<WA/>
2025

React Life Cycle

Making React Components Alive

Fulvio Corno
Luigi De Russis
Enrico Masala

https://react.dev/learn/lifecycle-of-reactive-effects

https://react.dev/learn/synchronizing-with-effects

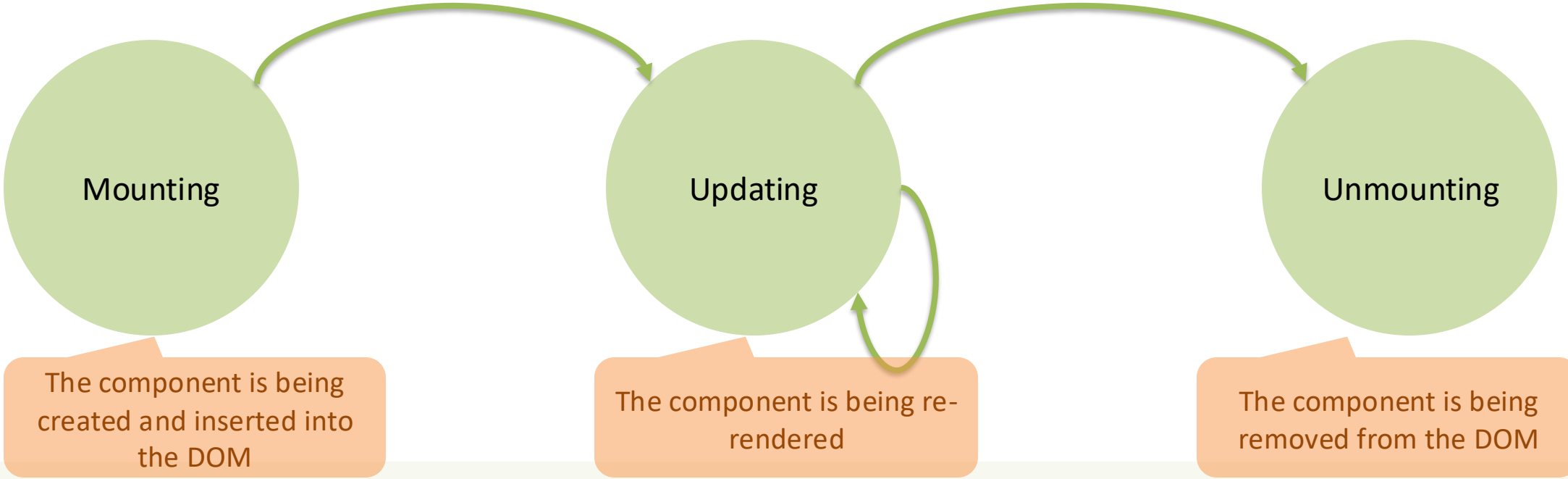
Full Stack React, Chapter “Advanced Component Configuration with props, state, and children”

There’s life before and after `return<JSX>`

COMPONENTS’ LIFECYCLE

Lifecycle Events

- The render action is the most important one for a component
- However, it is also useful to customize what happens at different moments in the evolution of the component



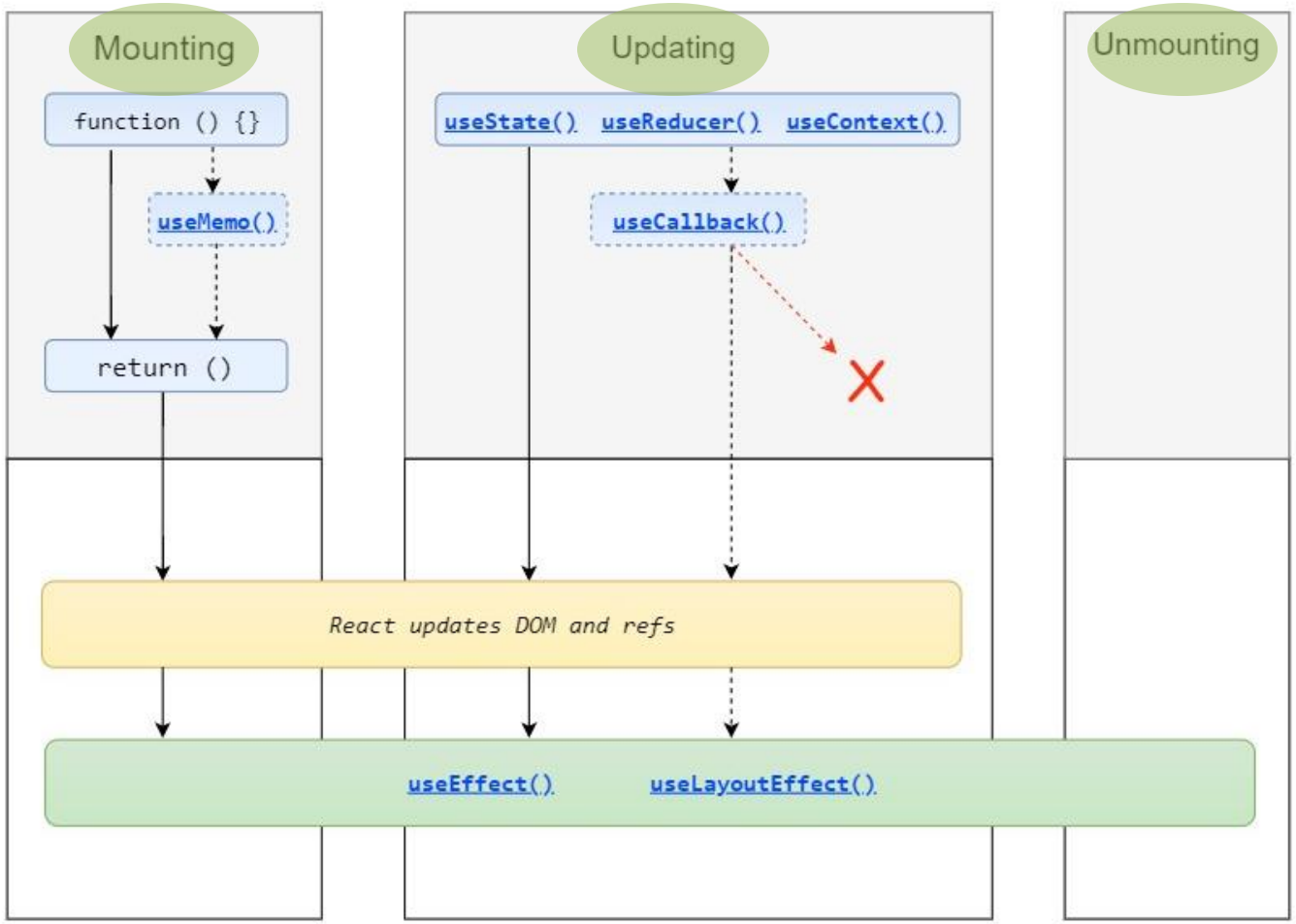
React Hooks Lifecycle

"Render phase"

Pure and has no side effects. May be paused, aborted or restarted by React

"Commit phase"

Can work with DOM, run side effects, schedule updates.



