

Web Dev 1

CS571: Building User Interfaces

Cole Nelson & Yuhang Zhao

Before Lecture

- Install Node 20 and NPM 10
- Clone today's code to your machine.
 - Run the command `npm install` inside of the `starter` folder.

Disclaimer

As with JS, this is not a comprehensive introduction to React, so be sure to check out the [React Docs](#).

Avoid legacy.reactjs.org

Learning Objectives

1. Understand the history and motivation for React
2. Be able to set up and build a basic React project
3. Differentiate between traditional web programming and React, including the use of JSX
4. Deconstruct websites into their basic components
5. Use the `useState` and `useEffect` hooks

What is React?

Definition: Also called ReactJS, React is a JS library for building user interfaces.

- Developed by Facebook, dating back to 2010.
- Started as an internal development tool, then open-sourced in 2013.

[More on the history of React](#)

Why should we use React?

Among many reasons, it **abstracts away interactions with the DOM** and enables a more **declarative** way of constructing the user interface via **components**.

Similar Alternatives: Angular, Vue, Svelte

Traditional Component Construction

`getElement` , `createElement` , and `appendChild`

```
// Set the instructions
const instructionsHTML = document.getElementById("instructions");
for(let step of data.recipe) {
  const node = document.createElement("li");
  node.innerText = step;
  instructionsHTML.appendChild(node)
}
```

This gets quite long with many children! It also focuses on the **how** rather than the **what**.

Traditional Component Construction

`innerHTML` focuses on the **what, but...**

```
let html = `<div>`;
html += `<h2>${stud.name.first} ${stud.name.last}</h2>`;
html += `<p><strong>${stud.major}</strong></p>`;
html += `</div>
document.getElementById('students').innerHTML = studentHtml;
```

...it is dangerous with untrusted input!

XSS

Cross-Site Scripting (XSS) attacks are a type of injection, in which malicious scripts are injected into otherwise benign and trusted websites.

Remember: You supplied the data in HW0!

OWASP Definition

The Virtual DOM

Abstracting away direct changes to the DOM.



The Virtual DOM

Rather than updating the `document` ourselves, we describe to React **what** we want to display, and then React does the updating for us!

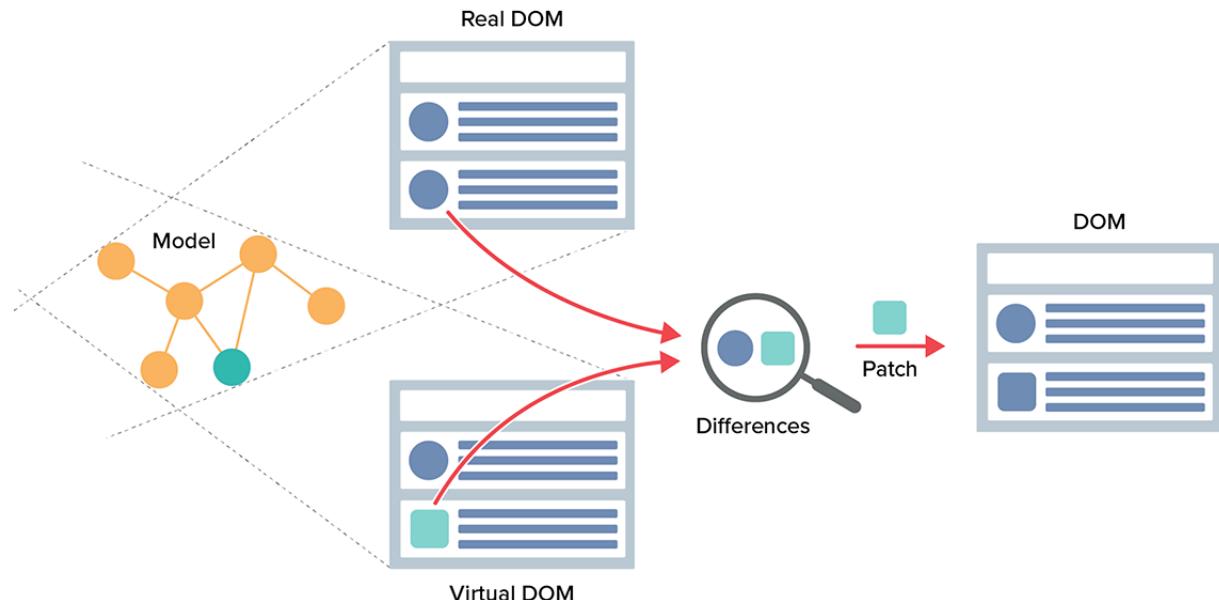
```
function Person(props) {  
  return <div>  
    <p>Hi! My name is {props.name} and I am {props.age} years old.</p>  
  </div>  
}
```

As `name` and `age` change, React will "react" and re-render the component with the new values.

