



# **React Client-Components**

# Outline

1. Server vs Client Components
2. Component State
3. Components Communication
4. Common React Hooks
5. Interleaving Server and Client Components

# Server vs Client Components



CLIENT COMPONENT

v/s



SERVER COMPONENT

# Server vs Client Components in Next.js

- **Server Components**

- Run on the server
- Great for:
  - Data fetching (from DB, API)
  - Static/SEO-friendly pages
  - Keep sensitive information on the server (access tokens, API keys, etc.)
  - Layouts and heavy logic



Use server components by default for performance and smaller bundle size (reduced client-side JavaScript)



Cannot use browser APIs or hooks such as `useState`, and `useEffect`

- **Client Components**

- Run in the browser: support React hooks like `useState`, `useEffect`
- Needed for:
  - Add interactivity and event listeners (`onClick()`, `onChange()`, etc)
  - Animations, modals, dropdowns
  - Access to browser APIs (`localStorage`, `window`)



Use client components only when **interactivity is required**



# Decision Tree

- Does the component use React hooks (e.g., useState/useEffect)?
  - └ Yes → Use Client Component
- Does it access browser-only APIs (e.g. window, localStorage)?
  - └ Yes → Use Client Component
- Does it fetch data from a Database or a Web API?
  - └ Yes → Use Server Component
- Is it interactive (e.g., handles client-side events such as click, mouseOver)?
  - └ Yes → Use Client Component



- **Default to Server Components** for performance and enhanced security
- **Isolate interactivity** into **small Client Components** where needed

# Component State

$$f(\text{State}) =$$

State

*name: John*  
*surname: Dough*

View

# Component State

- A component can store its own local data (**state**)
  - Private and fully controlled by the component
  - Can be passed as **props** to children
- Use **useState** hook to create a *state variable* and an *associated function* to update the state

```
const [count, setCount] = useState(0);
```

**useState** returns a state variable *count* initialized with 0 and a function *setCount* to be used to update it

- Calling *setCount* causes React to **re-render the app components** and **update the DOM** to reflect the state changes



**Never change the state directly by assigning a value to the state variable => otherwise React will NOT re-render the UI**

# State

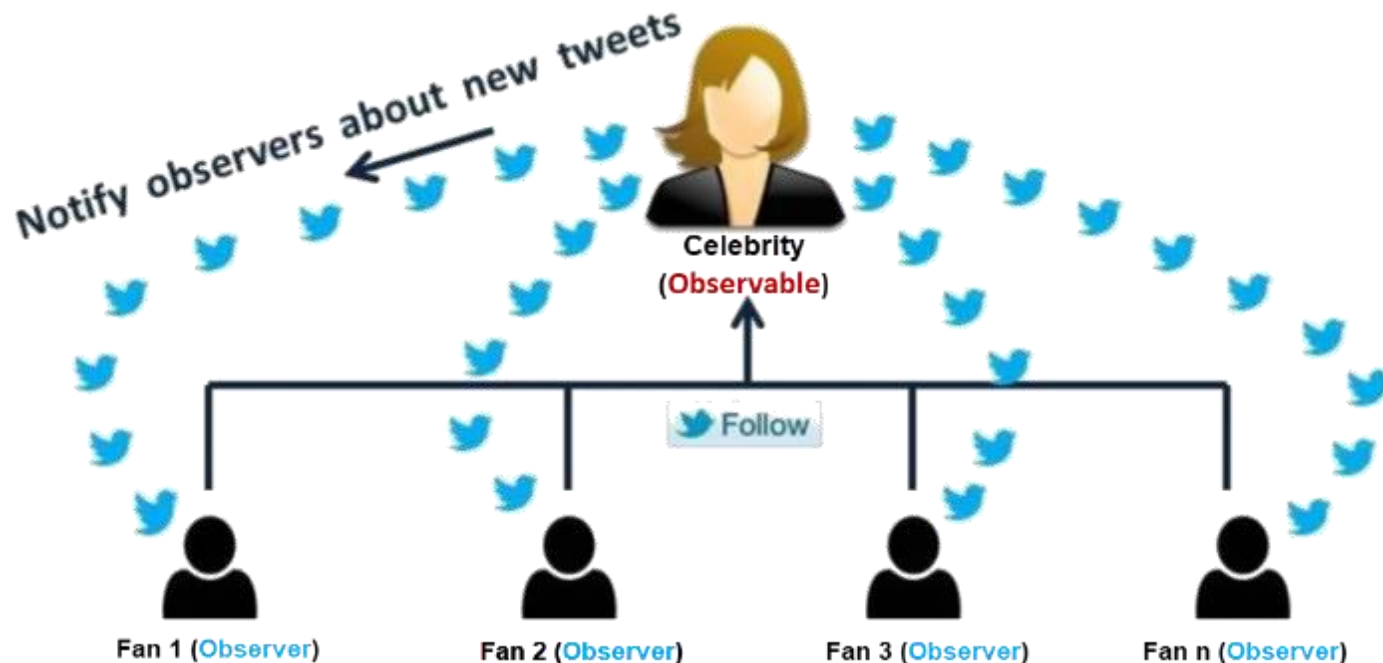
- State = any value that can change overtime
  - State variable must be declared using **useState** hook to act as **Change Notifiers**
    - 👍 • They **are observed** by the React runtime
    - Any change of a state variable will trigger the **re-rendering** of any functions that **reads** the state variable
    - Both props and state changes trigger a render update
- => UI is **auto-updated** to reflect the updated app state



# Observer Pattern at the heart of Jetpack Compose

Observer Pattern Real-Life Example: A celebrity who has many fans on Tweeter

- Fans want to get all the latest updates (posts and photos)
- Here fans are **Observers** and celebrity is an **Observable** (analogous **state variable** in React)
- A **State variable** is an **observable data holder**: React runtime **observes its changes** and updates the UI accordingly



# Imperative UI vs. Declarative UI

- Imperative UI – manipulate DOM to change its internal state / UI

```
document.querySelector('#bulbImage').src = 'images/bulb-on.png';  
document.querySelector('#switchBtn').value = "Turn off";
```



## UI in React is immutable

- In react you should NOT access/update UI elements directly (as done in the imperative approach)
- Instead update the UI is by updating the state variable(s) used by the UI elements – this triggers automatic UI update
  - E.g., change the bulb image by updating the *isBulbOn* state variable

```
<input type="button"  
  value= {isBulbOn ? "Turn off" : "Turn on"}  
  onClick={() => setIsBulbOn(!isBulbOn)} />
```

