



Components-Based UI



Outline

- Introduction
- React Components
- Components Communication
- Routing

React Introduction



Used by Facebook, Instagram, Netflix, Dropbox, Yahoo, Khan Academy,

<https://github.com/facebook/react/wiki/Sites-Using-React>

Course Roadmap



Web Client

Request

Response



Web Server

Frontend development

HTML for page structure



CSS for styling



JavaScript for interaction



We are
HERE

UI
Components



Backend development

Web API



Data Management

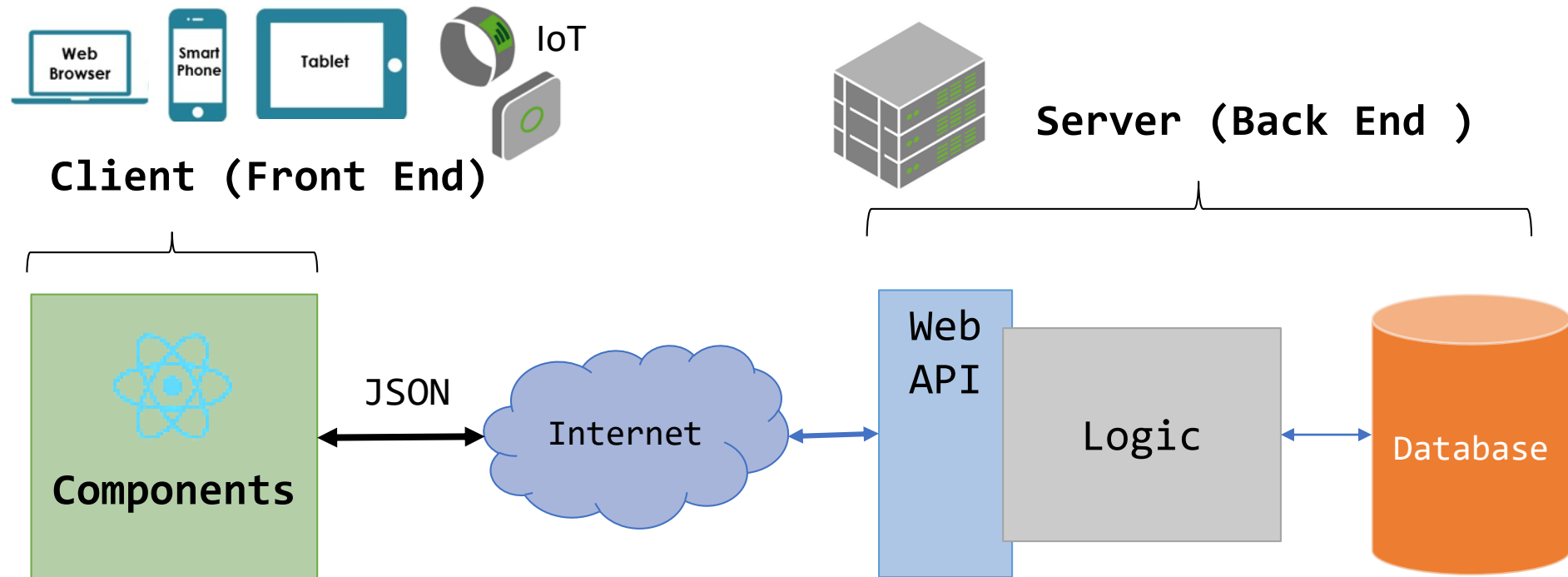


What is React?

