

# React原理解析01

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## React原理解析01

资源

课堂目标

知识点

虚拟dom

JSX

React核心api

ReactDOM

`render()`

实现React.createElement, ReactDOM.render, Component

CreateElement

ReactDOM.render

Component

总结:

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下节课内容

## 资源

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1. [React中文网](#)
2. [React源码](#)

## 课堂目标

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1. 掌握虚拟dom
2. 掌握createElement/render/Component三个核心api

## 知识点

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React 本身只是一个 DOM 的抽象层，使用组件构建虚拟 DOM。

## 虚拟dom

常见问题: react virtual dom是什么? 说一下diff算法?

# Virtual DOM 及内核

## 什么是 Virtual DOM?

Virtual DOM 是一种编程概念。在这个概念里，UI 以一种理想化的，或者说“虚拟的”表现形式被保存于内存中，并通过如 ReactDOM 等类库使之与“真实的”DOM 同步。这一过程叫做协调。

这种方式赋予了 React 声明式的 API：您告诉 React 希望让 UI 是什么状态，React 就确保 DOM 匹配该状态。这使您可以从属性操作、事件处理和手动 DOM 更新这些在构建应用程序时必要的操作中解放出来。

与其将“Virtual DOM”视为一种技术，不如说它是一种模式，人们提到它时经常是要表达不同的东西。在 React 的世界里，术语“Virtual DOM”通常与 React 元素关联在一起，因为它们都是代表了用户界面的对象。而 React 也使用一个名为“fibers”的内部对象来存放组件树的附加信息。上述二者也被认为是 React 中“Virtual DOM”实现的一部分。

## Shadow DOM 和 Virtual DOM 是一回事吗?

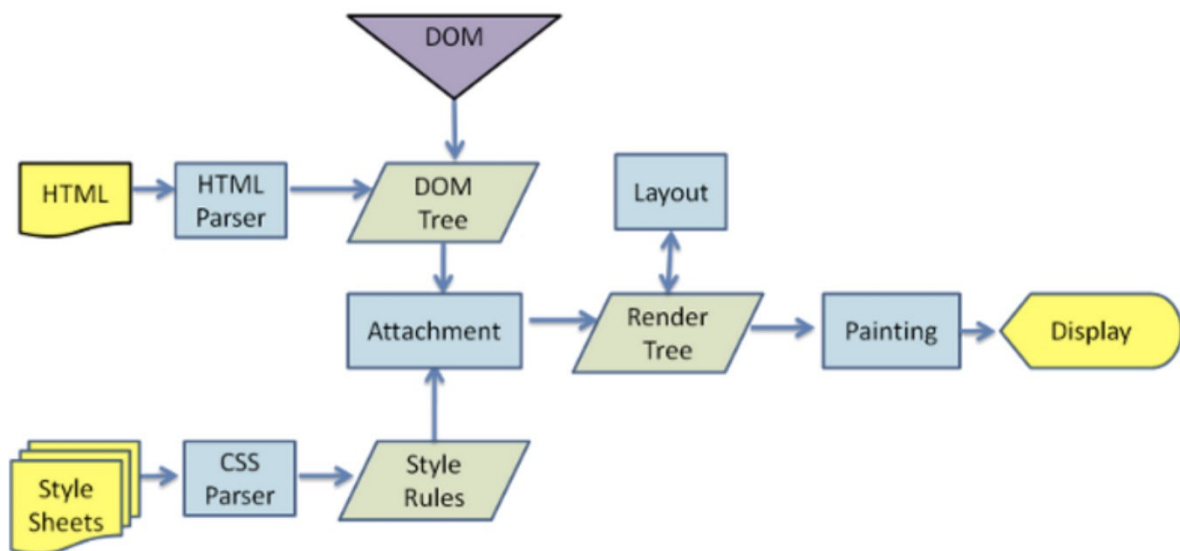
不，他们不一样。Shadow DOM 是一种浏览器技术，主要用于在 web 组件中封装变量和 CSS。Virtual DOM 则是一种由 Javascript 类库基于浏览器 API 实现的概念。

