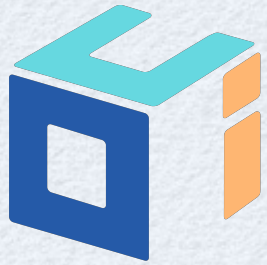
React Hooks

slides at https://github.com/mvolkmann/talks

R. Mark Volkmann
Object Computing, Inc.
http://objectcomputing.com
Email: mark@objectcompuing.com
Twitter: @mark_volkmann
GitHub: mvolkmann



OCI | TRAINING

Hooks Overview

- A feature added **in React 16.7.0-alpha.0**
- **Enable implementing stateful components with functions instead of classes**
- No plans to remove existing ways of implementing components
- Hooks simply provide a new way that most developers will find easier to understand and is backward-compatible with existing code
- Components that use hooks can be used together with class-based components
- Existing apps can choose to gradually incorporate hooks or never use them

Caveats

- Eventually it will be possible to use a function component
  to do everything that is currently possible with a class component
- However, currently there are some lifecycle methods
  whose functionality cannot yet be implemented when using hooks
  - `componentDidCatch` and `getSnapshotBeforeUpdate`
- Hooks are currently considered experimental
  and the API may still change

Hook Benefits

- Implementing components with functions removes need to
  - understand **`this`** keyword
  - understand **`bind`** and when to use it
- Easier to optimizing function component code than class component code
  - refers to minifying, hot reloading, and tree shaking
- Easier to work with component state and context
- Easier to reuse state logic between multiple components
- Removes most needs for higher-order components and render props
  - these require increased levels of code nesting
- Can use "effects" in place of lifecycle methods
  - makes it possible to better organize related code such as adding/removing event listeners and opening/closing resources

Hook Function Rules

- Names should start with **`use`**
  - allows linting rules to check for proper use of hooks
  - provides a clue that the function may access state
- Can only be called in function-based components and in custom hooks
- Cannot be called conditionally
  - means they cannot be called in **`if`**/**`else`** blocks, loops, or nested functions
  - ensures that for any component, the same hooks are invoked in the same order on every render

ESLint

- React provides ESLint rules to detect violations of these rules
  - see https://www.npmjs.com/package/eslint-plugin-react-hooks
- Currently a single rule named "**`react-hooks/rules-of-hooks`**"
  - should be configured with a value of "**`error`**"
  - assumes that any function whose name begins with "**`use`**" followed by an uppercase letter is a hook
  - verifies that hooks are only called from a function component (name starts uppercase) or a custom hook function
  - verifies that hooks are called in the same order on every render

Provided Hooks

- Implemented as functions exported by the **`react`** package
- Described on the following slides
  somewhat ordered based on
  how frequently they are expected to be used

State Hook ...

- Provides a way to add state to a function component
- The following can appear inside a function that defines a component

```
const [petName, setPetName] = useState('Dasher');
const [petBreed, setPetBreed] = useState('Whippet');
```

- **`useState`** is a hook that
  - takes the initial value of the state
  - returns an array containing the current value and a function to change it
- In this example,
  - **`petName`** holds current value of state
  - **`setPetName`** is a function that can be called to change value
- "set" functions
  - can be passed a new value, or a function that will be passed the current value and returns the new value
  - calls to them trigger the component to be re-rendered

... State Hook ...

- State is often a primitive value, but can also be an object or array (also an object)
- When an object
  - calls to corresponding set function must pass entire value
  - set functions do not merge the object passed to them with the current value as is done by the `Component` `setState` method
- Allows components to use state without using the `this` keyword
- `useState` calls are be made every time the component is rendered
  - to obtain current value for each piece of state
  - initial values are only be applied during first render

... State Hook

- Not necessary to understand how this works, but it's interesting
- State values are stored in a linked list
- Each call to `useState` associates a state value with a different node in the linked list
- In previous example
  - **`petName`** is stored in first node
  - **`petBreed`** is stored in second node

Effect Hook ...

- `useEffect` hook provides an alternative to lifecycle methods like `componentDidMount`, `componentDidUpdate`, and `componentWillUnmount` in function components
- Effects have two phases, setup and cleanup
  - think of setup as being performed when a class component would call `componentDidMount` or `componentDidUpdate`, which is after React updates the DOM.
  - think of cleanup as being performed when a class component would call `componentWillUnmount`
-

... Effect Hook ...