Reconciliation

This is done through periodic *reconciliation*.

Reconciliation is the process of *diffing* and syncing the virtual and real DOM to render changes for the user.



[Image Source](#)

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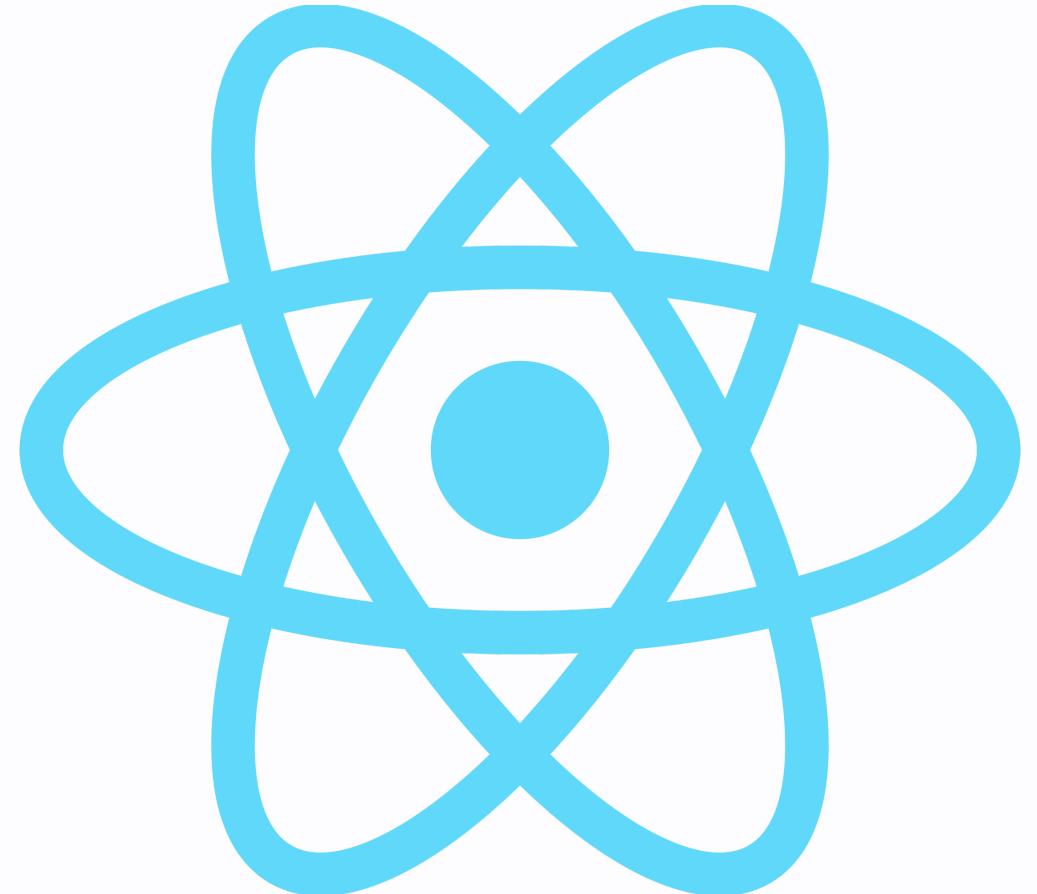
React DOM

react itself is platform-agnostic! It is simply an efficient tree reconciler

react-dom does the document transcription

React

by Meta





React in 100 Seconds

Getting Started

For an existing React project, you simply need to...

```
npm install  
npm run dev
```

Clone, install, and start the starter code. You can install and start the completed code later.

This has `react-bootstrap` installed.

You may need to run this with `sudo`. Do *not* save in OneDrive.

What did I just run?

