REACTJS

This documentation provides a complete guide to developing React applications using TypeScript. It covers the essential concepts, advanced techniques, and best practices that help you harness the full power of React and TypeScript together. Whether you're a beginner or an experienced developer, this guide will equip you with the knowledge and skills to create robust and efficient web applications.

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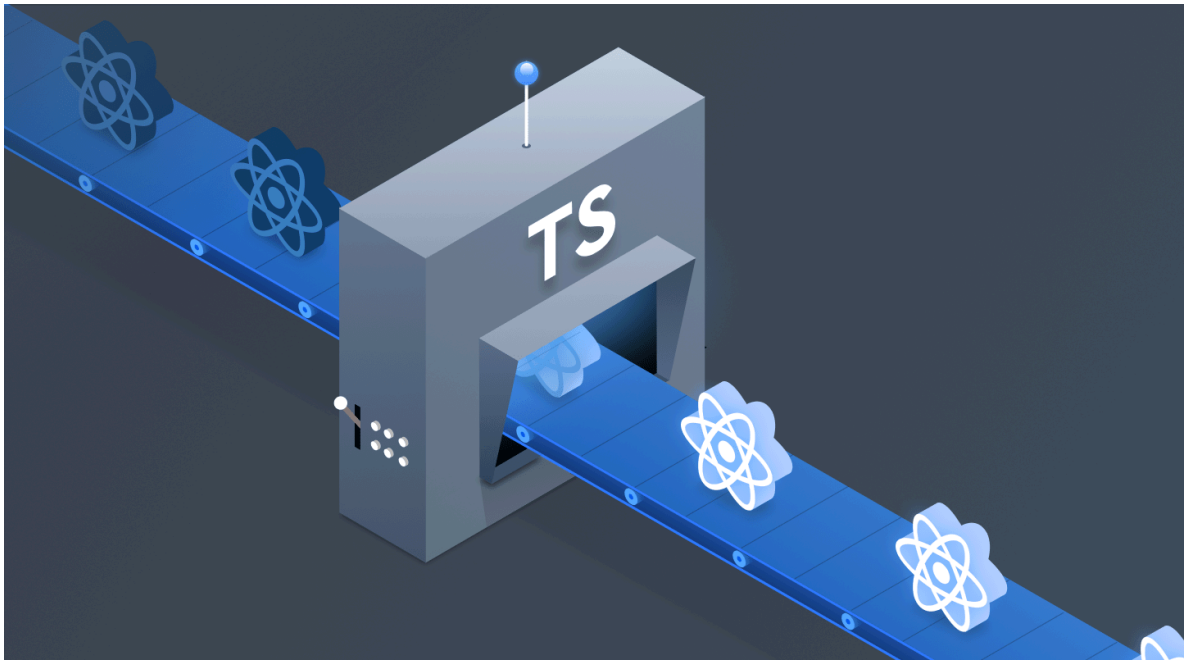
This outline should help you structure comprehensive and detailed documentation for React.js and TypeScript. Each section can be expanded with code examples, explanations, and best practices tailored to your audience.

See also

1. Intro to React



React TypeScript.png

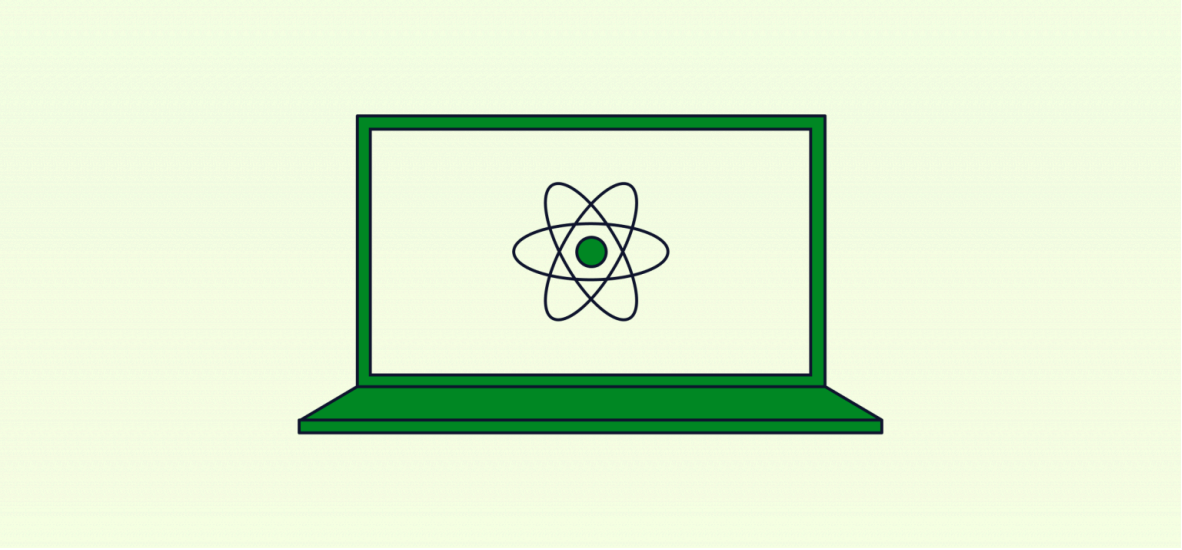
Overview of React

React Quickstart

Before you start, you should have a basic understanding of:

1. [x] What is HTML
2. [x] What is CSS
3. [x] What is DOM
4. [x] What is ES6
5. [x] What is Node.js
6. [x] What is npm

What is React?



react.png

- React, sometimes referred to as a frontend JavaScript framework, is a JavaScript library created by Facebook.
- React is a tool for building UI components.

