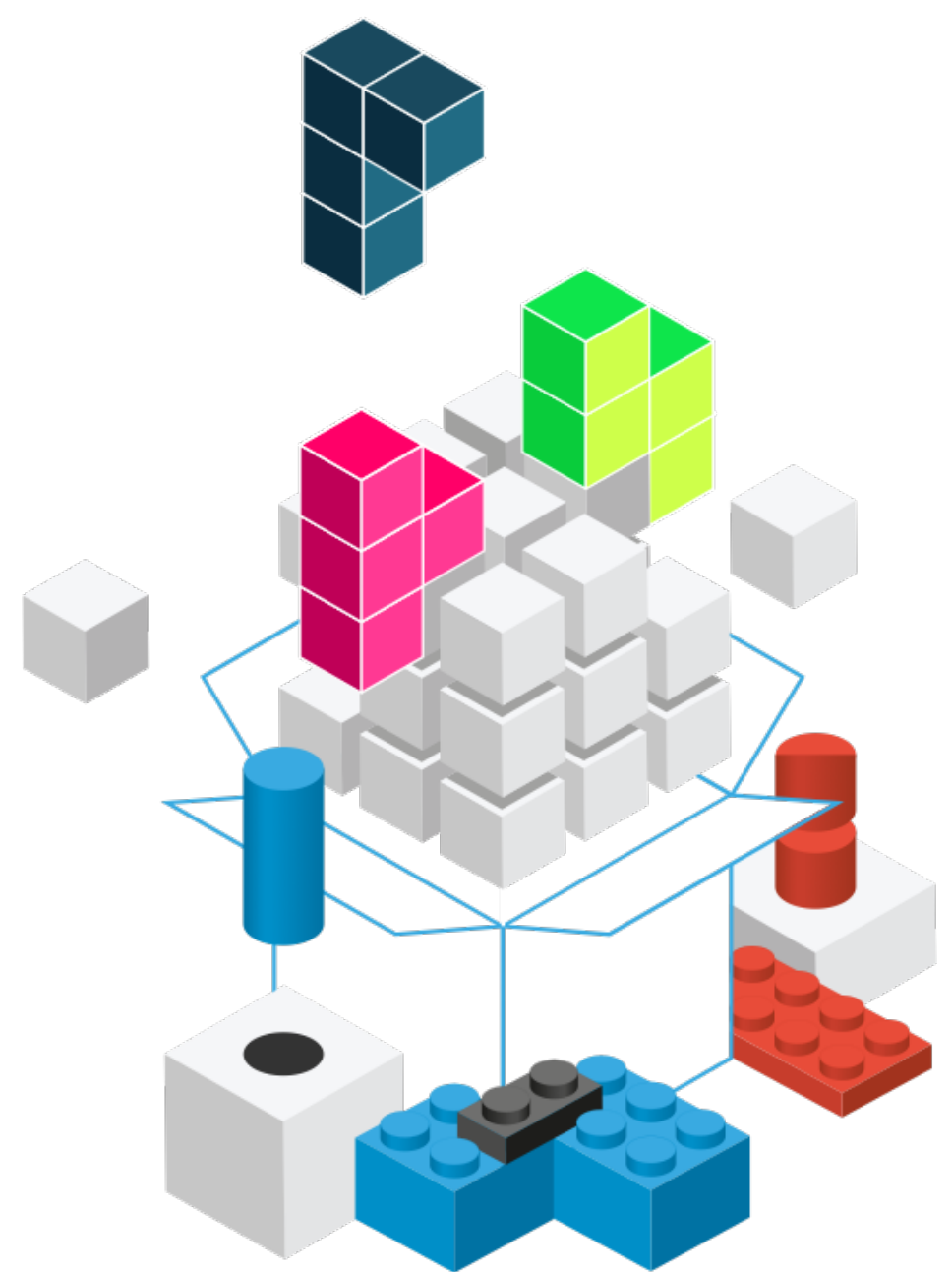


<WA1/>  
<AW1/>  
2023

# Elements, JSX, Components

## The Foundations of React

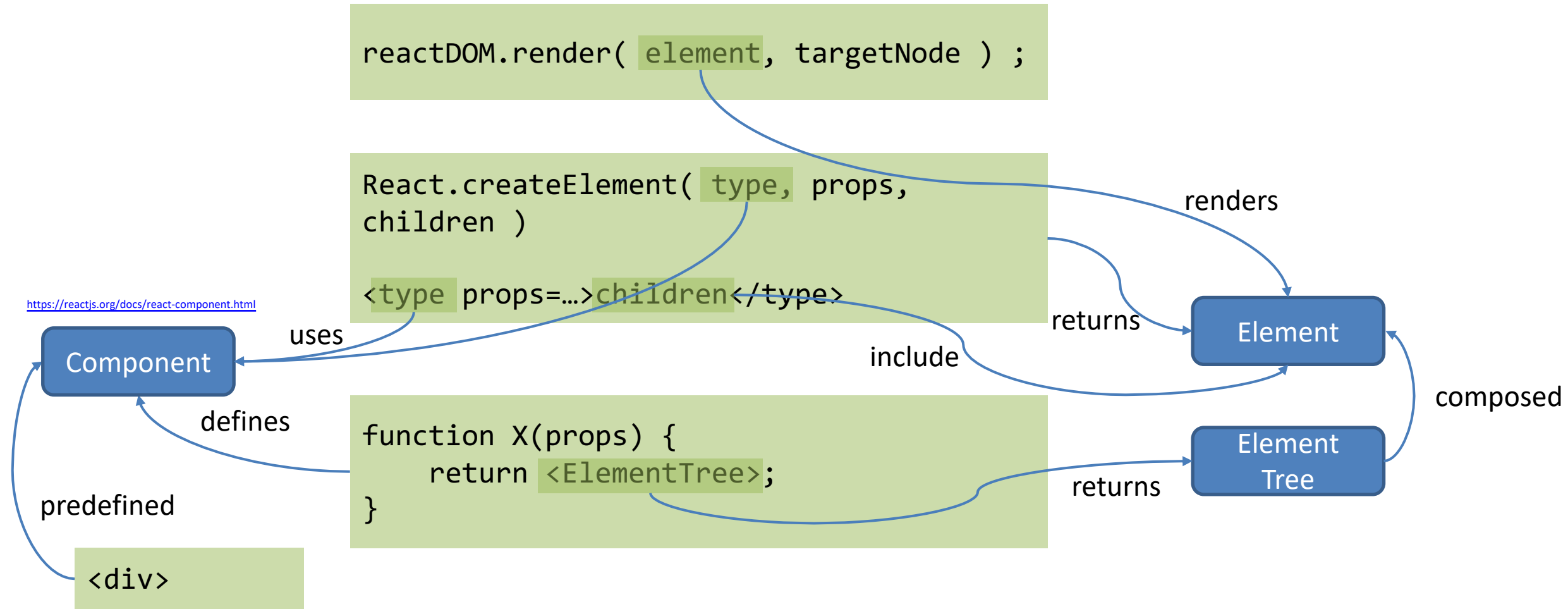
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# Outline

- React Elements
  - Creating
  - JSX language
- React Components
  - Defining

# Conceptual Overview





<https://react.dev/learn/your-first-component>

Full Stack React, Chapter “JSX and the Virtual DOM”

Building block for describing web page content

# REACT ELEMENTS

# React Element

- An **element** is a plain object describing a component instance or DOM node and its desired properties
- A ReactElement is a representation of a DOM element in the Virtual DOM.
- It contains only information about
  - the component **type** (for example, a Button)
  - its **properties** (for example, its color)
  - any **child** elements inside it.
- Not an *instance* of a part of a page, but a *description* about how to construct it.

# React.createElement (1/3)

- `React.createElement( type, props, children )`
- Type
  - **String**: a DOM node identified by the tag name (e.g., 'div')
  - React component **class/function**: a user-defined component

# React.createElement (2/3)

- `React.createElement( type, props, children )`
- Props: a simple object {}, containing:
  - DOM attributes for DOM nodes ( `type`, `src`, `href`, `alt`, ... )
  - Arbitrary values for React components (even array- or object-valued)
    - Available as props in the Component body
  - Represented as object properties (not strings like HTML attributes)
    - **Exceptions** (reserved words): `class` → `className`, `for` → `htmlFor`

# React.createElement (3/3)

- `React.createElement( type, props, children )`
- Children:
  - a `ReactNode` object, that may be:
    - A string or number: text content of the nodes
    - A `ReactElement` (that may contain a tree of Elements)
    - An array of `ReactNodes`
  - nested Elements to be rendered as children of the element



# Conventions

- **DOM** Elements are always **lowercase**
  - `div p li img ...`
- **React** Components are always **uppercase**
  - `WarningButton LoginForm TaskList ...`
- The two types of elements can be mixed, nested, combined in any way
  - React uses *composition* and not *inheritance*
- Element trees describe **portions of the Virtual DOM**