# useState: creates a state variable

- Used for basic state management inside a component

**const [state, setState] = useState(initialState)**



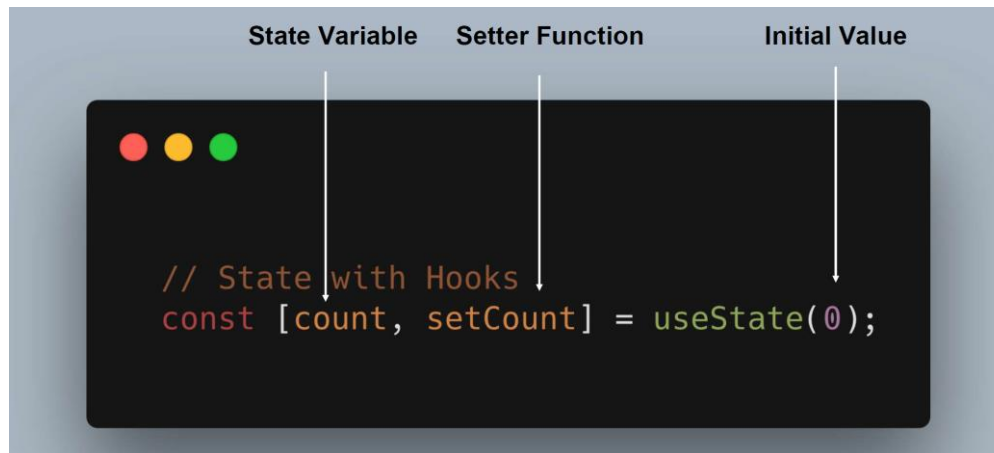
The name of  
your state



The function you'll  
eventually use to  
change the value of this  
state



The initial value  
of your state



# Component with State + Events Handling

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

Count: 4



```
function Counter({ startValue }) {  
  const [count, setCount] = useState(startValue);  
  const increment = () => { setCount(prev => prev + 1); };  
  
  const decrement = () => { setCount(prev => prev - 1); };  
  
  return <div>  
    Count: {count}  
    <button type="button" onClick={increment}>+</button>  
    <button type="button" onClick={decrement}>-</button>  
  </div>  
}  
export default Counter;
```



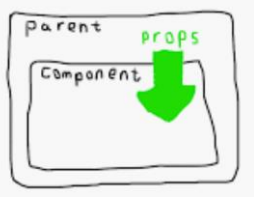
**Handling events** is done the way events are handled on DOM elements

- Use the **Counter** component

```
<Counter startValue={3}/>
```

# Uni-directional Data Flow:

## Props vs. State

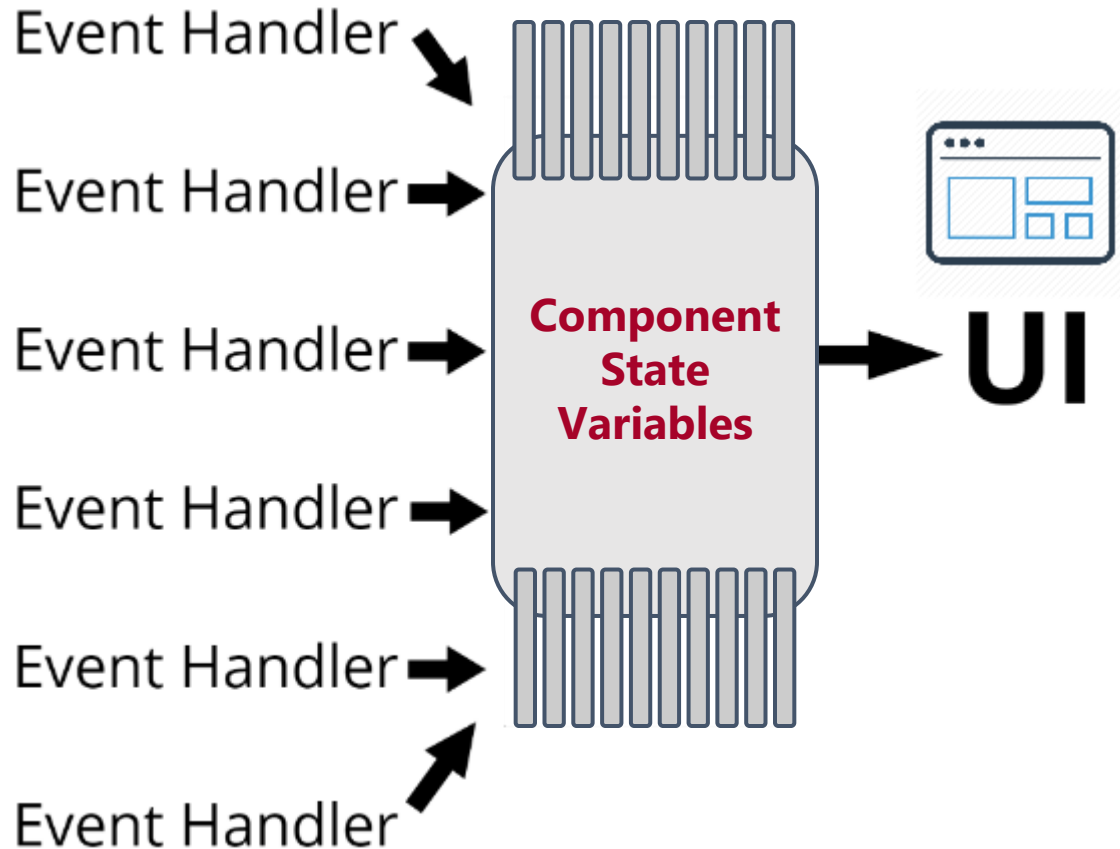


- **Props** = data passed to the child component from the parent component
- **Props** parameters are **read only**

- **State** = internal data managed by the component (cannot be accessed and modified outside of the component)
- **State** variables are **Private** and **Modifiable** inside the component only (through **set** functions returned by `useState`)

👍 React **automatically re-render the UI** whenever **state** or **props** are updated

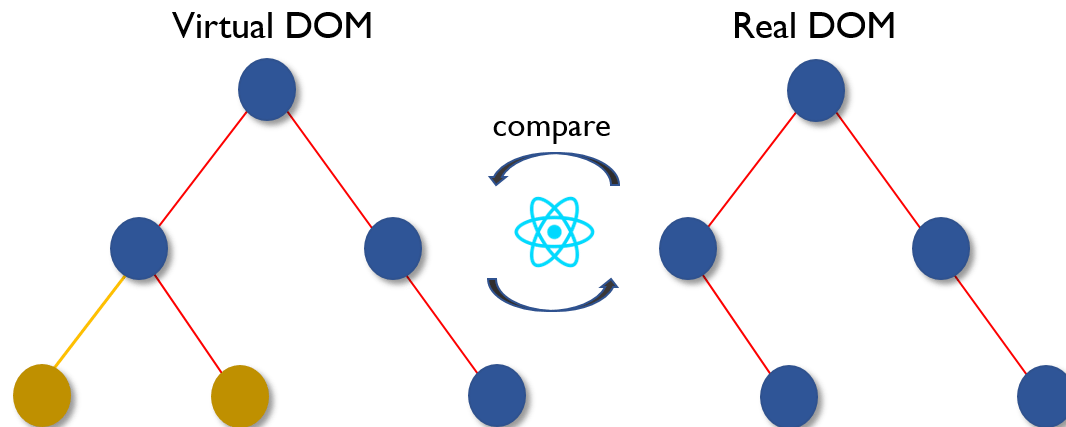
# Event Handlers update the State and React updates the UI