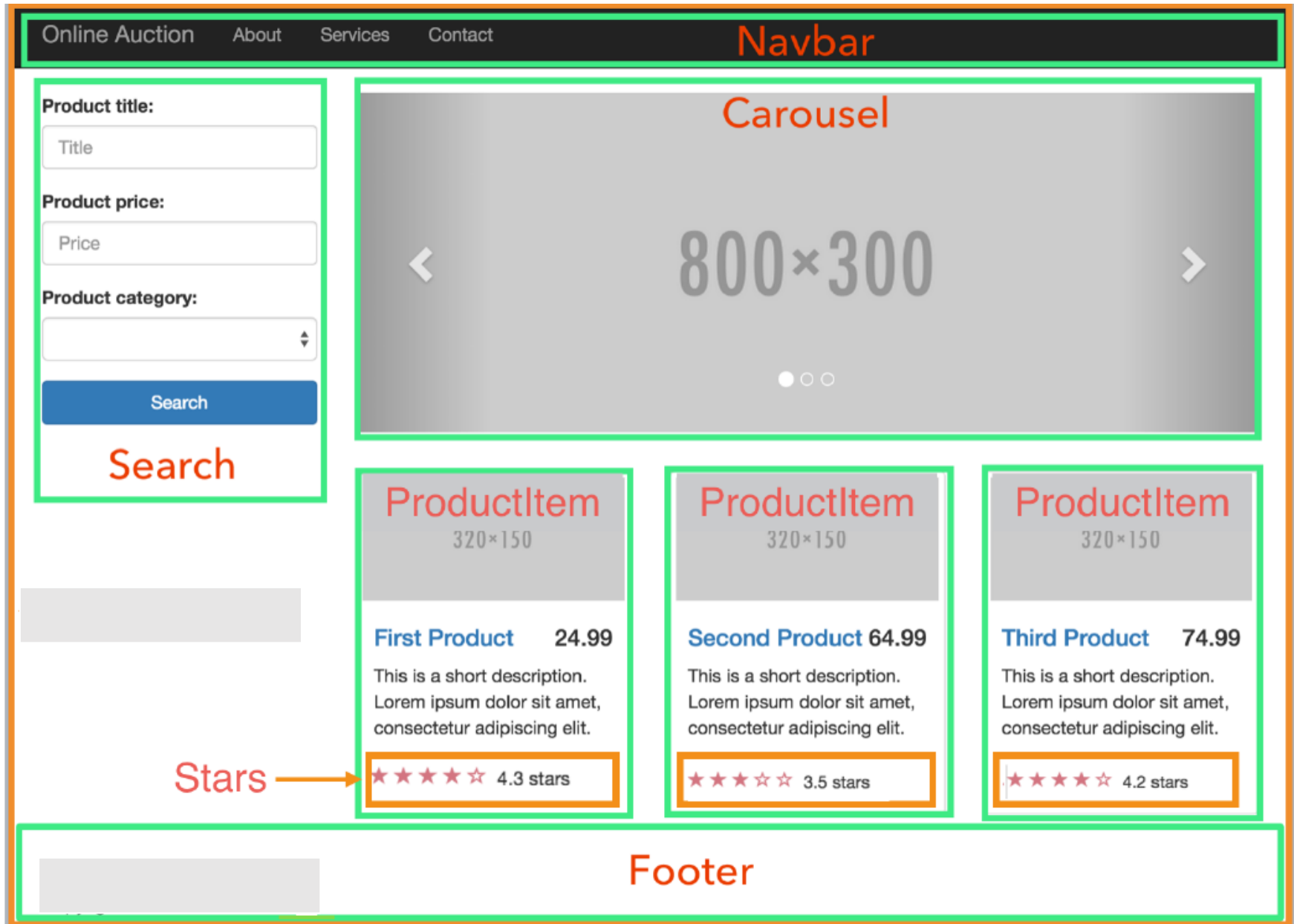
- React is an open source library for building **components-based user interfaces (UI)**
 - UI is **composed** of small reusable **components**
 - A component encapsulates **UI elements** and the **behavior** associated with them
- Ease creating a Single Page Application (SPA)
 - SPA is a Web app that load a single HTML page and **dynamically loads components** as the user interacts with the app
- Open-sourced by Facebook mid-2013 - <https://reactjs.org/>
- Competing with Angular <http://angular.io> and Vue.js <https://vuejs.org/>

Components of Single Page Application (SPA)

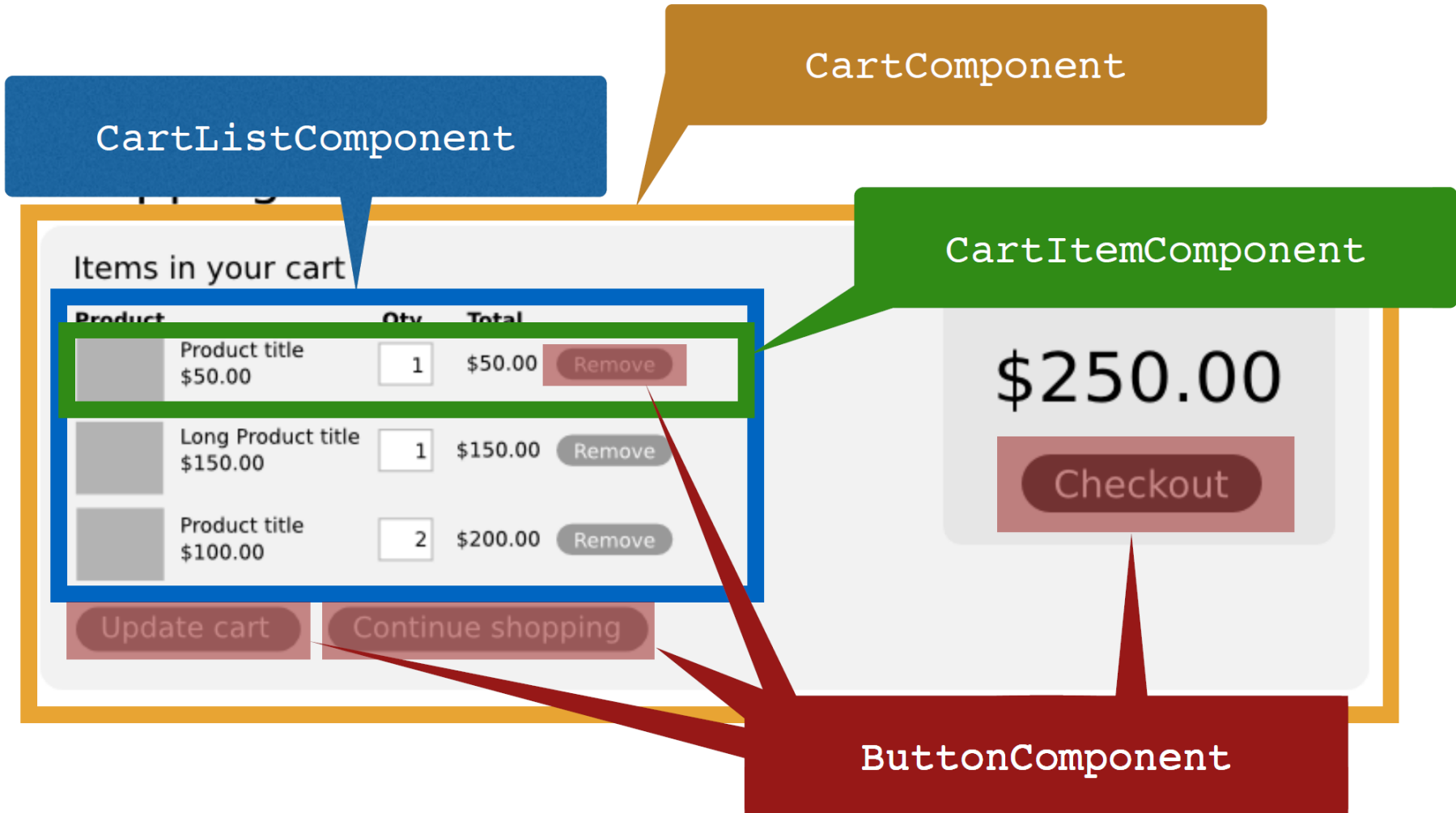
- A **Single-Page Application (SPA)** has **1 main shell page** and **multiple UI components loaded** in response to user actions