## 什么是“React Fiber”?

Fiber 是 React 16 中新的协调引擎。它的主要目的是使 Virtual DOM 可以进行增量式渲染。了解更多。

**what?** 用 JavaScript 对象表示 DOM 信息和结构，当状态变更的时候，重新渲染这个 JavaScript 的对象结构。这个 JavaScript 对象称为 virtual dom；

传统 dom 渲染流程



```

var div = document.createElement('div');
var str = '';
for(var key in div){
  str += ' ' + key ;
}
console.log(str);

```

align title lang translate dir hidden accessKey draggable spellcheck autocapitalize VM23717:6  
 contentEditable isContentEditable inputMode offsetParent offsetTop offsetLeft offsetWidth  
 offsetHeight style innerText outerText oncopy oncut onpaste onabort onblur oncancel oncanplay  
 oncanplaythrough onchange onclick onclose oncontextmenu oncuechange ondblclick ondrag ondragend  
 ondragenter ondragleave ondragover ondragstart ondrop ondurationchange onemptied onended onerror  
 onfocus oninput oninvalid onkeydown onkeypress onkeyup onload onloadeddata onloadedmetadata  
 onloadstart onmousedown onmouseenter onmouseleave onmousemove onmouseout onmouseover onmouseup  
 onmousewheel onpause onplay onplaying onprogress onratechange onreset onresize onscroll onseeked  
 onseeking onselect onstalled onsubmit onsuspend ontimeupdate ontoggle onvolumechange onwaiting  
 onwheel onauxclick ongotpointercapture onlostpointercapture onpointerdown onpointermove  
 onpointerup onpointercancel onpointerover onpointerout onpointerenter onpointerleave  
 onselectstart onselectionchange dataset nonce tabIndex click focus blur enterKeyHint onformdata  
 onpointerrawupdate attachInternals namespaceURI prefix localName tagName id className classList  
 slot part attributes shadowRoot assignedSlot innerHTML outerHTML scrollTop scrollLeft  
 scrollWidth scrollHeight clientTop clientLeft clientWidth clientHeight attributeStyleMap  
 onbeforecopy onbeforecut onbeforepaste onsearch previousElementSibling nextElementSibling  
 children firstElementChild lastElementChild childElementCount onfullscreenchange  
 onfullscreenerror onwebkitfullscreenchange onwebkitfullscreenerror setPointerCapture  
 releasePointerCapture hasPointerCapture hasAttributes getAttributeNames getAttribute  
 getAttributeNS setAttribute setAttributeNS removeAttribute removeAttributeNS hasAttribute  
 hasAttributeNS toggleAttribute getAttributeNode getAttributeNodeNS setAttributeNode  
 setAttributeNodeNS removeAttributeNode closest matches webkitMatchesSelector attachShadow  
 getElementsByTagName getElementsByTagNameNS getElementsByClassName insertAdjacentElement  
 insertAdjacentText insertAdjacentHTML requestPointerLock getClientRects getBoundingClientRect  
 scrollIntoView scroll scrollTo scrollBy scrollIntoViewIfNeeded animate computedStyleMap before  
 after replaceWith remove prepend append querySelector querySelectorAll requestFullscreen  
 webkitRequestFullscreen webkitRequestFullscreen createShadowRoot getDestinationInsertionPoints  
 elementTiming ELEMENT\_NODE ATTRIBUTE\_NODE TEXT\_NODE CDATA\_SECTION\_NODE ENTITY\_REFERENCE\_NODE  
 ENTITY\_NODE PROCESSING\_INSTRUCTION\_NODE COMMENT\_NODE DOCUMENT\_NODE DOCUMENT\_TYPE\_NODE  
 DOCUMENT\_FRAGMENT\_NODE INSTANTION\_NODE DOCUMENT\_POSITION\_DISCONNECTED DOCUMENT\_POSITION\_PRECEDING  
 DOCUMENT\_POSITION\_FOLLOWING DOCUMENT\_POSITION\_CONTAINS DOCUMENT\_POSITION\_CONTAINED\_BY  
 DOCUMENT\_POSITION\_IMPLEMENTATION\_SPECIFIC nodeType nodeName baseURI isConnected ownerDocument  
 parentNode parentElement childNodes firstChild lastChild previousSibling nextSibling nodeValue  
 textContent hasChildNodes getRootNode normalize cloneNode isEqualNode isSameNode  
 compareDocumentPosition contains lookupPrefix lookupNamespaceURI isDefaultNamespace insertBefore  
 appendChild replaceChild removeChild addEventListener removeEventListener dispatchEvent