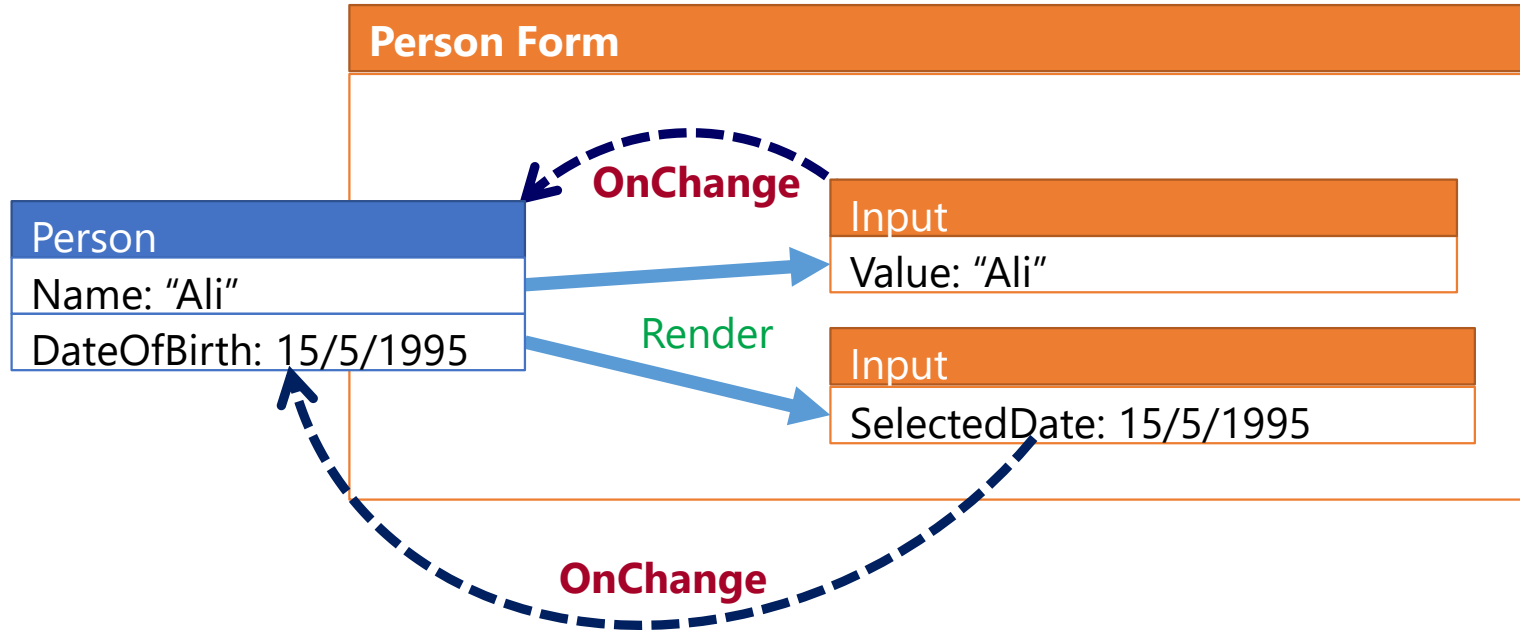
**Every place a state variable is displayed is guaranteed to be auto-updated**

# Virtual DOM

- Virtual DOM = Pure JavaScript lightweight DOM, totally separate from the browser's slow JavaScript/C++ DOM API
- Every time the component **updates its state** or **receives new data via props**
  - A new virtual DOM tree is generated
  - New tree is **diffed** against old...
  - ...producing a minimum set of changes to be performed on real DOM to bring it up to date



# Unidirectional Data Flow in Forms



**Common Events:** `onClick` - `onSubmit` - `onChange`



# Forms with React

## Form UI

```
<form onSubmit={handleSubmit}>
  <input
    name="email"
    type="email" required
    value={state.user}
    onChange={handleChange} />
  <input
    name="password"
    type="password" required
    value={state.password}
    onChange={handleChange} />
  <input type="submit" />
</form>
```

```
const [state, setState] = useState({ email: "", password: "" });
```

```
const handleChange = e => {
  const name = e.target.name;
  const value = e.target.value;
  //Merge the object before change with the updated property
  setState({ ...state, [name]: value });
};
```

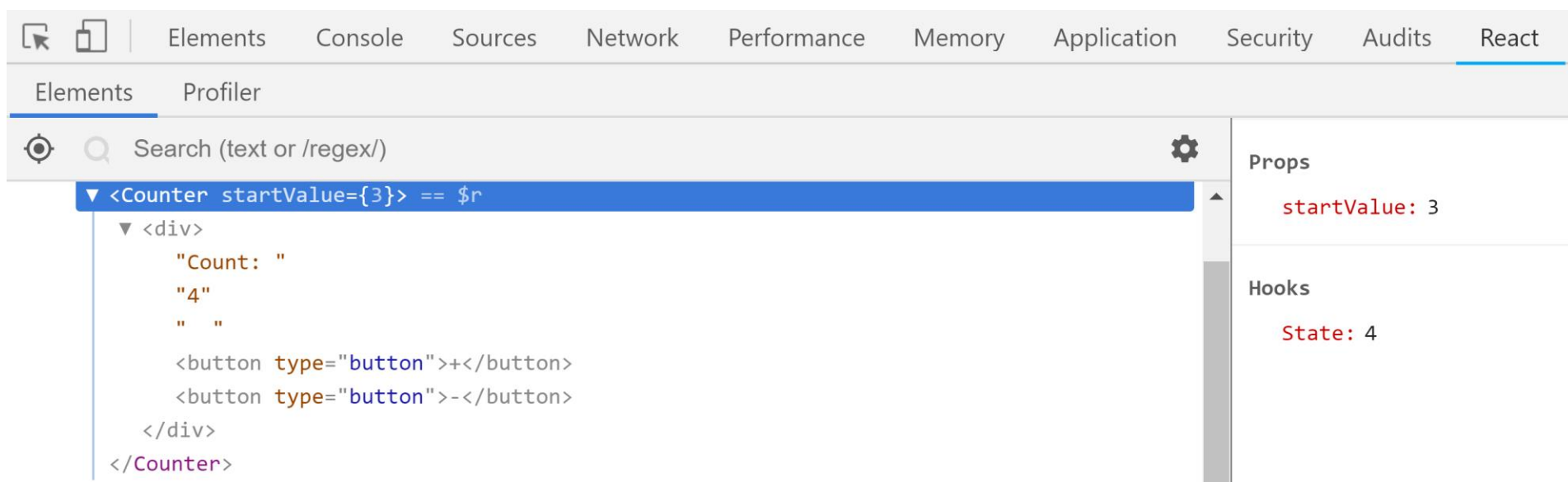
```
const handleSubmit = e => {
  e.preventDefault();
  alert(JSON.stringify(state));
};
```