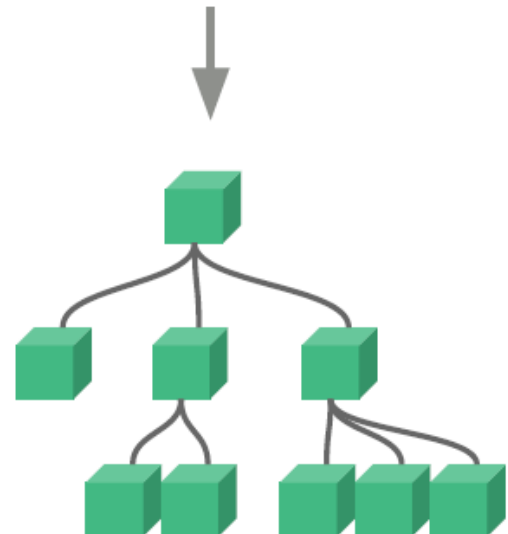
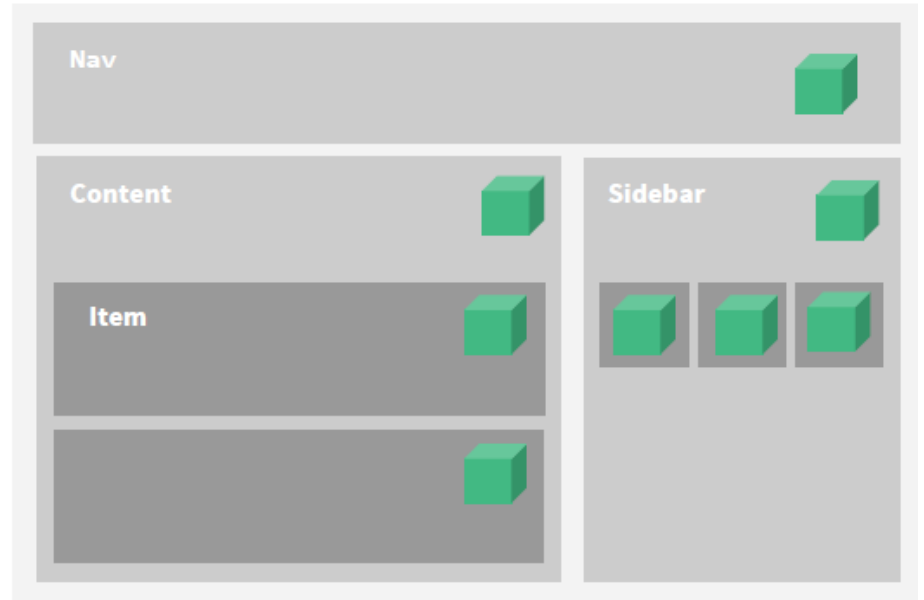
An app = a composition of components



An app = a tree of components



React Components



React Component

- A React App is composed of self-contained and often reusable **components**
- A ***component***:
 - Return **HTML *elements*** to provide the UI
 - Encapsulate **state** (internal component data) and **functions** to ***handle events*** raised from the UI elements
- Component = UI + display logic
- Components allows creating new 'HTML tags'

Component Example

- Create a **Welcome** component
 - Returns **JSX** : an HTML-like syntax to define the component UI
 - Can accept a parameter called **props**
 - Component name must start with a capital letter

```
import React from "react";  
function Welcome(props) {  
    return <h1>Welcome to {props.appName}</h1>;  
}  
export default Welcome;
```

- Use the **Welcome** component

```
<Welcome appName='React Demo App' />
```



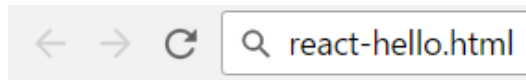
What is JSX?

