React 4

CS571: Building User Interfaces

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Today's Warmup

- Clone today's code to your machine.
  - Run the command `npm install` inside of the `starter` and `solution` folders.
- Download the HW6 Postman Collection

Other Announcements

1. Get started on projects **early!**
   a. Done > Started > Empty
   b. Perfect === 🦄
2. Midterm exam is on Thursday, Oct 26th @ 5:45 pm.
   a. No class during the afternoon.
   b. Old exams are on Canvas.
   c. You will have 1 hour for 30 MC problems.
   d. You may bring a **single-sided** notesheet.
   e. Conflict? Let us know ASAP.

Last Time...

We covered routing and state sharing.

Routing

We can create multi-page applications!

```
<BrowserRouter>
  <Routes>
    <Route path="/" element={<Layout />}>
      <Route index element={<Home />} />
      <Route path="about-us" element={<AboutUs />} />
      <Route path="other-info" element={<OtherInfo />} />
      <Route path="*" element={<Home />} />
    </Route>
  </Routes>
</BrowserRouter>
```

State Management

How do we talk back to our parent? How do siblings talk to each other?

- Using callbacks
- Using `useContext`
- Using `sessionStorage` and `localStorage`
- Using cookies and an API (next time!)
- Using third-party libraries like (on your own!)...
  - Redux, Recoil, MobX, XState

How do we persist data...

...permanently? and share with others?

What will we learn today?

- How can we store data more persistently?
- How do we work with "complex" APIs?
- What are the differences between controlled and uncontrolled components?
  - How can we use `useRef`?
- How to keep a secret? 🤫
- What is "memoization"?

Working with Complex APIs

Beyond GETting data...

Scenario

You are building a database system. What operations should you allow a developer to perform?

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You are building a database system. What operations should you allow a developer to perform?

1. **C**reate data.
2. **R**ead data.
3. **U**pdate data.
4. **D**elete data.

CRUD Operations via HTTP

CRUD Operation	HTTP Operation
Create	POST
Read	GET
Update	PUT
Delete	DELETE

HTTP Recap

Data is transmitted by requests and responses that allow us to create (POST), read (GET), update (PUT), and delete (DELETE) data!

