React (Guide)

Documentation

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Quick Start

Welcome to the React documentation! This page will give you an introduction to 80% of the React concepts that you will use on a daily basis.

You will learn

- How to create and nest components
- How to add markup and styles
- How to display data
- How to render conditions and lists
- How to respond to events and update the screen
- How to share data between components

Creating and nesting components

React apps are made out of *components*. A component is a piece of the UI (user interface) that has its own logic and appearance. A component can be as small as a button, or as large as an entire page.

React components are JavaScript functions that return markup:

```
function MyButton() {
  return (
    <button>I'm a button</button>
  );
}
```

Now that you've declared `MyButton`, you can nest it into another component:

```
export default function MyApp() {
  return (
    <div>
      <h1>Welcome to my app</h1>
      <MyButton />
    </div>
  );
}
```

Notice that `<MyButton />` starts with a capital letter. That's how you know it's a React component. React component names must always start with a capital letter, while HTML tags must be lowercase.

Have a look at the result:

App.js

```
function MyButton() {
  return (
    <button>
      I'm a button
    </button>
  );
}

export default function MyApp() {
  return (
    <div>
      <h1>Welcome to my app</h1>
      <MyButton />
    </div>
  );
}
```

The `export default` keywords specify the main component in the file. If you're not familiar with some piece of JavaScript syntax, MDN and javascript.info have great references.

Writing markup with JSX

The markup syntax you've seen above is called *JSX*. It is optional, but most React projects use JSX for its convenience. All of the tools we recommend for local development support JSX out of the box.

JSX is stricter than HTML. You have to close tags like `<br />`. Your component also can't return multiple JSX tags. You have to wrap them into a shared parent, like a `<div>...</div>` or an empty `<>...</>` wrapper:

```
function AboutPage() {
  return (
    <>
      <h1>About</h1>
      <p>Hello there.<br />How do you do?</p>
    </>
  );
}
```

If you have a lot of HTML to port to JSX, you can use an online converter.

Adding styles

In React, you specify a CSS class with `className`. It works the same way as the HTML `class` attribute:

```
<img className="avatar" />
```

Then you write the CSS rules for it in a separate CSS file:

```
/* In your CSS */
.avatar {
  border-radius: 50%;
}
```

React does not prescribe how you add CSS files. In the simplest case, you'll add a `<link>` tag to your HTML. If you use a build tool or a framework, consult its documentation to learn how to add a CSS file to your project.

Displaying data

JSX lets you put markup into JavaScript. Curly braces let you "escape back" into JavaScript so that you can embed some variable from your code and display it to the user. For example, this will display `user.name`:

```
return (
  <h1>
    {user.name}
  </h1>
);
```

You can also "escape into JavaScript" from JSX attributes, but you have to use curly braces *instead of* quotes. For example, `className="avatar"` passes the `"avatar"` string as the CSS class, but `src={user.imageUrl}` reads the JavaScript `user.imageUrl` variable value, and then passes that value as the `src` attribute:

```
return (
  <img
    className="avatar"
    src={user.imageUrl}
  />
);
```

You can put more complex expressions inside the JSX curly braces too, for example, string concatenation:

App.js

```
const user = {
  name: 'Hedy Lamarr',
  imageUrl: 'https://i.imgur.com/yXOvdOSs.jpg',
  imageSize: 90,
};

export default function Profile() {
  return (
    <>
      <h1>{user.name}</h1>
      <img
        className="avatar"
        src={user.imageUrl}
        alt={'Photo of ' + user.name}
        style={{
          width: user.imageSize,
          height: user.imageSize
        }}
      />
    </>
  );
}
```

In the above example, `style={{}}` is not a special syntax, but a regular `{}` object inside the `style={ }` JSX curly braces. You can use the `style` attribute when your styles depend on JavaScript variables.