React uses JSX (JavaScript Extension) syntax to define component's UI



You can embed JavaScript expressions in JSX

```
const age = 18;
const ageElement = <p>Age: {age}</p>;
ReactDOM.render(ageElement,
  document.querySelector('#root'));
```



Age: 18



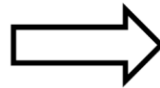
```
$$typeof: Symbol(react.element)
key: null
▼ props:
  ► children: (2) ["Age: ", 18]
  ► __proto__: Object
ref: null
type: "p"
_owner: null
► _store: {validated: false}
_self: null
_source: null
► __proto__: Object
```

What is JSX?

- Syntactic extension to JavaScript
- JSX allows us to write HTML like syntax which gets transformed to lightweight JavaScript objects

JSX

```
const element = (  
  <h1 className="greeting">  
    Hello, world!  
  </h1>  
);
```



JavaScript

```
const element = React.createElement(  
  'h1',  
  {className: 'greeting'},  
  'Hello, world!'  
);
```

It's just JavaScript!!

Try it @ <https://babeljs.io/repl>

A Component can be Styled using CSS

Error: Invalid login!

```
function ErrorBox(props) {  
  const css = {  
    color: 'red', fontWeight: 'bold',  
    border: '1px solid red', padding: '8px'  
  };  
  return <div style={css}>Error: {props.msg}</div>;  
}
```

- Use the **ErrorBox** component

```
<ErrorBox msg='Invalid login!'/>
```

Attributes can be passed as parameters to the component. They are available in the component as **props** object

Rendering a List of items (with .map())

Lists are handled using **.map** array function

```
function FriendsList({friends}) {  
  return <ul>  
    {friends.map( (friend, i) =>  
      <li key={i}>{friend}</li>  
    )}  
  </ul>  
}
```

- Fatima
- Mouza
- Sarah

```
<FriendsList>  
  <ul>  
    <li key="0">Fatima</li>  
    <li key="1">Mouza</li>  
    <li key="2">Sarah</li>  
  </ul>  
</FriendsList>
```

Key helps identify which items have changed, added or removed

- Use the **FriendsList** component

```
<FriendsList friends={['Fatima', 'Mouza', 'Sarah']}/>
```

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

useState Hook

State Variable

Setter Function

Initial Value



```
// State with Hooks  
const [count, setCount] = useState(0);
```

The diagram shows three white arrows pointing from the labels above to the code below. The first arrow points from 'State Variable' to the `count` variable in the array. The second arrow points from 'Setter Function' to the `setCount` function in the array. The third arrow points from 'Initial Value' to the `0` argument of the `useState` function.

Component With a State + Events Handling

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

Count: 4



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



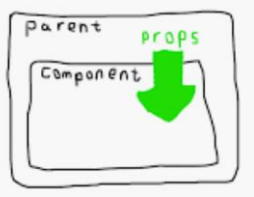
Handling events is done the way events are handled on DOM elements

- Use the **Counter** component

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

Uni-directional Data Flow:

Props vs. State

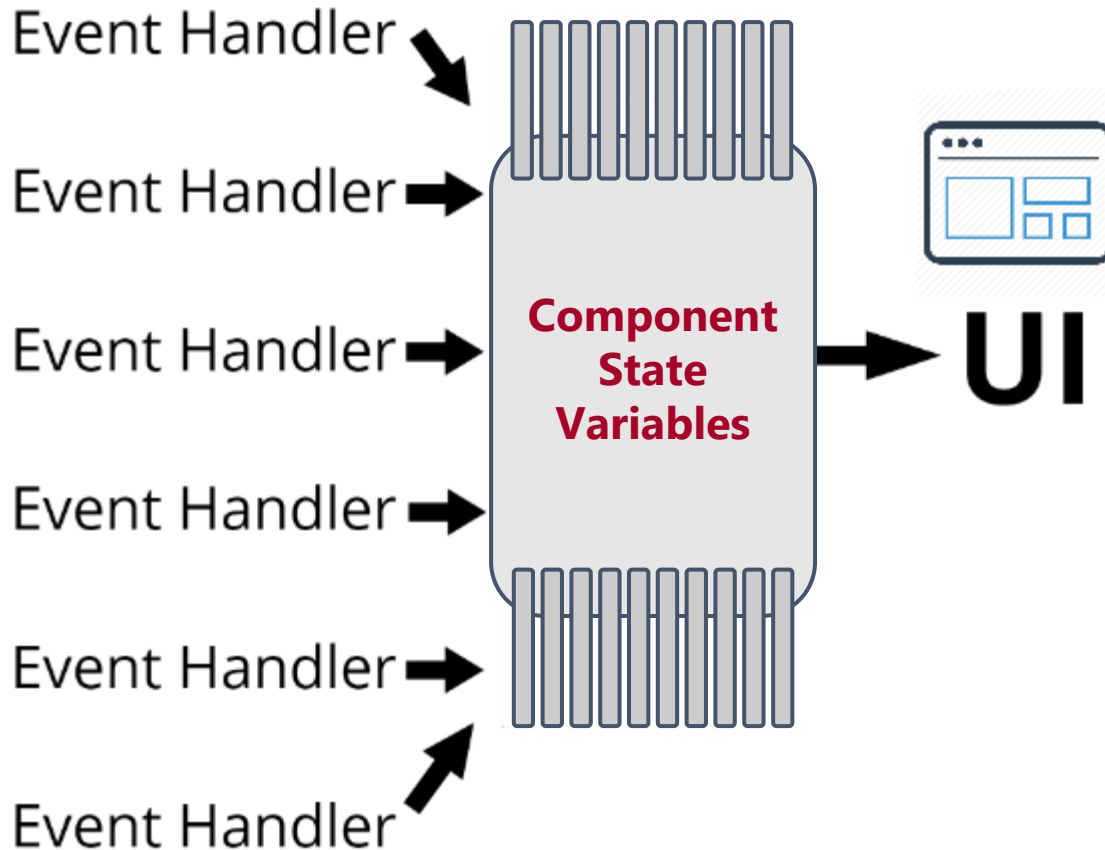


- **Props** = data passed to the child component from the parent component
- **Props** parameters are **read only**