- React has solidified its position as the go-to JavaScript front-end framework in the current tech landscape. It’s fascinating to see how it’s seamlessly woven itself into the development practices of well-established corporations and budding startups alike.

What is React used for?

1. Web development :
    - This is where React got its start and where you’ll find it used most often. React is component-based. An example of a component could be a form or even just a form field or button on a website. In React, you build up complete applications using components like these by nesting them.
    - Components in React can manage their own state and communicate that state to child components. By “state,” we mean the data that populates the web application.
2. Mobile app development :
    - React Native is a JavaScript framework that uses React. With React Native, developers can apply web-based React principles to creating mobile apps for Android and iOS. Here, React is used to connect the mobile user interface of the application to the phone’s operating system.
3. Desktop app development :
    - Developers can also use React with Electron, another JavaScript library, to create cross-platform desktop apps. Some apps you may know about that are built with Electron include Visual Studio Code, Slack, Skype, Discord, WhatsApp, and WordPress Desktop.

React.JS History

React.js, a popular JavaScript library for building user interfaces, particularly for single-page applications, has a fascinating history that reflects its evolution and growing adoption in the web development community. Here's a brief history of React.js in bullet points:

- **2011**: React.js created by Facebook's Jordan Walke for internal use.

- **2013**: Open-sourced at JSConf US; introduced virtual DOM.
- **2014**: Facebook introduced Flux, influencing state management in React.
- **2015**: React Native launched, expanding React to mobile apps.
- **2015**: React v0.14 split core into `react` and `react-dom`.
- **2016**: React v15 brought performance improvements and `prop-types`.
- **2017**: React Fiber (v16) restructured core for better responsiveness.
- **2018**: Hooks introduced in v16.8, transforming component design.
- **2019**: Experimental Suspense and Concurrent Mode introduced.
- **2020**: React v17 focused on easier upgrades.
- **2022**: React 18 brought full Concurrent Mode and enhanced UI responsiveness.
- **2023**: React 19 is the latest major release of the React JavaScript library, bringing a range of new features and improvements aimed at enhancing both developer experience and application performance. Some of the key updates include:

    1. **React Compiler**: A significant new feature, the React Compiler automates many performance optimizations, like memoization, which were previously handled manually using hooks like `useMemo` and `useCallback`. This simplifies the code and makes React apps faster and more efficient.

    2. **Actions and Form Handling**: React 19 introduces a new way to handle form submissions and state changes using "Actions." This feature simplifies managing asynchronous operations, making it easier to handle loading states, errors, and successful form submissions.

    3. **New Hooks**: Several new hooks have been introduced, such as `useOptimistic`, which allows for optimistic UI updates (i.e., updating the UI immediately while awaiting server confirmation), and `use`, which simplifies asynchronous operations within components. Additionally, the `useFormStatus` and `useActionState` hooks make managing form state more intuitive.

    4. **Server Components**: React 19 enhances server-side rendering by allowing server components, similar to features in frameworks like Next.js. This can lead to faster

page loads and improved SEO.

5. **Improved Metadata Management**: Managing document metadata like titles and meta tags is now easier and more integrated into React components, eliminating the need for third-party libraries like `react-helmet`.
6. **Background Asset Loading**: React 19 introduces background loading of assets (like images and scripts), which helps improve page load times and overall user experience by preloading resources in the background as users navigate through the app.

Thinking in React

"Thinking in React" is a concept that describes the process of designing and building user interfaces with React.js. It emphasizes breaking down the UI into components, managing data flow, and structuring the application in a way that aligns with React's component-based architecture. Here's a concise breakdown:

1. Break Down the UI into Components

1. **Start with a Mockup:** Look at your UI and identify the different parts that can be broken down into components.

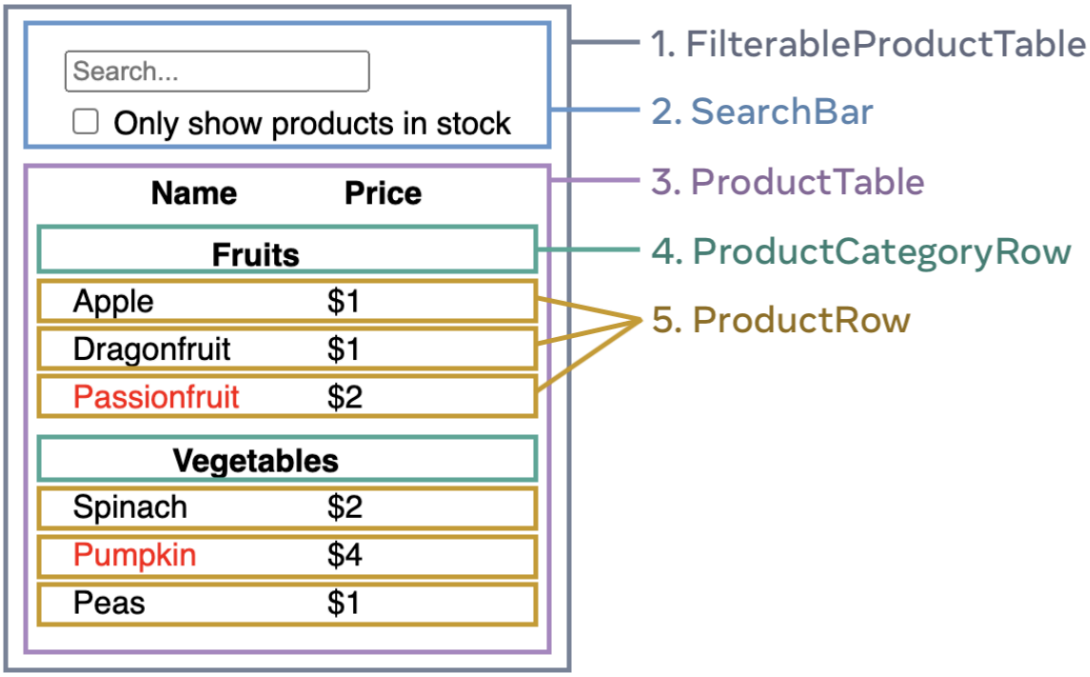
- Imagine that you already have a JSON API and a mockup from a designer.
  - The JSON API returns some data that looks like this:

```
[
  { category: "Fruits", price: "$1", stocked: true, name: "Apple" },
  { category: "Fruits", price: "$1", stocked: true, name:
"Dragonfruit" },
  { category: "Fruits", price: "$2", stocked: false, name:
"Passionfruit" },
  { category: "Vegetables", price: "$2", stocked: true, name:
"Spinach" },
  { category: "Vegetables", price: "$4", stocked: false, name:
"Pumpkin" },
  { category: "Vegetables", price: "$1", stocked: true, name: "Peas"
}
]
```