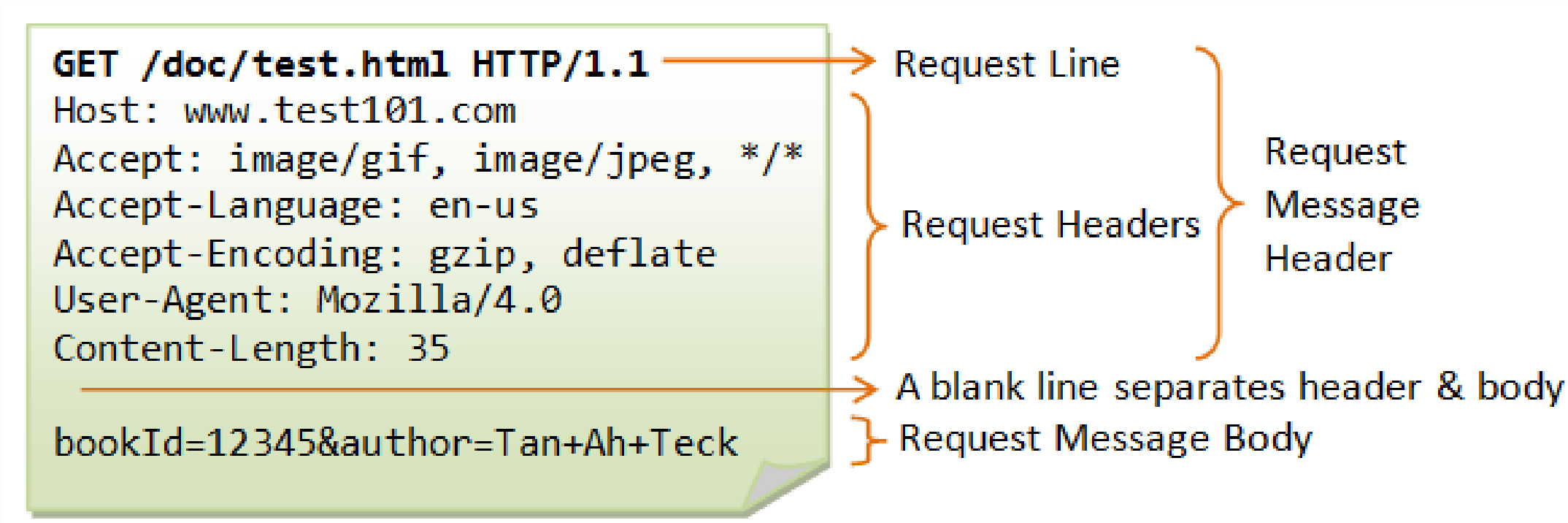


Image Source

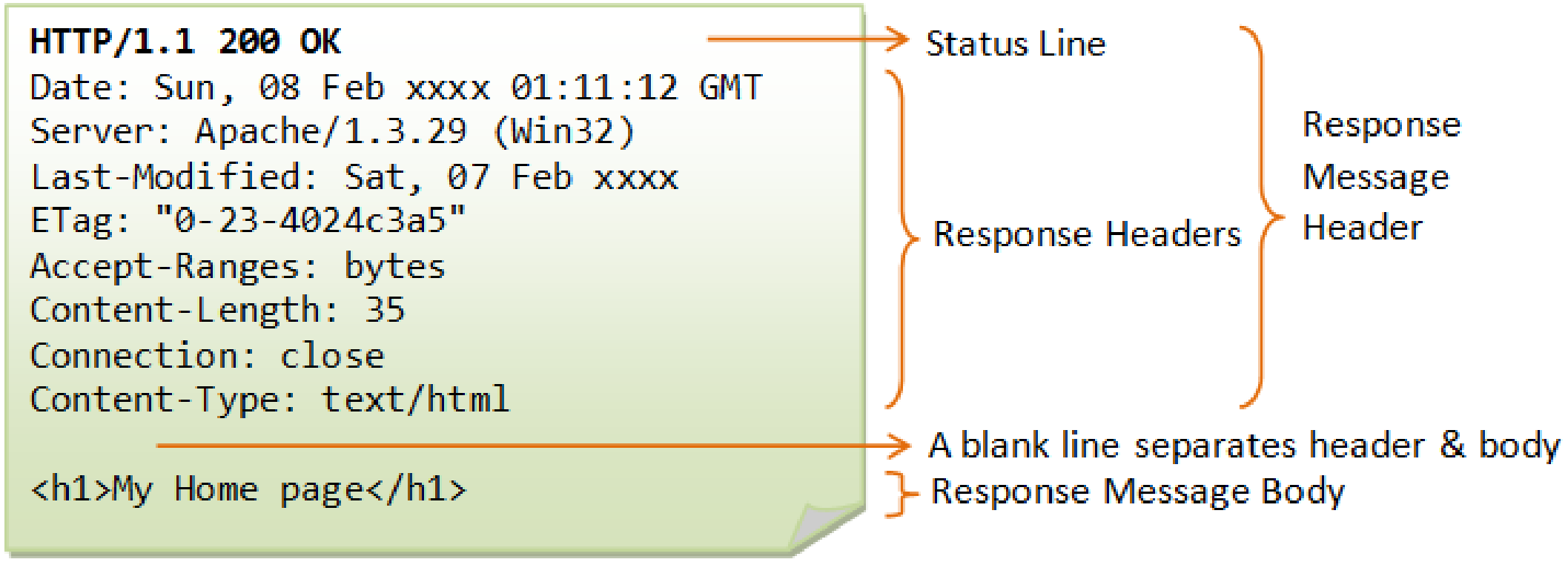


Image Source

HTTP Recap

An HTTP request may have *path* and *query* parameters

```
https://www.example.com/packers/AaronRodgers/stats?all=true&since=2010
```

Here, `AaronRodgers` is a *path* parameter while `all` and `since` are *query* parameters.