- **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

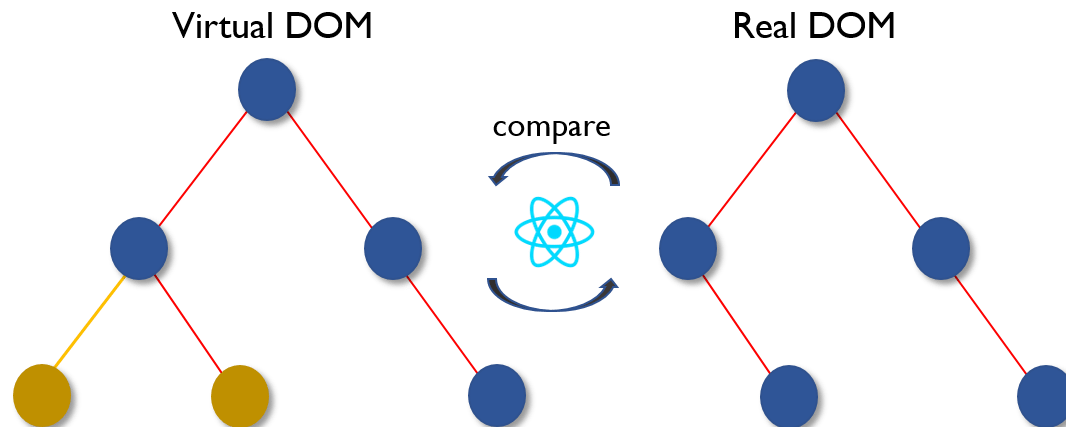
Event Handlers update the State and React updates the UI



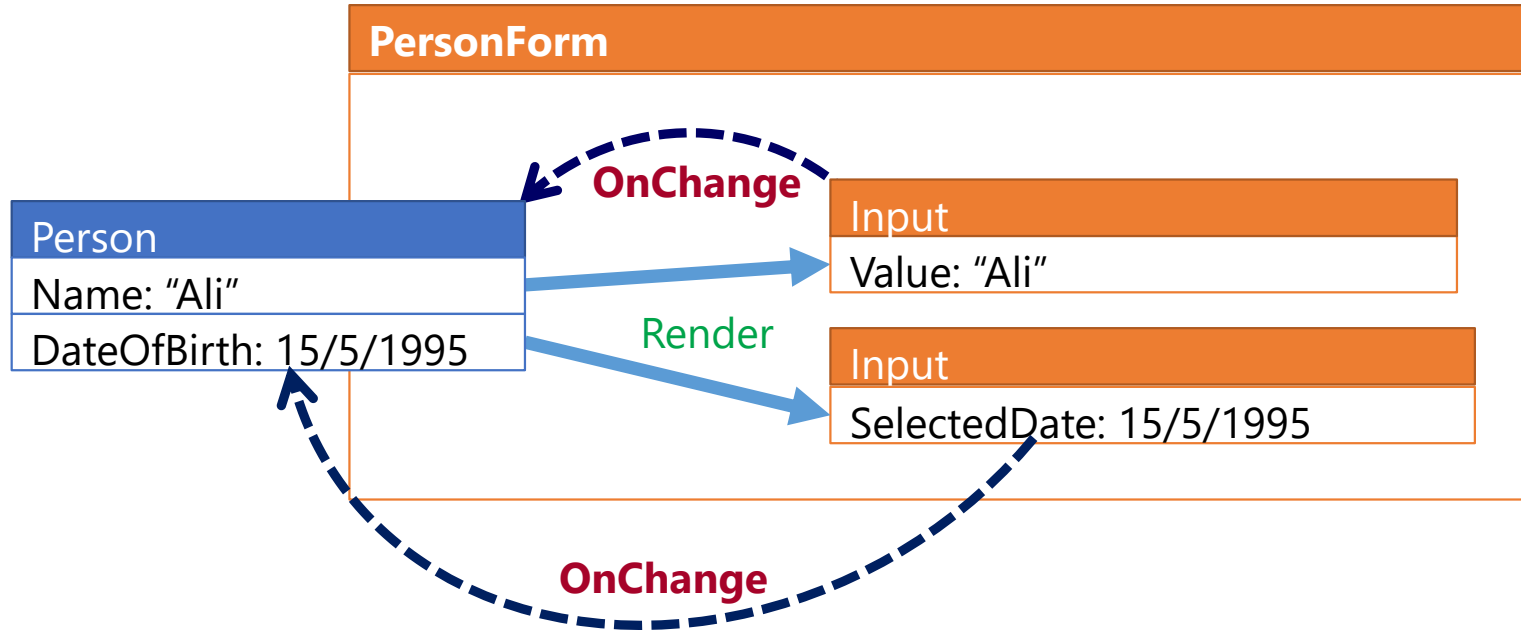
Every place a state variable is displayed is guaranteed to be auto-updated

