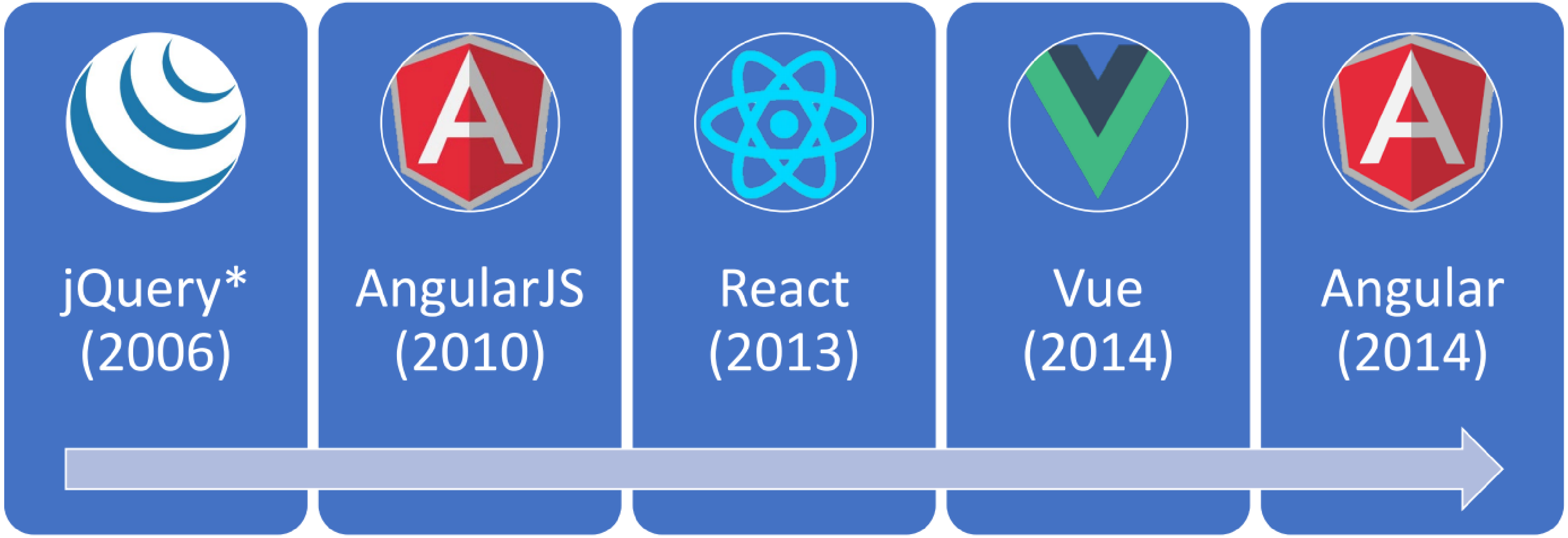
CS472 WAP
Introduction to React

Maharishi International University - Fairfield, Iowa

Timeline of font-end JavaScript Frameworks/Libraries



Common tasks in front-end development

App state	Data definition, organization, and storage
User actions	Event handlers respond to user actions
Templates	Design and render HTML templates
Routing	Resolve URLs
Data fetching	Interact with server(s) through APIs and AJAX

Why React?

1. Complexity: Working with the DOM API directly often requires writing verbose and complex code, which can be error-prone and challenging to maintain.
2. Inefficiency with Frequent Updates: Continuous updates to the DOM can lead to a phenomenon called "reflow" or "layout thrashing," where the browser recalculates the layout and rendering of the entire page. This can be computationally expensive.
3. Performance Overhead: Direct manipulation of the DOM can be slow and resource-intensive, especially when dealing with a large number of elements. Frequent updates or changes to the DOM can lead to performance bottlenecks and affect the user experience.
4. Lack of Component Reusability: Reusing components across different parts of an application can be challenging.