The mockup looks like this:

product page.png

2. There are five components on this screen:



products page decoupled.png

- FilterableProductTable (grey) contains the entire app.
- SearchBar (blue) receives the user input.
- ProductTable (lavender) displays and filters the list according to the user input.
- ProductCategoryRow (green) displays a heading for each category.
- ProductRow (yellow) displays a row for each product.

2. Build a Static Version in React

- **Create Stateless Components:** Initially, build components that don't manage their own state, simply taking in props and rendering UI.
  - In the App.js add

```
function ProductCategoryRow({ category }) {
    return (
      <tr>
        <th colSpan="2">
          {category}
```

```
        </th>
      </tr>
    );
}

function ProductRow({ product }) {
    const name = product.stocked ? product.name :
    <span style={{ color: 'red' }}>
    {product.name}
    </span>;
    return (
        <tr>
            <td>{name}</td>
            <td>{product.price}</td>
        </tr>
    );
}

function ProductTable({ products }) {
    const rows = [];
    let lastCategory = null;

    products.forEach((product) => {
        if (product.category !== lastCategory) {
            rows.push(
                <ProductCategoryRow
                    category={product.category}
                    key={product.category}
                 />
            );
        }
    rows.push(
        <ProductRow
            product={product}
            key={product.name}
        />
        );
        lastCategory = product.category;
```

```
    });

    return (
        <table>
            <thead>
                <tr>
                    <th>Name</th>
                    <th>Price</th>
                </tr>
            </thead>
            <tbody>{rows}</tbody>
        </table>
    );
}

function SearchBar() {
    return (
        <form>
            <input type="text" placeholder="Search..." />
            <label>
                <input type="checkbox" />
                {' '}
                Only show products in stock
            </label>
        </form>
    );
}

function FilterableProductTable({ products }) {
    return (
        <div>
            <SearchBar />
            <ProductTable products={products} />
        </div>
    );
}

const PRODUCTS = [
```

```
    {category: "Fruits", price: "$1", stocked: true, name: "Apple"},
    {category: "Fruits", price: "$1", stocked: true, name:
"Dragonfruit"},
    {category: "Fruits", price: "$2", stocked: false, name:
"Passionfruit"},
    {category: "Vegetables", price: "$2", stocked: true, name:
"Spinach"},
    {category: "Vegetables", price: "$4", stocked: false, name:
"Pumpkin"},
    {category: "Vegetables", price: "$1", stocked: true, name:
"Peas"}
 ];

 export default function App() {
    return <FilterableProductTable products={PRODUCTS} />;
 }
```

3. Identify the Minimal Representation of UI State

- **Determine What State Your UI Needs:** Consider what needs to change in your UI and represent it in the component's state.
- **Single Source of Truth:** Identify where the state should live—often in the highest common ancestor component that needs to share the state.

4. Identify Where Your State Should Live

- **Lift State Up:** When multiple components need to share state, lift it up to their closest common ancestor.
- **Controlled Components:** Ensure components only control their own state or receive state from a parent component.