Usage depends on the API documentation.

HTTP Recap

HTTP requests (specifically `PUT` and `POST`) may also have a *request body*. This is located below the headers.

```
{
    "title": "Hello world!",
    "content": "abc123",
}
```

For a JSON body, we need an additional HTTP header.

`Content-Type: application/json`

HTTP Status Codes

HTTP Code	Response Type
100s	Informational
200s	Successful
300s	Redirection
400s	Client Error
500s	Server Error

HTTP Specific Status Codes

HTTP Code	Response
200	OK
304	Not Modified
400	Bad Request
401	Unauthorized
404	Not Found
409	Conflict
413	Request Entity Too Large
500	Internal Server Error

What is this "HTTPS" I hear about?

The "secure" version of HTTP.

Same thing as the HTTP protocol with end-to-end encryption. We use HTTPS for our API.

```
{
  "username": "joe_schmoe21",
  "password": "mysecret123!"
}
```

This is only secure because of *HTTP**S***!

Week 6 API

Use Postman to `POST` a ticket.

Fetching w/ `POST`, `PUT`, and `DELETE`

`fetch` can do a lot more than just retrieving data.

- specify request method
- specify request headers
- specify request body
- inspect response status
- inspect response headers
- inspect response body
- ...and so much more!

```
fetch("https://example.com/create-content", {
    method: "POST",
    headers: {
        "Content-Type": "application/json" // must include this header
    },
    body: JSON.stringify({ // must stringify
        content: "Hello World!"
    })
}).then(res => {
    if (res.status === 409) {
        alert("This content already exists!")
    }
    return res.json();
}).then(json => {
    if (json.msg) {
        alert(json.msg)
    }
});
```

Your Turn!

Create *controlled* components for a user to type in their title and content.

When the user clicks "Create Ticket", `POST` the ticket to the API and reload the tickets on the screen.

Detour: Uncontrolled Components

Sometimes, we care about listening to form changes.

Other times, **we don't**. Notice that we didn't care about the changes to *name* and *description*.

In cases like these, we can use *uncontrolled components*.

Handling Text Input

We can get user input using the HTML `input` tag or the React-Bootstrap `Form.Control` component.

We can get user input...

- in a *controlled* way using its `value` and tracking `onChange` events
- in an *uncontrolled* manner using `useRef`.

`useRef` Hook

Usually used to "reference" an input element.

```
const inputVal = useRef();
return (
  <div>
    <label htmlFor="myInput">Type something here!</label>
    <input id="myInput" ref={inputVal}></input>
  </div>
);
```

The value of a ref can be retrieved via its `current` property, e.g. `inputVal.current.value`

Controlled vs Uncontrolled Components

`useRef` is used to create a reference to an *uncontrolled* input component.

This is opposed to *controlling* an input component via its `value` and `onChange` properties.

Example of an uncontrolled input component.

Example of a controlled input component.

Controlled vs Uncontrolled: Pros & Cons

React generally recommends controlled components.

Controlled components can cause many re-renders, however uncontrolled components give you no control over the `onChange` property.

We'll practice using both.

