What's Under the Hood in React.js

How React efficiently manages UI updates without touching the DOM directly.

Why care?

- DOM updates are expensive (reflows, repaints).
- React uses smart internals to minimize work and keep UIs smooth.
- We'll cover: **JSX → React Elements**, **Virtual DOM**, **Reconciliation**, **Fiber**, and the **Two-phase cycle**.

JSX & React Elements

JSX is **syntactic sugar** for `React.createElement`.

```
// JSX
const element = <h1>Hello, world!</h1>;
```

Transpiles to:

```
// After Babel transpiles JSX
const element = React.createElement("h1", null, "Hello, world!");
```

Result: a plain **JavaScript object** (React element) that describes the UI.

Element Tree (Blueprint)

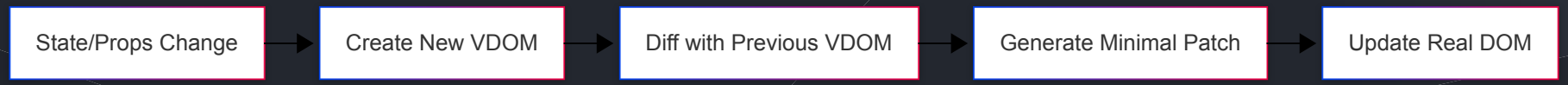
- React elements form a **tree** (component tree).
- This tree is a **blueprint** used to build the Virtual DOM.

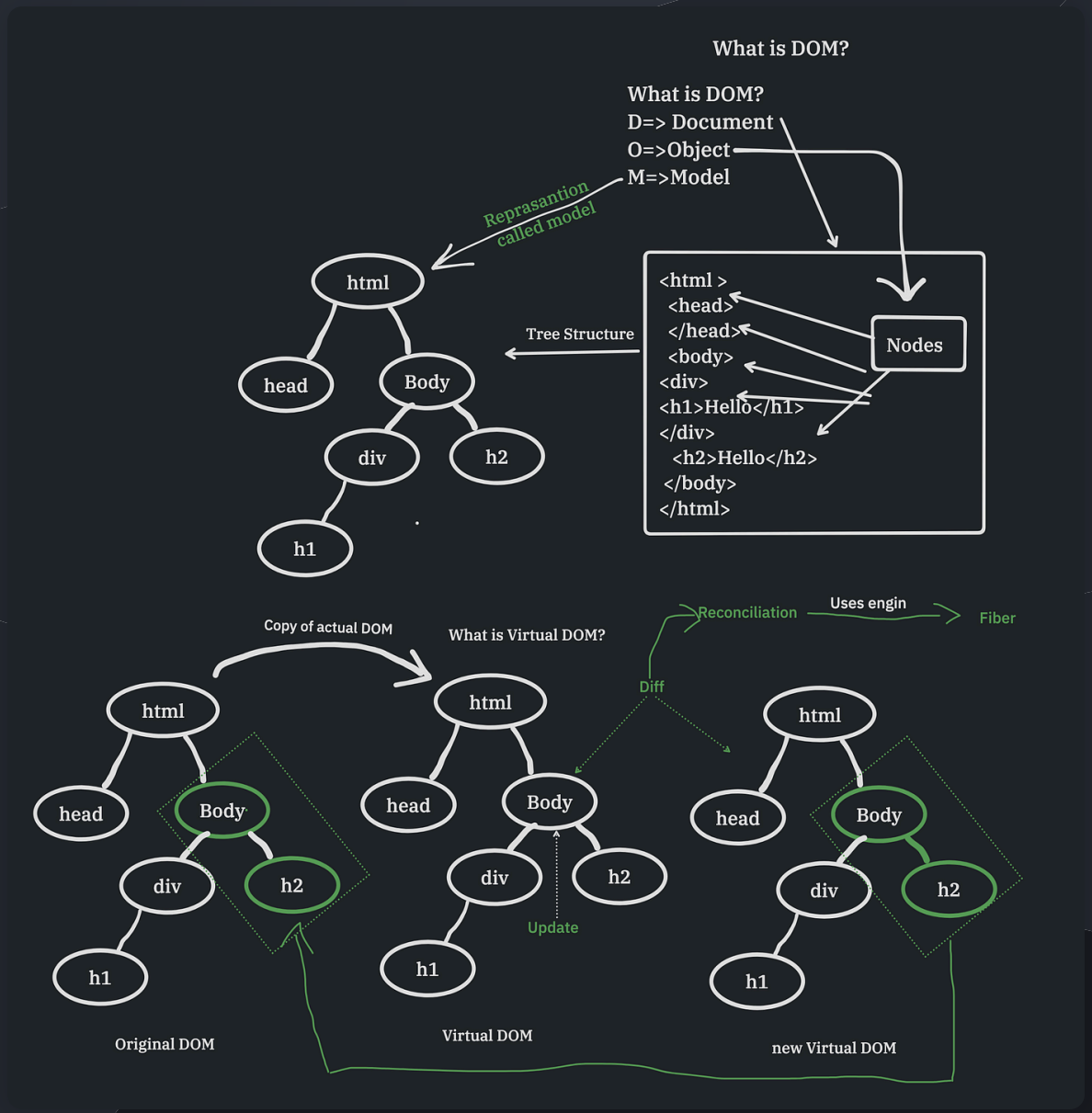
The Virtual DOM (VDOM)