Features of React

1. **Component-Based Architecture:** React is built around a component-based architecture where the user interface is divided into reusable, self-contained components. Components can be composed to create complex user interfaces, making it easier to manage and maintain code.
2. **Declarative Syntax**: React uses a declarative approach, where developers describe how the UI should look based on the current application state. This simplifies UI development and reduces the risk of bugs related to manual DOM manipulation.
3. **Virtual DOM + Diffing Algorithm**: React uses a virtual representation of the Document Object Model (DOM) called the Virtual DOM. This allows React to efficiently update the actual DOM by only re-rendering components when their state or props change. This results in improved performance and responsiveness.
4. **React Native**: React Native is a framework that extends React to build native mobile applications for iOS and Android using the same component-based approach. This enables code sharing between web and mobile applications.

Installation

- 1. To start a new Create React App project with TypeScript, you can run:

```
npx create-react-app my-app --template typescript
```

- 2. To add TypeScript to an existing Create React App project, first install it:

```
npm install --save typescript @types/node @types/react
@types/react-dom @types/jest
```

TypeScript Configuration File

- `tsconfig.json`
- at the root of a project
- Specifies settings that will be used by TypeScript when compiling our code.

Create React App types declaration file

- `react-app-env.d.ts`:
- inside `src` folder
- references TypeScript types declarations that are specific to projects started with Create React App.
- Add support for importing resources files such as bmp, gif, etc
- The tripe-slash directive:
  - Referring to a file with some types definitions
  - `node_modules/react-sripts/lib/react-app.d.ts`

`.tsx` files

- The introduction of `.tsx` also resulted in three additional things:
  - JavaScript bundlers like webpack, esbuild, and others can run different plugins for `.tsx` files
  - Test runners like Jest can run a different test environment only for `.tsx` files
  - New language support by code editors

- Difference between `.ts` and `.tsx` in TypeScript:
- The `.ts` file extension is used when you are creating functions, classes, reducers, etc., that do not require the use of JSX syntax and elements, whereas the `.tsx` file extension is used when you create a React component and use JSX elements and syntax.

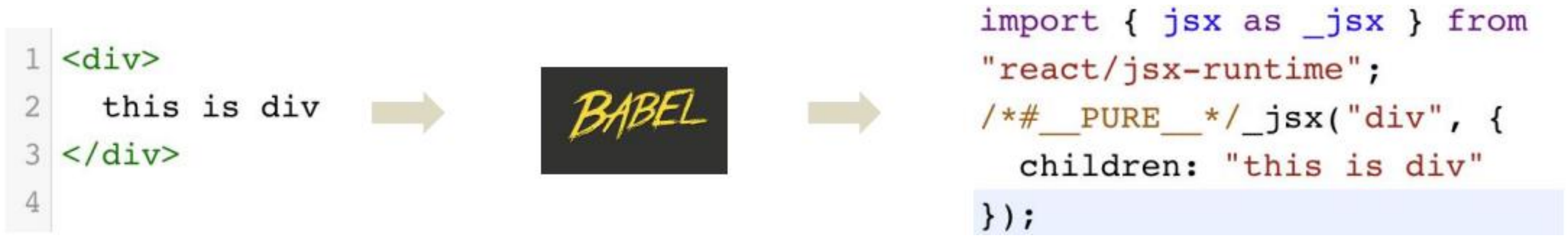
JSX

- JSX (JavaScript XML) is a syntax extension for JavaScript that is commonly used in React to describe the structure and elements of the user interface.
- Pros:
  - The declarative template syntax of HTML
  - write HTML-like code within JavaScript, easier to define and render React components

```
function App() {
  return (
    <div className="App">
      <header className="App-header">
          Learn React
      </header>
    </div>
  );
}
```

The essence of JSX

- JSX is not standard JavaScript syntax; it is a syntax extension of JavaScript. Browsers cannot recognize it on their own; it needs to be parsed by a parsing tool before it can run in the browser.



```
<div>
  this is div
</div>
```

```
import { jsx as _jsx } from
"react/jsx-runtime";
/*#__PURE__*/_jsx("div", {
  children: "this is div"
});
```