Input Best Practices

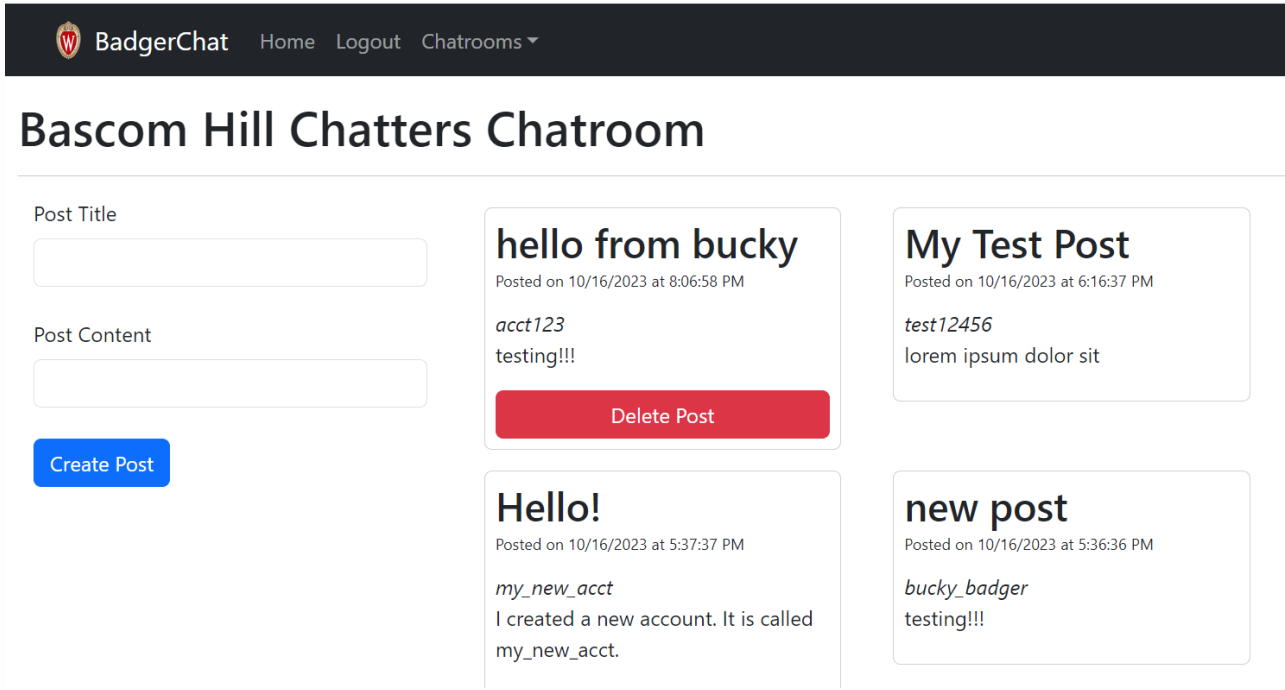
In either case, each `input` should have an `id` associated with the `htmlFor` of a `label`.

If you are using react-bootstrap components, be sure each `Form.Control` has an `id` associated with the `htmlFor` of a `Form.Label`.

Read more here.

HW6 Demo

BadgerChat! 



Credentialed Requests

Using cookies for a user's session.

Secrets! Secrets!

Is there anything **special** about requests for logging in? Kind of! We must include credentials.

It varies from system to system, but typically we POST a username and password in the request body to an authentication endpoint and recieve a cookie.

e.g. `POST /register` or `POST /login`

Secrets! Secrets!

These endpoints return a session for the user, in HW6 this is in the form of a cookie containing a JavaScript Web Token (JWT).

This is a temporary, all-access token for authenticating with the API. It is used in lieu of a username and password. Why might we do this?

Secrets! Secrets!

A session is typically stored in an http-only cookie.

An HTTP-Only cookie is not accessible by JavaScript.

Why might we want this?

Secrets! Secrets!

Because `cs571.org` is a different domain than `localhost`, we must also *explictly* include credentials to every endpoint affecting authorization...

This includes logging in, logging out, and posting!

```
fetch("https://example.com/api/submit", {
  method: "POST",
  credentials: "include",
  // ...
```

