REACT ADVANCED TOPICS (MMT-B2020)

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ROADMAP

» Performance in Tips

» Portals

» Refs

» Error Boundaries

» Code Splitting

REACT PERFORMANCE TIPS

REACT PERFORMANCE TIPS
USE THE PRODUCTION BUILD

» react adds development checks/warnings

» in the production build warnings are stripped

» with CRA [6] run npm run build

[6] Create React App (https://create-react-app.dev/)

REACT PERFORMANCE TIPS
IMMUTABILITY

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

REACT PERFORMANCE TIPS
IMMUTABLE OBJECTS IN JS

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

REACT PERFORMANCE TIPS
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 }
```

REACT PERFORMANCE TIPS
UNFREEZE AN OBJECT

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

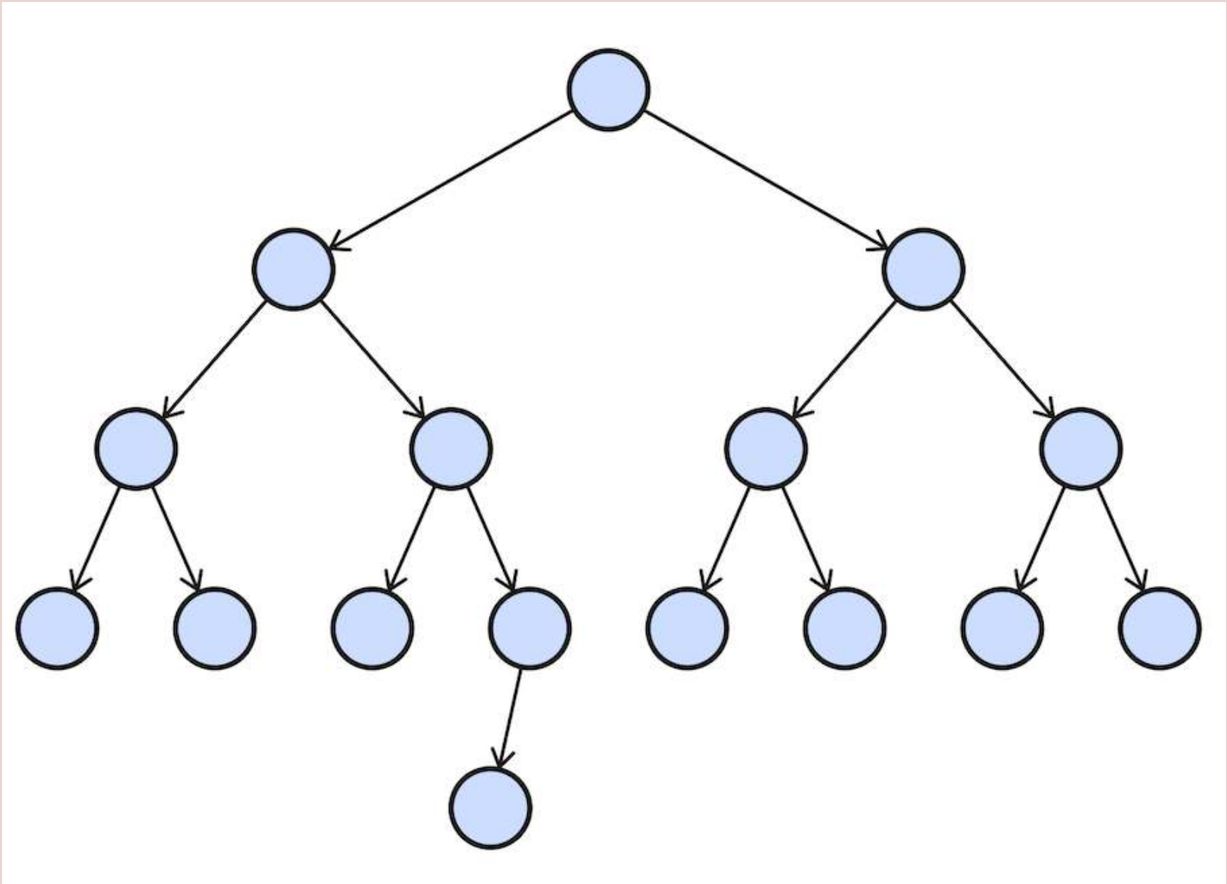
REACT PERFORMANCE TIPS
WHY IMMUTABILITY

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

REACT PERFORMANCE TIPS
MEMOIZATION

“`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. (https://metacpan.org/pod/Memoize)”

REACT PERFORMANCE TIPS
REACT COMPONENT TREE



REACT PERFORMANCE TIPS
REACT.MEMO

```
import React from 'react'

const MyComponent  = React.memo(({ users }) => {
//                   ^^^^^^^^^^
// memoize the component, all sub-components will
// be rerendered initially and only when the pointer
// to the user array changes

  return (
    <section>
      <Users users={users}>
    </section>
  )
})
```

REACT PERFORMANCE TIPS
FILTERING LARGE LISTS

```
import React from 'react'

const MyComponent = ({ users }) => {
  const activeUsers = users.map((user) => !user.inactive)

  return (
    <Users users={activeUsers} />
  )
}
```

REACT PERFORMANCE TIPS
FILTERING LARGE LISTS (MEMOIZATION)