5. Add Inverse Data Flow

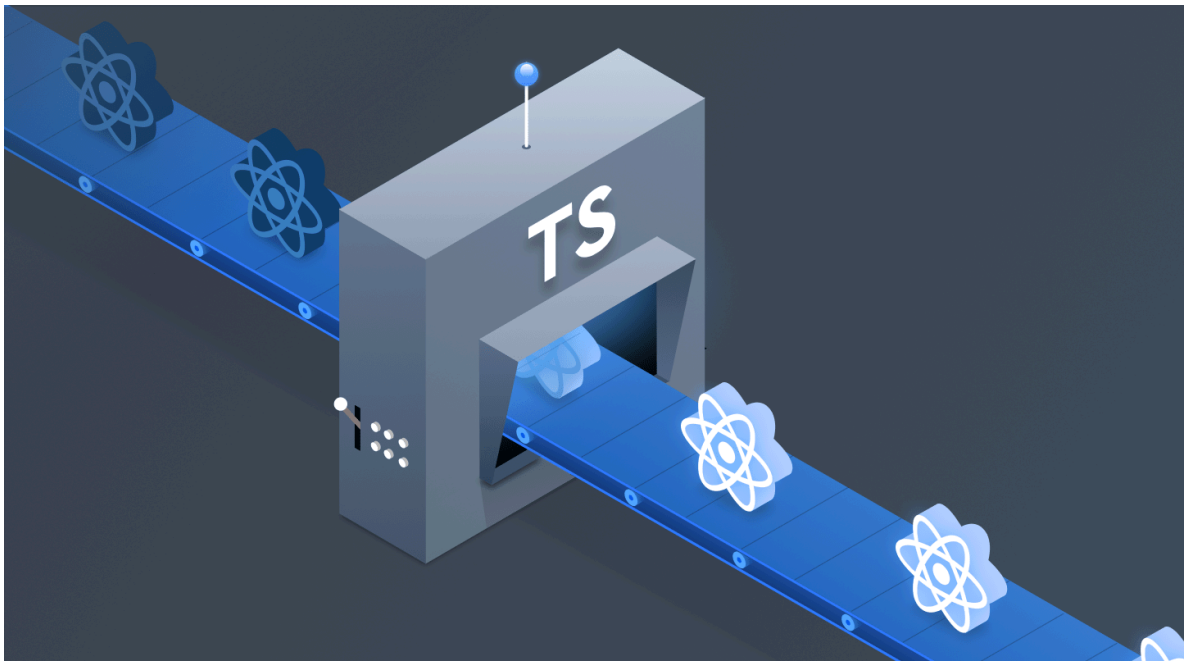
- **Pass Callbacks to Update State:** Child components that need to modify the parent's state should do so via callbacks passed down as props.

6. Implement the Final UI

- **Refine Components:** Continue to break down components, manage state efficiently, and ensure the data flows in a top-down manner.

"Thinking in React" is about modularity, clarity, and a clear data flow, which together make building complex UIs more manageable.

Introduction to TypeScript in React



React TypeScript.png

TypeScript is a statically typed superset of JavaScript that provides better tooling and helps catch errors early during development. Using TypeScript with React improves code quality and readability, especially in large projects.

Using TypeScript

TypeScript is a popular way to add type definitions to JavaScript codebases. Out of the box, TypeScript supports JSX and you can get full React Web support by adding `@types/react` and `@types/react-dom` to your project.

TypeScript with React Components

Writing TypeScript with React is very similar to writing JavaScript with React. The key difference when working with a component is that you can provide types for your component's props. These types can be used for correctness checking and providing inline documentation in editors.

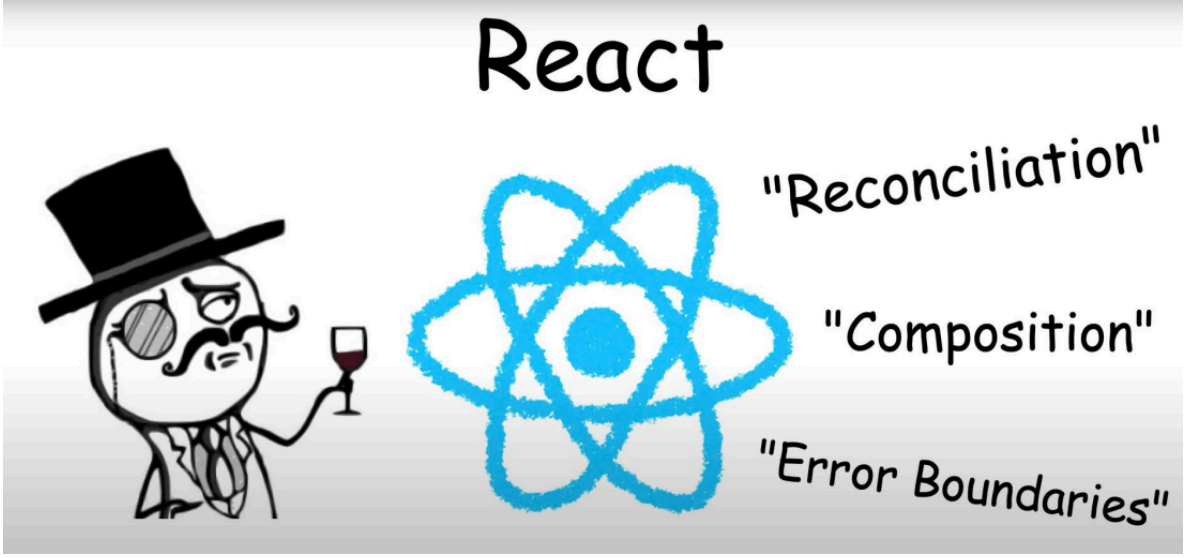
Button Component with TS

```tsx
function MyButton({ title }: { title: string }) {
  return (
    <button>{title}</button>
  );
}

export default function MyApp() {
  return (
    <div>
      <h1>Welcome to my app</h1>
      <MyButton title="I'm a button" />
    </div>
  );
}
```