`npm install` downloads the necessary dependencies from npmjs.com specified in your `package.json` to a folder called `node_modules`

`npm run dev` starts a local webserver. We don't open `index.html` anymore -- we go to `localhost:5173`

React 101

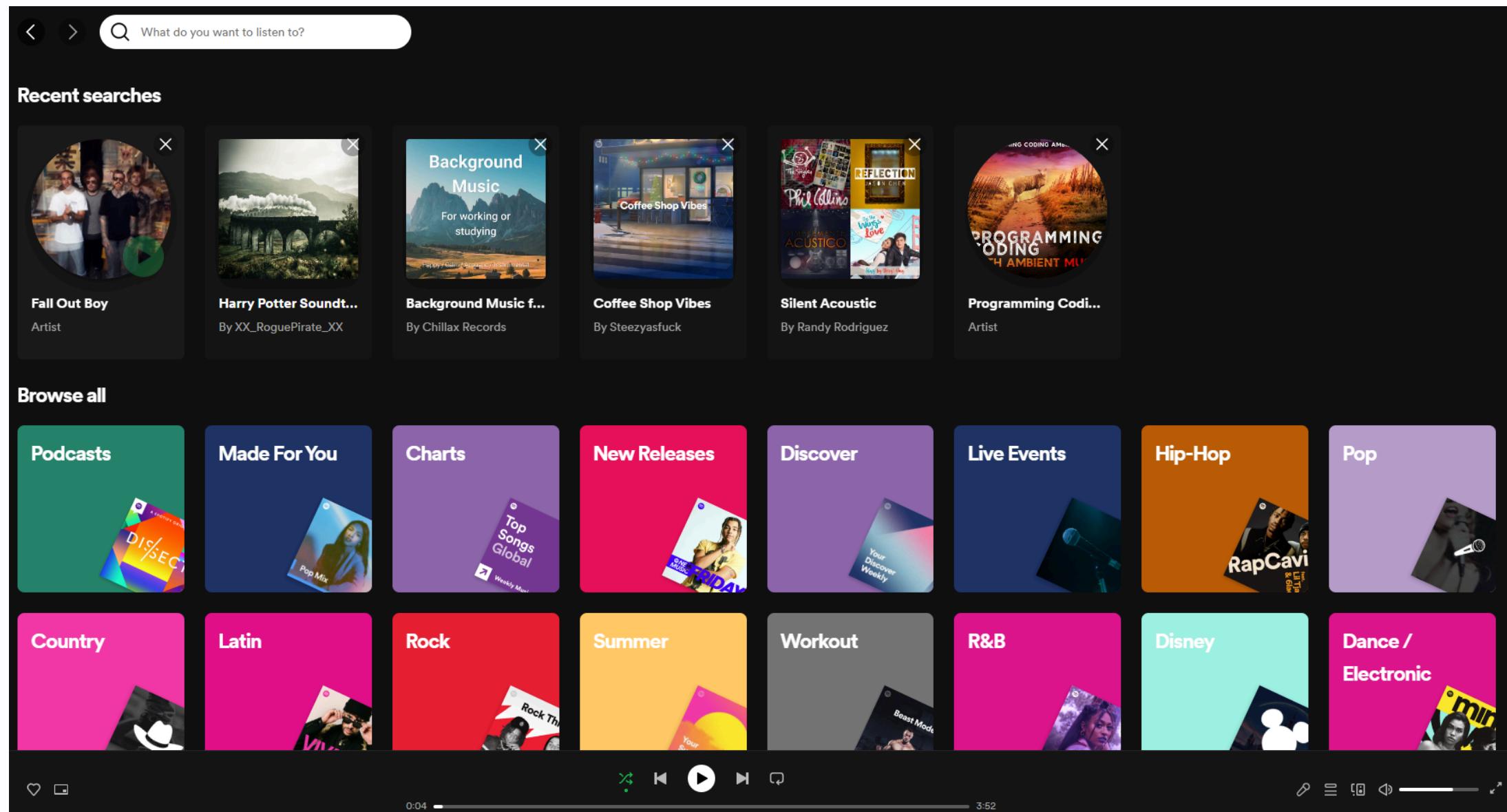
Thinking in a "reactive" way.

React Component Basics

In React, every *thing* is a component. What is a *thing*?

- Similar question: *what defines a class in Java?*
- Some re-usable piece of the interface.
- May have many children, but only one parent.

Identify components in the next slide...



Spotify Deconstruction

- Spotify
 - HeaderBar
 - MainContent
 - RecentSearches
 - Card[]
 - BrowseAll
 - Card[]
 - BottomBar

Your answers may vary! That's okay!