```
import React, useMemo from 'react'

const MyComponent = ({ users }) => {
  const activeUsers = useMemo(
//                    ^^^^^^^^
// add the useMemo hook
    () => users.map((user) => !user.inactive),
//  ^^
// define a callback so react can decide when to filter
    [users])
//  ^^^^^^
// define the "dependencies"
// = the filter function should be executed
//   when users array changes

  return (
    <Users users={activeUsers} />
  )
}
```

REACT PERFORMANCE TIPS
ARRAYS/OBJECTS AS DEFAULT VALUES

```
import React, useMemo from 'react'

const MyComponent = ({ users = [] }) => {
  const activeUsers = useMemo(
    () => users.map((user) => !user.inactive),
    [users])

  return (
    <Users users={activeUsers} />
  )
}
```

REACT PERFORMANCE TIPS
ARRAYS/OBJECTS AS DEFAULT VALUES

```
import React, useMemo from 'react'

const MyComponent = ({ users = []}) => {
//                            ^^
// every time undefined is passed to the component
// a new array will be created.

  const activeUsers = useMemo(
    () => users.map((user) => !user.inactive),
    [users])
//  ^^^^^^
// users change with each rerender
// => empty array will be filtered all the time

  return (
    <Users users={activeUsers} />
  )
}
```

REACT PERFORMANCE TIPS
ARRAYS/OBJECTS AS DEFAULT VALUES

```
import React, useMemo from 'react'

const DEFAULT_USERS = []
// ^^^^^^^^^^^^^^^^^^^^
// this array gets instantiated once when the code
// is parsed initially. The same array will be reused
// with each rerender.

const MyComponent = ({ users = DEFAULT_USERS}) => {
//                             ^^^^^^^^^^^^^
// use the global array

  const activeUsers = useMemo(
    () => users.map((user) => !user.inactive),
    [users])

  return (
    <Users users={activeUsers} />
  )
}
```

REACT PERFORMANCE TIPS
CALLBACKS

» Do you find anything problematic here?

```
import React, useMemo from 'react'

const Users = React.memo(({ users, onUserClick}) => {
   // ...
})

const MyComponent = ({ users = DEFAULT_USERS}) => {
  return (
    <Users
      users={activeUsers}
      onUserClick={() => console.log('test')}
    />
  )
}
```

REACT PERFORMANCE TIPS
CALLBACKS

```
import React, useMemo from 'react'

const Users = React.memo(({ users, onUserClick}) => {
   // ...
})

const MyComponent = ({ users = DEFAULT_USERS}) => {
  return (
    <Users
      users={activeUsers}
      onUserClick={() => console.log('test')}
  //                  ^^^^^^^^^^^^^^^^^^^^^^^^^^
  // Each time the component is rerendered a new function
  // will be created. This makes React.memo think that the
  // prop changed and will trigger a rerender of the Users
  // component.
    />

  )
}
```

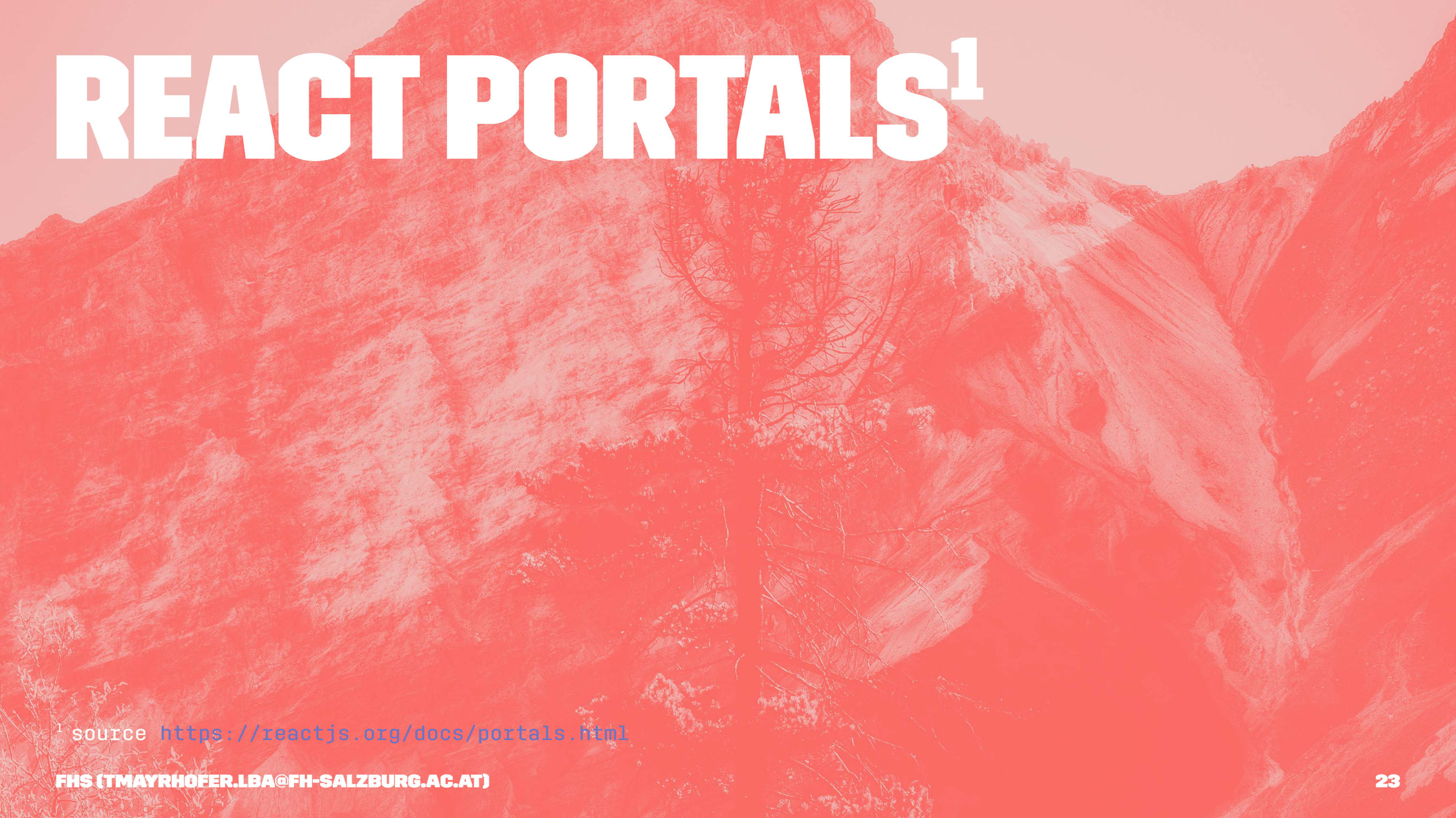
REACT PERFORMANCE TIPS
CALLBACKS