- Lightweight, in-memory representation of the real DOM.
- Cheap to create & manipulate in JS.
- React updates the VDOM on state/prop changes, diffs it, then applies minimal changes to the real DOM.

Key benefit: only update what changed — not the whole page.

Virtual DOM Flow




What is DOM?
What is DOM?
D=> Document
O=>Object
M=>Model
Reprasantion
called model
html
head
Body
div
h2
h1
Tree Structure
<html >
<head>
</head>
<body>

<h1>Hello</h1>

<h2>Hello</h2>
</body>
</html>
Nodes
Copy of actual DOM
What is Virtual DOM?
Reconciliation
Uses engin
Fiber
Diff
Update
Original DOM
Virtual DOM
new Virtual DOM

Reconciliation (Diffing)

- Reconciliation = matching the new VDOM to the old VDOM.
- React's diffing algorithm finds the **smallest set of changes**.

Example:

```
<!-- Old -->
<ul>
  <li>Apple</li>
  <li>Banana</li>
</ul>

<!-- New -->
<ul>
  <li>Apple</li>
  <li>Mango</li>
</ul>
```

React updates only the changed `<li>`.

Applying Patches

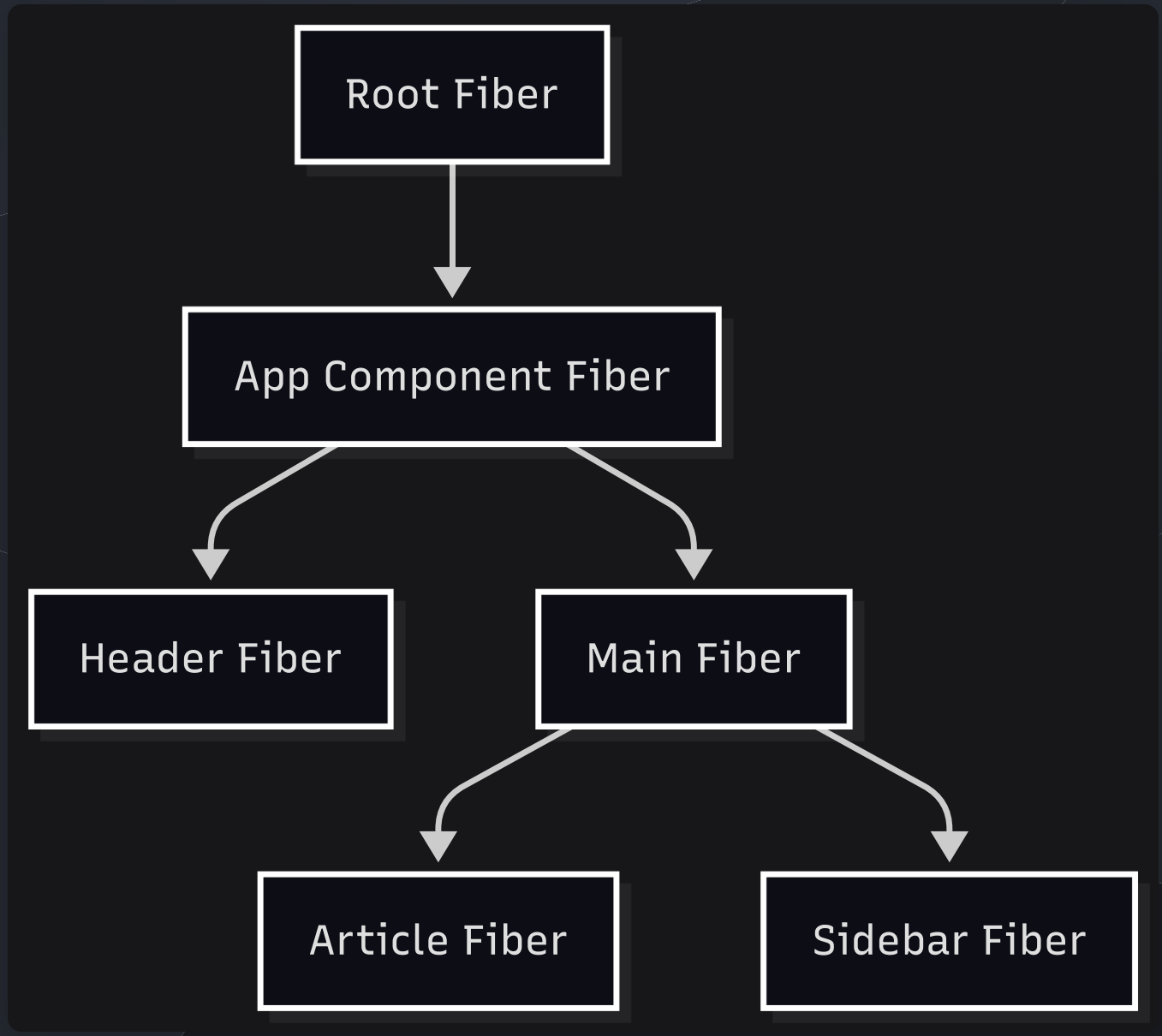
- React **batches** changes.
- Renderer (ReactDOM / React Native) applies patches to the actual UI.
- Batching reduces layout thrashing and improves throughput.