Note: Class vs Functional Components

A class component looks like this...

```
class Welcome extends React.Component {  
  render() {  
    return <div>  
      <h1>Hello World!</h1>  
      <p>This is my website.</p>  
    </div>  
  }  
}
```

Functional components were introduced in React 16.8.
We will not cover class components in this course.

React Component Basics

A functional component looks like this...

```
function Welcome() {  
  return <div>  
    <h1>Hello World!</h1>  
    <p>This is my website.</p>  
  </div>  
}
```

It returns a *single* element of JSX. If you have more than one element, you can return a div `<div></div>` or fragment `<></>`.

React Component Basics

JSX is a syntax that combines HTML, CSS, and JSX.

```
function Welcome(props) {  
  return <div>  
    <h1>Hello World!</h1>  
    <p>{props.msg}</p>  
  </div>  
}
```

{ } interpolates any JS *expression* and *safely* inserts it into the DOM. JSX is transpiled into HTML, CSS, and JS at runtime.

React Component Basics

For example, you can specify styling by interpolating a JavaScript object into your JSX.

```
function Welcome(props) {  
  return <div style={{border: "dotted", padding: "1rem"}}>  
    <h1>Hello World!</h1>  
    <p>{props.msg}</p>  
  </div>  
}
```

Side Note: Specify a CSS class with `className` rather than `class`

React Component Basics

```
function Person() {  
  return <div style={{border: "dotted", padding: "1rem"}}>  
    <h2>Cole Nelson</h2>  
    <p>26 years old</p>  
    <p>Works as a(n) Instructor</p>  
  </div>  
}
```

This is *good*, but...

StackBlitz

React Component Basics

```
function Person(props) {  
  return <div style={{border: "dotted", padding: "1rem"}}>  
    <h2>{props.name}</h2>  
    <p>{props.age} years old</p>  
    <p>Works as a(n) {props.role}</p>  
  </div>  
}
```

... this is even better!

StackBlitz

React Component Basics

Why? It's re-usable!

```
function App() {
  return <div>
    <h1>People</h1>
    <Person name={"Cole Nelson"} age={26} role={"Instructor"} />
    <Person name={"Zach Potter"} age={24} role={"Teaching Assistant"} />
  </div>
}
```

Notice: `props` are passed down as key-value pairs.

StackBlitz

Your Turn!

Construct a Recipe to display a...

- name
- author
- keywords (as a single string, e.g. "rich comforting")

Use any recipe!

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Classic Margherita Pizza

by OpenAI

described as Italian, traditional, simple, delicious

Syntactic Sugar 🍬

Use the `...` spread operator to pass down many props all at once.

```
const TA = {name: "Zach Potter", age: 24}

function YellowPages() {
  return <div>
    <Person {...TA}></Person>
  </div>
}
```

Syntactic Sugar 🍬

If the component does not take any children, you can even write it shorthand!

```
const TA = {name: "Zach Potter", age: 24}

function YellowPages() {
  return <div>
    <Person {...TA} />
  </div>
}
```

Syntactic Sugar

A component receiving `props` can explicitly deconstruct them before use.

```
function Person(props) {  
  // Access via props object, e.g. `props.name`, `props.age`  
  return ...  
}
```

```
function Person({name, age}) {  
  // Access directly, e.g. `name`, `age`  
  return ...  
}
```

Design Sugar



React-Bootstrap is Bootstrap for React! You can import existing components such as `Card`, `Button`, and more! Beware of your imports!

```
import { Card, Button } from 'react-bootstrap'

export default function Person({name, age}) {
  return <Card>
    <p>Hi! My name is {name} and I am {age} years old.</p>
    <Button onClick={() => alert('hello!')}>Say hello!</Button>
  </Card>
}
```

Imports and Exports

React-Bootstrap exports many components, we import them with curly braces, e.g.

```
import { Card, Button } from 'react-bootstrap'
```

We typically `export` one component by `default` (see last slide) and `import` directly as...

```
import Person from './person' // Use relative pathing for local files
```

Callback Handlers

In React, event listeners take *callback functions* as a parameter -- not function calls!

Correct!

```
<Button onClick={() => alert('hello!')}>Say hello!</Button>
```

Incorrect!

```
<Button onClick={alert('hello!')}>Say hello!</Button>
```

Reactive State Basics

We often use event listeners to *mutate state*.

Whereas *props* is given by the parent component, *state* is managed internally.

```
const [name, setName] = useState("James");
```

We get back a read-only variable and a mutator function; **do not mutate the variable directly!** Use the mutator function.