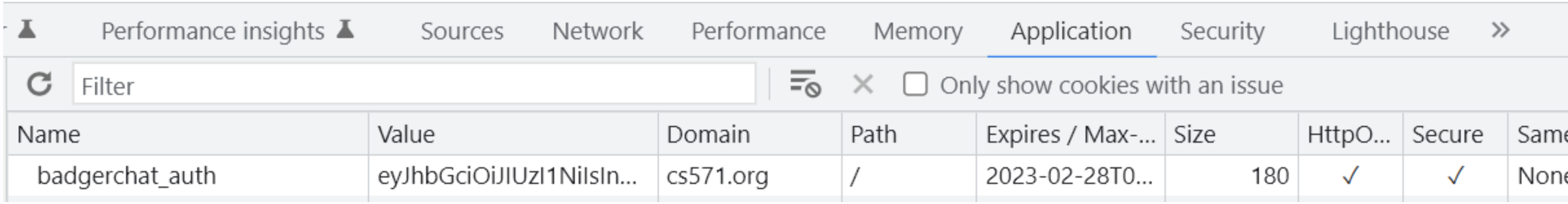
```
fetch("https://example.com/create-content", {
    method: "POST",
    credentials: "include", // add this to requests related to cookies!
    headers: {
        "Content-Type": "application/json"
    },
    body: JSON.stringify({
        content: "Hello World!"
    })
}).then(res => {
    if (res.status === 409) {
        alert("This content already exists!")
    }
    return res.json();
}).then(json => {
    if (json.msg) {
        alert(json.msg)
    }
});
```

Reading the Docs

Go over the HW6 API documentation.

Secrets! Secrets!

What's the benefit? The browser handles all things authentication! 🥳🎉



HW6 Technical Demo

Go over the HW6 API documentation and use Postman.

Memoization

Not memorization!

Memoization

Storing the result so you can use it next time instead of calculating the same thing again and again

what the frik is: memoization

`useCallback` to memoize functions

`useMemo` to memoize calculated values

`memo` to memoize components

`useCallback` Hook

Consider the following functional component...

```
function MyApp() {
  const myComplicatedFunction = () => {
    // ...
  }

  return <>
    <button onClick={myComplicatedFunction}>Click Me</button>
  </>
}
```

How many times do we *create* the function `myComplicatedFunction`? We do on *every render*!

`useCallback` Hook

`useCallback` is used to 'memoize' a callback function.

```
function MyApp() {
  const myComplicatedFunction = useCallback(() => {
    // ...
  }, []);

  return <>
    <button onClick={myComplicatedFunction}>Click Me</button>
  </>
}
```

Takes a callback function to 'memoize' and an optional list of dependencies (e.g. when to re-'memoize').

`useMemo` Hook

Same thing as `useCallback`, except memoizes the *value* of a *callback* rather than the *callback* itself.