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



Common Events: onClick - onSubmit - onChange

Forms with React

Form UI

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

```
const [values, setValues] = 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
  setValues({ ...values, [name]: value });
};
```

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

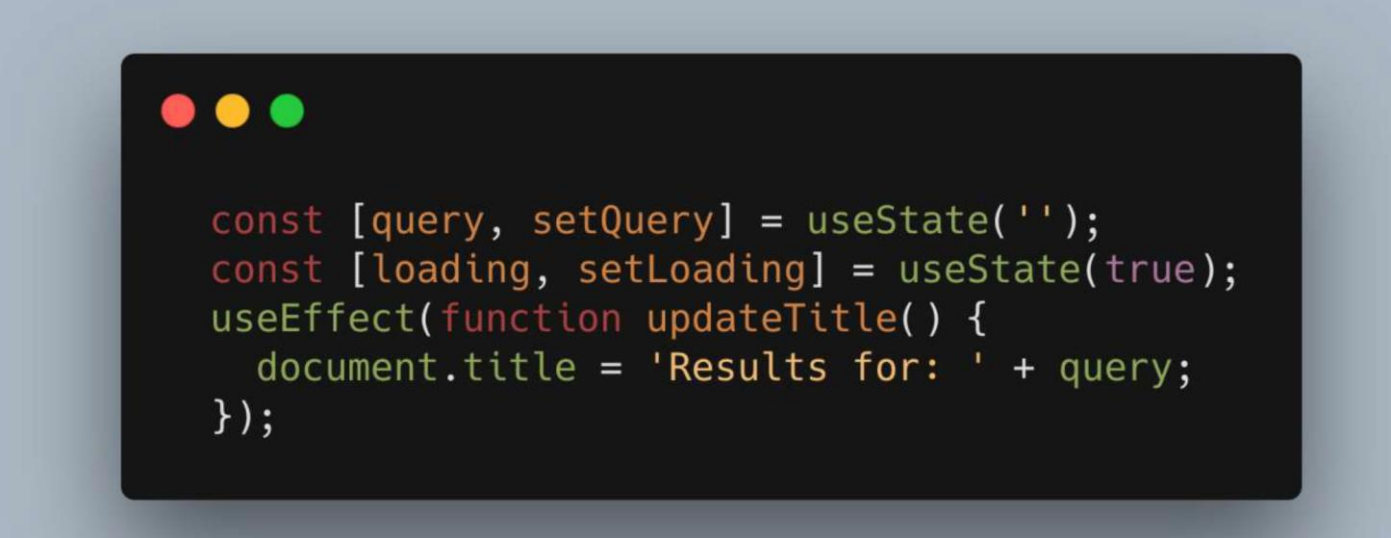
Form State and Event Handlers

useEffect – Executes code during Component Life Cycle

- Initialize state data when the component

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

- Executing a function on every re-render

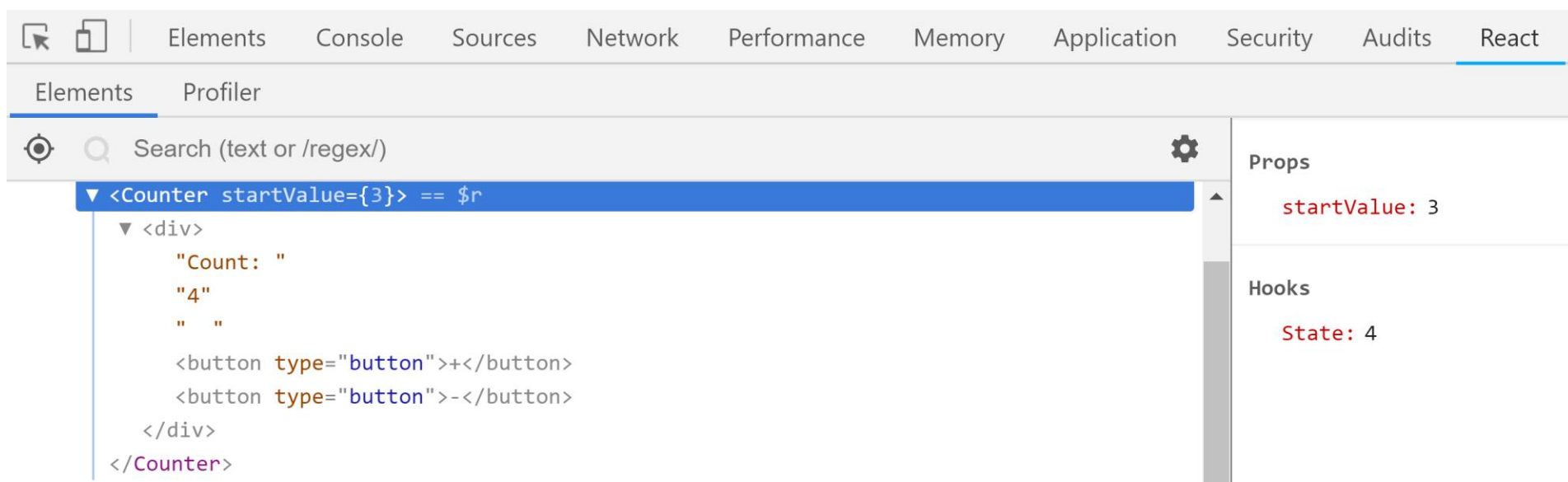


```
const [query, setQuery] = useState('');
const [loading, setLoading] = useState(true);
useEffect(function updateTitle() {
  document.title = 'Results for: ' + query;
});
```