Conditional rendering

In React, there is no special syntax for writing conditions. Instead, you'll use the same techniques as you use when writing regular JavaScript code. For example, you can use an `if` statement to conditionally include JSX:

```
let content;
if (isLoggedIn) {
  content = <AdminPanel />;
} else {
  content = <LoginForm />;
}
return (
  <div>
    {content}
  </div>
);
```

If you prefer more compact code, you can use the conditional `?` operator. Unlike `if`, it works inside JSX:

```
<div>
  {isLoggedIn ? (
    <AdminPanel />
  ) : (
    <LoginForm />
  )}
</div>
```

When you don't need the `else` branch, you can also use a shorter logical `&&` syntax:

```
<div>
  {isLoggedIn && <AdminPanel />}
</div>
```

All of these approaches also work for conditionally specifying attributes. If you're unfamiliar with some of this JavaScript syntax, you can start by always using `if...else`.

Rendering lists

You will rely on JavaScript features like `for` loop and the array `map()` function to render lists of components.

For example, let's say you have an array of products:

```
const products = [
  { title: 'Cabbage', id: 1 },
  { title: 'Garlic', id: 2 },
  { title: 'Apple', id: 3 },
];
```

Inside your component, use the `map()` function to transform an array of products into an array of `<li>` items:

```
const listItems = products.map(product =>
  <li key={product.id}>
    {product.title}
  </li>
);

return (
  <ul>{listItems}</ul>
);
```

Notice how `<li>` has a `key` attribute. For each item in a list, you should pass a string or a number that uniquely identifies that item among its siblings. Usually, a key should be coming from your data, such as a database ID. React uses your keys to know what happened if you later insert, delete, or reorder the items.

App.js

```
const products = [
  { title: 'Cabbage', isFruit: false, id: 1 },
  { title: 'Garlic', isFruit: false, id: 2 },
  { title: 'Apple', isFruit: true, id: 3 },
];

export default function ShoppingList() {
  const listItems = products.map(product =>
    <li
      key={product.id}
      style={{
        color: product.isFruit ? 'magenta' : 'darkgreen'
      }}
    >
      {product.title}
    </li>
  );

  return (
    <ul>{listItems}</ul>
  );
}
```

Responding to events

You can respond to events by declaring *event handler* functions inside your components:

```
function MyButton() {
  function handleClick() {
    alert('You clicked me!');
  }

  return (
    <button onClick={handleClick}>
      Click me
    </button>
  );
}
```

Notice how `onClick={handleClick}` has no parentheses at the end! Do not *call* the event handler function: you only need to *pass it down*. React will call your event handler when the user clicks the button.

Updating the screen

Often, you'll want your component to "remember" some information and display it. For example, maybe you want to count the number of times a button is clicked. To do this, add *state* to your component.

First, import `useState` from React:

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

Now you can declare a *state variable* inside your component:

```
function MyButton() {
  const [count, setCount] = useState(0);
  // ...
```

You'll get two things from `useState`: the current state (`count`), and the function that lets you update it (`setCount`). You can give them any names, but the convention is to write `[something, setSomething]`.

The first time the button is displayed, `count` will be `0` because you passed `0` to `useState()`. When you want to change state, call `setCount()` and pass the new value to it. Clicking this button will increment the counter:

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

  function handleClick() {
    setCount(count + 1);
  }

  return (
    <button onClick={handleClick}>
      Clicked {count} times
    </button>
  );
}
```

React will call your component function again. This time, `count` will be `1`. Then it will be `2`. And so on.

If you render the same component multiple times, each will get its own state. Click each button separately:

App.js

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

export default function MyApp() {
  return (
    <div>
      <h1>Counters that update separately</h1>
      <MyButton />
      <MyButton />
    </div>
  );
}

function MyButton() {
  const [count, setCount] = useState(0);

  function handleClick() {
    setCount(count + 1);
  }

  return (
    <button onClick={handleClick}>
      Clicked {count} times
    </button>
  );
}
```

Notice how each button "remembers" its own `count` state and doesn't affect other buttons.

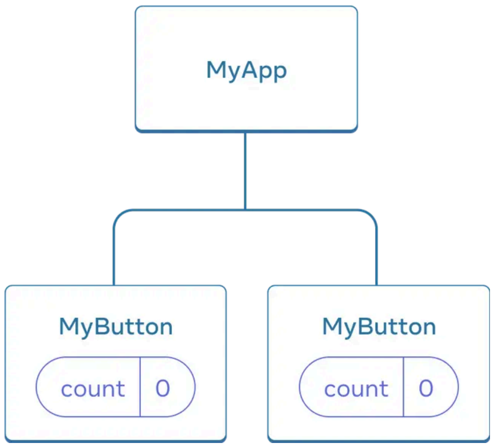
Using Hooks

Functions starting with `use` are called *Hooks*. `useState` is a built-in Hook provided by React. You can find other built-in Hooks in the API reference. You can also write your own Hooks by combining the existing ones.