Reactive State Basics

State variables declared with `useState` are **reactive**, meaning that a change to its state (via its mutator function) will trigger a re-render!

```
setName("Jim") // Will trigger a re-render!
```

This re-render will happen in the *near future*, causing the function to be ran again. **Initial state is only set on component mount.**

Reactive State Basics

```
function Person(props) {
  const [name, setName] = useState();

  function giveName() {
    const allNames = ["Amy", "Ben", "Eli", "Ian", "Leo", "Mia"];
    const randI = Math.floor(Math.random() * allNames.length);
    setName(allNames[randI]);
  }

  return <div>
    <h1>My name is {name}.</h1>
    <button onClick={giveName}>Give New Name</button>
  </div>
}
```

Detour: Conditional Rendering

```
<h1>My name is {name}.</h1>
```

The initial render isn't ideal... How can we handle this?

```
{name ? <h1>My name is {name}.</h1> : <p>I don't have a name yet...</p>}
```

You control what is returned; **do a conditional render!**
Remember that `{}` will interpolate any JS expression.

Reactive State Basics

```
function Person(props) {
  const [name, setName] = useState();

  function giveName() {
    const allNames = ["Amy", "Ben", "Eli", "Ian", "Leo", "Mia"];
    const randI = Math.floor(Math.random() * allNames.length);
    setName(allNames[randI]);
  }

  return <div>
    {name ? <h1>My name is {name}.</h1> : <p>I don't have a name yet...</p>}
    <button onClick={giveName}>Give New Name</button>
  </div>
}
```

Reactive State Basics

Finally, add a `console.log('My name is', name)` immediately after calling `setName` and click the button again... What do you notice?

My name is undefined

It is its previous value, why do you think this is?

[StackBlitz](#)

Reactive State Basics

Setting state happens *asynchronously!*

Just because the food is cooked doesn't mean the server has already brought it to the table!

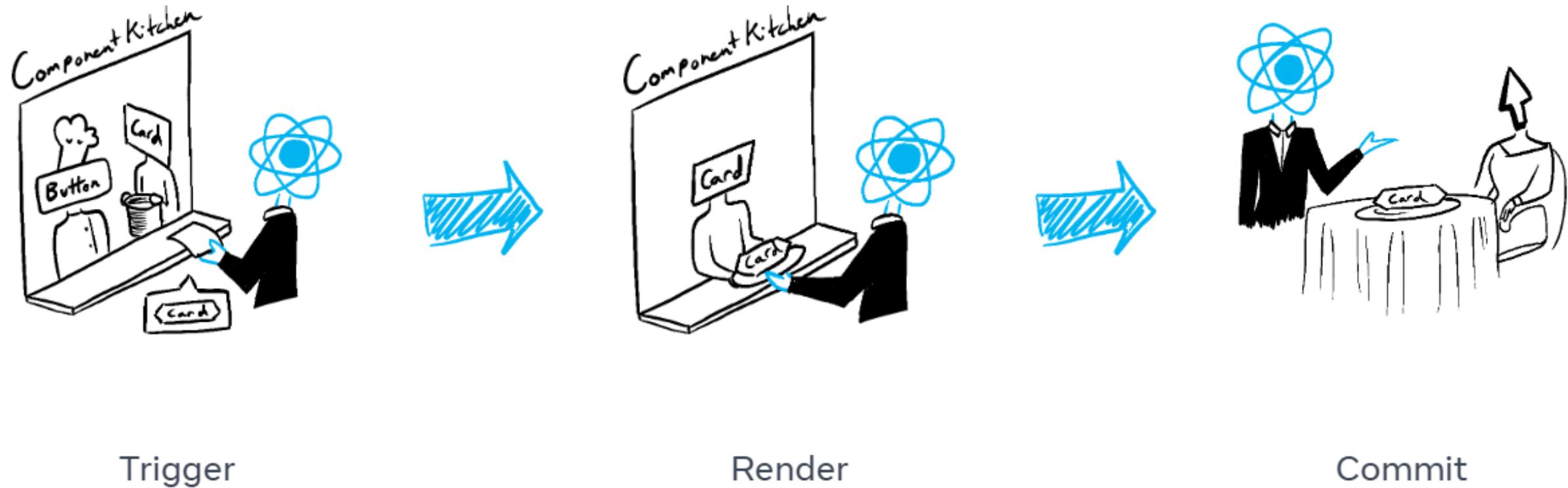


Illustration by Rachel Lee Narbors

Your Turn!