## Form State and Event Handlers

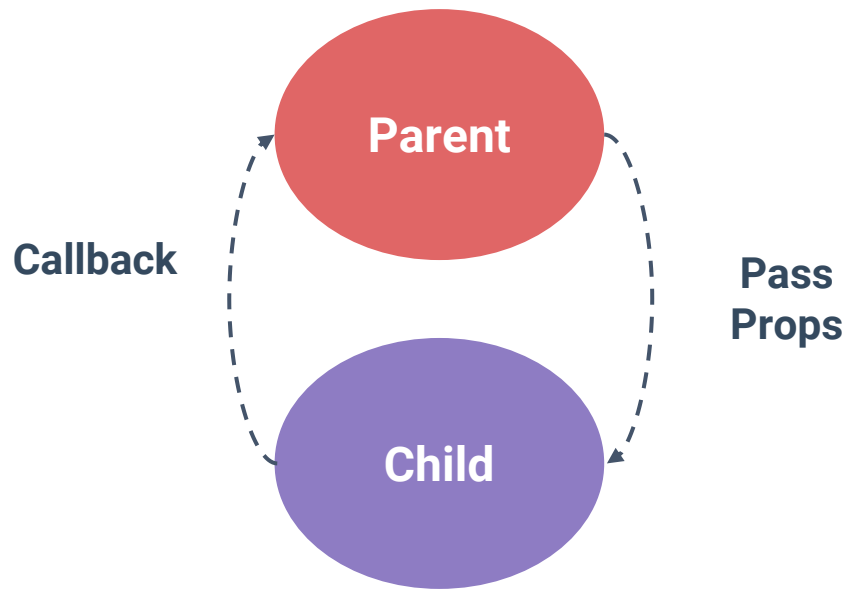
# React Dev Tools

- React Dev Tools

<https://chrome.google.com/webstore/detail/react-developer-tools/fmkadmapgofadopljbjfkapdkoienihi?hl=en>

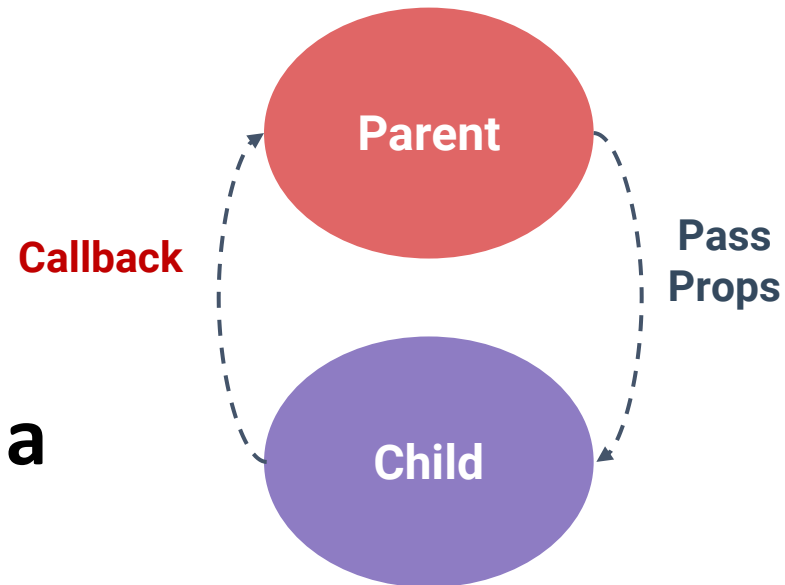


# Components Communication

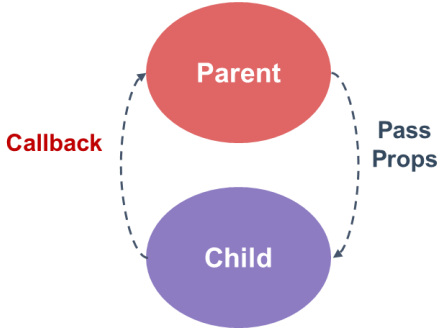


# Composing Components

- Components are meant to be used together, most commonly in parent-child relationships
- Parent passes data down to the child via **props**
- The child notify its parent of a **state change via callbacks** (a parent must pass the child a callback as a parameter)



# Parent-Child Communication



## Parent

```
function Main => <Counter startValue={3}  
  onChange={count => console.log(`Count from the child component: ${count}`)} />
```

## Child

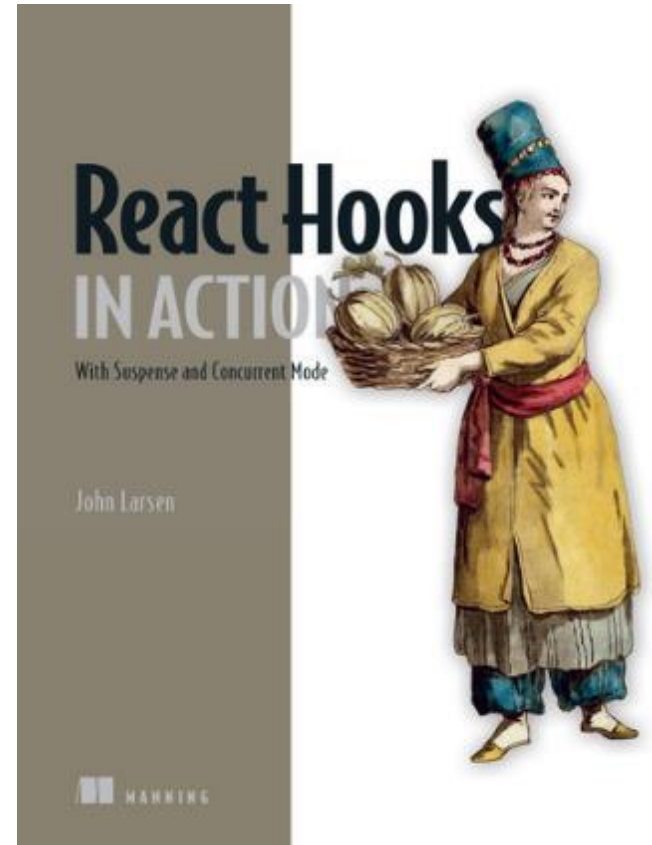
```
function Counter(props) {  
  const [count, setCount] = useState(props.startValue);  
  
  const increment = () => {  
    const updatedCount = count + 1;  
    setCount(updatedCount);  
    props.onChange(updatedCount);  
  };  
  
  return <div>  
    Count: {count}  
    <button type="button" onClick={increment}>+</button>  
  </div>  
}
```