<https://react.dev/learn/writing-markup-with-jsx>

Full Stack React, Chapter “JSX and the Virtual DOM”

React Handbook, Chapter “JSX”

A humane way of describing trees of ReactElements

# JSX

# JSX – JavaScript Syntax Extension

- Alternative syntax for `React.createElement`
- XML fragments inside the JS code
  - Syntax details: all tags must be `</closed>` or `<selfclosing/>`
- Transpiled by Babel into plain JS

```
<MyButton color="blue" shadowSize={2}>  
  Click Me  
</MyButton>
```

Element/Component name  
Props  
Children / Text content



```
React.createElement(  
  MyButton,  
  {color: 'blue', shadowSize: 2},  
  'Click Me'  
) ;
```

# Components are expanded during *rendering*

```
<Button color='blue'>  
OK!  
</Button>
```

render

```
<button class='button button-blue'>  
  <b>  
    OK!  
  </b>  
</button>
```



Components encapsulate element trees (generated given their properties).



React asks the Button component to render itself. It will generate a tree of elements, to replace this one.



Repeat until only DOM nodes are present.

# JSX Syntax

- May use `<tag>...</tag>` or `<tag />` anywhere a JS expression is syntactically valid
  - Not only in Components
  - May also store in Arrays/Objects
  - After all, they are just `ReactElements` generated by `React.createElement!`
- May enclose in `(...)` for clarity

```
const element = <div className="main">Hello world</div>;
```

```
const element2 = (<Message text="Hello world" />);
```

Note: use `<tag />` if the component doesn't have any children

# JSX Tag Name

- `<Foo>` is just `React.createElement(Foo,...)`
  - Foo must be in scope (imported or declared)

```
import CustomButton from './CustomButton';

function WarningButton() {
  return <CustomButton color="red" />;
}
```

# JSX Attribute Expressions

- Tag attributes are converted to props of the ReactElement
- String attributes become string-valued props
  - `color="blue" -> {color: 'blue'}`
- Other objects may be specified as a JS expression, enclosed in `{}`
  - `shadowSize={2} -> {shadowSize: 2}`
  - `log={true}`
  - `color={warningLevel === 'debug' ? 'gray' : 'red'}`
- Any JS expression is accepted

# JSX Children

- The *content* between the tags `<tag>content</tag>` is passed as a special property `props.children`
- Such content may be:
  - A string literal
  - More JSX elements (nested components)
  - Any {JS expression}
  - A {JS expression} returning an array of JSX elements (they are inserted as siblings)
  - A JS function (may be used as a callback by the Component)
  - Anything that the Component may understand (and render properly)

```
<MyComponent>Hello  
world!</MyComponent>
```

```
<MyContainer>  
  <MyFirstComponent />  
  <MySecondComponent />  
</MyContainer>
```



# JSX Child Expressions

- JS expressions in `{ }` may be used to specify element children
- One child (or an array of children) are generated by an expression

```
const Menu = (<ul>{loggedInUser ? <UserMenu /> : <LoginLink />}</ul>)
```

- `<JSX>` inside `{JS}` inside `<JSX>` inside JS. Totally Legit. 🍷
- `undefined`, `null` or Booleans (`true`, `false`) are **not rendered**
  - Useful for conditionally including children

```
return (<ul>  
  <li>Menu</li>  
  {userLevel === 'admin' && renderAdminMenu()}  
</ul>)
```

# Render Children Components

- In the component, you may render `{props.children}` to include the nested elements

```
return (  
  <Container>  
    <Article headline="An interesting  
Article">  
      Content Here  
    </Article>  
  </Container>  
)
```

```
function Container (props) {  
  return (<div className="container">  
    {props.children}  
  </div>);  
}
```

# Boolean HTML Attributes in JSX

- In HTML some attributes do not have a value. Their simple presence “activates” a behavior
  - HTML: `<option value='WA' selected>Washington</option>`
  - HTML: `<input name='Name' disabled />`
- In JSX, a Boolean value may be given
  - True, for the presence of the attribute (optional in recent React versions)
  - False (or nothing) for the absence of the attribute
  - JSX: `<option value='WA' selected={true}>Washington</option>`
  - JSX: `<input name='Name' disabled={true} />`

# Comments in JSX

- There are **no** comments in JSX
- The HTML/XML comments syntax `<!-- ... -->` does **not** work
- If you want to insert comments, you must do that in an embedded JS expression (using **JS** syntax inside `{ }`)

```
{ /* ... */ }
```