**why?** DOM操作很慢，轻微的操作都可能导致页面重新排版，非常耗性能。相对于DOM对象，js对象处理起来更快，而且更简单。通过diff算法对比新旧vdom之间的差异，可以批量的、最小化的执行dom操作，从而提高性能。

**where?** React中用JSX语法描述视图，通过babel-loader转译后它们变为React.createElement(...)形式，该函数将生成vdom来描述真实dom。将来如果状态变化，vdom将作出相应变化，再通过diff算法对比新老vdom区别从而做出最终dom操作。

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how?

## JSX

[在线尝试](#)

### 1. 什么是JSX

语法糖

React 使用 JSX 来替代常规的 JavaScript。

JSX 是一个看起来很像 XML 的 JavaScript 语法扩展。

### 2. 为什么需要JSX

- 开发效率：使用 JSX 编写模板简单快速。
- 执行效率：JSX编译为 JavaScript 代码后进行了优化，执行更快。
- 类型安全：在编译过程中就能发现错误。

### 3. 原理：babel-loader会预编译JSX为React.createElement(...)

### 4. 与vue的异同：

- react中虚拟dom+jsx的设计一开始就有，vue则是演进过程中才出现的
- jsx本来就是js扩展，转义过程简单直接的多；vue把template编译为render函数的过程需要复杂的编译器转换字符串-ast-js函数字符串

JSX预处理前：

```
LIVE JSX EDITOR ✓ JSX?

class HelloMessage extends React.Component {
  render() {
    return (
      <div class="app">
        Hello {this.props.name}
      </div>
    );
  }
}

ReactDOM.render(
  <HelloMessage name="Taylor" />,
  document.getElementById('hello-example')
);|
```

JSX预处理后：



```
class HelloMessage extends React.Component {
  render() {
    return React.createElement(
      "div",
      { "class": "app" },
      "Hello ",
      this.props.name
    );
  }
}

ReactDOM.render(React.createElement(HelloMessage, { name:
"Taylor" }), document.getElementById('hello-example'));
```

使用自定义组件的情况:

```
import React from "react";
import ReactDOM from "react-dom";
import "./index.css";

class ClassCmp extends React.Component {
  render() {
    return (
      <div className='app'>
        Hello {this.props.name}
      </div>
    );
  }
}

function FuncCmp(props) {
  return <div>name: {props.name}</div>;
}

const jsx = (
  <div>
    <p>我是内容</p>
    <FuncCmp name="我是function组件" />
    <ClassCmp name="我是class组件" />
  </div>
);
```

```
ReactDOM.render(  
  jsx,  
  document.getElementById('hello-example')  
);
```

build后

```
class ClassCmp extends React.Component {  
  render() {  
    return React.createElement(  
      "div",  
      { "class": "app" },  
      "Hello ",  
      this.props.name  
    );  
  }  
}  
  
function FuncCmp(props) {  
  return React.createElement(  
    "div",  
    null,  
    "name: ",  
    props.name  
  );  
}  
  
const jsx = React.createElement(  
  "div",  
  null,  
  React.createElement(  
    "p",  
    null,  
    "我是内容"  
  ),  
  React.createElement(FuncCmp, { name: "我是function组件" }),  
  React.createElement(ClassCmp, { name: "我是class组件" })  
);  
  
ReactDOM.render(jsx, document.getElementById('hello-example'));
```