Made with ❤️ by Gal Margalit. Feel free to contribute and share wavez/react-hooks-lifecycle

Side Effects in Function Components

- A functional React component uses props and state to calculate its output
- **Side effect**: any calculation that do not target the output values, anything that affects something *outside the scope of the function component* being executed
- Examples of side effects:
  - **Data fetching**
  - Log recording
  - Setting up a subscriptions (handlers, etc.), or removing them
  - Scheduling additional actions when some state values change
  - Manually changing the DOM in React components
  - Managing timeouts and interval timers
  - …

Side Effects in Function Components

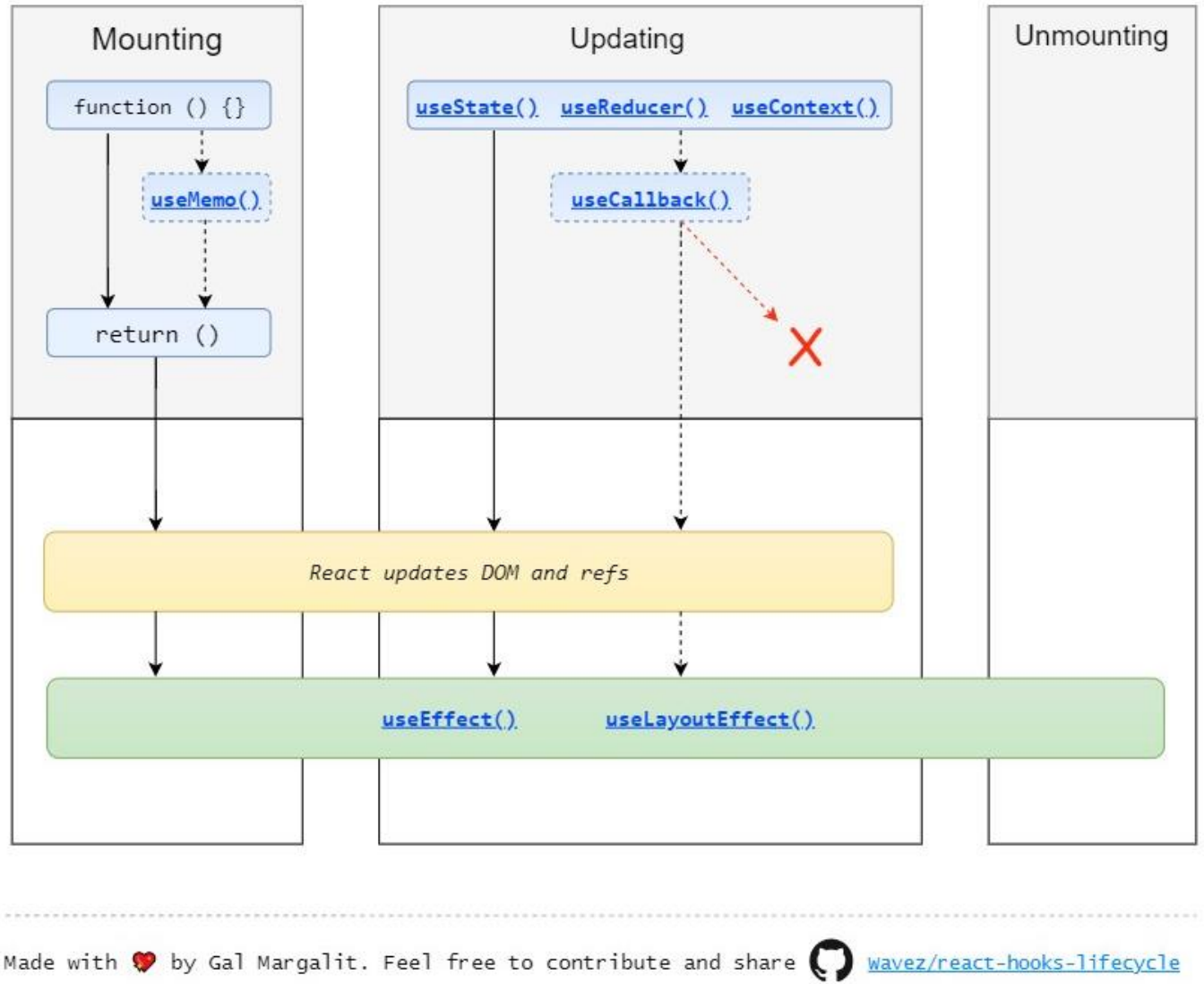
- A functional React component uses props and state to calculate its output
- **Side effect**: any calculation that do not target the output values, anything that affects something *outside the scope of the function component* being executed
- Examples of side effects:
  - **Data fetching**
  - Log recording
  - Setting up a subscriptions (handlers, etc.), or r
  - Scheduling additional actions when some stat
  - Manually changing the DOM in React compon
  - Managing timeouts and interval timers
  - …

The component rendering and side-effect logic are *independent*.

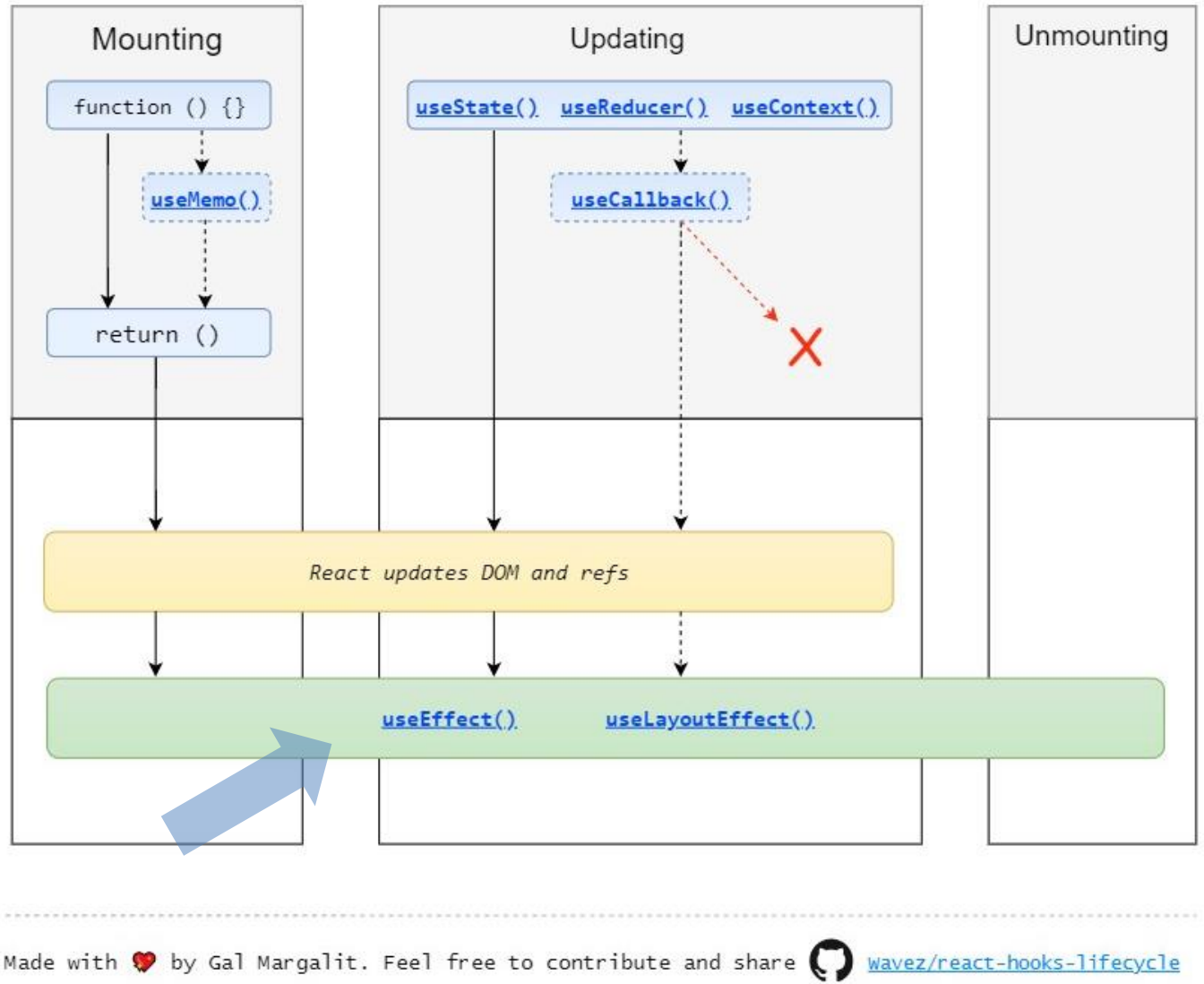
It would be a mistake to perform side-effects directly in the body of the component.

