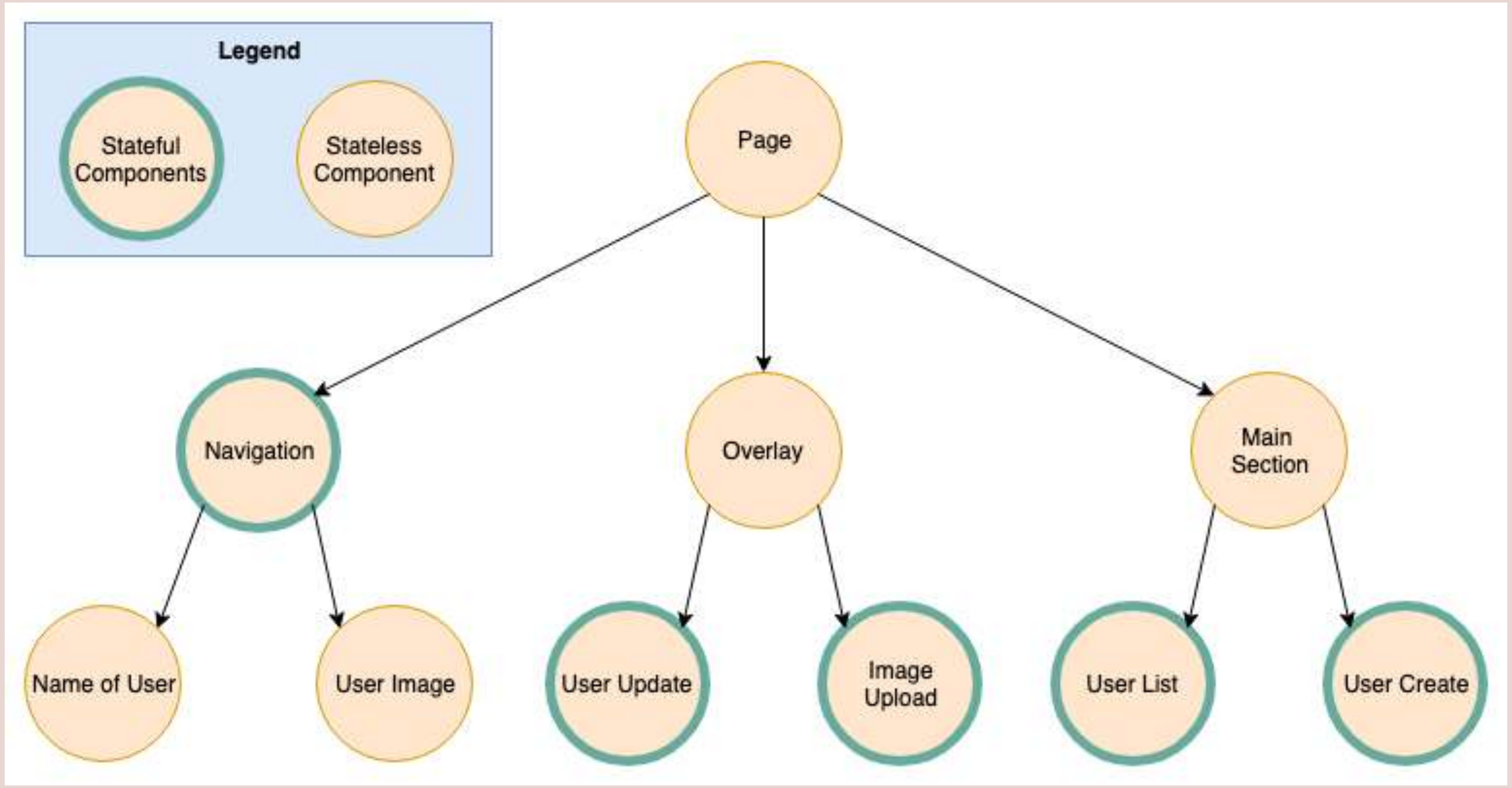
State in Redux terms

“Every bit of information the application needs in order to render.”