```
import React, { useCallback } from 'react'

const Users = React.memo(({ users, onUserClick}) => {
   // ...
})

const MyComponent = ({ users = DEFAULT_USERS}) => {
  const onUserClick = useCallback(
  //                  ^^^^^^^^^^^
  // cache/memoize the callback function
    () => console.log('test'),
    []
  //^^
  // dependencies (when should the function be recreated)

  )
  return (
    <Users users={activeUsers} onUserClick={onUserClick} />
  )
}
```

TASK (15 MIN)

- Go to your application
- Create a new branch
- Find performance optimizations
  - Default Arrays
  - Arrays which could be memoized

REACT PORTALS[1]



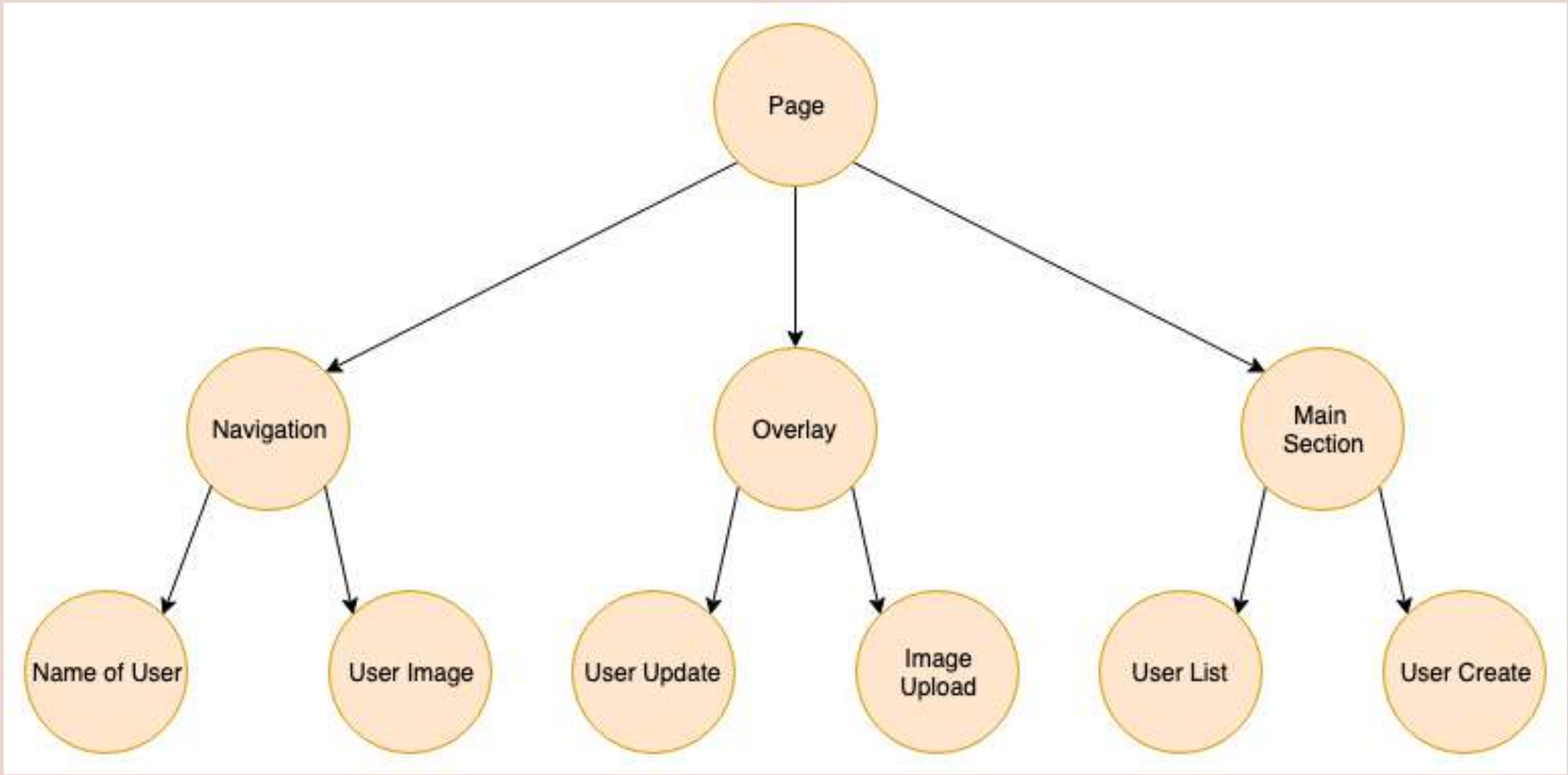
[1] source https://reactjs.org/docs/portals.html

REACT PORTALS[1]

"Portals provide a first-class way to render children into a DOM node that exists outside the DOM hierarchy of the parent component."

[1] source https://reactjs.org/docs/portals.html

REACT PORTALS[1]



[1] source https://reactjs.org/docs/portals.html

REACT PORTALS[1]

» Components are rendered inside nearest parent DOM