React Hooks Lifecycle

No side effects
in the render phase



React Hooks Lifecycle



No side effects in the render phase

Side effects run after rendering and DOM updating

Full Stack React, “Appendix C: React Hooks”

React Handbook, chapter “Hooks”

https://react.dev/reference/react/useEffect

https://dmitripavlutin.com/react-useeffect-explanation/ (source for many examples)

Side-effects and Life Cycle in Functional Components

USEEFFECT HOOK

No Side Effects in Render Function

```
function GreetBAD(props) {
    const message = `Hello, ${props.name}!`;
    // Calculates output

    // Bad!
    console.log(`Greetings: ${message}`); // Side-effect!

    return <div>{message}</div>;        // Calculates output
}
```

The side effect will be executed when React decides to [re-]render.

Never? Once? Twice? When?

Rendering is under React control

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

function Greet(props) {
    const message = `Hello, ${props.name}!`;
    // Calculates output

    useEffect(() => {
        // Good!
        console.log(`Greetings: ${message}`); // Side-effect!
    }, []);

    return <div>{message}</div>;        // Calculates output
}
```

Side effects are confined within a useEffect hook.

The hook controls their execution

How To `useEffect`

Very "dense" API

- `useEffect(callback, [dependencies])`

What to execute

When to execute it

  - `callback`: function containing side-effect logic
  - `useEffect` executes the `callback` function after React has committed the changes to the screen
  - the callback may return a "cleanup function" (see later…)

  - `[dependencies]`: an *optional* array of dependencies
  - `useEffect` executes `callback` only if at least one of the `dependencies` have changed between renderings

`useEffect`'s Dependency Array

- **Not provided**: the side-effect runs after *every* rendering
- **An empty array** `[]`: the side-effect runs *once* after the initial rendering
- **Has props or state values** `[prop1, prop2, ..., state1, state2]`: the side-effect runs *once* after the initial rendering, then only *when any dependency value changes*

`useEffect`'s Dependency Array

- **Not provided**: the side-effect runs after *every* rendering

- **An empty array** `[ ]`: the

```
import { useEffect } from 'react';

function MyComponent() {
  useEffect(() => {
    // Runs after EVERY rendering
  });
}
```

- **Has props or state value**
  `state2]`: the side-effect runs only *when any dependency value changes*

`useEffect`'s Dependency Array

- **Not provided**: the side-effect runs after *every* rendering

- **An empty array** `[ ]`: the side-effect runs *once* after the initial rendering

- **Has props or state va**
  `state2]`: the side-e *nges*

```
import { useEffect } from 'react';

function MyComponent() {
  useEffect(() => {
    // Runs ONCE after initial rendering
  }, []);
}
```

`useEffect`'s Dependency Array

- **Not provided**: the side
- **An empty array** `[ ]`: th g

```jsx
import { useEffect, useState } from 'react';

function MyComponent({ prop }) {
  const [state, setState] = useState('');
  useEffect(() => {
    // Runs ONCE after initial rendering
    // and after every rendering ONLY IF `prop` or `state` changes
  }, [prop, state]);
}
```

- **Has props or state values** `[prop1, prop2, ..., state1, state2]`: the side-effect runs only *when any dependency value changes*

Side Effects At Mount Time / Update Time

```
<Count num={num}/> <button onClick={()=>setNum(i=>i+1)}>+</button>
```

```
function Count(props) {

    useEffect( ()=>{ console.log(`My static number is ${props.num}`)},  [] ) ;
    // run only once

    useEffect( ()=>{ console.log(`My dynamic number is ${props.num}`)},  [props.num] ) ;
    // run at every change

    return <div>{props.num}</div> ;
}
```

```
My static number is 3          Count.js:5
My dynamic number is 3         Count.js:8
My dynamic number is 4         Count.js:8
My dynamic number is 5         Count.js:8
My dynamic number is 6         Count.js:8
My dynamic number is 7         Count.js:8
My dynamic number is 8         Count.js:8
My dynamic number is 9         Count.js:8
My dynamic number is 10        Count.js:8
```

Only when the component is *mounted*.

Will print the *initial value* of the num, only.

At mount time, *plus* every time the num changes.

Will print all the values.

Side Effects At Mount Time / Update Time

```
<Count num={num}/> <button onClick={()=>setNum(i=>i+1)}>+</button>
```

```
function Count(props) {

    useEffect( ()=>{ console.log(`My static number is ${props.num}`)},  [] ) ;
    // run only once

    useEffect( ()=>{ console.log(`My dynamic number is ${props.num}`)},  [props.num] ) ;
    // run at every change

    return <div>{props.num}</div> ;
}
```

```
My static number is 3          Count.js:5
My dynamic number is 3         Count.js:8
My dynamic number is 4         Count.js:8
My dynamic number is 5         Count.js:8
My dynamic number is 6         Count.js:8
My dynamic number is 7         Count.js:8
My dynamic number is 8         Count.js:8
My dynamic number is 9         Count.js:8
My dynamic number is 10        Count.js:8
```

TIMELINE

- Component Count is created (num=3) and mounted in App
- Function Count is called
- useEffects are registered (not executed)
- The JSX is returned (with 3)
- Component just mounted => run 1st effect
- Component just mounted => run 2nd effect
- …
- User clicks, App updates state, num changes to 4
- Function Count is called for re-rendering (num=4)
- The JSX is returned (4)
- `props.num` changed (prev=3, curr=4) => run 2nd effect
- …

`useState` meets `useEffect`

- A state variable may be listed as a dependency in an effect
  - When the state changes, the effect is run
  - If the state is updated, but the value does not change, the effect is not run
- Inside a `useEffect` function, you may schedule a state update
  - The state will be updated after the effect is finished (*asynchronously*)
  - If the state value changes, the component is re-rendered

useState meets useEffect