Using the React Dev Tools

React Dev Tools

<https://github.com/facebook/react-devtools>



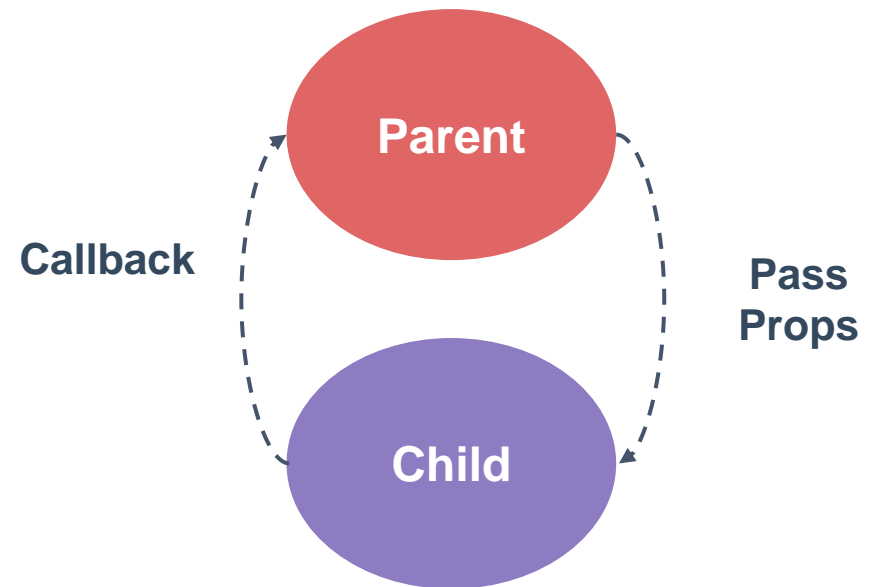


parcel-bundler

```
App.js ---> |  
Dashboard.js -> | Bundler | -> bundle.js  
About.js ---> |
```

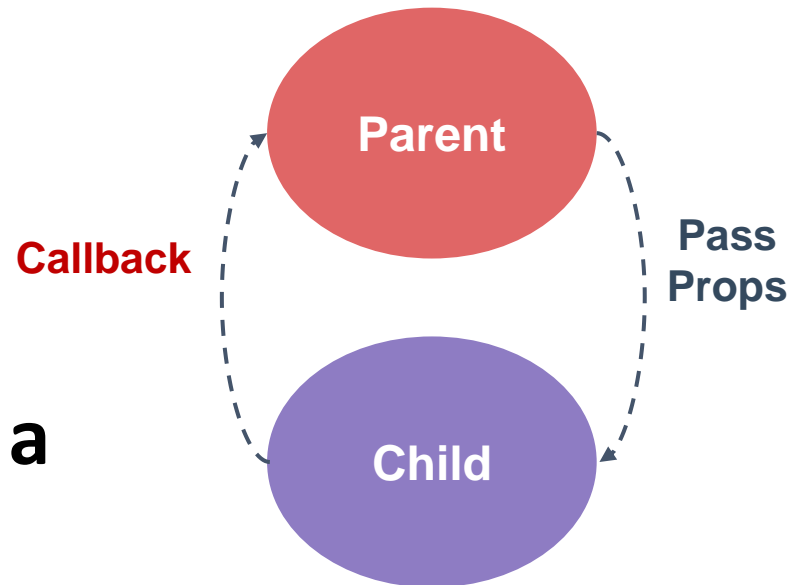
- <https://parceljs.org/>
- Examine all of the app modules, transform them (e.g., **transpiles JSX to plain JavaScript**), then intelligently put all of them together into one or more bundle(s)
- Alternative <https://webpack.js.org/>
- create-react-app <https://github.com/facebook/create-react-app>

Components Communication

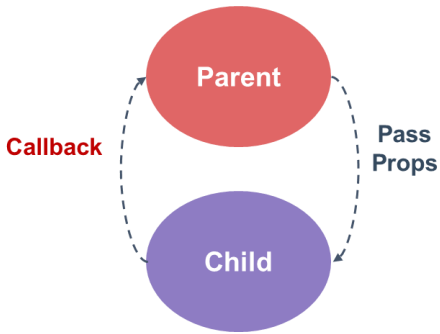


Composing Components

- 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

```
<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>  
}
```