JSX

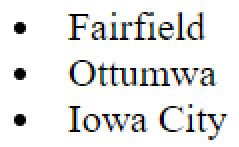
- JSX (JavaScript XML) is a syntax extension for JavaScript that is commonly used in React to describe the structure and elements of the user interface. JSX allows you to write HTML-like code within JavaScript, making it easier to define and render React components.
- Rules:

1. Don’t use quote when define virtual DOM.
2. JavaScript Expressions: To insert dynamic data, variables, or expressions into the rendered content, curly braces `{}` inside JSX elements. You cannot use statements.
3. Class Name: Use the `className` attribute to set the CSS class of an element.
4. Inline Style: Use the `style` attribute to set inline style with syntax `{{key:value}}.`
5. Only One Top-Level Element: all elements within a JSX expression must be wrapped in a single parent element.
6. Must have closing tag. Be aware of Self-Closing Tags.
7. The first letter of a tag
   1) If it’s lower case, it’ll be translated to HTML element with the same tag name. If couldn’t find in HTML, throw error but still display.
   2) If it’s upper case, react will render the component, if no component, throw error.
8. Comments: use syntax below, must inside the top-level element.

```
{/* THis is a comment*/}
```

JSX Exercise

- Create a page display a list of locations which stored in Array.



- Fairfield
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- Iowa City

Main Points

- A good design reflects re-usability and adaptability and most importantly traceability of requirements. A good web design promotes stability in the business application and flexibility in the presentation layer. The Field of Pure Creative Intelligence is characterized by the qualities of stability and flexibility.
- Transcendental consciousness is the experience of pure consciousness, the unified field of physics. Just by having this experience one gains this wholeness of knowledge and actions will be accord with all the laws of nature.

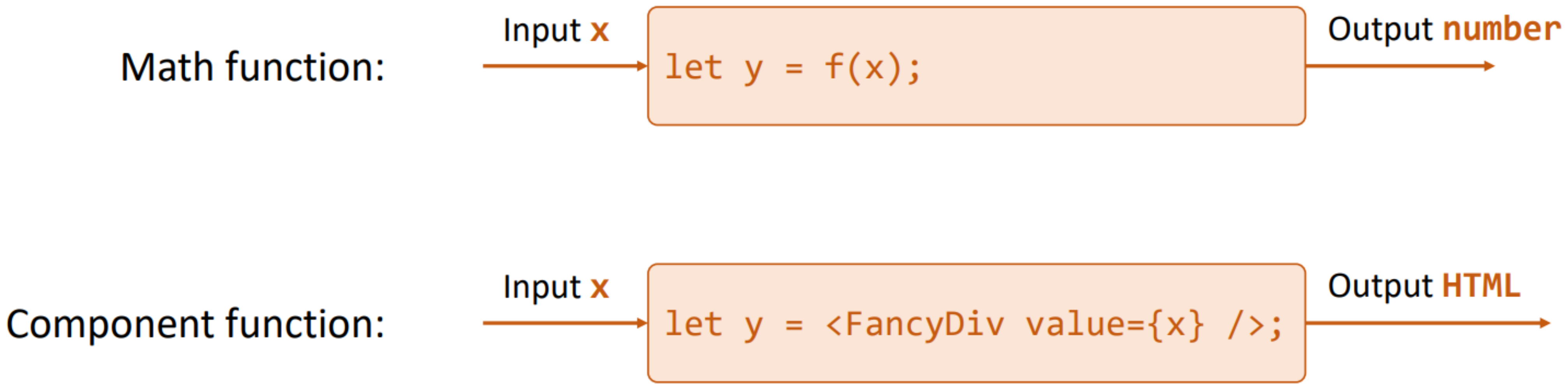
Module vs Component

- Module:
  - JavaScript modules allow you to break up your code into separate files.
  - Example: 1 giant js file -> separate into multiple JS files(a.js, b.js, c.js, etc)