# Common React Hooks



# React Hooks

1. useState
2. useEffect
3. useRef
4. useContext
5. useRouter
6. useActionState
7. useOptimistic



Some of the slides are based on  
<https://learning.oreilly.com/library/view/react-hooks-in/9781617297632/>

# What is Hook?

- A Hook is a special function that lets you **hook** into React features such as state and lifecycle methods
- There are 3 rules for hooks:
  - Hooks can only be called at the top level of a component
  - Hooks cannot be conditional



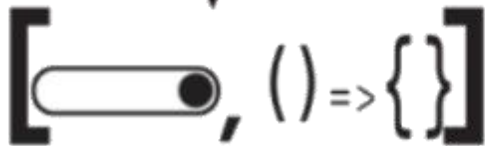
# useEffect

- For doing stuff when a component is mounts/unmounts/updates
- Ideal for fetching data when the component is mounted

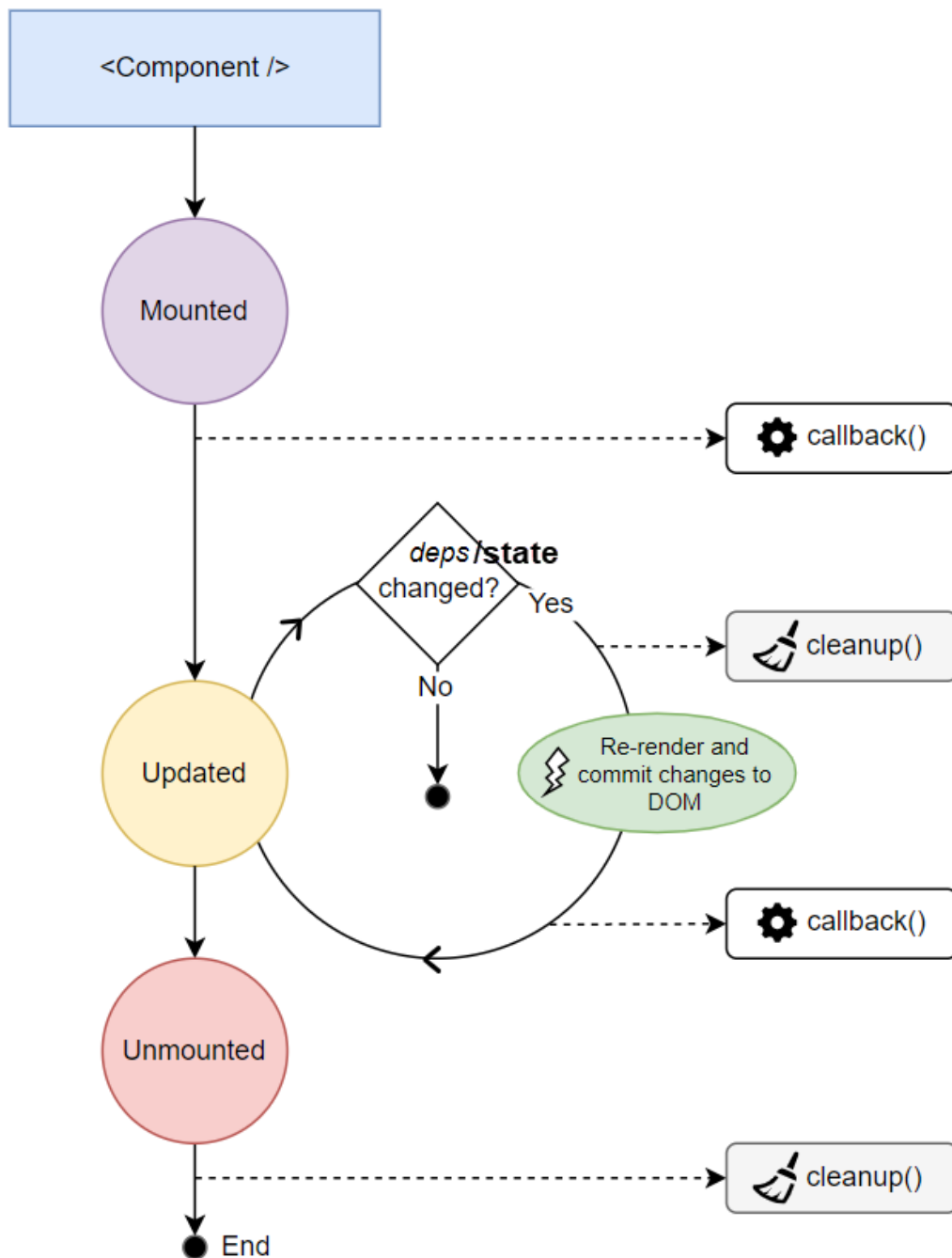
```
useEffect( () => {  
  // do something with dep1 and dep2  
  return () => { /* clean up */ };  
}, [dep1, dep2] );
```



**Cleanup function:**  
Return a function to clean up  
after the effect (e.g., unsubscribe,  
stop timers, remove listeners, etc.).



**Dependency list:**  
Run the effect only if the  
values in the array change.



A) After initial rendering, `useEffect()` invokes the callback having the side-effect. cleanup function is not invoked