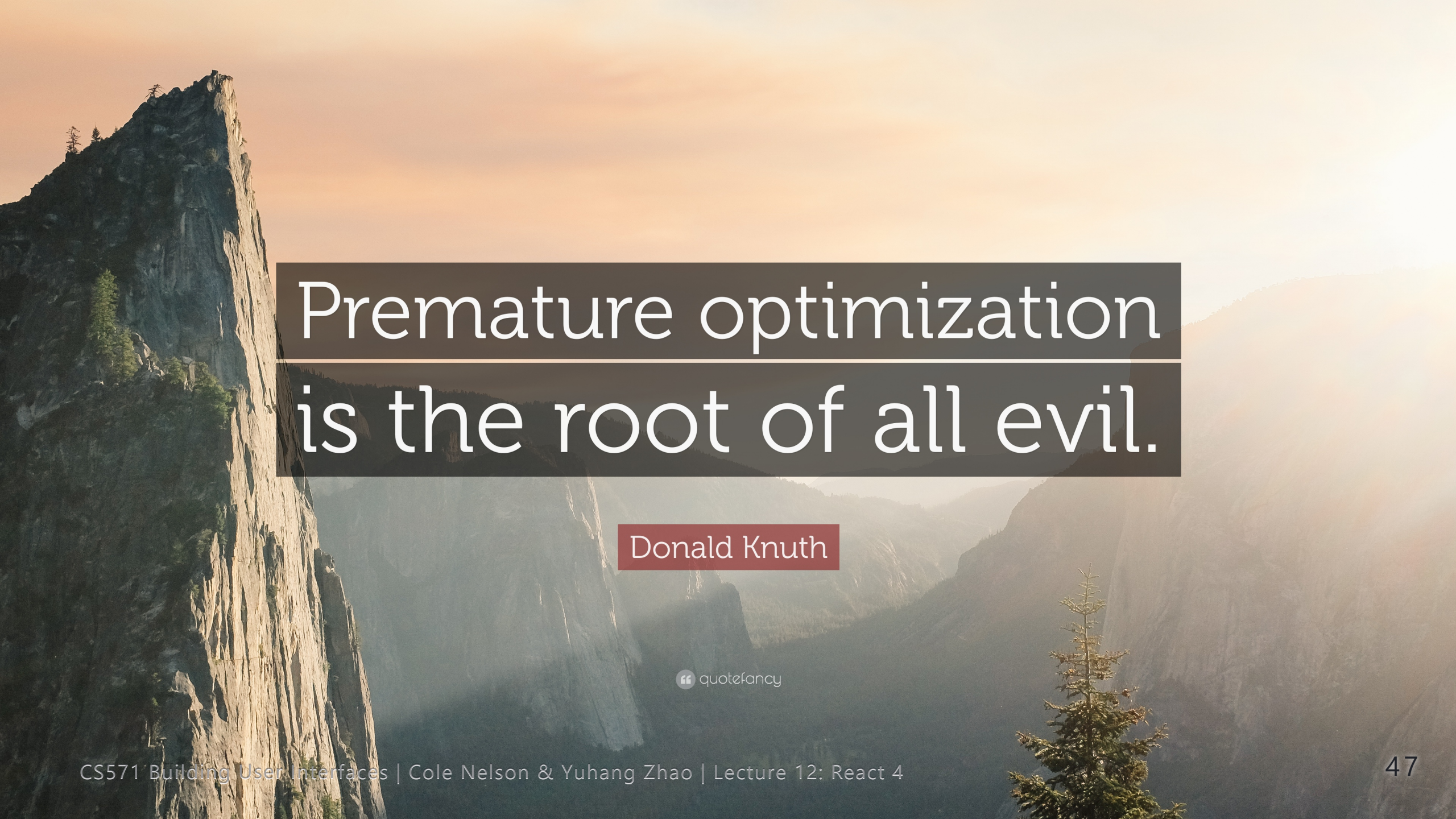
```
function MyApp() {
  const myComplicatedValue = useMemo(() => { /* Some complex call */}, []);

  return <>
    <p>{myComplicatedValue}</p>
  </>
}
```

`memo` -ized Components

Used for creating *purely functional* components. Given the same props, the function renders the same output.

```
//                      v--- Name of functional component!
export default memo(GroceryList, (prevProps, nextProps) => {
  return prevProps.apples === nextProps.apples &&
    prevProps.bananas === nextProps.bananas &&
    prevProps.coconuts === nextProps.coconuts;
})
```