## React核心api

[react](#)

```

const React = {
  Children: {
    map,
    forEach,
    count,
    toArray,
    only,
  },

  createRef,
  Component,
  PureComponent,

  createContext,
  forwardRef,
  lazy,
  memo,

  useCallback,
  useContext,
  useEffect,
  useImperativeHandle,
  useDebugValue,
  useLayoutEffect,
  useMemo,
  useReducer,
  useRef,
  useState,

  Fragment: REACT_FRAGMENT_TYPE,
  Profiler: REACT_PROFILER_TYPE,
  StrictMode: REACT_STRICT_MODE_TYPE,
  Suspense: REACT_SUSPENSE_TYPE,

  createElement: __DEV__ ? createElementWithValidation : createElement,
  cloneElement: __DEV__ ? cloneElementWithValidation : cloneElement,
  createFactory: __DEV__ ? createFactoryWithValidation : createFactory,
  isValidElement: isValidElement,

  version: ReactVersion,

  __SECRET_INTERNALS_DO_NOT_USE_OR_YOU_WILL_BE_FIRED: ReactSharedInternals,
};

```

核心精简后：

```
const React = {  
  createElement,  
  Component  
}
```

最核心的api:

React.createElement: 创建虚拟DOM

React.Component: 实现自定义组件

ReactDOM.render: 渲染真实DOM

## ReactDOM

### render()

```
ReactDOM.render(element, container[, callback])
```

当首次调用时，容器节点里的所有 DOM 元素都会被替换，后续的调用则会使用 React 的 DOM 差分算法（DOM diffing algorithm）进行高效的更新。

如果提供了可选的回调函数，该回调将在组件被渲染或更新之后被执行。

## 实现React.createElement, ReactDOM.render, Component

### CreateElement

将传入的节点定义转换为vdom。

注意节点类型：

- 文本节点
- HTML标签节点
- function组件
- class组件
- fragment
- 其他如portal等节点



> DebugReact > src > react > packages > shared > ReactWorkTags.js > ...

```
export const FunctionComponent = 0;
export const ClassComponent = 1;
export const IndeterminateComponent = 2; // Before we know whether it is function or class
export const HostRoot = 3; // Root of a host tree. Could be nested inside another node.
export const HostPortal = 4; // A subtree. Could be an entry point to a different renderer.
export const HostComponent = 5;
export const HostText = 6;
export const Fragment = 7;
export const Mode = 8;
export const ContextConsumer = 9;
export const ContextProvider = 10;
export const ForwardRef = 11;
export const Profiler = 12;
export const SuspenseComponent = 13;
export const MemoComponent = 14;
export const SimpleMemoComponent = 15;
export const LazyComponent = 16;
export const IncompleteClassComponent = 17;
export const DehydratedFragment = 18;
export const SuspenseListComponent = 19;
export const FundamentalComponent = 20;
export const ScopeComponent = 21;
export const Block = 22;
```

src/index.js

```
import React, {Component} from "react";
import ReactDOM from "react-dom";

// import React from "../kreact/";
// import ReactDOM from "../kreact/react-dom";
// import Component from "../kreact/Component";
import "../index.css";

const ProcessInput = ({value, onChange}) =>
  React.cloneElement(<input />, {
    placeholder: "omg",
    value,
    onChange: e => {
      onChange(e.target.value);
    }
  });

function FunctionComponent({name}) {
  const [value, onChange] = React.useState("");
  return (
    <div className="border">
      {name}
      <button
        onClick={() => {
```

```

        console.log("omg"); //sy-log
      }}>
      click
    </button>
    <ProcessInput value={value} onChange={onChange} />
  </div>
);
}

class ClassComponent extends Component {
  static defaultProps = {
    color: "pink"
  };
  render() {
    return (
      <div className="border">
        <p className={this.props.color}>color</p>
        {this.props.name}
      </div>
    );
  }
}

const jsx = (
  <div className="border">
    <p>全栈</p>
    <a href="https://www.kaikeba.com/">开课吧</a>
    <FunctionComponent name="FunctionComponent" />
    <ClassComponent name="ClassComponent" color="red" />
    { /* <>
      <h1>aa</h1>
      <h1>bb</h1>
    </> */ }
  </div>
);

ReactDOM.render(jsx, document.getElementById("root"));

// ! vnode 虚拟dom节点
// ! node 真实dom节点