```
function QuickGate(props) {
    const [open, setOpen] = useState(false) ;

    useEffect(()=>{
        setTimeout(()=>setOpen(false), 500)
    }, [open]) ;

    const openMe = () => {
        setOpen(true) ;
    } ;

    return <div onClick={openMe}>
        {open ? <span>GO</span> : <span>STOP</span>}
    </div> ;
}
```

TIMELINE

- Component `QuickGate` is created and mounted in App
- Function `QuickGate` is called
- `useState` creates state `open` with default value
- `useEffect` is registered (not executed)
- The JSX is returned (STOP)
- Component just mounted => run effect
  - `setTimeout` is executed: Timeout is set
- Timeout expires
- `setOpen` is executed
- State `open` becomes `false` => no change
- …
- User clicks
- `openMe` callback is called
  - `setOpen(true)` executed
- State `open` becomes `true`
- Component re-renders
- The JSX is returned (GO)
- `useEffect` finds `open` changed (from `false` to `true`)
  - `setTimeout` is executed: Timeout is set
- …
- Timeout expires
  - `setOpen` is executed
- State `open` becomes `false`
- Component re-renders
- `useEffect` finds `open` changed (from `true` to `false`)
- …

`useEffect` Dependency Array Caveats

- Make sure the array includes **all** values from the component scope (such as props and state) that change over time and that are used by the effect
- Otherwise, your code will reference stale values from previous renders
  - **Rule**: every value *referenced inside the effect* function should also appear in the dependencies array
    - *arguments* of the functions
    - variables (and functions) accessed through *closure*
- If the array includes variables that *always change* when executing the effect, you risk having an infinite loop

`useState` & `useEffect` meet `fetch`

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

function FetchEmployeesByQuery({ query }) {
  const [employees, setEmployees] = useState([]);

  useEffect(() => {
    async function fetchEmployees() {
      const response = await fetch(
        `/employees?q=${encodeURIComponent(query)}`
      );
      const fetchedEmployees = await response.json(response);
      setEmployees(fetchedEmployees);
    }
    fetchEmployees();
  }, [query]);

  return (
    <div>
      {employees.map(name => <div>{name}</div>)}
    </div>
  );
}
```

- useEffect() can perform data fetching side-effect
- When props.query changes, the effect is run
  - Also at the first component mount
- fetchEmployees fetches data from the server
- When the response is available, the employees state is updated
  - Component will re-render

⚠Note ⚠

- The `callback` argument of useEffect(callback) **cannot** be an `async function`.
- But you can always define and then invoke an `async` function inside the callback itself
  - Inside the function, you may then use `await`

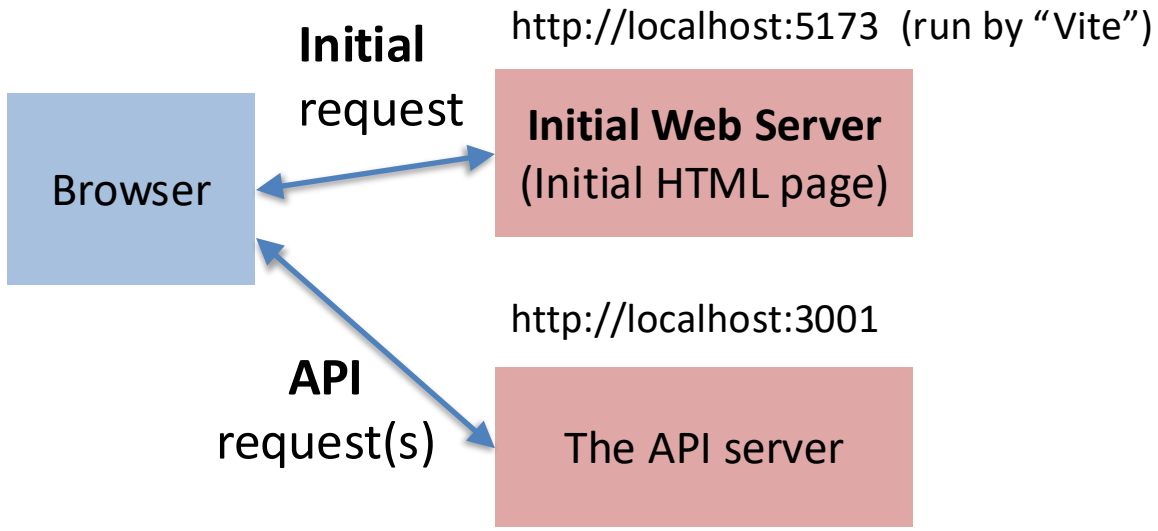
```
function FetchEmployeesByQuery({ query }) {
  const [employees, setEmployees] = useState([]);

  useEffect(() => {  // <--- CANNOT be an async function
    async function fetchEmployees() {
      // ...
    }
    fetchEmployees(); // <--- But CAN invoke async functions
  }, [query]);

  // ...
}
```

Example

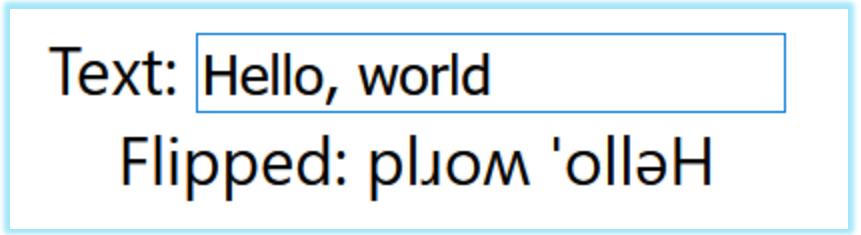
Text: Hello, world

Flipped: plɹoʍ 'ollǝH

- Type text in a form
- The client sends the text to the server, which returns it in “flipped” form
- The client displays the flipped text below the form