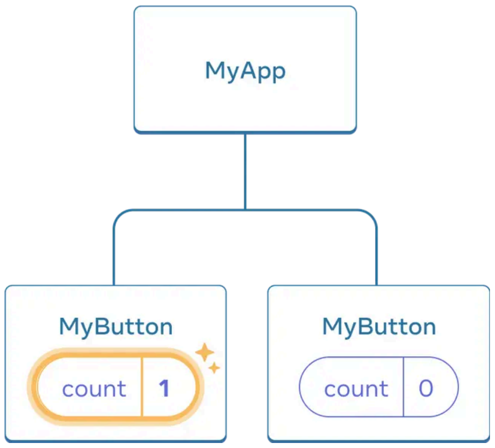
Hooks are more restrictive than other functions. You can only call Hooks *at the top* of your components (or other Hooks). If you want to use `useState` in a condition or a loop, extract a new component and put it there.

Sharing data between components

In the previous example, each `MyButton` had its own independent `count`, and when each button was clicked, only the `count` for the button clicked changed:



Initially, each `MyButton`'s `count` state is `0`

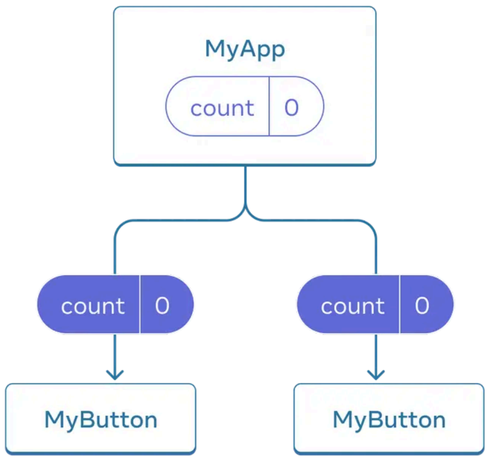


The first `MyButton` updates its `count` to `1`

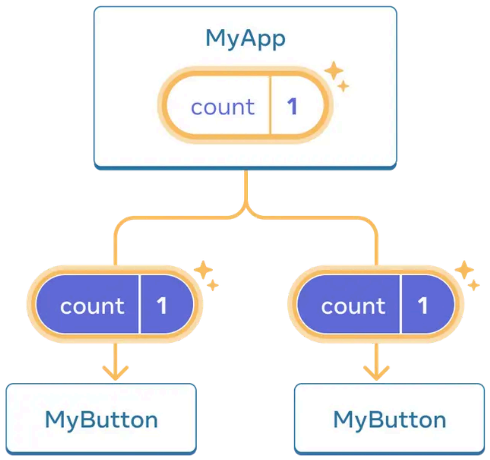
However, often you'll need components to *share data and always update together*.

To make both `MyButton` components display the same `count` and update together, you need to move the state from the individual buttons "upwards" to the closest component containing all of them.

In this example, it is `MyApp`:



Initially, `MyApp`'s `count` state is `0` and is passed down to both children



On click, `MyApp` updates its `count` state to `1` and passes it down to both children

Now when you click either button, the `count` in `MyApp` will change, which will change both of the counts in `MyButton`. Here's how you can express this in code.