B) 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

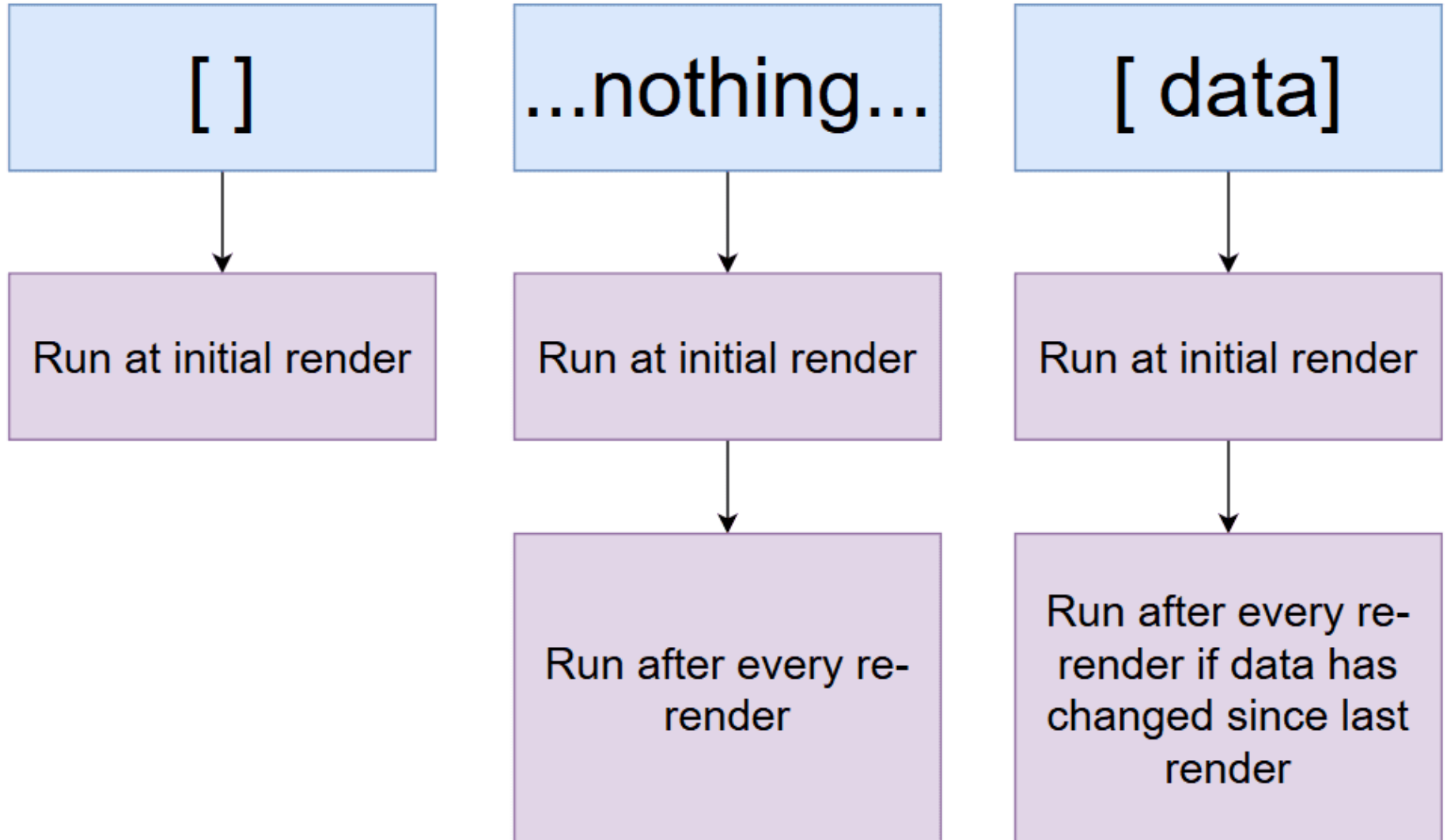
C) Finally, after unmounting the component, `useEffect()` invokes the cleanup function from the latest side-effect

# Common side effects

Common side effects include:

- Setting the page title imperatively
- Working with timers like `setInterval` or `setTimeout`
- Logging messages to the console or other service
- Fetching data or subscribing and unsubscribing to services
- Setting or getting values in local storage

# useEffect - 2<sup>nd</sup> argument



# Use cases for the useEffect hook

Call pattern	Code pattern	Execution pattern
No second argument	<pre>useEffect(() =&gt; {   // perform effect });</pre>	Run after every render.
Empty array as second argument	<pre>useEffect(() =&gt; {   // perform effect }, []);</pre>	Run once, when the component mounts.
Dependency array as second argument	<pre>useEffect(() =&gt; {   // perform effect   // that uses dep1 and dep2 }, [dep1, dep2]);</pre>	Run whenever a value in the dependency array changes.
Return a function	<pre>useEffect(() =&gt; {   // perform effect   return () =&gt; {/* clean-up */}; }, [dep1, dep2]);</pre>	React will run the cleanup function when the component unmounts and before rerunning the effect.

# useEffect – Executes code during Component Life Cycle

- **Initialize state data** when the component loads

```
useEffect(() => {
  async function fetchData() {
    const url = "https://api.github.com/users";
    const response = await fetch(url);
    setUsers( await response.json() ); } // set users in state
  fetchData();
}, []); // pass empty array to run this effect once when the component is first mounted to the DOM.
```

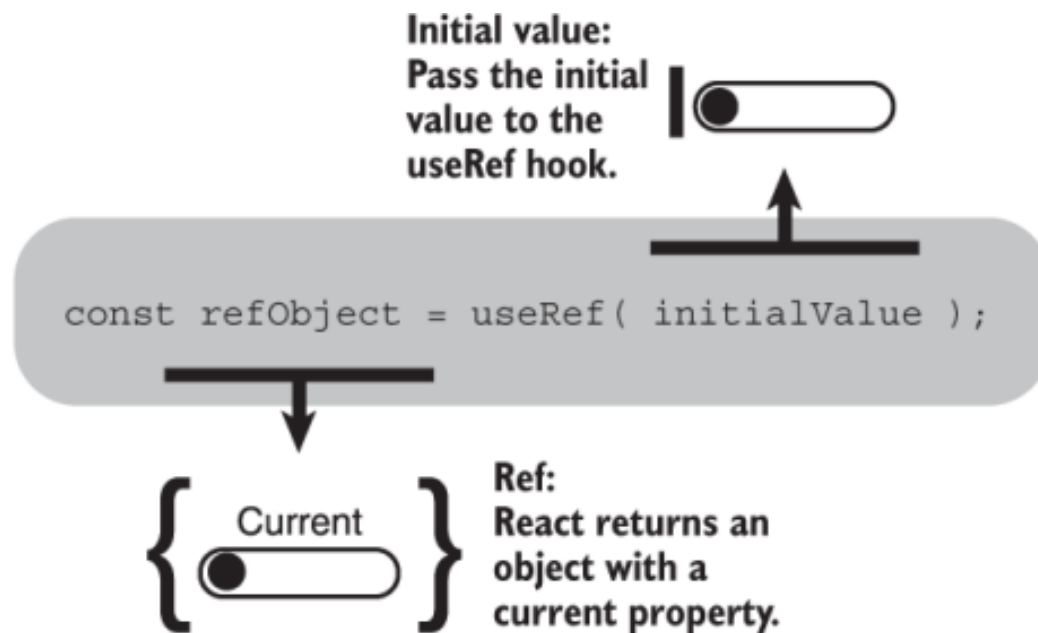
- **Executing a function every time a state variable changes**

```
useEffect(() => {
  async function fetchData() {
    const url = `https://hn.algolia.com/api/v1/search?query=${query}`;
    const response = await fetch(url);
    const data = await response.json();
    setNews(data.hits);
  }
  fetchData();
}, [query]);
```

**If 2<sup>nd</sup> parameter is not set, then the useEffect function will run on every re-render**

# useRef

- useRef() hook to create **persisted mutable values** as well as directly **access DOM elements** (e.g., focusing an input)
  - The value of the reference is persisted (stays the same) between component re-renderings
  - Updating a reference doesn't trigger a component re-rendering.