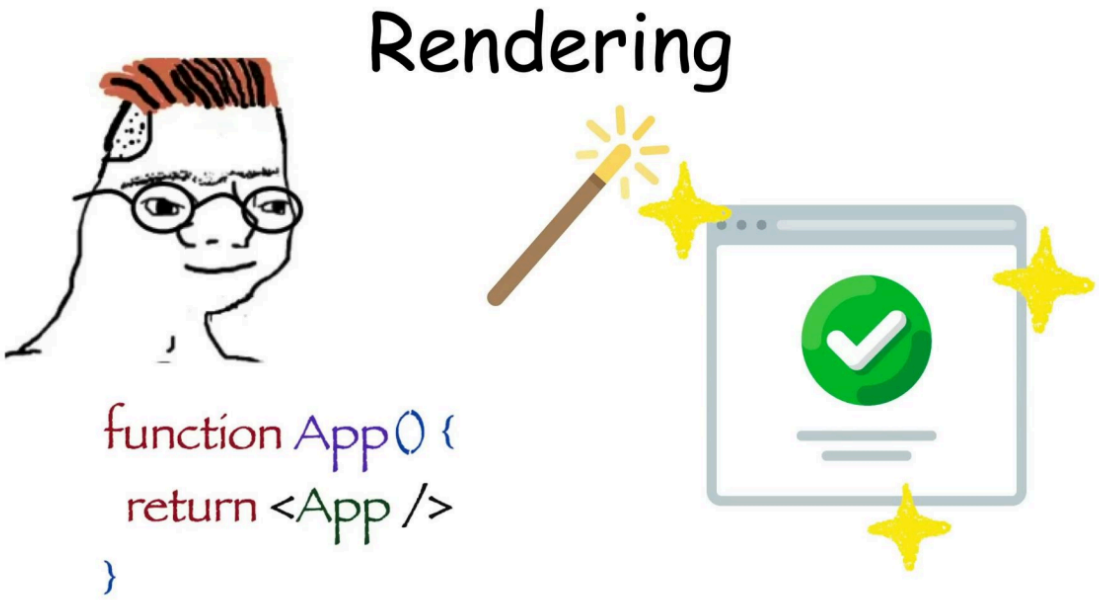
Ts button.png

React Concepts



react_concepts.png

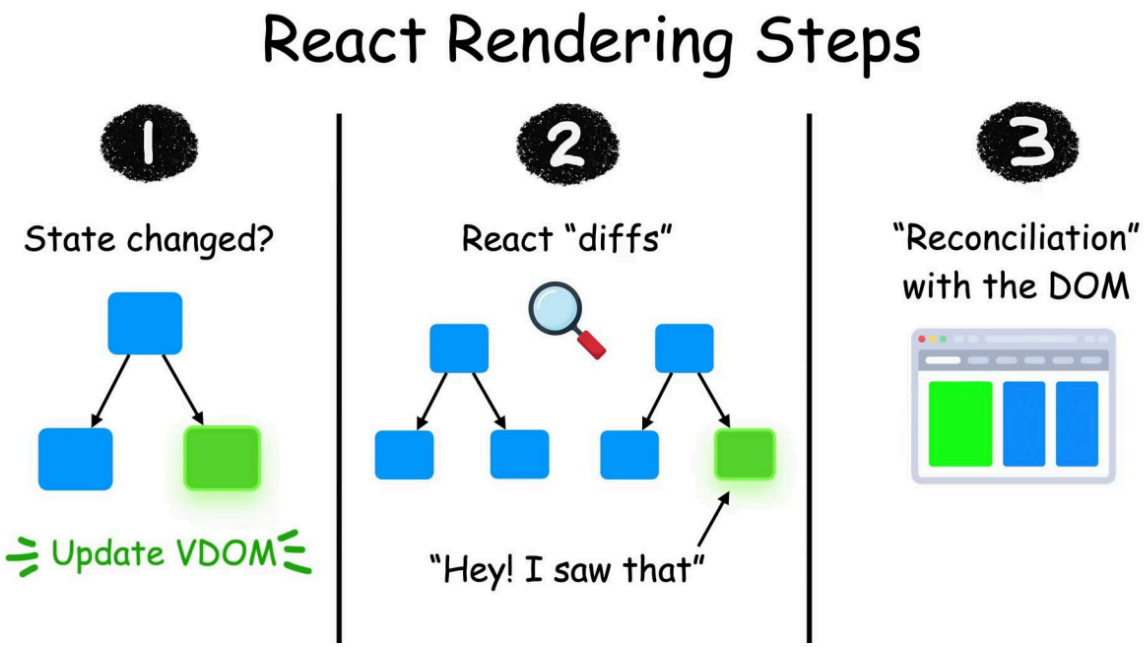
- Reconciliation: This is the process React uses to update the user interface (UI) efficiently. When something changes in your app (like a piece of data), React compares the new state with the old state and only updates the parts of the UI that need to change. This comparison is what "reconciliation" refers to.
- Composition: React encourages breaking down your UI into small, reusable pieces called components. Composition is the process of combining these components to create more complex UIs. Instead of creating one big component, you compose multiple smaller ones.
- Error Boundaries: These are special components in React that catch errors in any components below them in the component tree. This prevents the whole app from crashing if something goes wrong in a small part of your UI.



react_rendering.png

Rendering in React

- Rendering in React is the process of taking your React components and turning them into something that users can see on their screen (usually HTML). The code example shown (a simple function returning JSX) illustrates how you define a React component. When this component is rendered, React translates the JSX into HTML and updates the browser's DOM to reflect this.



React_rendering_steps.png

React Rendering Steps

- **Step 1**: State Change? React checks if any part of your application's state has changed. If it has, React creates a new "virtual" version of the UI (Virtual DOM).
- **Step 2**: React "diffs" React compares the new Virtual DOM with the previous version (this process is called "diffing"). It identifies what has changed.
- **Step 3**: Reconciliation with the DOM React updates only the parts of the actual DOM that need to change, based on the diffing process. This is the reconciliation step, where React ensures that the UI reflects the latest state efficiently without re-rendering the entire page.