```
const MyComponent = ({ children }) => {
  return (
    <div>
      {children}
    </div>
  );
}
```

[1] source https://reactjs.org/docs/portals.html

REACT PORTALS[1]

» Sometimes components need to render outside of DOM nodes

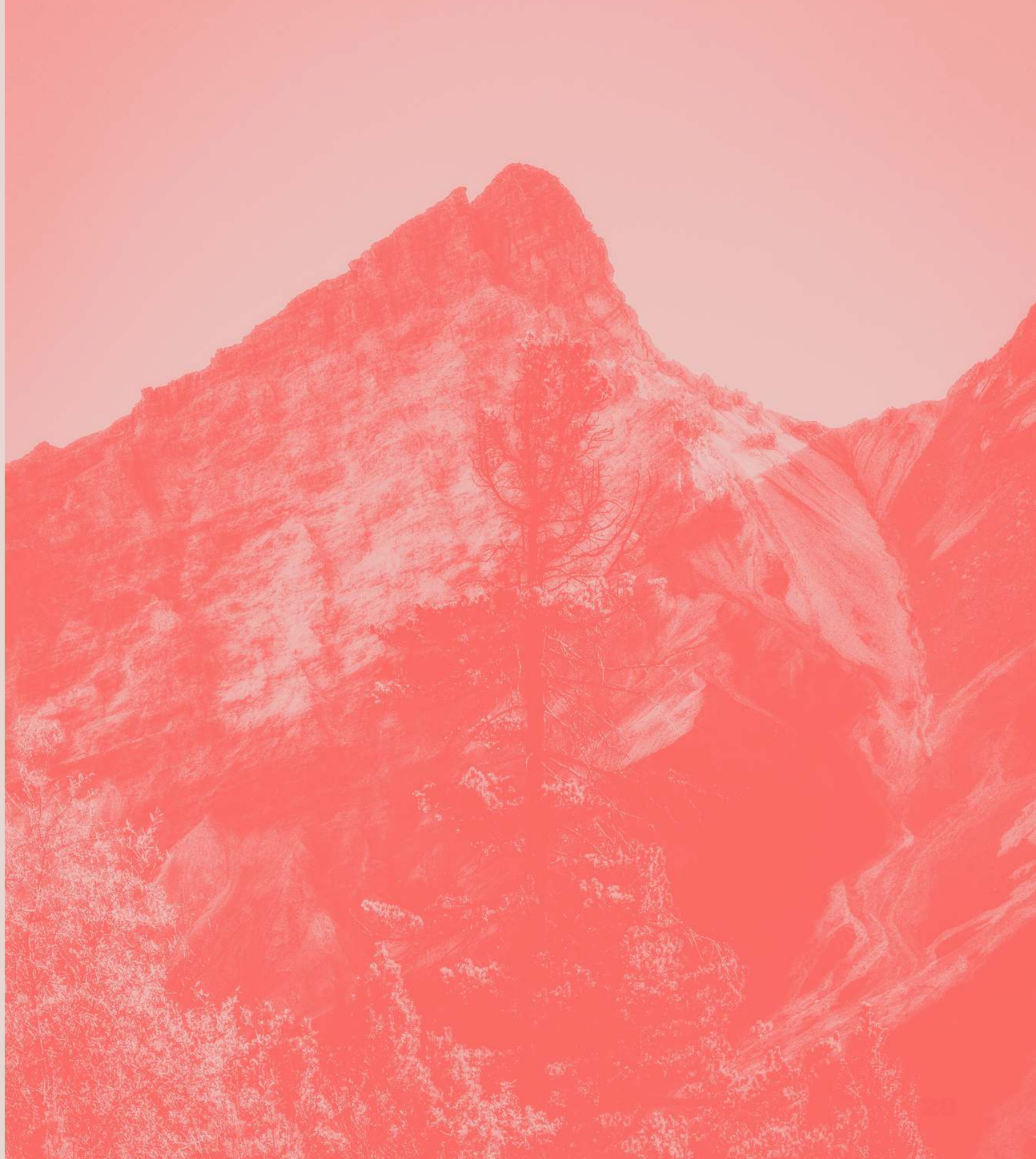
» eg. modals