First, *move the state up* from `MyButton` into `MyApp`:

```
export default function MyApp() {
  const [count, setCount] = useState(0);

  function handleClick() {
    setCount(count + 1);
  }

  return (
    <div>
      <h1>Counters that update separately</h1>
      <MyButton />
      <MyButton />
    </div>
  );
}

function MyButton() {
  // ... we're moving code from here ...
}
```

Then, *pass the state down* from `MyApp` to each `MyButton`, together with the shared click handler. You can pass information to `MyButton` using the JSX curly braces, just like you previously did with built-in tags like `<img>`:

```
export default function MyApp() {
  const [count, setCount] = useState(0);
  function handleClick() {
    setCount(count + 1);
  }

  return (
    <div>
      <h1>Counters that update together</h1>
      <MyButton count={count} onClick={handleClick} />
      <MyButton count={count} onClick={handleClick} />
    </div>
  );
}
```

The information you pass down like this is called *props*. Now the `MyApp` component contains the `count` state and the `handleClick` event handler, and *passes both of them down as props* to each of the buttons.

Finally, change `MyButton` to *read* the props you have passed from its parent component:

```
function MyButton({ count, onClick }) {
  return (
    <button onClick={onClick}>
      Clicked {count} times
    </button>
  );
}
```

When you click the button, the `onClick` handler fires. Each button's `onClick` prop was set to the `handleClick` function inside `MyApp`, so the code inside of it runs. That code calls `setCount(count + 1)`, incrementing the `count` state variable. The new `count` value is passed as a prop to each button, so they all show the new value. This is called “lifting state up”. By moving state up, you’ve shared it between components.

App.js

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

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

  function handleClick() {
    setCount(count + 1);
  }

  return (
    <div>
      <h1>Counters that update together</h1>
      <MyButton count={count} onClick={handleClick} />
      <MyButton count={count} onClick={handleClick} />
    </div>
  );
}

function MyButton({ count, onClick }) {
  return (
    <button onClick={onClick}>
      Clicked {count} times
    </button>
  );
}
```

Next Steps

By now, you know the basics of how to write React code!

Check out the Tutorial to put them into practice and build your first mini-app with React.

Tutorial: Tic-Tac-Toe

You will build a small tic-tac-toe game during this tutorial. This tutorial does not assume any existing React knowledge. The techniques you'll learn in the tutorial are fundamental to building any React app, and fully understanding it will give you a deep understanding of React.

Note

This tutorial is designed for people who prefer to **learn by doing** and want to quickly try making something tangible. If you prefer learning each concept step by step, start with Describing the UI.

The tutorial is divided into several sections:

- Setup for the tutorial will give you **a starting point** to follow the tutorial.
- Overview will teach you **the fundamentals** of React: components, props, and state.
- Completing the game will teach you **the most common techniques** in React development.
- Adding time travel will give you **a deeper insight** into the unique strengths of React.

What are you building?

In this tutorial, you'll build an interactive tic-tac-toe game with React.

You can see what it will look like when you're finished here:

App.js

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

function Square({ value, onSquareClick }) {
  return (
    <button className="square" onClick={onSquareClick}>
      {value}
    </button>
  );
}

function Board({ xIsNext, squares, onPlay }) {
  function handleClick(i) {
    if (calculateWinner(squares) || squares[i]) {
      return;
    }
    const nextSquares = squares.slice();
    if (xIsNext) {
      nextSquares[i] = 'X';
    } else {
      nextSquares[i] = 'O';
    }
    onPlay(nextSquares);
  }

  const winner = calculateWinner(squares);
  let status;
  if (winner) {
    status = 'Winner: ' + winner;
  } else {
    status = 'Next player: ' + (xIsNext ? 'X' : 'O');
  }

  return (
    <>
      <div className="status">{status}</div>
      <div className="board-row">
        <Square value={squares[0]} onSquareClick={() => handleClick(0)} />
        <Square value={squares[1]} onSquareClick={() => handleClick(1)} />
        <Square value={squares[2]} onSquareClick={() => handleClick(2)} />
      </div>
      <div className="board-row">
        <Square value={squares[3]} onSquareClick={() => handleClick(3)} />
        <Square value={squares[4]} onSquareClick={() => handleClick(4)} />
        <Square value={squares[5]} onSquareClick={() => handleClick(5)} />
      </div>
      <div className="board-row">
        <Square value={squares[6]} onSquareClick={() => handleClick(6)} />
        <Square value={squares[7]} onSquareClick={() => handleClick(7)} />
        <Square value={squares[8]} onSquareClick={() => handleClick(8)} />
      </div>
    </>
  );
}

export default function Game() {
  const [history, setHistory] = useState([Array(9).fill(null)]);
  const [currentMove, setCurrentMove] = useState(0);
  const xIsNext = currentMove % 2 === 0;
  const currentSquares = history[currentMove];

  function handlePlay(nextSquares) {
    const nextHistory = [...history.slice(0, currentMove + 1), nextSquares];
    setHistory(nextHistory);
    setCurrentMove(nextHistory.length - 1);
  }

  function jumpTo(nextMove) {
    setCurrentMove(nextMove);
  }

  const moves = history.map((squares, move) => {
    let description;
    if (move > 0) {
      description = 'Go to move #' + move;
    } else {
      description = 'Go to game start';
    }
    return (
      <li key={move}>
        <button onClick={() => jumpTo(move)}>{description}</button>
      </li>
    );
  });

  return (
    <div className="game">
      <div className="game-board">
        <Board xIsNext={xIsNext} squares={currentSquares} onPlay={handlePlay}
      </div>
      <div className="game-info">
        <ol>{moves}</ol>
      </div>
    </div>
  );
}

function calculateWinner(squares) {
  const lines = [
    [0, 1, 2],
    [3, 4, 5],
    [6, 7, 8],
    [0, 3, 6],
    [1, 4, 7],
    [2, 5, 8],
    [0, 4, 8],
    [2, 4, 6],
  ];
  for (let i = 0; i < lines.length; i++) {
    const [a, b, c] = lines[i];
    if (squares[a] && squares[a] === squares[b] && squares[a] === squares[c])
      return squares[a];
    }
  }
  return null;
}
```