- Components:
  - let you split the UI into independent, reusable pieces, and think about each piece in isolation.
  - Example: not only js file is splited, all resources such as html, css, js, videos, images, etc

Components

- Components are functions for user interfaces

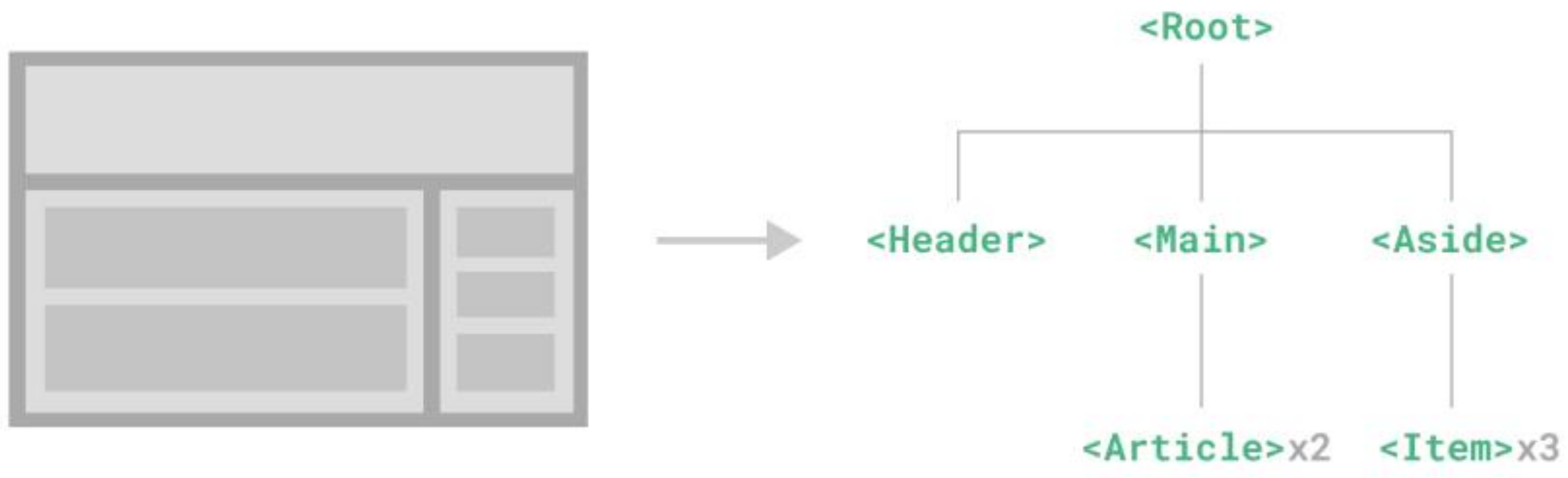


```
let y = f(x);
```

```
let y = <FancyDiv value={x} />;
```

Components

- A component is a part of the user interface that can have its own logic and appearance. Components can be nested within each other and reused multiple times



- Component-based development allows developers to build a complete and large-scale application like assembling building blocks.

Types of Components in React

- Two types of Components:
  - Function Component
    - Function components are defined as functions and are used for simple, stateless presentation components.
    - With the introduction of React Hooks, functional components have become even more powerful and can manage state and side effects as well.
    - The name of function component must start with capital case.
  - Class Component
    - A class component must include the extends React.Component statement. This statement creates an inheritance to React.Component, and gives your component access to React.Component's functions.
    - The component also requires a render() method, this method returns JSX.
    - In older React code bases, you may find Class components primarily used. It is now suggested to use Function components along with Hooks, which were added in React 16.8.

Function Component Demo

- The simplest way to define a component is to write a JavaScript function:
  - Function name must start with capital case
  - ndefined.