```
const MyComponent = ({ children }) => {
  return ReactDOM.createPortal(
    children,
    // specify elements to be rendered

    document.getElementById("myComponentRoot")
    // children will be rendered inside #myComponentRoot
  );
}
```

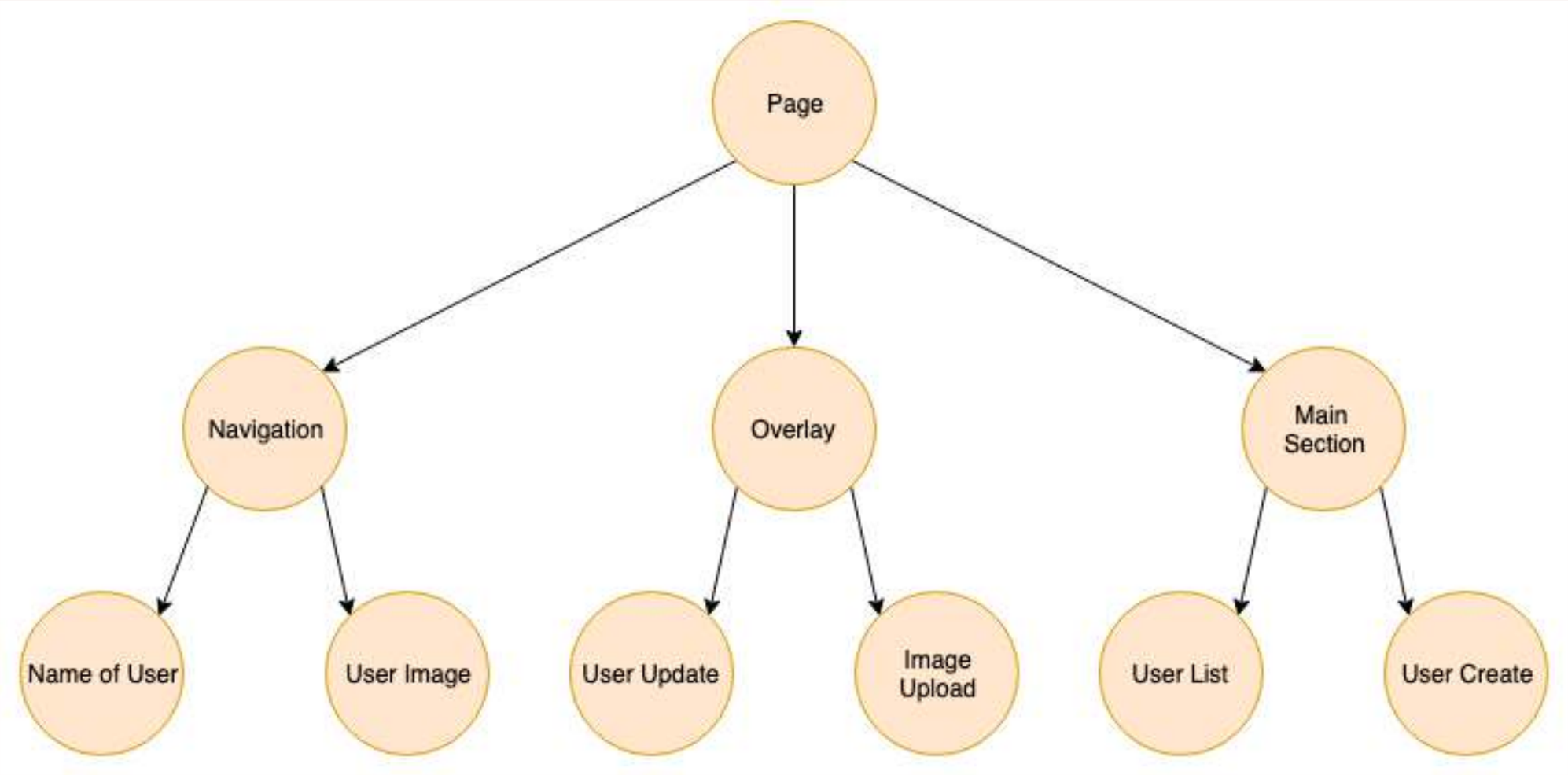
[1] source https://reactjs.org/docs/portals.html

REFS

“Refs provide a way to access DOM nodes or React elements created in the render method.”



REFS


Page
Navigation
Overlay
Main Section
Name of User
User Image
User Update
Image Upload
User List
User Create