If the code doesn't make sense to you yet, or if you are unfamiliar with the code's syntax, don't worry! The goal of this tutorial is to help you understand React and its syntax.

We recommend that you check out the tic-tac-toe game above before continuing with the tutorial. One of the features that you'll notice is that there is a numbered list to the right of the game's board. This list gives you a history of all of the moves that have occurred in the game, and it is updated as the game progresses.

Once you've played around with the finished tic-tac-toe game, keep scrolling. You'll start with a simpler template in this tutorial. Our next step is to set you up so that you can start building the game.

Setup for the tutorial

In the live code editor below, click **Fork** in the top-right corner to open the editor in a new tab using the website CodeSandbox. CodeSandbox lets you write code in your browser and preview how your users will see the app you've created. The new tab should display an empty square and the starter code for this tutorial.

App.js

```
export default function Square() {
  return <button className="square">X</button>;
}
```

Note

You can also follow this tutorial using your local development environment. To do this, you need to:

1. Install Node.js
2. In the CodeSandbox tab you opened earlier, press the top-left corner button to open the menu, and then choose **Download Sandbox** in that menu to download an archive of the files locally
3. Unzip the archive, then open a terminal and `cd` to the directory you unzipped
4. Install the dependencies with `npm install`
5. Run `npm start` to start a local server and follow the prompts to view the code running in a browser