- Examples of setup functionality include
  - fetching data (ex. calling a REST service)
  - registering an event listener
  - opening a network connection
  - starting a timeout or interval
- Examples of cleanup functionality include
  - unregistering an event listener
  - closing a network connection
  - clearing a timeout or interval

... Effect Hook ...

- An effect is configured by calling **`useEffect`** which takes a function
- This function performs the setup
- If this function returns another function, it is used for cleanup
- If no cleanup is required, nothing is returned
- For example

```
useEffect(() => {
  console.log('performing setup');
  return () => {
    console.log('performing cleanup');
  };
});
```

- **`useEffect`** can be called any number of times inside a function component
- Typically called once for each distinct kind of effect
  rather than combining the code for multiple effects in a single call

... Effect Hook ...

- In first render of a component, order of execution is
  1. all code in component function
  2. setup code in all effects
- In subsequent renders, order of execution is
  1. all code in component function
  2. cleanup code in all effects
  3. setup code in all effects

… Effect Hook

- If it is desirable to prevent the setup and cleanup code from running in every render
  - supply a second argument `useEffect` that is an array of variables
  - cleanup and setup steps are only executed again if any of these variables has changed since the last call
- One use of an effect is to move focus to a particular input
  - demonstrated in "Ref Hook" section ahead

Context Hook ...

- `useContext` hook provides an alternative way to consume context state in function components
- Hooks do not change the way context providers are implemented
  - still implemented by creating a class that
  - extends from `React.Component` and rendering a `Provider`
  - for details, see https://reactjs.org/docs/context.html
- Suppose a context provider has been implemented in component `SomeContext`
- `useContext` can be used in another component to access its state

```
import {SomeContext} from './some-context';

export default MyComponent() {
  const context = useContext(SomeContext);
  return <div>{context.someData}</div>;
}
```

... Context Hook ...

- `context` variable is set to an object that provides
  - read-only access to the state properties of the context
  - access to any methods defined on it
- Context methods can provide a way for context consumers to modify the context state
- Directly setting properties on `context` affects the local object, but not the context state
  - doing this is not flagged as an error
- Calling `useContext` also subscribes the function component to context state updates
  - whenever context state changes, the function component is re-rendered

… Context Hook

- To avoid re-rendering the component on every context state change, wrap returned JSX in a call to **`useCallback`** described next

- A great use of **`useContext`** is in conjunction with the npm package "context-easy"
  - https://www.npmjs.com/package/context-easy

Callback Hook ...

- `useCallback` takes an expression and
  an array of variables that affect the result
- It returns a memoized value
- Often the expression is a function
- Can be used to avoid recreating callback functions
  defined in function components every time they are rendered
- Such functions are often used as DOM event handlers
-

... Callback Hook ...

- For example, consider the difference between these

```
<input onChange={e => processInput(e, color, size)}>

<input onChange={useCallback(e => processInput(e, color, size), [color, size]}>
```

- These lines have the same functionality,
  but the second line only creates a new function
  for the **`onChange`** prop when the value of
  `color` or **`size`** has changed since the last render
- Avoiding the creation of new callback functions
  allows the React reconciliation process to correctly
  determine whether the component needs to be re-rendered
- A performance benefit comes from avoiding unnecessary renders

... Callback Hook ...

- If the callback function does not depend on any variables, pass an empty array for second argument
  - causes `useCallback` to always return same function
- If second argument is omitted, a new function will be returned on every call which defeats the purpose

Why doesn't `useCallback` treat omitting the second argument the same as passing an empty array?

… Callback Hook

- **useCallback** can also serve as a substitute for the lifecycle method **shouldComponentUpdate** available in class components
- For example, suppose **v1** and **v2** are variables whose values come from calls to **useState** or **useContext** and these are used in the calculation of JSX to be rendered
- To only calculate new JSX if one or both of them have changed since the last render, pass the JSX as the first argument to **useCallback**
- For example

```
return useCallback(<div>component JSX goes here.</div>, [v1, v2]);
```

Memo Hook ...