REFS [2]

- props are used to interact with child components
  - to modify children rerender with different props
  - might be triggered via setState/useState
- refs are used to access DOM elements directly
  - setting focus
  - trigger imperative animations

[2] source https://reactjs.org/docs/refs-and-the-dom.html

REFS [2]

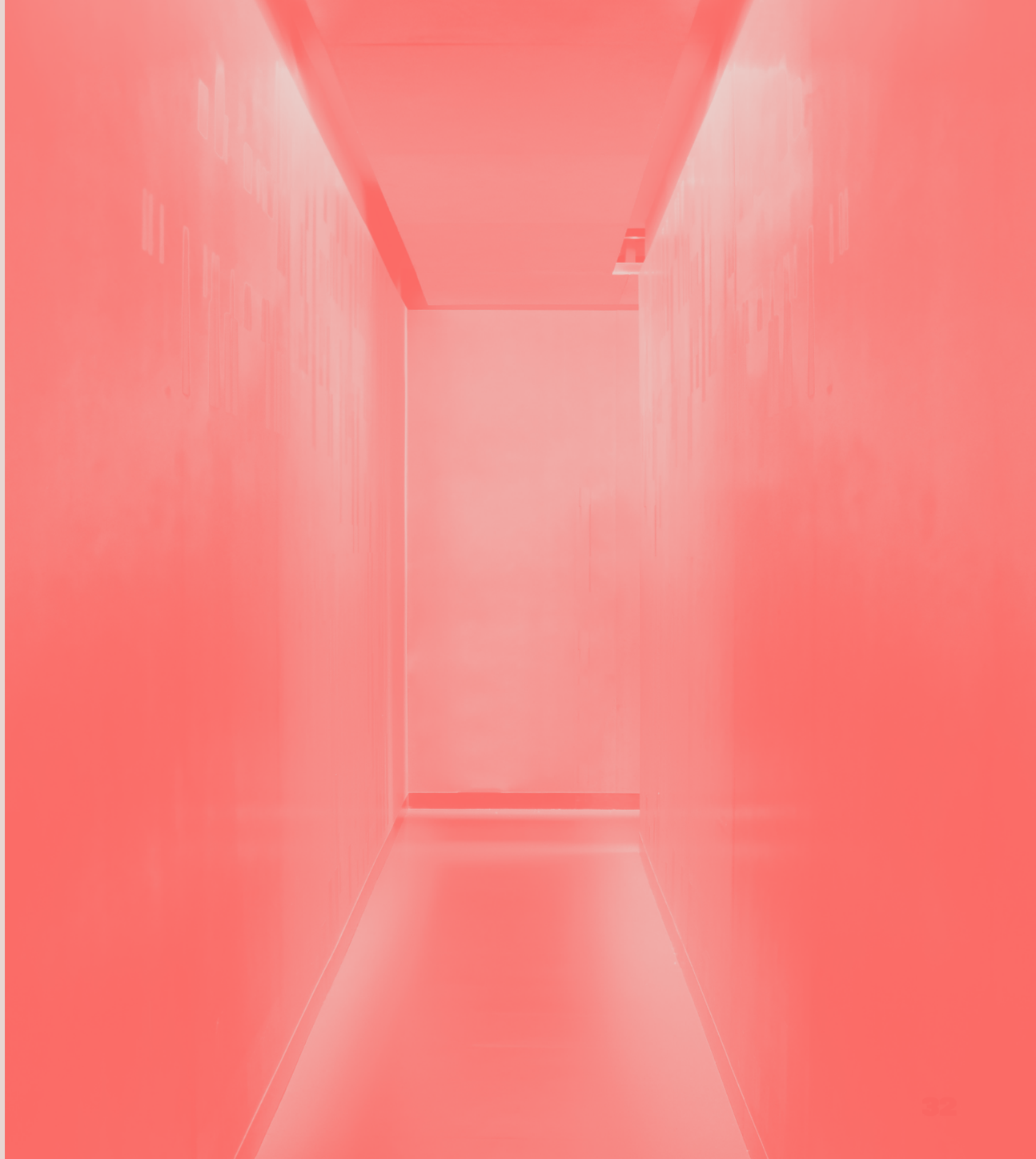
```
const MyInputComponent = ({ autofocus }) => {
    const inputRef = useRef(null);
    //                 ^^^^^^^^^^^^
    // specify a reference with an initial value of null