Example

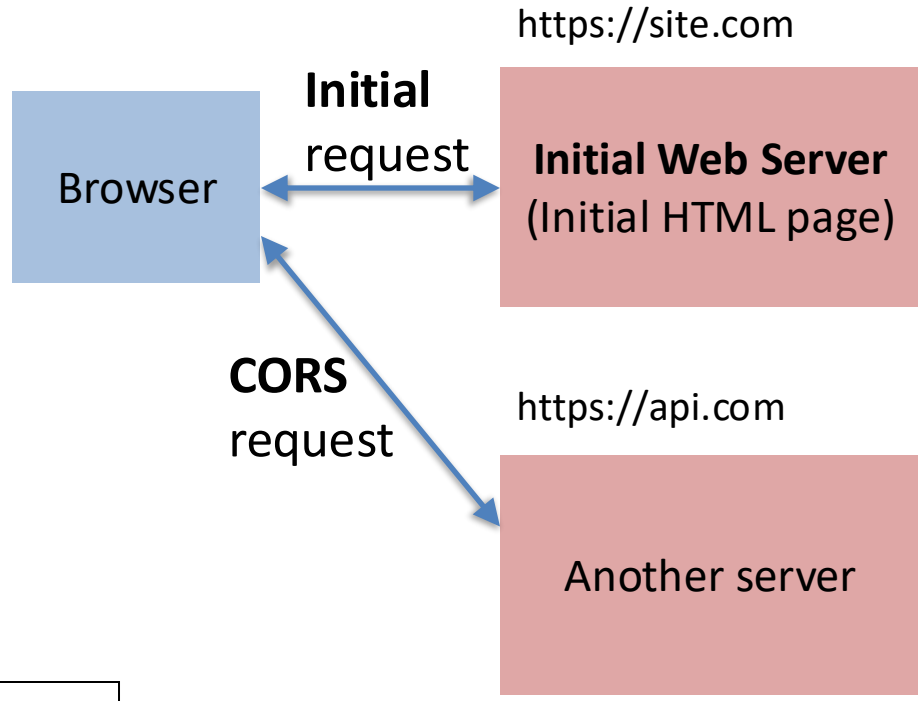



```
import {useEffect, useState} from "react";

function TextFlipper(props) {
    const [text, setText] = useState('') ;
    const [flipped, setFlipped] = useState('') ;

    useEffect( ()=>{
        const fetchFlipped = async () => {
            const response = await fetch('/flip?text='+text) ;
            const responseBody = await response.json() ;
            setFlipped( responseBody.text ) ;
        };
        fetchFlipped(text) ;
    }, [text] ) ;

    const handleChange = (ev) => {
       setText(ev.target.value) ;
    } ;

    return <div>
        Text: <input type='text' value={text} onChange={handleChange}/><br/>
        Flipped: {flipped}
    </div> ;
}
```

```
const express = require('express') ;
const flip = require('flip-text') ;

const app = express() ;

app.get('/flip', (req, res) => {
   const text = req.query.text ;
   const flipped = flip(text) ;
   res.json({text: flipped}) ;
});

app.listen(3001, ()=>{console.log('running')})
```

Note on Using Two Servers

- The browser imposes limitations on what the initial page (in particular Javascript) can do with the second server
  - So called “CORS” request (Cross-Origin Resource Sharing)
  - *More on this soon in the course*
- To make the example (and this situation) works, the API server must allow CORS requests




```
const express = require('express') ;
const flip = require('flip-text') ;
const cors = require('cors') ;

const app = express() ;
app.use(cors());
…
```

Handling Slow Responses

```
function TextFlipper(props) {
    const [text, setText] = useState('') ;
    const [flipped, setFlipped] = useState('') ;
    const [waiting, setWaiting] = useState(true) ;

    useEffect( ()=>{
        const fetchFlipped = async () => {
            const response = await fetch('/flip?text='+text) ;
            const responseBody = await response.json() ;
            setFlipped( responseBody.text ) ;
            setWaiting(false);
        };
        setWaiting(true) ;
        fetchFlipped(text) ;
    }, [text] ) ;

    const handleChange = (ev) => {
       setText(ev.target.value) ;
    } ;

    return <div>
        Text: <input type='text' value={text}
                     onChange={handleChange}/><br/>
        Flipped: {waiting && <span>🕘</span>}{flipped}
    </div> ;
}
```

- If HTTP API calls are slow, you can use an extra state to remember whether a call is still ongoing (or if it is been answered)
- The Effect will initially set it to ‘waiting’, and when the response is back, it may be reset to ‘not waiting’
- The component rendering will show in some way that the result is still temporary

Clean-up After Side Effects

- Some side-effects need cleanup: close a socket, clear timers
- If the callback returns a function, then `useEffect()` considers this as an effect cleanup:

```
useEffect(() => {
  // Side-effect...

  return function cleanup() {
    // Side-effect cleanup...
  };
}, dependencies);
```

- Cleanup works in the following way:
  - After initial rendering, `useEffect()` invokes the callback having the side-effect. `cleanup()` function is **not** invoked.
  - On later renderings, before invoking the next side-effect callback, `useEffect()` invokes the `cleanup()` function from the previous side-effect execution (to clean up everything after the previous side-effect), *then* runs the current side-effect.
  - Finally, after unmounting the component, `useEffect()` invokes the `cleanup()` function from the latest side-effect.

You Might Not Need an Effect

- Two common cases where you **do not need** effects:
  1. **To transform data for rendering**. For example, if you want to filter a list in the client before displaying it, you can transform all the data at the top level of your components (so, every time a render is needed), just before returning the JSX for rendering.
  2. **To handle user events**. Handle user events in the code of the event handler.
- Instead, use effects when you want to synchronize with external systems.