- Yes, it's ugly

# DOM Attribute Names

- When passing props to a DOM native node, some differences exist
- Attribute names are camelCase
  - HTML onchange → JSX onChange
- The style attribute accepts an **object** and not a string
  - `<div style={{color: 'white'}}>Hello World!</div>`
  - Object keys are CSS Properties, and are camelCase (e.g., margin-top → marginTop)
  - Object values are CSS values, represented as strings

# JSX Spread Syntax

- Shortcut syntax for passing all properties of an object as props to a React Component

```
const welcome = {msg: "Hello", recipient: "World"} ;
```

```
<Component  
  msg={welcome.msg}  
  recipient={welcome.recipient} />
```

```
const welcome = {msg: "Hello", recipient: "World"} ;
```

```
<Component {...welcome} />
```

```
// properties of the welcome object  
// are “spread” as individual props  
// with the same name
```

# JSX Spread Example (Property Passthrough)

```
const Button = props => {
  const { kind, ...other } = props;
  const className = kind === "A" ? "ABtn" : "BBtn";
  return <button className={className} {...other} />;
};

const App = () => {
  return (
    <div>
      <Button kind="primary"
        onClick={() => console.log("clicked!")}>
        Hello World!
      </Button>
    </div>
  );
};
```

- The 'kind' property is "consumed" by <Button>
- All other properties (...other) are passed to the child <button>
- In this way, <App> can specify the kind to Button and all other properties to "pass through" down the hierarchy

# JSX Syntax Reminders

- The HTML `class` attribute is called `className`
  - Useful to add CSS classes for layout (e.g. `className='d-block vh-100'`)
- The HTML `for` attribute is called `htmlFor`
- HTML entities (`<`; `&`; `&copy;`; `&star;`; etc...) may not be supported directly in older JSX
  - Use the corresponding Unicode character (`<` & © ☆) inside a string in JS `{ '☆' }`
  - Alternatively, use a Unicode Escape sequence: `{ '\u2606' }`
    - See: <https://www.toptal.com/designers/htmlarrows/>





<https://react.dev/learn/passing-props-to-a-component>

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

Full Stack React, Chapter “Advanced Component Configuration with props, state, and children”

Putting together the building blocks

# REACT COMPONENTS: INTRO

# Declaring Components

## Components (as functions)

```
const Button = ( props ) => (  
  <Element>...</Element>  
);  
  
function Button(props) {  
  return <Element>...</Element> ;  
}
```

- **Components:**
- Take **props** as their input
- Return the **elements** as their output

# Components (as functions)

- Defined as function statement, function expression or arrow expression
- Receive (props) argument
- Must return a React Element tree
- The returned elements are function of the props
- Must be a **pure function** (no side-effects) and **idempotent**
- State and lifecycle may be managed with the *Hooks* mechanism

# Tips for Creating Components

- It is normal to create many different “small” components
- Each component is constructed by *composing* other components
  - Components may be repeated (with different props)
  - It’s up to the parent to determine the children’s props
- If a component becomes too complex, try to *extract small re-usable parts* as independent components

# Lists and Keys (1/2)

```
function NumberList(props) {  
  const numbers = props.numbers;  
  const listItems = numbers.map(  
    (number) => <li>{number}</li> );  
  return (<ul>{listItems}</ul>);  
}
```

```
Function App(props) {  
  const numbers = [1, 2, 3, 4, 5];  
  return <NumberList  
    numbers={numbers}/>;  
}
```

- NumberList generates a `<ul>` containing `<li>` for each of the numbers in `props.numbers`
- Whenever you construct a **list** of elements, you **must** pass a **unique key attribute** to identify each item
- Unique keys help React identify which items have changed, are added, or are removed.

# Lists and Keys (2/2)

- **Always** assign to each item in the list a special 'key' attribute, with **unique values**
  - `<li key={number}>{number}</li>`
- Most likely, we may reuse unique IDs from the data itself
  - `<li key={todo.id}>{todo.text}</li>`
- Keys **must** be specified when building the array of components
  - Usually in the `.map()` call, in the 'container' component
- Uniqueness is only required within *the same list*
  - Not globally on the page
- Keys are not available as props in the component

# React Fragments

- A component should always return a tree of elements, **with a single root**.
- To return a list of elements, you must include them in some “container” (such a `<div>`)
  - This generates an “extra” DOM node, and in some contexts it might be invalid
- The special node `<React.Fragment>` may be used to wrap a list of element into a single root.
  - `React.Fragment` will not generate any node at the DOM level
- A shortcut syntax for fragments is `<> ... </>`



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