APPLICATION STATE
REACT COMPONENT TREE



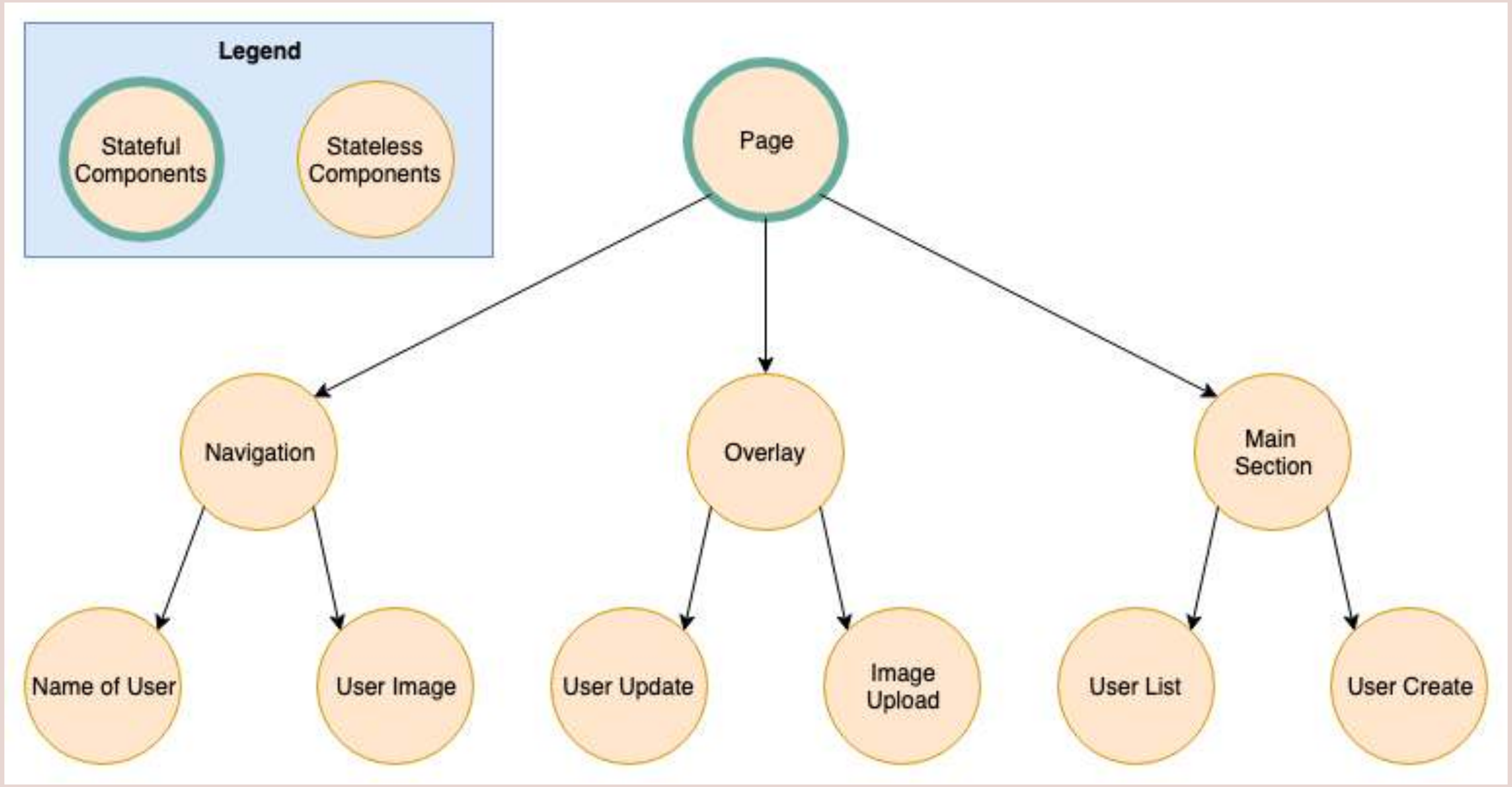
APPLICATION STATE
STORING STATE IN COMPONENTS



Application State
Storing State in Components

- Pros
  - Components are independent
  - eg. "Navigation" doesn't know about "User Update"
- Cons
  - User data needs to be fetched multiple times
  - If UserUpdate component changes name of user