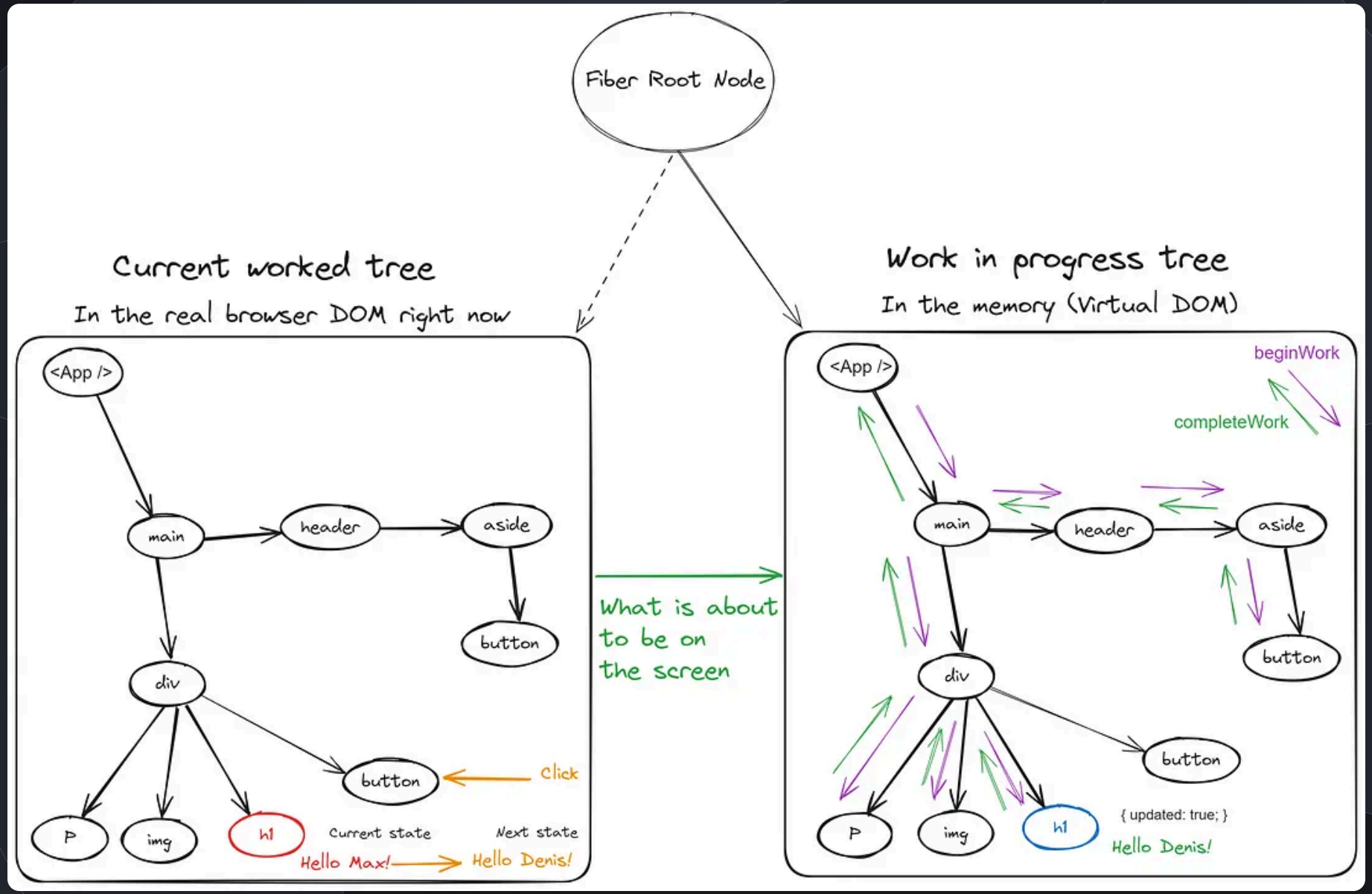
Fiber Architecture (React 16+)

- Fiber is a **complete rewrite** of React's core renderer.
- It breaks rendering into **units of work** (Fibers).
- Fibers allow:
  - Interruptible & asynchronous rendering
  - Prioritization of updates
  - Pausing & resuming work

Fiber Tree

Each Fiber stores state, props, and links to parent/child/sibling.


Root Fiber
App Component Fiber
Header Fiber
Main Fiber
Article Fiber
Sidebar Fiber


Fiber Root Node
Current worked tree
In the real browser DOM right now
Work in progress tree
In the memory (Virtual DOM)
<App />
main
header
aside
button
div
button
p
img
h1
Click
Current state
Next state
Hello Max!
Hello Denis!
What is about to be on the screen
beginWork
completeWork
{ updated: true; }

Two-Phase Render Cycle

1. **Render / Reconciliation Phase**
   - Build a work-in-progress Fiber tree.
   - Diffing happens here.
   - **Asynchronous & interruptible.**
2. **Commit Phase**
   - Apply changes to the real DOM **synchronously**.
   - Run lifecycle methods and effects (`componentDidMount` , `useEffect`).

Why it matters

- Smooth user interactions (typing, animations).
- Better perceived performance through prioritization.
- Predictable lifecycle: render diffing separate from DOM mutations.

Summary

- **JSX → React Elements**: syntactic sugar to create element objects.
- **Virtual DOM**: fast in-memory representation for cheap diffs.
- **Reconciliation**: computes the minimal set of changes.
- **Fiber**: makes rendering interruptible and prioritized.
- **Two-Phase Cycle**: async render + sync commit.

Slide Suggestions & Q&A

- Intro: Why internal mechanisms?
- JSX & elements: show code + transpilation
- VDOM: show diagram
- Diffing: small example
- Fiber: flowchart + benefits
- Two-phase cycle: timeline
- **Q&A**