    useEffect(() => {
        inputRef.current?.focus();
        //       ^^^^^^^^
        // current might be <input /> or null
        // when <input /> then focus input
    }, [inputRef.current])


    return <input ref={inputRef} />
    //            ^^^^^^^^^^^^^^
    // specify to which element the ref should be bound
}
```

[2] source https://reactjs.org/docs/refs-and-the-dom.html

REFS [2]

» Don’t Overuse Refs

» prefer using props and lift up state



[2] source https://reactjs.org/docs/refs-and-the-dom.html

ERROR BOUNDARIES [3]

[3] source https://reactjs.org/docs/error-boundaries.html

ERROR BOUNDARIES [3]

- an error in a component might break the whole app
  - react mixes up state
  - reloading page is the only way to recover
  - bad UX
- Error boundaries handle errors of components

[3] source https://reactjs.org/docs/error-boundaries.html

ERROR BOUNDARIES [3]

- static getDerivedStateFromError
  - invoked after an error in child has been thrown
  - should return new component state
- componentDidCatch
  - invoked after an error in child has been thrown
  - used to trigger side effects (eg. server logging)

[3] source https://reactjs.org/docs/error-boundaries.html

ERROR BOUNDARIES [3]

```
class ErrorBoundary extends React.Component {
    state = { hasError: false }
    static getDerivedStateFromError(error) {
        // Update state so the next render will show the fallback UI.
        return { hasError: true };
    }

    componentDidCatch(error, errorInfo) {
        // You can also log the error to an error reporting service
        logErrorToMyService(error, errorInfo);
    }

    render() {
        if (this.state.hasError) {
            // You can render any custom fallback UI
            return <h1>Something went wrong.</h1>;
        }

        return this.props.children;
    }
}
```

[3] source https://reactjs.org/docs/error-boundaries.html

ERROR BOUNDARIES [3]
USING ERROR BOUNDARIES

- using boundaries is up to the developer
- place boundaries around use-cases [4] eg:
  - sign-up form
  - create money-transactions
  - money-transaction list

[3] source https://reactjs.org/docs/error-boundaries.html

[4] personal opinion

CODE SPLITTING

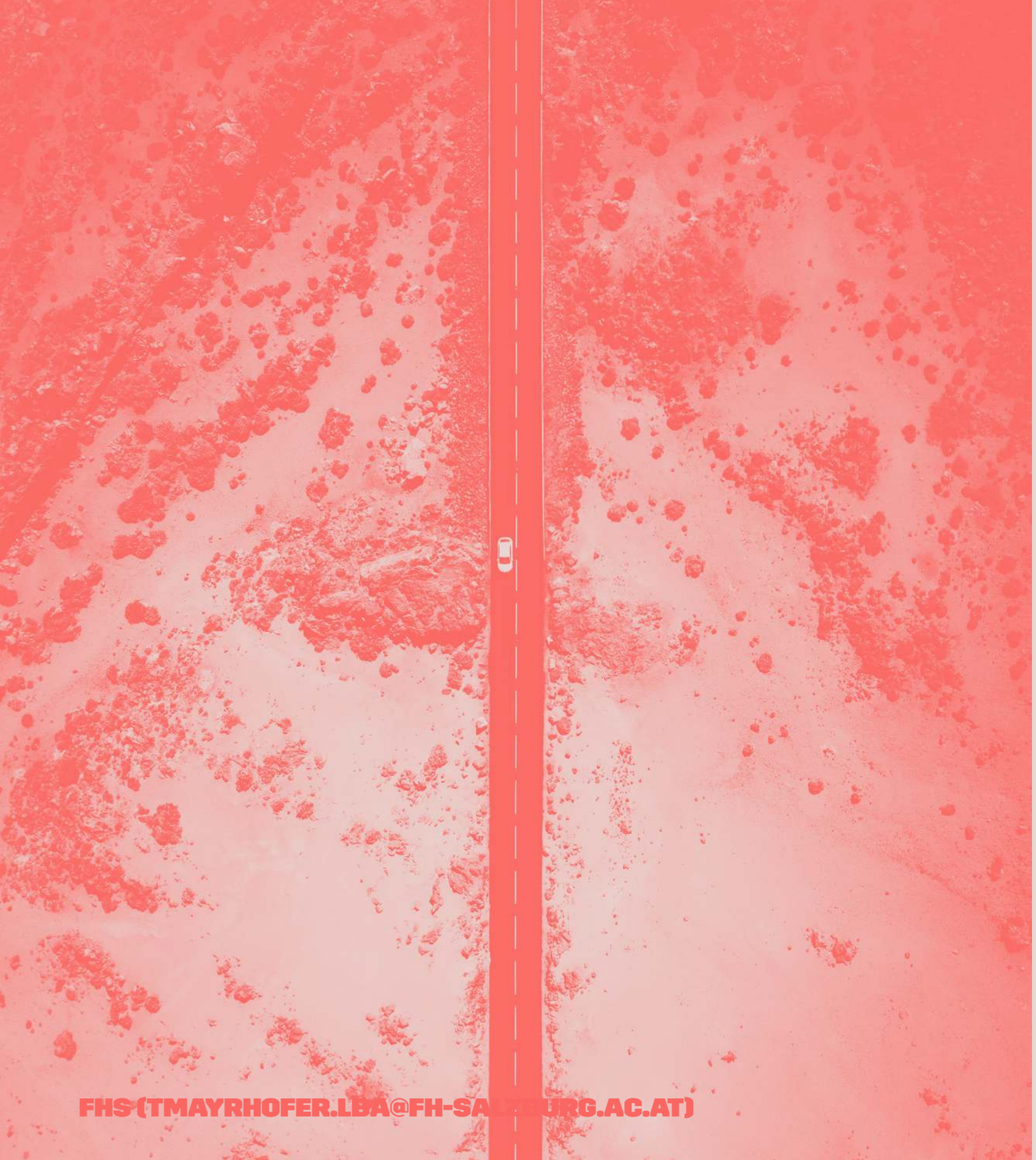
CODE SPLITTING
BUNDLING

“combine multiple JS modules into a single bundle”

» when apps grow the bundle will grow

» large libraries are added to bundle

  » increases download/parse time



CODE SPLITTING [5]

“split bundle into multiple bundles which can be loaded lazily during runtime”

[5] source https://reactjs.org/docs/code-splitting.html

CODE SPLITTING [5]
DYNAMIC IMPORTS