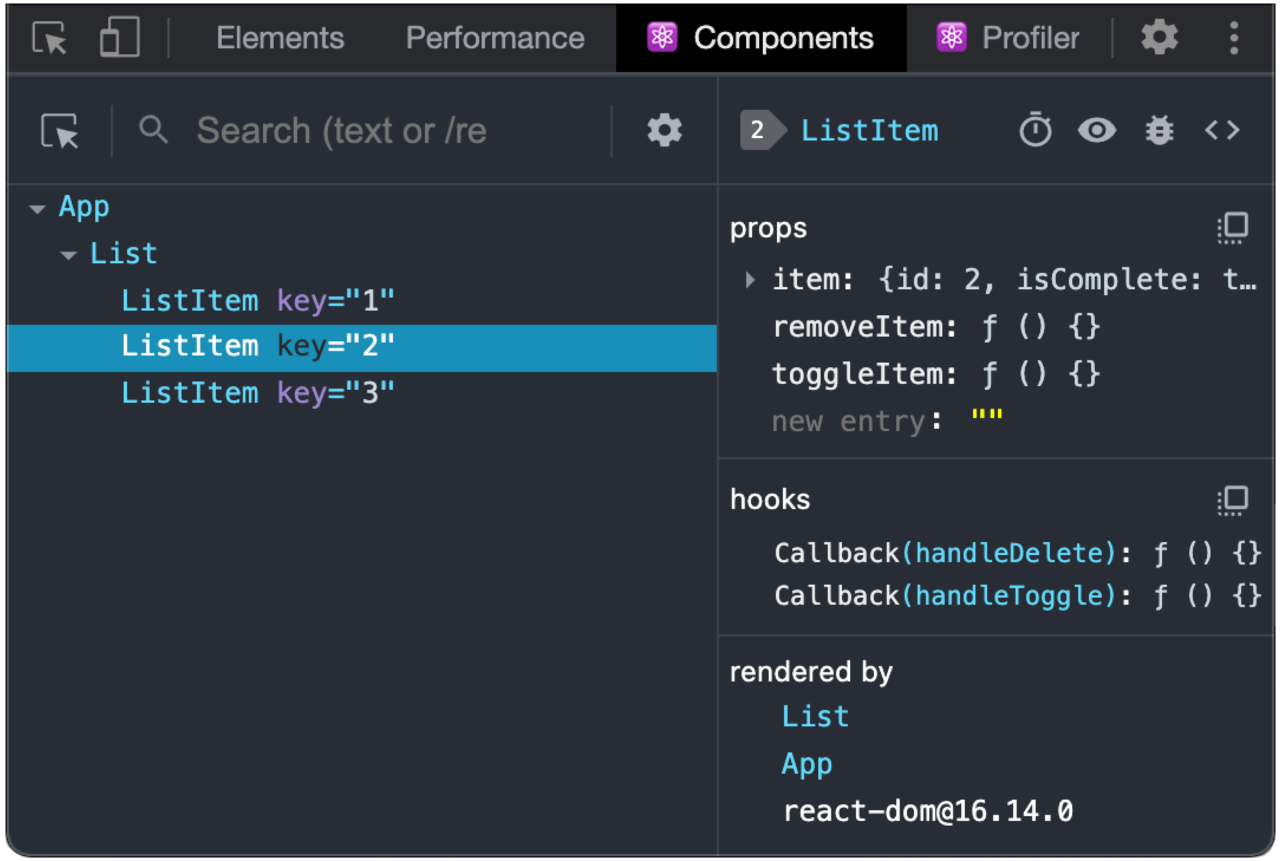
```
function App() {
  return (
    <div className="App">
      <header className="App-header">
          Learn React
      </header>
    </div>
  );
}
```

React Developer Tools

- Use React Developer Tools to inspect React components, edit props and state, and identify performance problems.