- Further examples:
  - https://react.dev/learn/you-might-not-need-an-effect

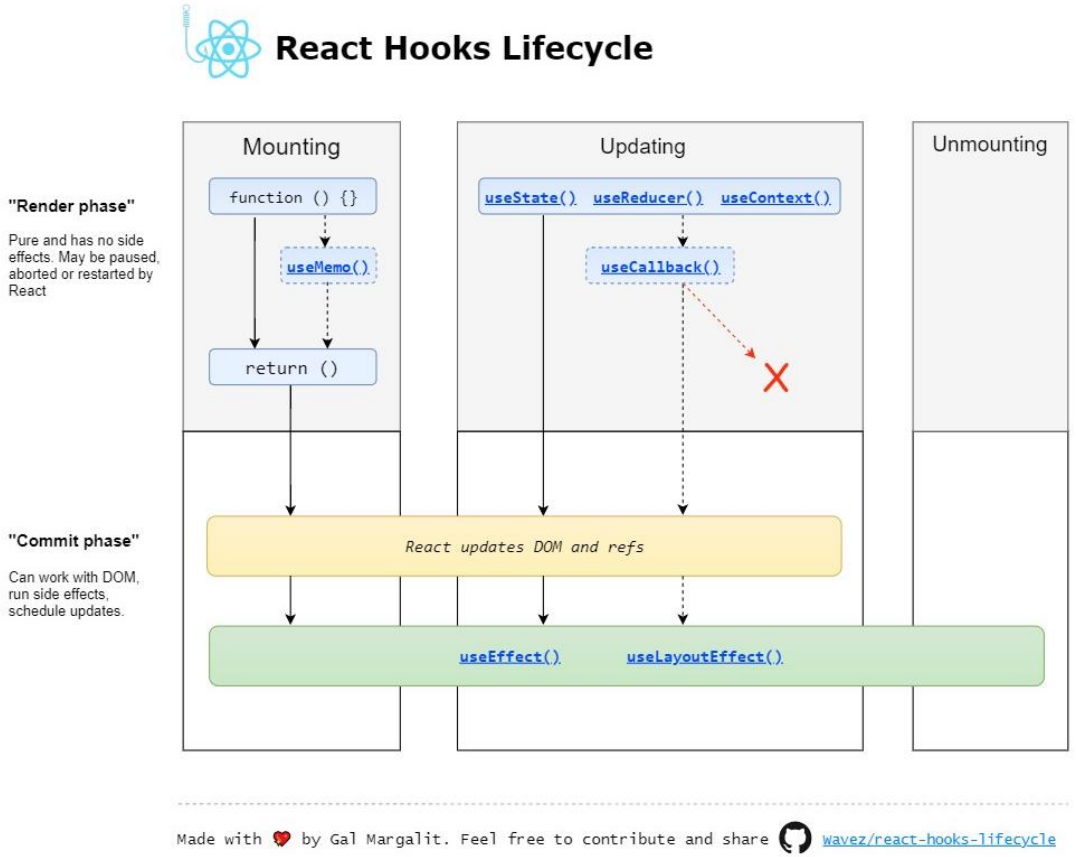
Summary: Four Ways To Call `useEffect`

- Once, when the component mounts
  - `useEffect( () => callOnce(), [] )  // empty 2nd arg`
- On every component render
  - `useEffect( () => callAtEveryRender() ) // missing 2nd arg`
- On every component render, **if** some values changed
  - in addition, it is called when the component mounts
  - `useEffect( () => callIfAnyDepChange(dep1,dep2), [dep1,dep2])`
- When component unmounts
  - `useEffect( () => { doSomething();`
    `return ()=>cleanupFunction(); }, [] )`

https://dev.to/spukas/4-ways-to-useeffect-pf6

How To Handle Other Lifecycle Situations

- Full lifecycle is more complex
- Other hooks available for particular situations
  - `useLayoutEffect`: it fires *synchronously* after all DOM mutations
  - `useMemo`: returns a *memoized* value (re-computed by a pure function when its parameters change)
  - `useCallback`: returns a *memoized* callback function
- *Not recommended in general*



https://www.robinwieruch.de/react-fetching-data

The Road to Learn React, Chapter “Getting Real with APIs”

Taming the State in React, Chapter “Local State Management”

React as an API Client

HANDLING API CALLS IN REACT

Different Kinds Of State

Application State (or Entity State)

- **Retrieved from the back-end**
- Should update the back-end
  - on user-initiated CRUD actions
- Should “periodically” check for updates
  - caused by other users, by other open sessions, or by connected systems
- Globally managed, accessible by various components

Presentation State (or View State)

- Not stored in the back-end
  - only in React
- Does not need to persist
- Lives and dies within the controlling Component
- Implemented as **Local State**
  - by using useState

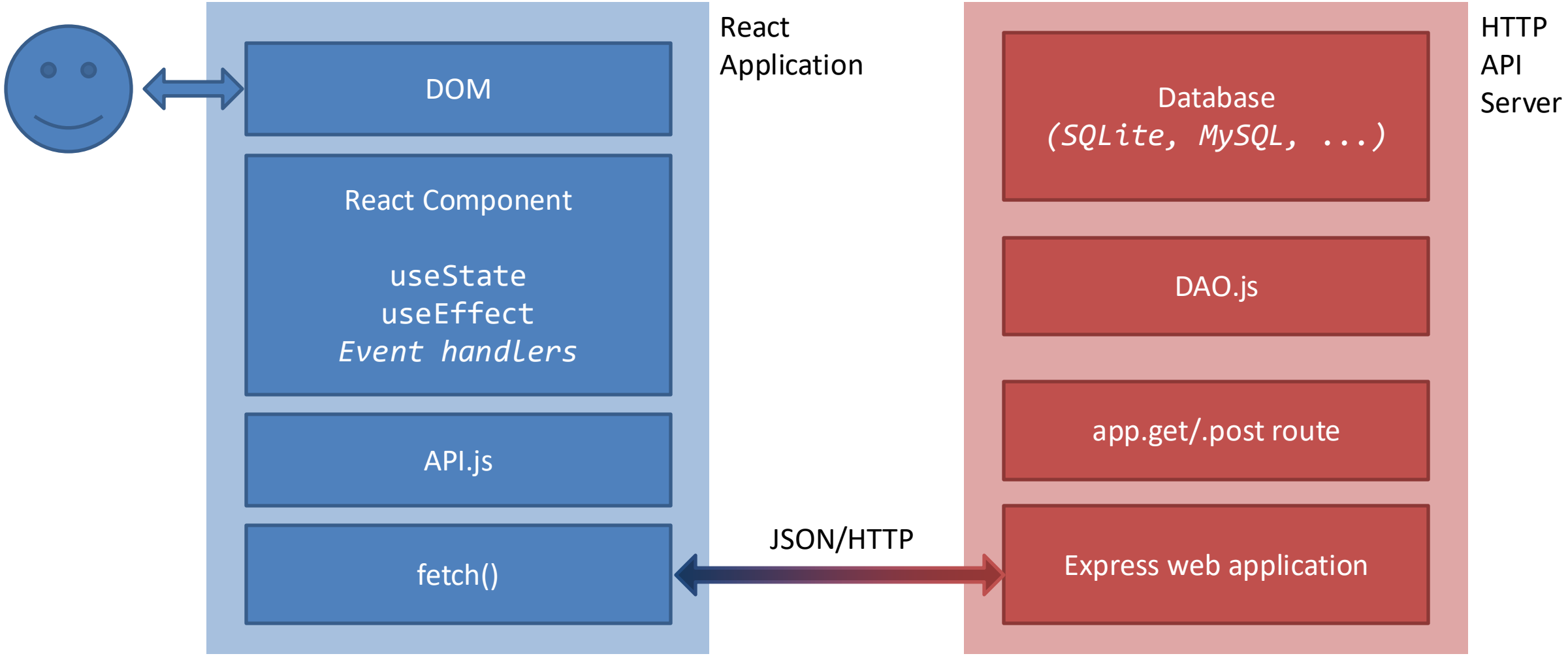
Frequent Use Cases

- How to integrate remote HTTP APIs
- Where/when to load data from remote APIs?
- Delays and “loading…”
- Updating remote data

API Client Classes

- *Recommendation*: keep your fetch methods in a separate JS module (e.g., `API.js`)
- Keeps details of HTTP methods inside the API module
  - API should not depend on React or application state/props
  - Application code should not call fetch or have any HTTP information
- Allows easy swapping with “stub” methods for testing

Conceptual Architecture



Rehydrating And Dehydrating

- Application State is retrieved via HTTP APIs
  - e.g., from info stored in a DB and accessed through the HTTP API server
- **Rehydrating** the Application State means getting it from the HTTP APIs
  - Must happen when the React application mounts
  - **Best place**: inside a `useEffect(fn, [])` method
- Rehydrating should **also** happen when we want to "refresh" the state
  - The React app cannot know whether ***others*** changed the info provided by the API server
- **Dehydrating** the Application State means extracting it from the React application
  - May happen several times during the React app execution
  - Should happen whenever something (in the Application State) is modified