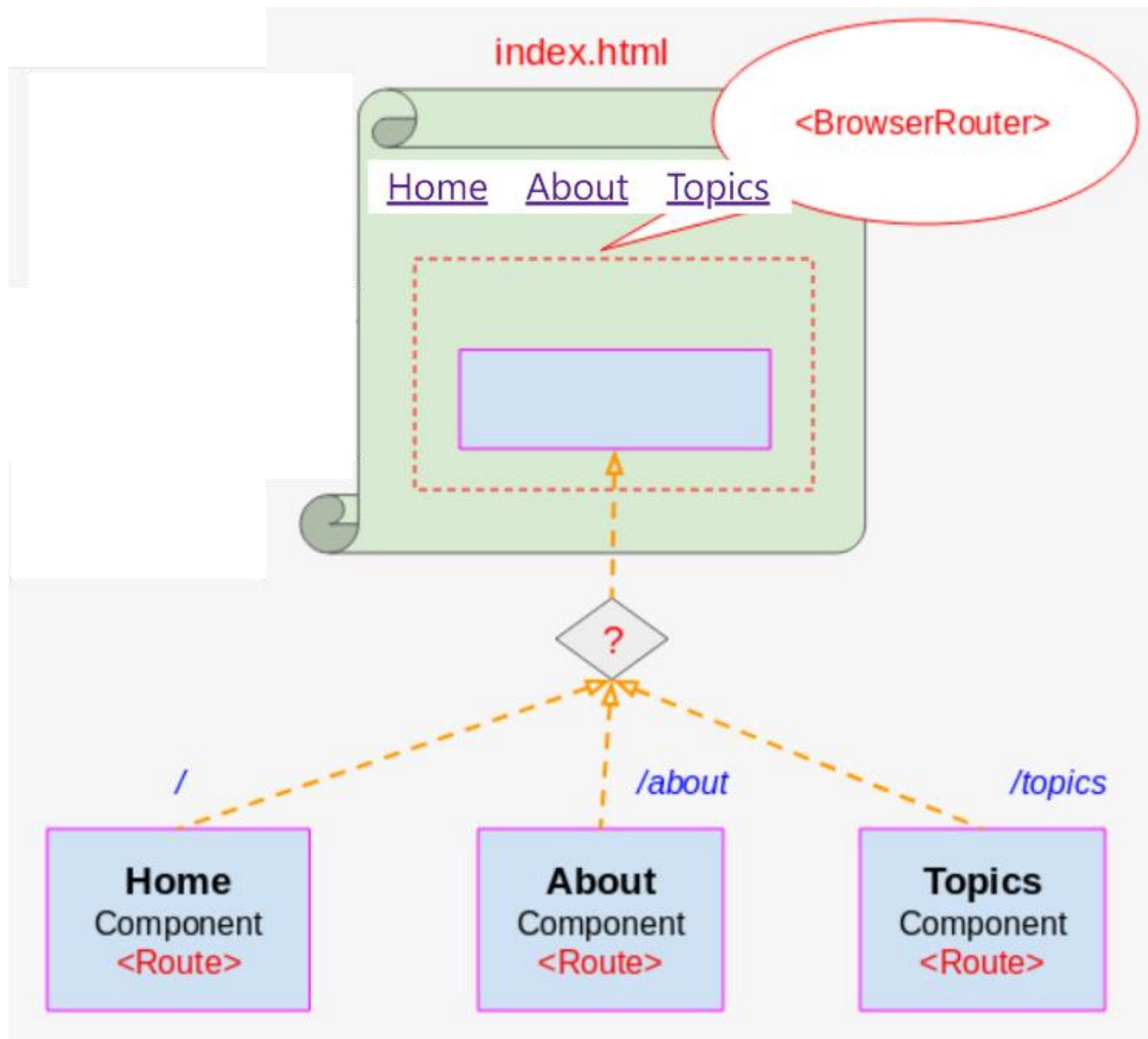
Routing



<https://reacttraining.com/react-router/>

Routing

- Routing implements client-side navigation for SPA:
 - Configure routes: map relative Url to the corresponding components in a declarative way
 - On URL change the router loads the associated component



Routing with React Router

```
import React from "react";
import { BrowserRouter as Router, Route, Link } from "react-router-dom";

function RouterBasicExample() {
  return (
    <Router>
      <div>
        <ul>
          <li> <Link to="/">Home</Link> </li>
          <li> <Link to="/about">About</Link> </li>
          <li> <Link to="/topics">Topics</Link> </li>
        </ul>
        <hr />
        <Route exact path="/" component={Home} />
        <Route path="/about" component={About} />
        <Route path="/topics" component={Topics} />
      </div>
    </Router>
  );
}
```

Router programmatic access

- Request the router to navigate to a Url programmatically

```
props.history.push('/calculator');
```

- Get route parameter

```
props.match.params.heroId
```

Route configured in the router:



```
<Route path="/hero/:heroId" component={HeroForm} />
```

React Components Libraries

- **Material-UI:** React components with Material Design

<https://material-ui.com/>

- ReactStrap Bootstrap Components

<https://reactstrap.github.io>

Summary

- React is awesome
- Decompose UI into self-contained and often reusable components
 - UI = Composition of Components
- React DOM uses JSX (JavaScript Extension) syntax to define component's UI
- Component Router ease loading components as the user interacts with the page

Resources

- Thinking in React

<https://reactjs.org/docs/thinking-in-react.html>

- React Router

<https://reacttraining.com/react-router/>

- Useful list of resources

<https://github.com/enaqx/awesome-react>

<https://awesomereact.com/>

- Books

<https://www.manning.com/books/react-in-action>