- `useMemo` takes a function and an array of variables that affect the result
- It memoizes the function and returns its current result
- For example, suppose `x` and `y` are variables
  whose values come from calls to `useState` or `useContext`
  and we need to compute a value based on these
- The following code reuses the previous result
  if the values of `x` and `y` have not changed

```
const hypot = useMemo(
  () => {
    console.log('calculating hypotenuse');
    return Math.sqrt(x * x + y * y);
  },
  [x, y]
);
```

... Memo Hook

- Only remembers result for last set of input values
- Does not store all past unique calculations

- Note difference between `useCallback` and `useMemo`
- While both provide memoization,
  `useCallback` returns a value (which could be a function) and
  `useMemo` returns the result of calling a function

`React.memo` Function

- `React.memo` is a function, not a hook, added in React 16.6
- It memoizes a function component so
  it is only re-rendered if at least one of its props has changed
- Does what class components do when they
  extend from `PureComponent` instead of `Component`
- For example, the following code defines a `Percent` component
  that renders the percentage a count represents of a total

```
const import React from 'react';

export default React.memo(({count, total}) => {
  console.log('Percent rendering'); // to verify when this happens
  return <span>{((count / total) * 100).toFixed(2)}%</span>;
});
```

Reducer Hook ...

- `useReducer` supports implementing components whose state is updated by dispatching actions that are handled by a reducer function
  - patterned after Redux.
- Example
  - very simple todo app with a single component, `TodoList`
  - uses Sass for styling
  - calls `useReducer` to obtain **`state`** and **`dispatch`** function
  - calls `dispatch` in event handling functions

... Reducer Hook ...

todo-list.scss

```
.todo-list {
  .delete-btn {
    background-color: transparent;
    border: none;
    color: red;
    font-weight: bold;
  }

  .done-true {
    color: gray;
    text-decoration: line-through;
  }

  form {
    margin-bottom: 10px;
  }

  .todo {
    margin-bottom: 0;
  }
}
```

... Reducer Hook ...

todo-list.js

```
import React, {useReducer} from 'react';
import './todo-list.scss';

const initialState = {
  text: '',
  todos: []
  // objects in this have id, text, and done properties.
};

let lastId = 0;
```

... Reducer Hook ...

todo-list.js

```
function reducer(state, action) {
  const {text, todos} = state;
  const {payload, type} = action;
  switch (type) {
    case 'add-todo': {
      const newTodos = todos.concat({id: ++lastId, text, done: false});
      return {...state, text: '', todos: newTodos};
    }
    case 'change-text':
      return {...state, text: payload};
    case 'delete-todo': {
      const id = payload;
      const newTodos = todos.filter(todo => todo.id !== id);
      return {...state, todos: newTodos};
    }
    case 'toggle-done': {
      const id = payload;
      const newTodos = todos.map(
        todo => (todo.id === id ? {...todo, done: !todo.done} : todo)
      );
      return {...state, todos: newTodos};
    }
    default:
      return state;
  }
}
```

... Reducer Hook ...

todo-list.js

```
export default function TodoList() {
  const [state, dispatch] = useReducer(reducer, initialState);

  const handleAdd = () => dispatch({type: 'add-todo'});

  const handleDelete = id => dispatch({type: 'delete-todo', payload: id});

  const handleSubmit = e => e.preventDefault(); // prevents form submit

  const handleText = e =>
    dispatch({type: 'change-text', payload: e.target.value});

  const handleToggleDone = id => dispatch({type: 'toggle-done', payload: id});
```

… Reducer Hook

todo-list.js

```
  return (
    <div className="todo-list">
      <h2>Todos</h2>
      <form onSubmit={handleSubmit}>
        <label htmlFor="text">
          <input
            placeholder="todo text"
            onChange={handleText}
            value={state.text}
          />
        </label>
        <button onClick={handleAdd}>+</button>
      </form>
      {state.todos.map(todo => (
        <div className="todo" key={todo.id}>
          <input
            type="checkbox"
            onChange={() => handleToggleDone(todo.id)}
            value={todo.done}
          />
          <span className={`done-${todo.done}`}>{todo.text}</span>
          <button className="delete-btn" onClick={() => handleDelete(todo.id)}>
            X
          </button>
        </div>
      ))}
    </div>
  );
}
```

Ref Hook ...

- `useRef` provides an alternative to
  class component instance variables in function components
- Refs persist across renders
- They differ from capturing data using `useState` in that
  changes to their values do not trigger the component to re-render
- `useRef` takes the initial value and returns
  an object whose `current` property holds the current value
- A common use is to capture references to DOM nodes

... Ref Hook ...