These images illustrate core concepts and the process by which React efficiently updates and renders UIs, ensuring that changes are reflected quickly and with minimal performance impact.

Setting up the Development Environment

Start typing here...

Installing Node.js and pnpm

1. Installing PNPM

PNPM is a fast, disk space-efficient package manager for Node.js. More information on https://pnpm.io/installation (https://pnpm.io/installation)

1. **Install PNPM**:
   - Using Powershell:

     ```
     Invoke-WebRequest https://get.pnpm.io/install.ps1 -UseBasicParsing | Invoke-Expression
     ```

   - On POSIX systems, you can use curl or wget:

     ```
     curl -fsSL https://get.pnpm.io/install.sh | sh -
     ```

     If you don't have curl installed, you would like to use wget:

     ```
     wget -qO- https://get.pnpm.io/install.sh | sh -
     ```

2. **Verify Installation**: After the installation completes, verify it by typing:

   ```
   pnpm -v
   ```

   This should display the installed PNPM version.

3. **Updating pnpm**: To update pnpm, run the `self-update` command:

   ```
   pnpm self-update
   ```

To install Node.js with PNPM on your system, follow the steps below:

1. Installing Node.js

Node.js is a JavaScript runtime that allows you to run JavaScript code on your server or local machine. Here's how to install it:

use

- Install and use the specified version of Node.js. Install the LTS version of Node.js:

```
pnpm env use --global lts
```

- Or if you prefer a specific Install Node.js v16:

```
pnpm env use --global 16
```

PnPm Cheatsheet

Here's a cheat sheet for using PNPM to perform common tasks. PNPM is a fast and efficient package manager for Node.js projects, and this guide will help you get started with some of the most frequently used commands.

1. Initialization

- **Initialize a new project (create `package.json`):**

```
pnpm init
```

2. Installing Packages

- **Install all dependencies listed in `package.json`:**

```
pnpm install
```

- **Install a specific package (e.g., `lodash`):**

```
pnpm add lodash
```

- **Install a package as a development dependency:**

```
pnpm add eslint --save-dev
```

  or

```
pnpm add -D eslint
```

- **Install a specific version of a package:**

```
pnpm add lodash@4.17.20
```

- **Install dependencies without modifying `package.json` (useful for CI/CD):**

```
pnpm install --frozen-lockfile
```

3. Removing Packages

- **Uninstall a package:**

```
pnpm remove lodash
```

4. Running Scripts

- **Run a script defined in `package.json`:**

```
pnpm run <script_name>
```

Example:

```
pnpm run build
```

- **Run a package binary without installing it globally:**

```
pnpm dlx <package_name>
```

Example:

```
pnpm dlx create-react-app my-app
```

5. Working with Global Packages

- **Install a package globally:**

```
pnpm add -g eslint
```

- **List globally installed packages:**

```
pnpm list -g --depth 0
```

6. Managing Dependencies

- **Update all dependencies to the latest versions:**

```
pnpm update --latest
```

- **Install dependencies without running `preinstall` and `postinstall` scripts:**

```
pnpm install --ignore-scripts
```

7. Managing the PNPM Cache

- **Clear the PNPM cache:**

```
pnpm cache clean
```

8. Workspaces

- **Create a new workspace:**

```
pnpm init
```

- **Add a package to a workspace:**

```
pnpm add <package_name> -w
```

- **Run a command in all workspace packages:**

```
pnpm -r <command>
```

  Example:

```
pnpm -r build
```

9. Linking Packages

- **Link a package globally:**

```
pnpm link
```

- **Link a package locally within a project:**

```
pnpm link <package_name>
```

10. Miscellaneous

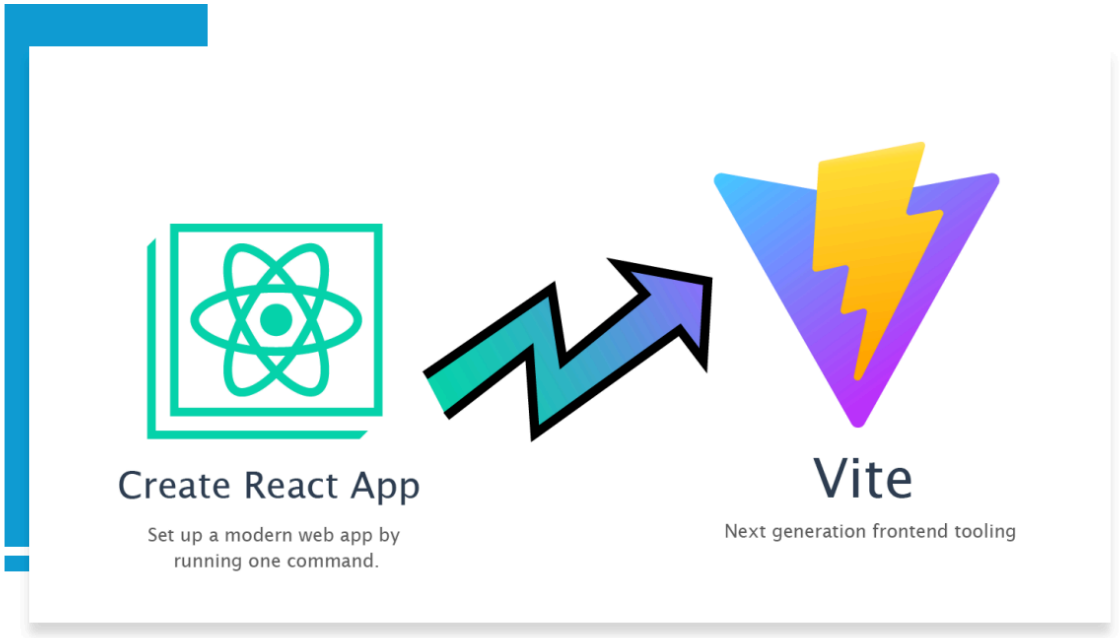
- **Check for outdated packages:**

```
pnpm outdated
```

- **List all installed packages:**

```
pnpm list
```

Creating React with Vite



vite.png

The preferred way between **Create React App (CRA)** and **Vite** depends on your specific needs and preferences: In summary, if you prioritize ease of use and community support, go with CRA. If you want faster builds and a modern toolchain, Vite is likely the better option.