Install for **Chrome** Install for **Firefox** Install for **Edge**

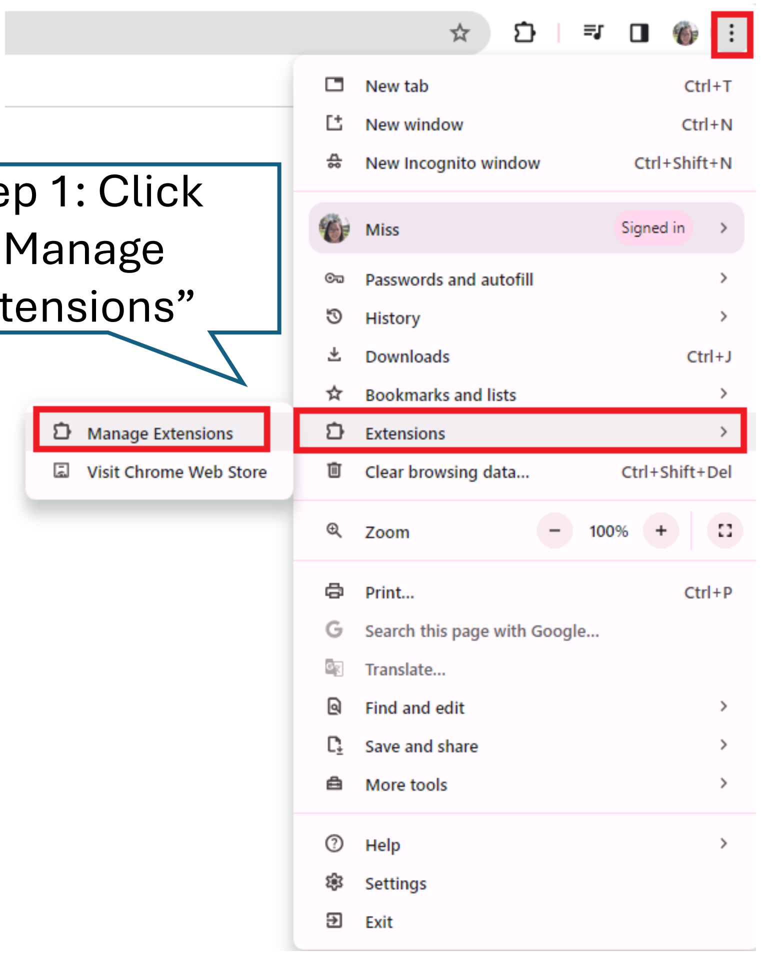
- if you visit a website **built with React,** you will see the *Components* and *Profiler* panels.



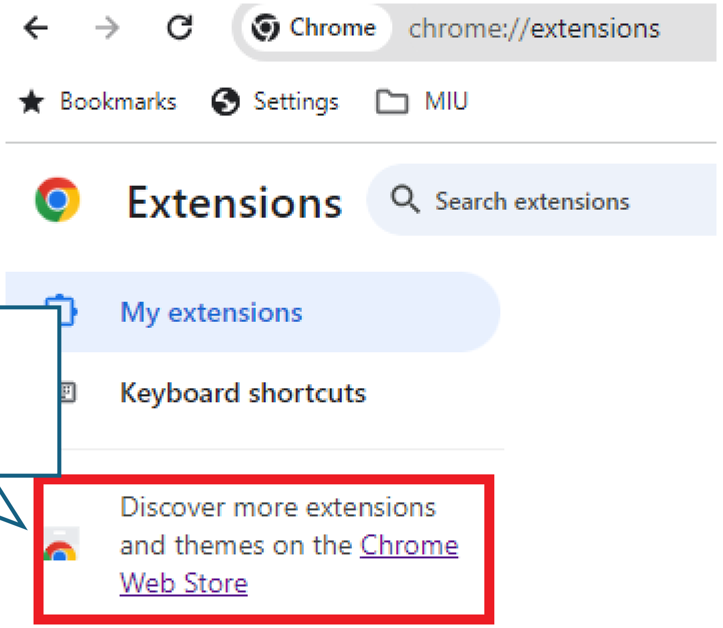
```
▾ App
  ▾ List
      ListItem key="1"
      ListItem key="2"
      ListItem key="3"
```

```
props
 ▸ item: {id: 2, isComplete: t…
   removeItem: ƒ () {}
   toggleItem: ƒ () {}
   new entry: ""

hooks
   Callback(handleDelete): ƒ () {}
   Callback(handleToggle): ƒ () {}

rendered by
   List
   App
   react-dom@16.14.0
```