# useRef for Mutable values

- `useRef(initialValue)` accepts one argument as the initial value and returns a reference. A reference is an object having a special property `current`

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

function LogButtonClicks() {
  const countRef = useRef(0);

  const handle = () => {
    countRef.current++;
    console.log(`Clicked ${countRef.current} times`);
  };

  console.log('I rendered!');

  return <button onClick={handle}>Click me</button>;
}
```

- `reference.current` accesses the reference value, and `reference.current = newValue` updates the reference value
- The value of the reference is persisted (stays the same) between component re-renderings
- Updating a reference doesn't trigger a component re-rendering



# useRef for accessing DOM elements

- useRef() hook can be used to access DOM elements

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

function InputFocus() {
  const inputRef = useRef();

  useEffect(() => {
    inputRef.current.focus();
  }, []);

  return (
    <input
      ref={inputRef}
      type="text"
    />
  );
}
```

- Define the reference to access the element

```
const inputRef = useRef();
```

- Assign the reference to **ref** attribute of the element:

```
<input ref={inputRef} />
```

- After mounting, `inputRef.current` points to the DOM element

=> In this example, we access the input to focus on it when the component mounts. After mounting we call

```
inputRef.current.focus()
```

# Store Previous State Value

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

export default function PreviousValueTracker() {
  const [count, setCount] = useState(0);
  const prevCountRef = useRef();

  useEffect(() => {
    prevCountRef.current = count; // update after render
  }, [count]);

  return (
    <div>
      <p>Current count: {count}</p>
      <p>Previous count: {prevCountRef.current ?? 'N/A'}</p>
      <button onClick={() => setCount(count + 1)}>Increment</button>
    </div>
  );
}
```

prevCountRef stores the previous count value **after each render**. Unlike useState, updating useRef **does not cause a re-render**.

# useRef vs. useState

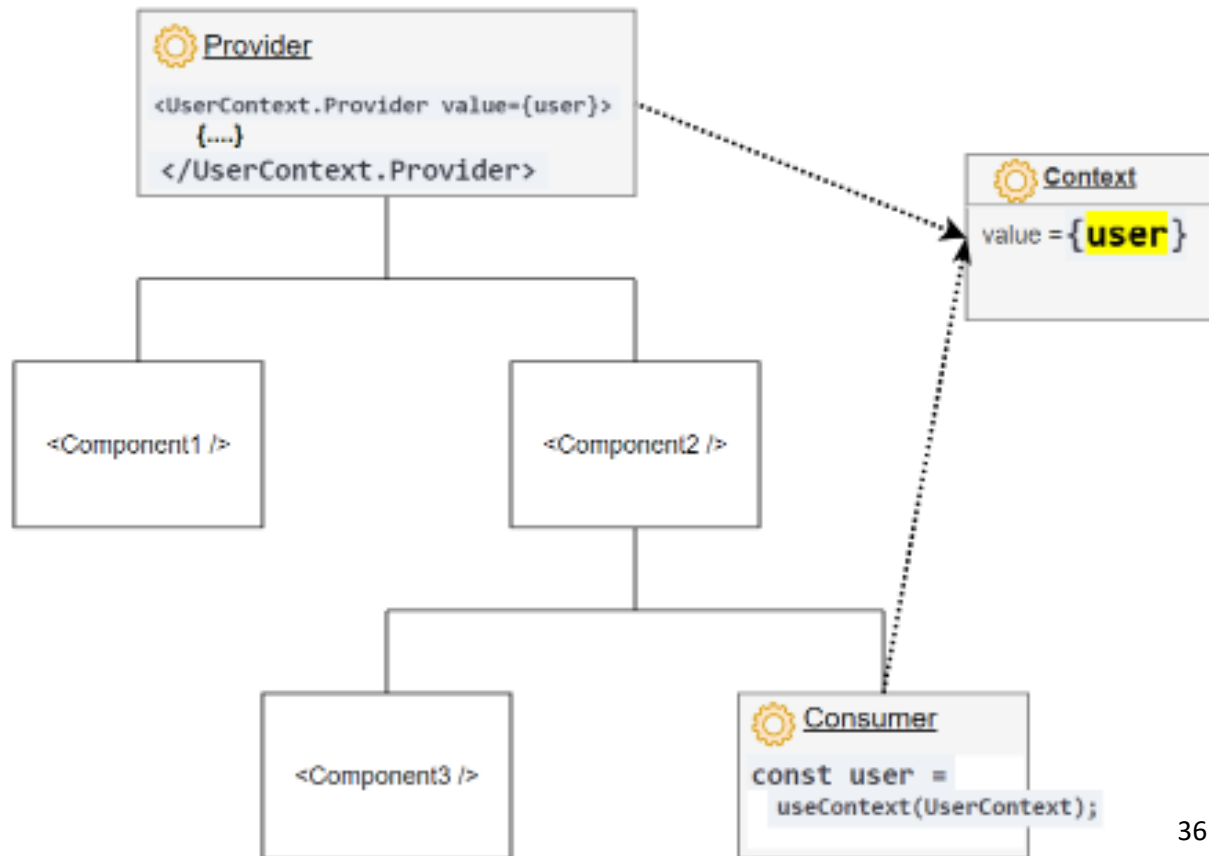
- useState, and useContext hooks triggering re-renders when a state variable changes
- useRef remembers the state value but change of value does not trigger rerender
  - The values of refs persist throughout render cycles

# useContext

- Share state (e.g., current user, user settings) between deeply nested components more easily than prop drilling (i.e., without pass the state as props through each nested component)

- Using the context requires 3 steps: creating, providing, and consuming the context

- If the context variables change then all consumers are notified and re-rendered



# useContext – provides shared variables and functions

1. **Create a context** instance (i.e., a container to hold shared variables and functions)