Create React App (CRA):

- **Pros:**
  - **Established and widely used:** CRA has been the go-to tool for creating React apps for years, with extensive documentation and community support.
  - **Easy to use:** It's beginner-friendly, with minimal configuration needed to get started.
  - **Comprehensive setup:** CRA includes everything you need for a React project, including testing and build tools.
- **Cons:**

- **Performance:** CRA can be slower, especially with larger projects, due to its older build tools.
- **Limited customization:** While CRA abstracts away configuration for simplicity, this can be limiting for developers who need more control.

Vite:

- **Pros:**
  - **Faster:** Vite is designed with performance in mind, offering faster build times and a more responsive development experience.
  - **Modern toolchain:** Vite uses modern build tools (like ESBuild) that take advantage of new web standards and are optimized for speed.
  - **Flexibility:** Vite provides more flexibility and control over the configuration, making it easier to customize for specific project needs.
- **Cons:**
  - **Less established:** While growing rapidly, Vite is newer compared to CRA, so there might be less community support or documentation for very niche use cases.
  - **More setup required:** Vite might require slightly more setup, especially if you're accustomed to CRA's out-of-the-box simplicity.

Recommendation:

- **For beginners or small projects**: **Create React App** is still a solid choice due to its simplicity and extensive support.
- **For more advanced users or larger projects**: **Vite** is often preferred because of its performance benefits and modern tooling, especially if you're looking for a more optimized development experience.

To create a new React application using the tools mentioned in the image (Create React App and Vite), here are the brief commands:

Using Vite:

1. **Create a new React app with Vite with javaScript:**

```
pnpm create vite my-app --template react
```

   with **TypeScript**

```
pnpm create vite my-app --template react-ts
```

2. **Navigate to the project directory:**

```
cd my-app
```

3. **Install dependencies:**

```
pnpm install
```

4. **Start the development server:**

```
pnpm dev
```

Using Create React App:

1. **Create a new React app:**

```
npx create-react-app my-app
```

2. **Navigate to the project directory:**

```
cd my-app
```

3. **Start the development server:**

```
npm start
```

2. Core Concepts

Start typing here...

JSX & Props

Start typing here...

What is JSX?

Start typing here...

Embedding JavaScript in JSX

Start typing here...

Passing Props to Components

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Using Props for Reusable Components

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Components in React

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Functional vs. Class Components

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Creating Components with TypeScript

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Default and Named Exports

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Rendering Components

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3. Intro to State

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useState Hook

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Introduction to useState

Start typing here...

Managing State in Functional Components

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Example: Managing Form Inputs

Start typing here...

useReducer Hook

Start typing here...

Introduction to useReducer

Start typing here...

Complex State Management

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Example: Building a Counter with useReducer

Start typing here...

4. Intermediate React Concepts

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all

Certainly! Let's go into detail on topics 1 and 2, using React with Vite, along with code examples and explanations.

1. Introduction to React with TypeScript

Overview of React

React is a JavaScript library for building user interfaces, particularly single-page applications where you can develop reusable UI components. It allows developers to create large web applications that can update and render efficiently in response to data changes.

Benefits of Using React

- **Component-Based Architecture:** React's component-based structure allows for better modularization and reusability.
- **Virtual DOM:** React uses a virtual DOM to optimize rendering and update only the necessary parts of the UI.
- **Strong Community and Ecosystem:** React has a vast ecosystem of libraries, tools, and a large community, making it easier to find solutions and resources.

Introduction to TypeScript in React

TypeScript is a statically typed superset of JavaScript that provides better tooling and helps catch errors early during development. Using TypeScript with React improves code quality and readability, especially in large projects.

Setting Up the Development Environment

Installing Node.js and npm

First, you need to have Node.js and npm installed on your machine. You can download them from Node.js official website (https://nodejs.org/).

Setting up a React Project with Vite

Vite is a next-generation front-end build tool that is faster and leaner than traditional bundlers like Webpack. It's perfect for setting up a React project with TypeScript due to its speed and ease of use.

1. **Create a New React Project Using Vite:** Open your terminal and run the following command:

   ```
   npm create vite@latest my-react-app --template react-ts
   ```

   This command does the following:

   - `my-react-app`: The name of your project directory.
   - `--template react-ts`: Specifies that you want to use the React template with TypeScript.

2. **Navigate to Your Project Directory:**

   ```
   cd my-react-app
   ```

3. **Install the Project Dependencies:**

   ```
   npm install
   ```

4. **Start the Development Server:**

   ```
   npm run dev
   ```

   This command will start a local development server and open your project in the browser. You can now begin developing your React app.

Configuring TypeScript in a React Project

Vite automatically configures TypeScript when you create a project using the `react-ts` template. The `tsconfig.json` file in the root directory allows you to customize TypeScript settings.