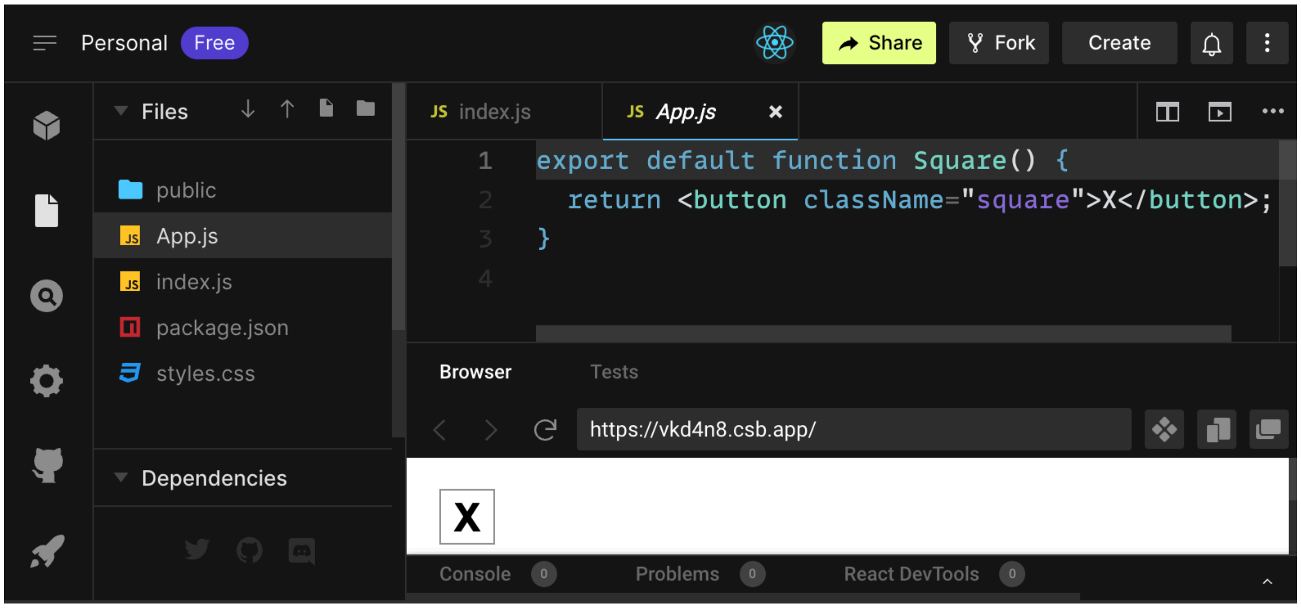
If you get stuck, don't let this stop you! Follow along online instead and try a local setup again later.

Overview

Now that you're set up, let's get an overview of React!

Inspecting the starter code

In CodeSandbox you'll see three main sections:



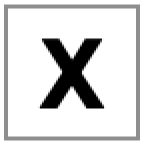
```
export default function Square() {
  return <button className="square">X</button>;
}
```

1. The *Files* section with a list of files like `App.js`, `index.js`, `styles.css` and a folder called `public`
2. The *code editor* where you'll see the source code of your selected file
3. The *browser* section where you'll see how the code you've written will be displayed

The `App.js` file should be selected in the *Files* section. The contents of that file in the *code editor* should be:

```
export default function Square() {
  return <button className="square">X</button>;
}
```

The *browser* section should be displaying a square with an X in it like this:



Now let's have a look at the files in the starter code.

`App.js`

The code in App.js creates a *component*. In React, a component is a piece of reusable code that represents a part of a user interface. Components are used to render, manage, and update the UI elements in your application. Let's look at the component line by line to see what's going on:

```
export default function Square() {
  return <button className="square">X</button>;
}
```

The first line defines a function called Square. The export JavaScript keyword makes this function accessible outside of this file. The default keyword tells other files using your code that it's the main function in your file.

```
export default function Square() {
  return <button className="square">X</button>;
}
```

The second line returns a button. The return JavaScript keyword means whatever comes after is returned as a value to the caller of the function. <button> is a *JSX element*. A JSX element is a combination of JavaScript code and HTML tags that describes what you'd like to display. className="square" is a button property or *prop* that tells CSS how to style the button. X is the text displayed inside of the button and </button> closes the JSX element to indicate that any following content shouldn't be placed inside the button.

styles.css

Click on the file labeled styles.css in the *Files* section of CodeSandbox. This file defines the styles for your React app. The first two *CSS selectors* (* and body) define the style of large parts of your app while the .square selector defines the style of any component where the className property is set to `square`. In your code, that would match the button from your Square component in the `App.js` file.

`index.js`

Click on the file labeled `index.js` in the *Files* section of CodeSandbox. You won't be editing this file during the tutorial but it is the bridge between the component you created in the `App.js` file and the web browser.

```
import { StrictMode } from 'react';
import { createRoot } from 'react-dom/client';
import './styles.css';

import App from './App';
```

Lines 1-5 bring all the necessary pieces together:

- React
- React's library to talk to web browsers (React DOM)
- the styles for your components
- the component you created in `App.js`.

The remainder of the file brings all the pieces together and injects the final product into `index.html` in the `public` folder.

Building the board

Let's get back to `App.js`. This is where you'll spend the rest of the tutorial.

Currently the board is only a single square, but you need nine! If you just try and copy paste your square to make two squares like this:

```
export default function Square() {
```