```
import React from 'react';  
const UserContext = React.createContext();  
export default UserContext;
```

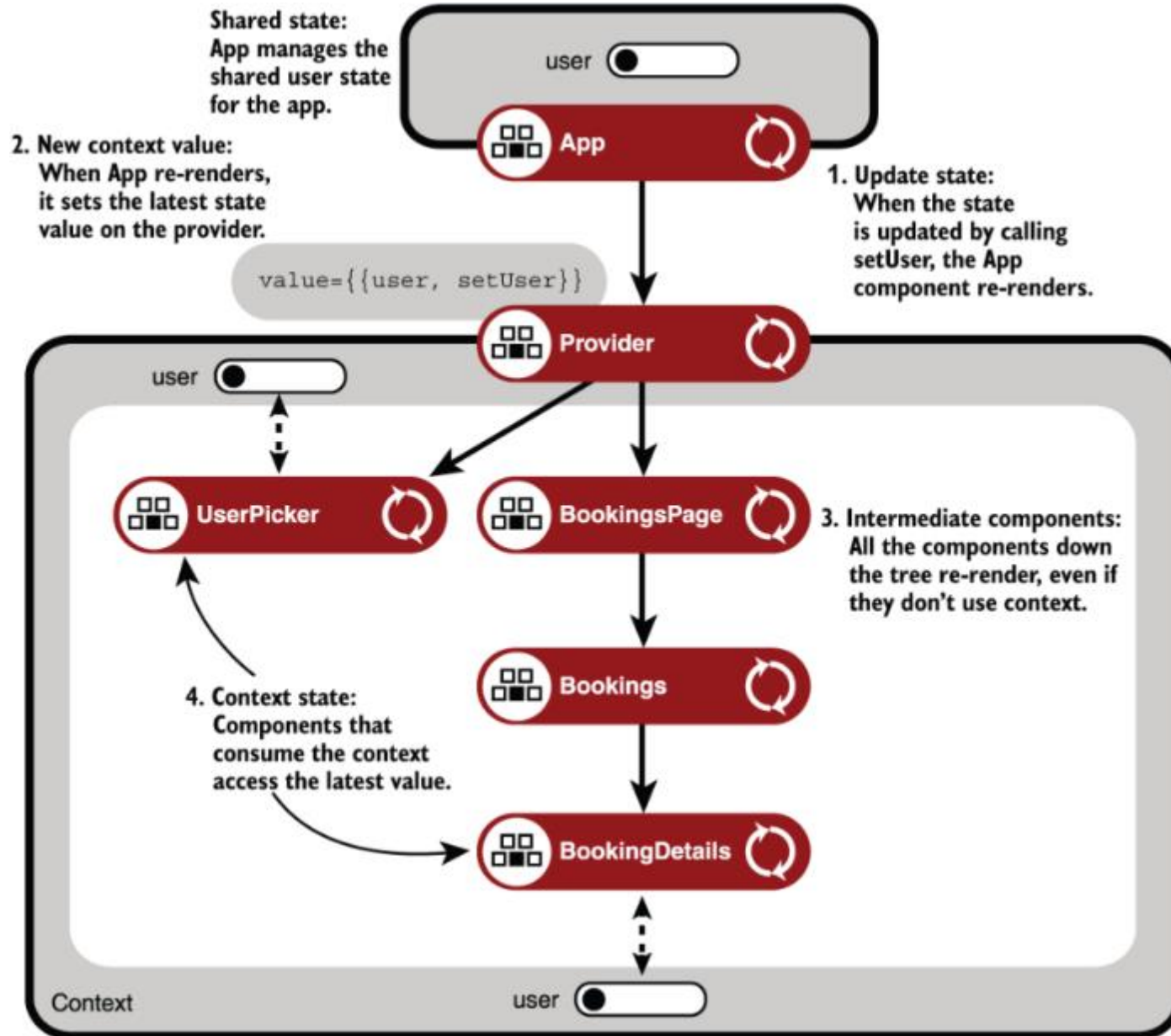
2. **Provider places shared variables / functions in the context** to make them available to child components

```
import UserContext from './components/UserContext';  
function App() { return (  
  <UserContext.Provider value={ user }>  
    <Welcome /> ...  
  </UserContext.Provider>  
); }
```

3. **Consumer access the shared variables / functions in the context**

```
import React, {useContext} from "react"; import UserContext from './UserContext';  
export default function Welcome() {  
  const user = useContext(UserContext);  
  return <div>You are login as: {user.username}</div>;  
}
```

# Shared State Example



# useRouter

- **useRouter** hook allows you to programmatically change routes inside Client Components
  - Use the <Link> component for navigation unless you have a specific requirement for using useRouter

```
'use client'

import { useRouter } from 'next/navigation'

export default function Page() {
  const router = useRouter()

  return (
    <button type="button" onClick={() => router.push('/dashboard')}>
      Dashboard
    </button>
  )
}
```

# useActionState

- useActionState is a new React hook that manages the state of a form submission
  - It simplifies form logic by tracking pending, success, or error states after an action runs
  - Built-in support for server actions
  - Returns [state, dispatch, isPending]
  - Ideal for handling form submissions (e.g., login, register, feedback)
  - <https://react.dev/reference/react/useActionState>
- ToDo: More details soon...



# useOptimistic

- `useOptimistic`: allows showing instant feedback to users before the server confirms a mutation (like adding a comment, updating a list, etc.)
  - It lets you optimistically update the UI to reflect the expected result of a server action, while still calling that action in the background
  - Think of it like: “Act as if the update already happened while we wait for the real response”
  - Keeps UI responsive: Improves user experience

# Example

```
import { useState, useOptimistic } from 'react';
export default function CommentsPage() {
  const [comments, setComments] = useState([]);
  const [optimisticComments, addOptimisticComment] = useOptimistic(
    comments,
    (prevComments, newComment) => [...prevComments, newComment]
  );

  async function handleSubmit(formData) {
    const newComment = formData.get('comment');
    addOptimisticComment(newComment);
    const saved = await addCommentToServer(newComment);
    setComments(prev => [...prev, saved]);
  }

  return (
    <form action={handleSubmit}>
      <input type="text" name="comment" placeholder="Add a comment" required />
      <button type="submit">Post</button>
      <ul>
        {optimisticComments.map((c, i) => (
          <li key={i}>{c}</li>
        ))}
      </ul>
    </form>
  );
}
```

# Summary of Hooks

- **useState:** Manage local component state
- **useEffect:** Handle side effects and respond to component lifecycle events
- **useRef:** Persist values across renders or directly reference DOM elements
- **useContext:** Share state/functions globally without prop drilling
- **useRouter:** Access routing information and navigation methods
- **useActionState:** Manage form state updates and errors when using server actions
- **useOptimistic:** Implement optimistic UI updates by temporarily updating state before a server action completes

# Interleaving Server and Client Components



# Common patterns for interleaving Server and Client Components

Pattern	Description	Use Case	Benefits
<b>Server Wrapper, Client Core</b>	Server fetches data and passes it to client component	Dashboard, data-driven UIs	Fast render, clear separation
<b>Client Component with Server Actions</b>	Client triggers server logic via form action or <code>useActionState</code>	Forms, to-dos, CRUD apps	Clean server logic, smaller client bundle
<b>Server Component with Client Children</b>	Server renders parent layout, client handles interactive children	Modals, filters, dynamic widgets	Reusable layout with local interactivity

# Resources

- Thinking in React

<https://react.dev/learn/thinking-in-react>

- Hooks

- <https://react.dev/reference/react/hooks>
- [React Hooks in Action textbook](#)

- Useful list of resources

<https://github.com/rehooks/awesome-react-hooks>

- Shadcn <https://ui.shadcn.com/>

- Material-UI <https://mui.com/>