- For example, in the Todo app above we can automatically move focus to the text input
- To do this we need to:

1. import `useEffect` and `useRef` hooks

```
import React, {useEffect, useRef} from 'react';
```

2. create a ref inside the function
3. add an effect to move the focus

```
const inputRef = useRef();
useEffect(() => inputRef.current.focus());
```

4. set the ref using the `input` element `ref` prop

```
<input
  placeholder="todo text"
  onChange={handleText}
  ref={inputRef}
  value={state.text}
/>;
```

... Ref Hook

- The value held in a ref is not required to be DOM node
- For example, suppose we wanted to
  log the number of todos that have been deleted
  every time one is deleted
- To do this we need to

1. create ref inside function that holds number
2. increment ref value every time a todo is deleted
3. log current value

```
const deleteCountRef = useRef(0); // initial value is zero

// Modified version of the handleDelete function above.
const handleDelete = id => {
  deleteCountRef.current++;
  dispatch({type: 'delete-todo', payload: id});
  console.log('You have now deleted', deleteCountRef.current, 'todos.');
};
```

Imperative Methods Hook

- `useImperativeMethods` modifies the instance value that parent components will see if they obtain a ref to the current component
- One use is to add methods to the instance that parent components can call
- Example
  - suppose the current component contains multiple inputs
  - it could use this hook to add a method to its instance value that parent components can call to move focus to a specific input

Layout Effect Hook

- `useLayoutEffect` is used to query and modify the DOM
- It is similar to `useEffect`,
  but differs in that the function passed to it
  is invoked after every DOM mutation in the component
- DOM modifications are applied synchronously
- One use for this is to implement animations

Mutation Effect Hook

- `useMutationEffect` is used to modify the DOM
- It is similar to `useEffect`,
  but differs in that the function passed to it
  is invoked before any sibling components are updated
- DOM modifications are applied synchronously
- If it is necessary to also query the DOM,
  `useLayoutEffect` should be used instead

Custom Hooks ...

- A custom hook is a function whose
  name begins with "use" and
  calls one more hook functions
- They typically return an array or object
  that contains state data and
  functions that can be called to modify the state
- Custom hooks are useful for extracting hook functionality
  from a function component so it can be
  reused in multiple function components

Custom Hooks

- For example, Dan Abramov demonstrated a custom hook that watches the browser window width

```
function useWindowWidth() {
  const [width, setWidth] = useState(window.innerWidth);
  useEffect(() => {
    // setup steps
    const handleResize = () => setWidth(window.innerWidth);
    windowAddEventListener('resize', handleResize);
    return () => {
      // cleanup steps
      windowRemoveEventListener('resize', handleResize);
    };
  });
}
```

- To use this in a function component

```
const width = useWindowWidth();
```

Custom Hooks

- Another example Dan Abramov demonstrated simplifies associating a state value with a form input

```
function useFormInput(initialValue) {
  const [value, setValue] = useState(initialValue);
  const onChange = e => setValue(e.target.value);
  // Returning these values in an object instead of an array
  // allows it to be spread into the props of an HTML input.
  return {onChange, value};
}
```

- To use this in a function component that renders an **`input`** element for entering a name

```
const nameProps = useFormInput('');

return (
  <input {...nameProps} />;
);
```

Third Party Hooks

- The React community is busy creating and sharing additional hooks
- Many of these are listed at https://nikgraf.github.io/react-hooks

Wrap Up

- Hooks are a great addition to React!
- They make implementing components much easier.
- They also likely spell the end of implementing React components with classes
- You may not want to use them in production apps just yet since they are still considered experimental and their API may change

Resources

- "React Today and Tomorrow and 90% Cleaner React" talk at React Conf 2018 by Sophie Alpert, Dan Abramov, and Ryan Florence
  - https://www.youtube.com/watch?v=dpw9EHDh2bM&t=2792s
- "Introducing Hooks" official documentation in 8 parts
  - https://reactjs.org/hooks
- egghead.io videos by Kent Dodds
  - https://egghead.io/lessons/react-use-the-usestate-react-hook
- "Everything you need to know about React Hooks" by Carl Vitullo
  - https://medium.com/@vcarl/everything-you-need-to-know-about-react-hooks-8f680dfd4349