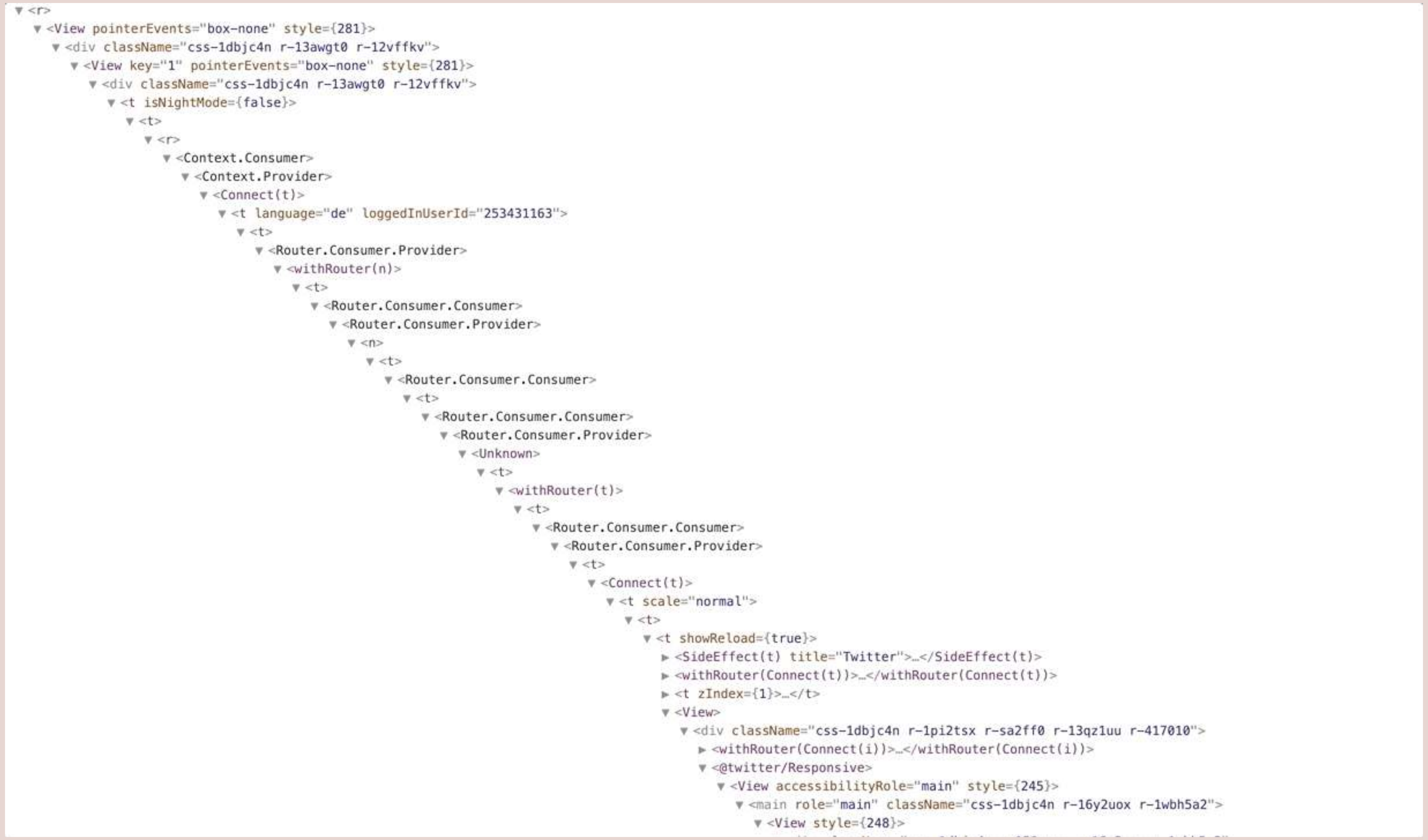
APPLICATION STATE
STORING STATE IN THE ROOT COMPONENT



Application State
Storing state in the root component

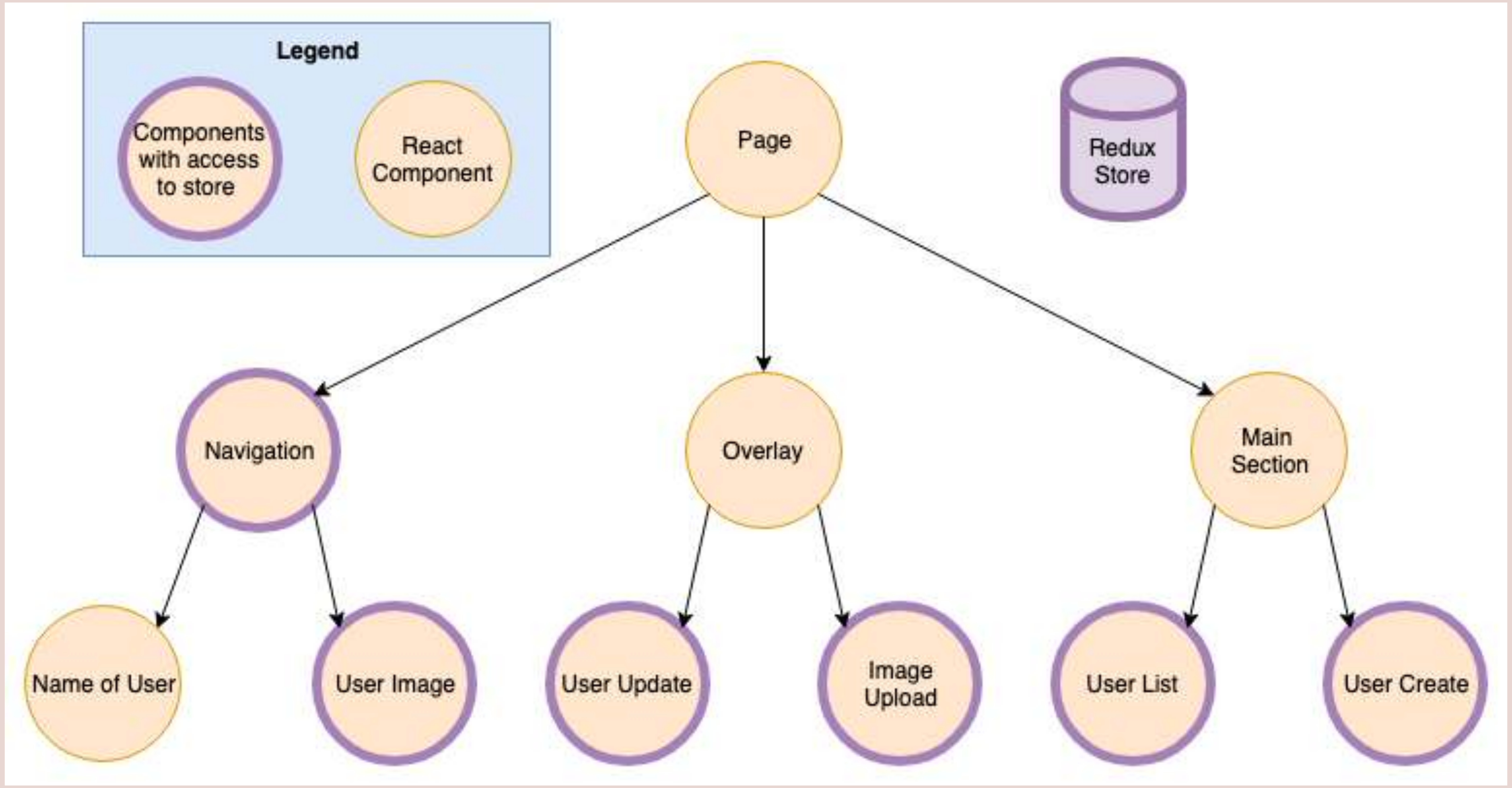
- Pros
  - User data could be fetched only once
  - If UserUpdate component changes name of user
  - navigation component is automatically updated
- Cons
  - State needs to be passed down to every component
  - (Root component contains all state logic)

APPLICATION STATE
STORING STATE IN THE ROOT COMPONENT



```
▼ <r>
  ▼ <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}>
```