```

- 创建./src/kreact/index.js, 它需要包含createElement方法

```

import {TEXT} from "../const";

function createElement(type, config, ...children) {

```

```

if (config) {
  delete config.__self;
  delete config.__source;
}
// ! 源码中做了详细处理, 比如过滤掉key、ref等
const props = {
  ...config,
  children: children.map(child =>
    typeof child === "object" ? child : createTextNode(child)
  )
};

return {
  type,
  props
};
}

function createTextNode(text) {
  return {
    type: TEXT,
    props: {
      children: [],
      nodeValue: text
    }
  };
}

export default {
  createElement
};

```

- 修改index.js实际引入kreact, 测试

```

import React from "../kreact/";
import ReactDOM from "../kreact/react-dom";
import Component from "../kreact/Component";

```

createElement被调用时会传入标签类型type, 标签属性props及若干子元素children

index.js中从未使用React类或者其任何接口, 为何需要导入它?

JSX编译后实际调用React.createElement方法, 所以只要出现JSX的文件中都需要导入React

## ReactDOM.render

```

// !vnode代表虚拟dom节点
// !node代表真实dom节点

```

```

import {TEXT} from "../const";

function render(vnode, container) {
  console.log("vnode", vnode); //sy-log
  // vnode _> node
  const node = createNode(vnode, container);
  container.appendChild(node);
}

// 返回真实的dom节点
function createNode(vnode, parentNode) {
  let node = null;
  const {type, props} = vnode;
  if (type === TEXT) {
    node = document.createTextNode("");
  } else if (typeof type === "string") {
    node = document.createElement(type);
  } else if (typeof type === "function") {
    node = type.isReactComponent
      ? updateClassComponent(vnode, parentNode)
      : updateFunctionComponent(vnode, parentNode);
  } else {
    node = document.createDocumentFragment();
  }

  reconcileChildren(props.children, node);
  updateNode(node, props);

  return node;
}

function reconcileChildren(children, node) {
  for (let i = 0; i < children.length; i++) {
    let child = children[i];
    if (Array.isArray(child)) {
      for (let j = 0; j < child.length; j++) {
        render(child[j], node);
      }
    } else {
      render(child, node);
    }
  }
}

function updateNode(node, nextVal) {
  Object.keys(nextVal)
    .filter(k => k !== "children")
    .forEach(k => {

```

```

    if (k.slice(0, 2) === "on") {
      let eventName = k.slice(2).toLocaleLowerCase();
      node.addEventListener(eventName, nextVal[k]);
    } else {
      node[k] = nextVal[k];
    }
  });
}

function updateFunctionComponent(vnode, parentNode) {
  const {type, props} = vnode;
  let vvnnode = type(props);
  const node = createNode(vvnnode, parentNode);
  return node;
}

function updateClassComponent(vnode, parentNode) {
  const {type, props} = vnode;
  let cmp = new type(props);
  const vvnnode = cmp.render();
  const node = createNode(vvnnode, parentNode);
  return node;
}

export default {
  render
};

```

## Component

```

class Component {
  static isReactComponent = {};
  constructor(props) {
    this.props = props;
  }
}

// function Component(props) {
//   this.props = props;
// }

// Component.prototype.isReactComponent = {};

export default Component;

```



## 总结:

1. webpack+babel编译时, 替换JSX为React.createElement(type,props,...children)
2. 所有React.createElement()执行结束后得到一个JS对象即vdom, 它能够完整描述dom结构
3. ReactDOM.render(vdom, container)可以将vdom转换为dom并追加到container中
4. 实际上, 转换过程需要经过一个diff过程。

## 回顾

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JSX

React核心api

ReactDOM

`render()`

实现React.createElement, ReactDOM.render, Component

CreateElement

ReactDOM.render

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作业

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## 作业

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1. 实现defaultProps: 补充代码, 在createElement里加上defaultProps的实现, 使得class组件中可以正常使用defaultProps。

## 下节课内容

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Fiber