Display a Recipe for each recipe as well as a like button that increases the number of likes for *that* recipe.

Optional: Make use of Bootstrap components like Card and Button



Classic Margherita Pizza

by OpenAI | 7 likes

described as Italian, traditional, simple, delicious

Like this Recipe

2 Ways to Set State

- `setLikes(0)` overwrites the existing value
- `setLikes(old => old + 1)` updates existing value

The second notation (using a *callback function*) is never a wrong answer, it can just be verbose. What you return is what the state will be set as.

fetch 'ing data with `useEffect`

`useEffect` allows us to run a function at a particular stage of the update cycle.

```
useEffect(() => {  
  // This code will ONLY be run on component mount.  
}, []); // <-- Don't forget the []!
```

We will be covering some other ways to use `useEffect` next lecture!

fetch 'ing data with useEffect

```
fetch("https://cs571api.cs.wisc.edu/rest/f24/ice/pizza", {  
  headers: {  
    "X-CS571-ID": CS571.getBadgerId()  
  }  
})  
.then(res => res.json())  
.then(data => {  
  console.log("Received pizza!", data);  
  setPizza(data);  
})
```

What would happen if this was not within a useEffect
that only runs on mount?

```
function PizzaDisplayer() {
  const [pizza, setPizza] = useState();
  fetch("https://cs571api.cs.wisc.edu/rest/f24/ice/pizza", {
    headers: {
      "X-CS571-ID": CS571.getBadgerId()
    }
  })
  .then(res => res.json())
  .then(data => {
    setPizza(data);
  });
  return <p>{JSON.stringify(pizza)}</p>
}
```

The function runs. The `fetch` changes the state. This triggers a re-render, running the function. ↴

```
function PizzaDisplayer() {
  const [pizza, setPizza] = useState();
  useEffect(() => {
    fetch("https://cs571api.cs.wisc.edu/rest/f24/ice/pizza", {
      headers: {
        "X-CS571-ID": CS571.getBadgerId()
      }
    })
    .then(res => res.json())
    .then(data => {
      setPizza(data);
    });
  }, [])
}

return <p>{JSON.stringify(pizza)}</p>
}
```

Much better! This will *only* run the `fetch` on mount.

Rendering Basics

A component will re-render shortly after...

1. Its `props` changes
2. Its state changes

We will expand on this lifecycle next lecture!

Your Turn!

fetch the data for the recipes instead of using the hardcoded data!

Hint: You'll need to create 3 state variables, we'll explore a better way in the next lecture!



Classic Margherita Pizza

by OpenAI | 7 likes

described as Italian, traditional, simple, delicious

Like this Recipe

It's not working!

A laundry list of common problems we experience...

Blank Screen

Use your Developer Tools! (F12)

Check both the "Console" and "Network" tabs.

HTTP 401

Unauthorized... Are you passing a X-CS571-ID header?

HTTP 429

Too many requests...

```
useEffect(() => {  
    // your code here!  
}, []) // <--- don't forget me!
```

... did you forget the
empty dep. array?

	Status	Type	Initiator	Size	Time
ured-baked-good	200	fetch	BadgerBakery...	307 B	101 ms
ured-baked-good	200	fetch	BadgerBakery...	587 B	173 ms
ured-baked-good	200	fetch	BadgerBakery...	587 B	168 ms
ured-baked-good	200	fetch	BadgerBakery...	587 B	171 ms
ured-baked-good	429	fetch	BadgerBakery...	0 B	160 ms
ured-baked-good	429	fetch	BadgerBakery...	0 B	356 ms

quests | 110 kB transferred | 4.1 MB resources | Finish: 1.1 min

X is not defined

Did you import it? e.g.

Common React Imports

```
import { useState, useEffect } from "react";
```

- ✖ ➔ Uncaught ReferenceError: Button is not defined
at BakedGood ([BakedGood.jsx:20:14](#))
- ✖ ➔ Uncaught ReferenceError: Card is not defined
at BakedGood ([BakedGood.jsx:15:13](#))

Common Bootstrap Imports

```
import { Button, Card } from "react-bootstrap";
```

Empty State

Setting state is asynchronous!

```
const [name, setName] = useState("James");
console.log(name);
setName("Jim");
console.log(name); // still James!
```

We will talk about more ways to `useEffect` next time.

Questions?