```
const add = async (a, b) => {
    const math = await import("./math")
    //               ^^^^^^^^^^^^^^^^^^^^
    // load "./math" module only when `add` is executed
    // for the first time. Bundlers will split the bundle
    // automatically. (2 files will be generated)

    return math.add(a, b)
});
```

[5] source https://reactjs.org/docs/code-splitting.html

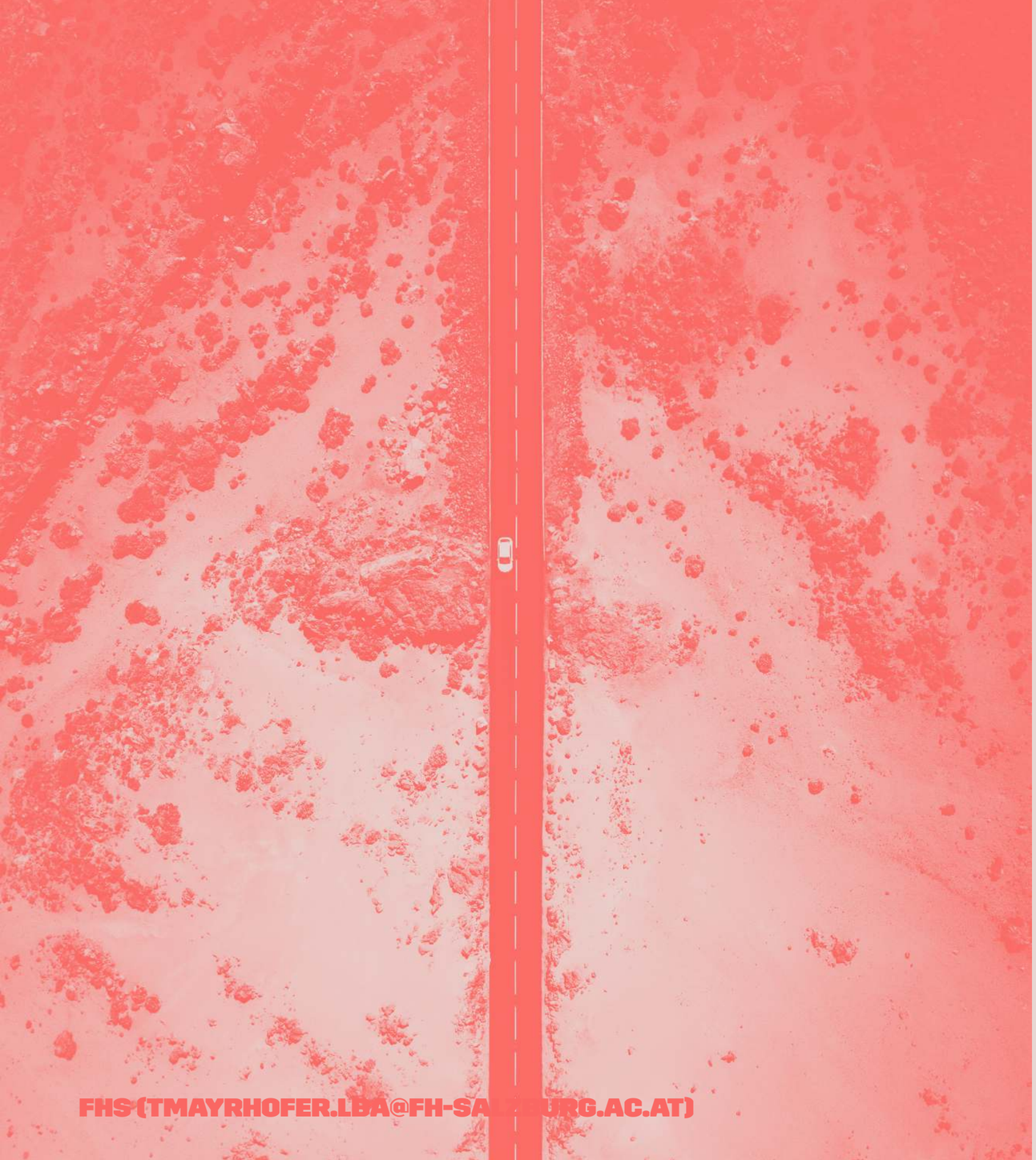
CODE SPLITTING [5]

React.lazy

"The React.lazy function lets you render a dynamic import as a regular component."

```
const OtherComponent = React.lazy(() => import('./OtherComponent'));
//                                       ^^^^^^
// dynamically import `./OtherComponent` when the component is rendered
// for the first time.
// `./OtherComponent` needs to be exported as default
```

[5] source https://reactjs.org/docs/code-splitting.html



CODE SPLITTING [5]
React.Suspense

» importing modules dynamically is an async operation

» a loading screen needs to be displayed

“React.Suspense lets components “wait” for something before rendering.”

[5] source https://reactjs.org/docs/code-splitting.html

CODE SPLITTING [5]
React.Suspense

```
import React, { Suspense } from 'react';

const OtherComponent = React.lazy(() => import('./OtherComponent'));

function MyComponent() {
  return (
      <Suspense fallback={<div>Loading...</div>}>
        <OtherComponent />
      </Suspense>
  );
}
```

[5] source https://reactjs.org/docs/code-splitting.html

FEEDBACK

» Questions: tmayrhofer.lba@fh-salzburg.ac.at

» https://s.surveyplanet.com/x1ibwm85