React Developer Tools Installation



Step 1: Click “Manage Extensions”


Chrome chrome://extensions
Bookmarks
Settings
MIU
Extensions
Search extensions
My extensions
Keyboard shortcuts
Discover more extensions and themes on the Chrome Web Store

Step 2: Click “Chrome Web Store”

Responding to Events

Responding to Event

- React lets you add event handlers to your JSX. Event handlers are your own functions that will be triggered in response to interactions like clicking, hovering, focusing form inputs, and so on.

1. Register through onEvent property, be aware of the camel case used here.
   a. React customs onEvent, not using the original DOM event.
   b. Events in React are handled through event delegation (delegated to the outermost element of the component)
2. Can get the DOM object via event.target. Don’t overuse Refs.

Example

```
function App() {

  const clickHandler = () => {
    console.log('Button is clicked!!!');
  }

  return (
      <button onClick={clickHandler}>Click Me</button>
  );
}
```

- `clickHandler` is a function, doesn’t matter using function declaration or arrow function
- Register `clickHandler` as a function reference, not call the function

Example: get event object

- Set parameter 'e' in the event callback function

```
function App() {

  const clickHandler = (e: MouseEvent<HTMLButtonElement>):void => {
    console.log('Button is clicked!!!', e);
  }

  return (
      <button onClick={clickHandler}>Click Me</button>
  );
}
```

Example: Pass custom parameters

- Transform event binding into arrow function syntax, and pass arguments when executing the `clickHandler` to handle actual

```
function App() {

  const clickHandler = (name: string):void => {
    console.log('Button is clicked!!!', name);
  }

  return (
      <button onClick={() => clickHandler('MIU')}>Click Me</button>
  );
}
```

Example: Pass Event object and Custom Parameters together

Be Careful: The order of the parameters

```
function App() {

  const clickHandler = (name: string, e: MouseEvent<HTMLButtonElement>):void => {
    console.log('Button is clicked!!!', name);
  }

  return (
      <button onClick={(e) => clickHandler('MIU', e)}>Click Me</button>
  );
}
```

Hooks: useState

React

Hooks

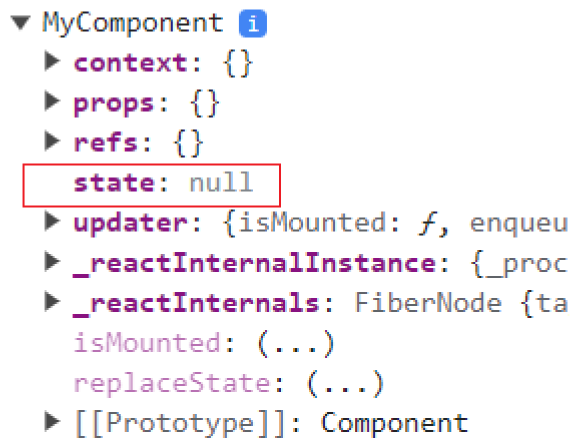
- Hooks are functions that allow functional components to "hook into" React state and lifecycle features.
- There are many hooks:

1. State Hooks
2. Ref Hooks
3. Effect Hooks
4. Context Hooks
5. …

Component Cores: State

- The state is a built-in React object that is used to contain data or information about the component.
- A component's state can change over time; whenever it changes, the component re-renders. (Data Driven View)