Rehydrating At Mount Time

- Very similar to what we saw before…
- Rehydrating may require some time, while the component renders “empty” (with the initial state)
  - May need to use the approach for *handling slow responses*
  - i.e., a loading/waiting local state

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

function ShoppingList() {
  const [list, setList] = useState([]);
  const [loading, setLoading] = useState(true) ;

  useEffect(()=> {
    const getItems = async () => {
      const response = await fetch('/api/items');
      const items = await response.json();
      setList(items);
      setLoading(false);
    };
    getItems();
  }, []);

return (<>
  {loading && <span>🕘</span>}
  <ul>{list.map((item, i) =>
    <li key={i}>{item}</li>)}</ul>
  </>);
}
```

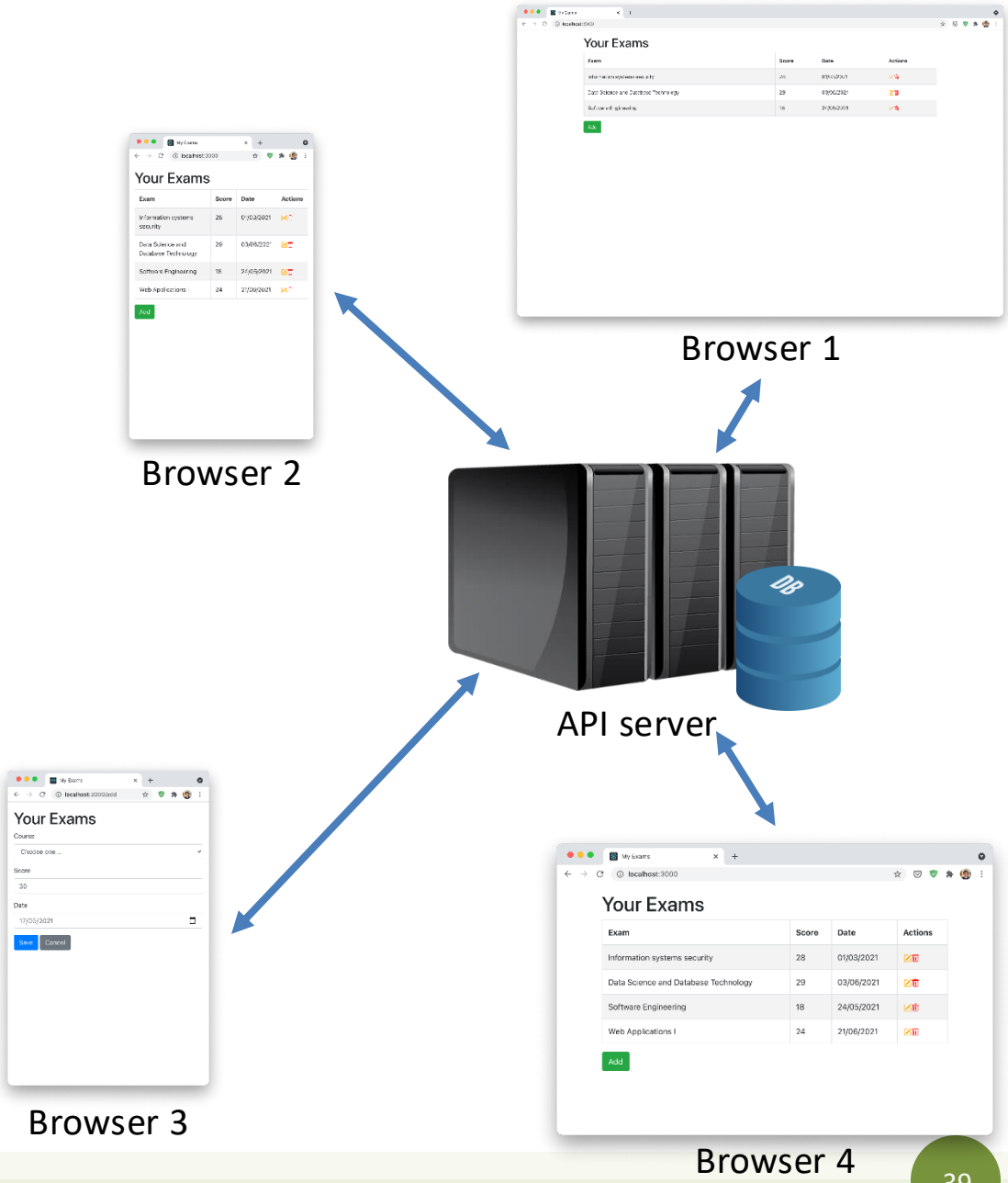
Rehydrating To Refresh The State

- Once you know that something has been changed in the API server, you can use `useEffect()` as before
  - with one or more dependencies, e.g., `[dep1, dep2]`

- **Beware**: two problems might arise
  - the "n-clients problem"
  - infinite loops

The “N-Clients Problem”

- We are creating a web application that will be opened on *multiple* browsers at once
  - They read and write info from a *unique* API server, however
- What happens in the web app running in, e.g., Browser 1 when Browser 3 updates something in the API server?
  - How can one web app know that *someone else* changed *something* in the server?



The “N-Clients Problem”

The Better-Than-Nothing Solution

- The *web app* asks for data as frequently as possible
  - when it loads a new page/view
  - after adding/updating/removing something
  - periodically (i.e., polling)
  - …
- **Not a solution**: just a way to *minimize* the problem

The Real Solution

- The *server* communicates changes as soon as they appear
  - to *all* the current consumers of its information
- **Out of scope** for this course
  - unfortunately!

- For the curious:
  - WebSockets (e.g., https://socket.io)
  - PubSub mechanisms

Infinite Loops with `useEffect`

- One of the main pitfalls that might happen with `useEffect`
  - infinite loops both in rendering and in external (e.g., HTTP) calls
  - especially when `useEffect` is used with `useState`

- Two significant cases:
  1. The dependency array is missing, but it should not
  2. One of the items in the dependency array is a JavaScript Object { } or Array [ ]

Examples from: https://dmitripavlutin.com/react-useeffect-infinite-loop/

Example: Missing Dependencies

What is wrong, here?

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

function CountInputChanges() {
  const [value, setValue] = useState('');
  const [count, setCount] = useState(-1);

  useEffect( () => setCount((c) => (c + 1)) );

  const handleChange = (ev) => setValue(ev.target.value);

  return (
    <div>
      <input type="text" value={value} onChange={handleChange} />
      <div>Number of changes: {count}</div>
    </div> );
}
```

1. Set Up Dependencies Correctly

- Without the dependency (no dependency array), the code in the example will re-render the component **forever**
- It is also a clear error:
  - the update of `count` depends on the change of `value`

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

function CountInputChanges() {
  const [value, setValue] = useState('');
  const [count, setCount] = useState(-1);

  useEffect( () => setCount((c) => (c + 1)), [value] );

  const handleChange = ({ target }) =>
setValue(target.value);

  return (
    <div>
      <input type="text" value={value}
onChange={handleChange} />
      <div>Number of changes: {count}</div>
    </div> );

}
```

Example: Objects as Dependencies

What is wrong, here?