APPLICATION STATE
STORING STATE GLOBALLY



Application State
Storing State Globally

- » Global state which acts like local state
- » Pros:
  - » Components are independent
  - » eg. Navigation doesn't know about UserUpdate
  - » State changes are synchronised with the whole app
  - » State doesn't need to be passed down the tree

CUSTOM STATE MANAGEMENT

Framework Agnostic State Mgmt

Creating a library agnostic store

» Create a library agnostic store to be used by any framework

```
// Interface
type CreateStore = <T>(stateFactory: () => T) => {
  set: (updateFn: (state: T) => T) => unknown
  get: () => T
}
```

Framework Agnostic State Mgmt
Task

- » Create an implementation for CreateStore type
- » Add unit tests to your implementation
- » Usage:

```
const store = createStore(() => ({ someValue: 1 }))

store.get() // { someValue: 1 }
store.set((current) => ({ someValue: current.someValue + 1}))
store.get() // { someValue: 2 }
```

REACT STATE MGMT ADAPTER

» Interface for wrapping the agnostic state management

```
type UseReactStore<T> = () => [
  T,
  (updateFn: (state: T) => T) => unknown
]

type CreateReactStore = <T>(stateFactory: () => T) => UseReactStore<T>
//                                                    ^^^^^^^^^^^^^^^^
// higher order function which returns a hook
```

REACT STATE MGMT ADAPTER TASK

» create an implementation for CreateReactStore

» Usage:

```
const useMyStore = createReactStore(() => ({ someValue: 1 }))
//    ^^^^^^^^^^
// useMyStore is defined globally/outside of the react context

const MyComponet = () => {
   const [myState, setMyState] = useMyStore()
   // ...
}
```

Build Adapter for React
Issue

- Did you encounter any issues?

Build Adapter for React
Issue

» state is not updated in components

BUILD ADAPTER FOR REACT
USESYNCEXTERNALSTORE

“useSyncExternalStore is a React Hook that lets you subscribe to an external store.”

```
const todos = useSyncExternalStore(store.subscribe, store.getSnapshot);
// 1)                              ^^^^^^^^^^^^^^^
// 2)                                                 ^^^^^^^^^^^^^^^^^

// 1) callback function which adds the current component to the list of components
//    to be updated in case the state changes. (similar to observer pattern)
// 2) callback function which returns an immutable snapshot of the current state.
//    This function is used to get the state into the react component.
```

Build Adapter for React

Subscribe Function

» callback function which adds/removes components to be notified on state changes

```
type Listener = () => unknown
const createMyStore = () => {
  // ...
  const listeners: Listener[] = []

  return () => {
    const subscribe = (listener: Listener) => {
      listeners.push(listener)
// 1)           ^^^^^^^^^^^^^^
      return () => listeners.splice(listeners.indexOf(listener), 1)
// 2)        ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
    }
  }
}
// 1) adds listener to be called when the store changes
// 2) removes listener when component gets unmounted
```

Build Adapter for React
Notify components about changes

» notify react about state changes

```
const createMyStore = <T>() => {
  const listeners: Listener[] = []
  const emitChanges = () => listeners.forEach((listener) => listener())
//                          ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
// notify components about state changes

  return () => {
    const set = (updateFn: (state: T) => T) => {
        store.set(updateFn)
        emitChanges()
    }
    // ...
  }
}
```

Build Adapter for React

getSnapshot function

» returns the current state/snapshot of the store

```
const createMyStore = () => {
// ...

  const getSnapshot = () => store.get()
//                    ^^^^^^^^^^^^^^^^^
// function which returns the current snapshot of the store
}
```

Build adapter for React
Combine callback functions

```
const createMyStore = () => {
// ... listeners, emitChanges
  return () => {
    // ...
    const state = useSyncExternalStore(subscribe, getSnapshot);

    return [
      state,
      set
    ]
  }
}
```

Build Adapter for React
Task

- Add useSyncExternalStore to your state management solution
- Verify that connected components are updated

Functional Programming
Task

- Add transformer to your state mgmt solution
  - make sure the value is not recalculated on every rerender (use Reacts useMemo)
  - value should only be recalculated when state changes
- Throw/log error when state update is not immutable in generic store
  - previousState !== updatedState

Feedback

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