  - A state can be modified based on user action or network changes
  - Every time the state of an object changes, React re-renders the component to the browser
  - The state object is initialized in the constructor
  - The state object can store multiple properties using Object.



```
▼ MyComponent i
  ▶ context: {}
  ▶ props: {}
  ▶ refs: {}
    state: null
  ▶ updater: {isMounted: ƒ, enqueu
  ▶ _reactInternalInstance: {_proc
  ▶ _reactInternals: FiberNode {ta
    isMounted: (...)
    replaceState: (...)
  ▶ [[Prototype]]: Component
```

State Hook - `useState`

- useState is a React Hook that lets you add a state variable to your component.

```
const [state, setState] = useState(initialState);
```

  - initialState: The value you want the state to be initially. It can be a value of any type, but there is a special behavior for functions. This argument is ignored after the initial render.
    - If you pass a function as initialState, it will be treated as an initializer function. It should be pure, should take no arguments, and should return a value of any type. React will call your initializer function when initializing the component, and store its return value as the initial state.
  - useState returns an array with exactly two values:
  1. The current state. During the first render, it will match the initialState you have passed.
  2. The set function that lets you update the state to a different value and trigger a re-render.
- The convention is to name state variables like [something, setSomething] using array destructuring.

useState Demo

- In React, state is considered to be read-only. We should always replace it instead of modifying it directly. Modifying state directly does not trigger view updates.

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

function App() {

  let [count, setCount] = useState<number>(0);

  const clickHandler = () => {
    count++;
    console.log(count);
  }

  return (
    <div>
      {count}
      <button onClick={clickHandler}>Click Me</button>
    </div>
  );
}
```

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

function App() {

  let [count, setCount] = useState<number>(0);

  const clickHandler = () => {
    setCount(++count);
    console.log(count);
  }

  return (
    <div>
      {count}
      <button onClick={clickHandler}>Click Me</button>
    </div>
  );
}
```

useState Demo: object

- For object type state variables, pass a completely new object to the set method for modification

```
function App() {

  interface UserFormState {
    email: string;
    password: string;
    username: string;
  }

  const [userForm, setUserForm] = useState<UserFormState>({
    email: '',
    password: '',
    username: 'MIU'
  });

  const handleChangeName = () => {
    userForm.username = 'MSD';
  }

  return (
    <div>
      {userForm.username}
      <button onClick={handleChangeName}>Change Name</button>
    </div>
  );
}
```

✗

```
const handleChangeName = () => {
  setUserForm({
    ...userForm,
    username: 'MSD'
  })
}
```

✓

useState & TypeScript

1. Typically, React automatically infers the type based on the default value passed to useState, so explicit type annotations are not required.
   - `const [value, toggle] = useState(false);`
     - `value: boolean`
     - `toggle: boolean`
2. `useState` is a generic function that can take specific custom types as arguments.

```
type User = {
  name: string,
  age: number
}
```

```
const [user, setUser] = useState<User>();
```

   - Restricting the initial value parameter of the useState function to be of type: User | (() => User)
   - Restricting the parameter of the setUser function to be of type: User | (() => User) | undefined

useState & TypeScript (Cont.)

3. When we are unsure about the initial value of a state, setting `useState`'s initial value to `null` is a common practice, and explicit annotation can be done by using a specific type union with `null`.

```
type User = {
  name: string,
  age: number
}
```

```
const [user, setUser] = useState<User | null>(null);
```

- Restricting the initial value parameter of the `useState` function to be either `User` or `null`.
- Restricting the parameter type of the `setUser` function to be `User` or `null`.

Main Point

- React Hooks, introduced in React 16.8, are a set of functions that enable developers to add state and side-effect handling to functional components. This innovation allows for the management of component logic without the need for class components. By using hooks like useState and useEffect, developers can achieve cleaner, more readable code and better component reusability. Hooks have become a cornerstone of modern React development, simplifying state management and making it more approachable for both new and experienced developers.
- The existence of a unified field of all the laws of nature, from which everything in the universe originates. It is described as a field of pure consciousness and the source of all knowledge and creativity.