See StackBlitz for `useCallback`, `useMemo`, and `memo`


Premature optimization is the root of all evil.
Donald Knuth
quotefancy

A Plea for Lean Software

Niklaus Wirth
ETH Zürich

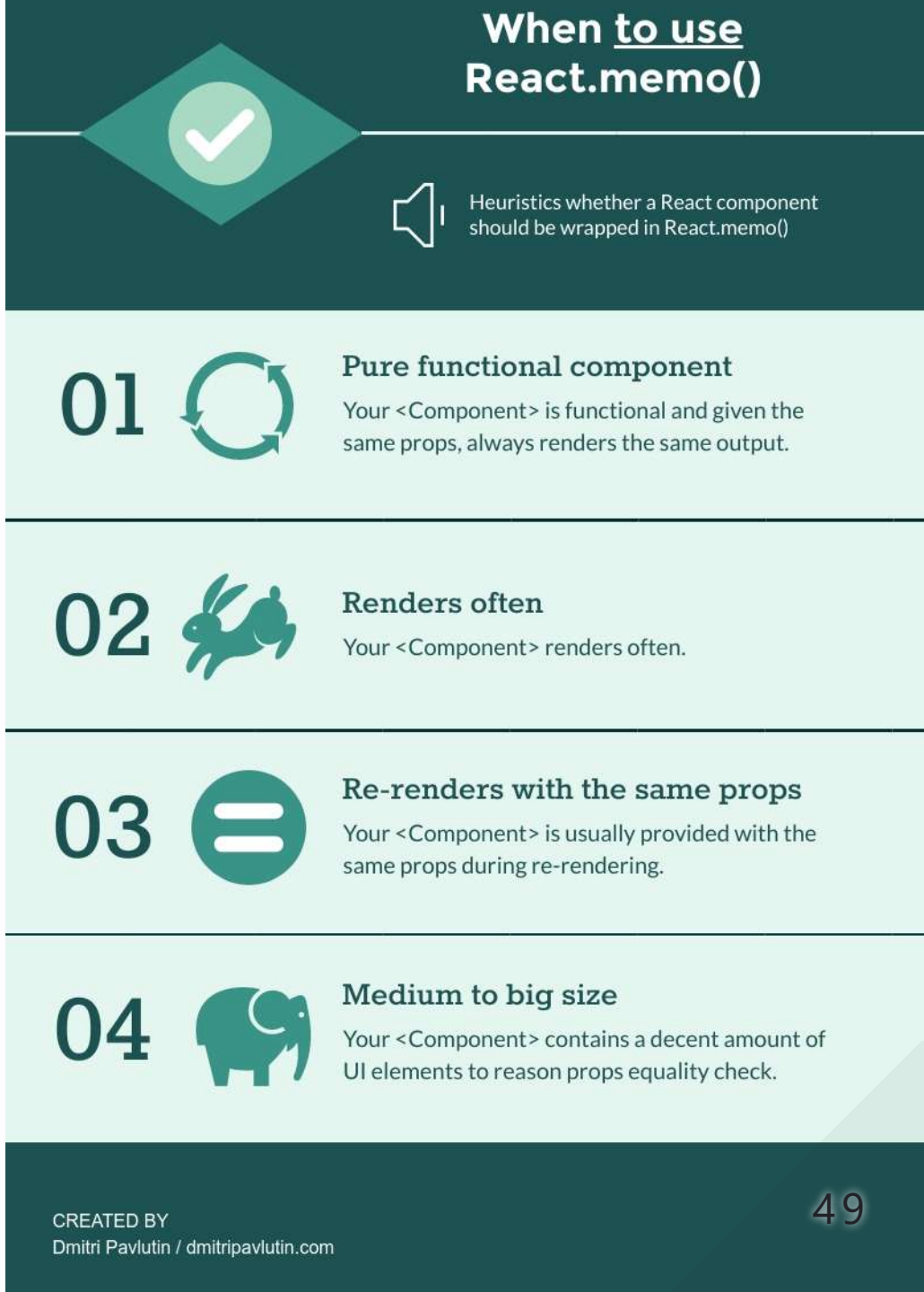
Memory requirements of today's workstations typically jump substantially—from several to many megabytes—whenever there's a new software release. When demand surpasses capacity, it's time to buy add-on memory. When the system has no more extensibility, it's time to buy a new, more powerful workstation. Do increased performance and functionality keep pace with the increased demand for resources? Mostly the answer is no.

About 25 years ago, an interactive text editor could be designed with as little as 8,000 bytes of storage. (Modern program editors request 100 times that much!) An operating system had to manage with 8,000 bytes, and a compiler had to fit into 32 Kbytes, whereas their modern descendants require megabytes. Has all this inflated software become any faster? On the contrary. Were it not for a thousand times faster hardware, modern software would be utterly unusable.

Finding a Balance

1. Given the same input, renders the same output.
2. Is rendered often.
3. Does not change often.
4. Is of substantial size.

Dmitri Pavlutin Blog Post



Badger Bingo

Cumulative example, see StackBlitz.

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- What is "memoization"?

Questions?