```
function CountSecrets() {
  const [secret, setSecret] = useState({ value: "", countSecrets: 0 });

  useEffect(() => {
    if (secret.value === 'secret')
      setSecret(s => ({...s, countSecrets: s.countSecrets + 1}));
  }, [secret]);

const onChange = (ev) => { setSecret(s => ({ ...s, value: ev.target.value })); };

return ( <div>
    <input type="text" value={secret.value} onChange={onChange} />
    <div>Number of secrets: {secret.countSecrets}</div>
  </div>
);
```

2a. Avoid Objects As Dependencies

- **Problem**: `secret` as a dependency!
- Inside `useEffect`, when the input value equals 'secret', `setSecret()` is called
- `setSecret()` increments the secrets counter, but also creates a new object
  - `secret` is now a new object, and the dependency has changed
- So `useEffect` invokes again the callback that updates the state, and a new `secret` object is created again, etc.
- **How to solve:** do not use objects as dependencies!

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

function CountSecrets() {
  const [secret, setSecret] = useState({ value: "",
countSecrets: 0 });

  useEffect(() => {
    if (secret.value === 'secret')
      setSecret(s => ({...s, countSecrets: s.countSecrets
+ 1}));
  }, [secret.value]);

const handleChange = ({ target }) => { setSecret(s => ({
...s, value: target.value })); };

return ( <div>
    <input type="text" value={secret.value}
onChange={handleChange} />
    <div>Number of secrets: {secret.countSecrets}</div>
  </div>
);
```

2b. Avoid Arrays As Dependencies

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

function ShoppingList() {
  const [list, setList] = useState([]);

  useEffect(()=> {
    const getItems = async () => {
      const response = await fetch('/api/items');
      const items = await response.json();
      setList(items);
    };
    getItems();
  }, []); // don't use: [list]

return (
  <ul>{list.map((item, i) => <li
key={i}>{item}</li>)}</ul>
  );
}
```

- The same issue might happen with arrays…
- … so, it is better to avoid arrays as dependencies
  - you can use an empty dependency array [ ]
  - or an additional state to trigger `useEffect`
  - or any item in the array, the `length` property (if appropriate), or …

Dehydrating During Updates

```
const addItem = async () => {
  setList(items => [...items, element]);

  const response = await fetch('/api/items', {
    method: 'POST',
    body: element,
  });
  ...
};

return (...
    <input type="text" value={element} ... }></input>
    <button onClick={addItem}>Add</button>
  ...);
```

The two updates (remote API, local state) run **in parallel**.

Optimistic state update: it assumes that remote state will be updated without errors => **Risky!**

Dehydrating During Updates – Alternative

```
const addItem = async () => {

  const response = await fetch('/api/items', {
    method: 'POST',
    body: element,
  });
  if (response.ok)
    setList(items => [...items, element]);
  ...
};

return (...
    <input type="text" value={element} ... }></input>
    <button onClick={addItem}>Add</button>
  ...);
```

The state is updated only **after** checking that the request is successfully
=> **No parallel updates!**

Issue: the user of our app will not see the just added item for a while…

During Updates: Dehydrate And Rehydrate

```
function ShoppingList() {
  const [list, setList] = useState([]);
  const [element, setElement] = useState('');

  useEffect(()=> {
    getItems();
  }, []);

  const getItems = async() => {
    const response = await fetch('/api/items');
    const items = await response.json();
    setList(items);
  };

  const addItem = async () => {
    setElement('');
    setList(items => [...items, `${element} (temp)`]);

    const response = await fetch('/api/items', {
      method: 'POST',
      body: element,
    });
    if (response.ok)
      getItems();
  };

  return (<>
      <ul>{list.map((item, i) => <li key={i}>{item}</li>)}</ul>
      <input type="text" value={element}
onChange={(ev)=>setElement(ev.target.value)}></input>
      <button onClick={addItem}>Add</button>
    </>
  );
}
```

1. **Update** the state in parallel so that the user can see that the operation is *completed*
2. **Mark** the just updated item as *temporary*
   - e.g., by using a different background color, label, … than the others
3. **Refresh** the *entire* component as soon as the server completes the update operation

Full Stack React, “Appendix C: React Hooks”

React Handbook, chapter “Hooks”

https://reactjs.org/docs/hooks-rules.html

Peeking Under the Hood

THE RULES OF HOOKS

Quiz

- What is the “magic” behind `useState`?
- How can the same function return different state variables?
- How can the values be persisted across function calls?

```
function Example(props) {

  [hidden, setHidden] = useState(true) ;
  [count, setCount] = useState(0) ;
  [mode, setMode] = useState('view') ;

  . . .

  setHidden(false) ;
  . . .
  setCount( c => c+1 ) ;
  . . .
  setMode('edit') ;
  . . .

}
```

Answer

- React associates an array of Hook “slots” to each functional component
  - Slots are stored with the function, therefore they are persistent
- Each time you call a Hook, a new “slot” is used
  - The first time, it is created
  - The other times, it is reused

```
function Example(props) {

  [hidden, setHidden] = useState(true) ;
  [count, setCount] = useState(0) ;
  [mode, setMode] = useState('view') ;

  . . .

  setHidden(false) ;
  . . .
  setCount( c => c+1 ) ;
  . . .
  setMode('edit') ;
  . . .

}
```

Corollary

- React must “know” which functions may host Hooks
- Hooks must always be called in the same order each time a component renders

```
function Example(props) {

  [hidden, setHidden] = useState(true) ;
  [count, setCount] = useState(0) ;
  [mode, setMode] = useState('view') ;

  . . .

  setHidden(false) ;
  . . .
  setCount( c => c+1 ) ;
  . . .
  setMode('edit') ;
  . . .

}
```

Hook Usage Rules

- Only Call Hooks at the Top Level
  - Always call Hooks at the top level of your React function
  - Do not call Hooks inside loops, conditions, or nested functions
- Only Call Hooks from React Functions
  - Do not call Hooks from regular JavaScript functions
  - You may call Hooks from React function components
  - You may call Hooks from custom Hooks

https://reactjs.org/docs/hooks-rules.html

License

- These slides are distributed under a Creative Commons license “**Attribution-NonCommercial-ShareAlike 4.0 International (CC BY-NC-SA 4.0)**”
- **You are free to:**
  - **Share** — copy and redistribute the material in any medium or format
  - **Adapt** — remix, transform, and build upon the material
  - The licensor cannot revoke these freedoms as long as you follow the license terms.
- **Under the following terms:**
  - **Attribution** — You must give appropriate credit, provide a link to the license, and indicate if changes were made. You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use.
  - **NonCommercial** — You may not use the material for commercial purposes.
  - **ShareAlike** — If you remix, transform, or build upon the material, you must distribute your contributions under the same license as the original.
  - **No additional restrictions** — You may not apply legal terms or technological measures that legally restrict others from doing anything the license permits.
- https://creativecommons.org/licenses/by-nc-sa/4.0/