Here's a basic `tsconfig.json` configuration:

```
{
  "compilerOptions": {
    "target": "ESNext",
    "useDefineForClassFields": true,
    "lib": ["DOM", "DOM.Iterable", "ESNext"],
    "allowJs": false,
    "skipLibCheck": true,
    "esModuleInterop": false,
    "allowSyntheticDefaultImports": true,
    "strict": true,
    "forceConsistentCasingInFileNames": true,
    "module": "ESNext",
    "moduleResolution": "Node",
    "resolveJsonModule": true,
    "isolatedModules": true,
    "noEmit": true,
    "jsx": "react-jsx"
  },
  "include": ["src"],
  "references": [{ "path": "./tsconfig.node.json" }]
}
```

This configuration is tailored for modern React development and ensures that TypeScript and JSX work together seamlessly.

2. Core Concepts

JSX & Props

What is JSX?

JSX stands for JavaScript XML. It's a syntax extension for JavaScript that looks similar to HTML. JSX allows you to write HTML elements directly in your React code, making it easier to create UI components.

Example:

```
import React from 'react';
```

```tsx
const Greeting: React.FC = () => {
  const name = 'John';
  return <h1>Hello, {name}!</h1>;
};

export default Greeting;
```

In this example:

- **JSX:** The HTML-like syntax `<h1>Hello, {name}!</h1>` is JSX.
- **Curly Braces:** `{name}` allows you to embed a JavaScript expression inside the JSX.

Passing Props to Components

Props are a way to pass data from a parent component to a child component. They allow you to customize and reuse components with different data.

Example:

```tsx
import React from 'react';

interface GreetingProps {
  name: string;
}

const Greeting: React.FC<GreetingProps> = ({ name }) => {
  return <h1>Hello, {name}!</h1>;
};

const App: React.FC = () => {
  return <Greeting name="Alice" />;
};

export default App;
```

In this example:

- `GreetingProps`: An interface that defines the type of the props expected by the `Greeting` component.
- `Greeting`: A functional component that receives `name` as a prop and displays it.
- `App`: The main component that passes the `name` prop to the `Greeting` component.

Using Props for Reusable Components

By using props, you can create reusable components that can be customized with different data.

Example:

```
import React from 'react';

interface ButtonProps {
  label: string;
  onClick: () => void;
}

const Button: React.FC<ButtonProps> = ({ label, onClick }) => {
  return <button onClick={onClick}>{label}</button>;
};

const App: React.FC = () => {
  const handleClick = () => {
    alert('Button clicked!');
  };

  return (
    <div>
      <Button label="Click Me" onClick={handleClick} />
      <Button label="Submit" onClick={() => console.log('Submitted!')}
/>
    </div>
  );
};
```

```
export default App;
```

In this example:

- **ButtonProps**: The Button component can accept different label and onClick functions, making it reusable in different scenarios.
- **App**: Demonstrates the use of the Button component with different props.

Components in React

Functional vs. Class Components

React allows you to create components as either functions or classes. However, functional components are now the preferred way, especially with hooks like useState and useEffect.

Example: Functional Component

```
import React from 'react';

const Welcome: React.FC = () => {
  return <h1>Welcome to React with TypeScript!</h1>;
};

export default Welcome;
```

Example: Class Component

```
import React, { Component } from 'react';

class Welcome extends Component {
  render() {
    return <h1>Welcome to React with TypeScript!</h1>;
  }
}
```

```
export default Welcome;
```

Functional components are simpler and more concise. With the introduction of hooks, they can manage state and side effects without the complexity of class components.

Creating Components with TypeScript

TypeScript enhances React components by providing type safety, which helps catch errors at compile-time rather than at runtime.

Example:

```
import React from 'react';

interface UserCardProps {
  name: string;
  age: number;
}

const UserCard: React.FC<UserCardProps> = ({ name, age }) => {
  return (
    <div>
      <h2>{name}</h2>
      <p>Age: {age}</p>
    </div>
  );
};

export default UserCard;
```

In this example:

- **`UserCardProps`**: Specifies the types for the props `name` and `age`.
- **`React.FC`**: React's `FunctionComponent` type, ensuring that the component adheres to functional component standards.

Default and Named Exports

React components can be exported using default or named exports.

Example: Default Export

```
// UserCard.tsx
const UserCard: React.FC<UserCardProps> = ({ name, age }) => {
  return (
    <div>
      <h2>{name}</h2>
      <p>Age: {age}</p>
    </div>
  );
};

export default UserCard;
```

Example: Named Export

```
// UserCard.tsx
export const UserCard: React.FC<UserCardProps> = ({ name, age }) => {
  return (
    <div>
      <h2>{name}</h2>
      <p>Age: {age}</p>
    </div>
  );
};
```

Usage in Other Files:

```
// Default import
import UserCard from './UserCard';

// Named import
import { UserCard } from './UserCard';
```

Using default exports is common when you have a single main component in a file, whereas named exports are useful when you have multiple components or utilities in a single file.

Rendering Components

Rendering components is straightforward in React. You can render them directly within other components or within the `ReactDOM.render` method at the root of your application.

Example:

```
import React from 'react';
import ReactDOM from 'react-dom/client';
import App from './App';

const root = ReactDOM.createRoot(document.getElementById('root') as
HTMLElement);
root.render(
  <React.StrictMode>
    <App />
  </React.StrictMode>
);
```

In this example:

- **`ReactDOM.createRoot`**: Initializes the root of your React application.
- **`App`**: The main component that gets rendered within the