

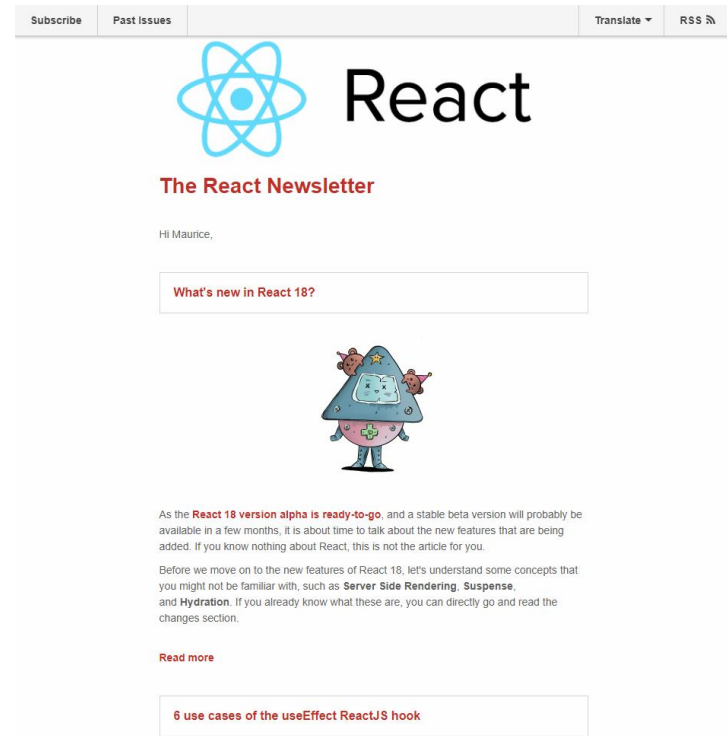
Concurrent Rendering Adventures in React 18



- Maurice de Beijer
- The Problem Solver
- Microsoft MVP
- Freelance developer/instructor
- Twitter: @mauricedb
- Web: <http://www.TheProblemSolver.nl>
- E-mail: maurice.de.beijer@gmail.com



The React Newsletter



Workshop goal

- Learn about using **<Suspense />** today
 - Lazy loading of data
 - Nest and/or parallelize **<Suspense />** components as needed
 - Error handling while suspended with an **<ErrorBoundary />**
- Learn about using **concurrent mode** tomorrow
 - Using `createRoot()` to render a React 18 application
 - The what and how of React concurrent mode
 - Orchestrating **<Suspense />** boundaries using **<SuspenseList />**
 - Using `startTransition()` and/or `useTransition()` to defer work

Type it out
by hand?

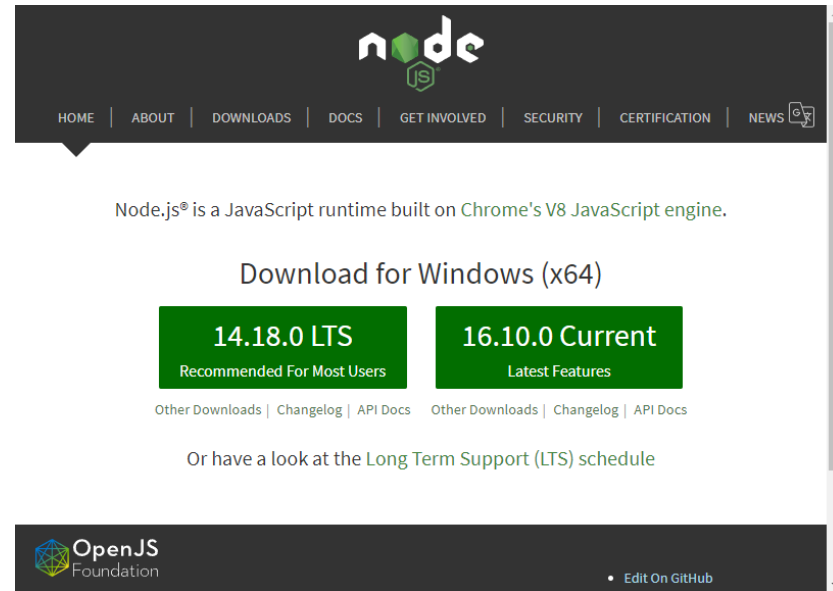
"Typing it drills it into your brain much better than simply copying and pasting it. You're forming new neuron pathways. Those pathways are going to help you in the future. Help them out now!"

Prerequisites

Install Node & NPM

Install the GitHub repository

Install Node.js & NPM



```
Windows PowerShell
PS C:\Temp> node --version
v14.18.0
PS C:\Temp> npm --version
7.24.0
PS C:\Temp> |
```

Clone the GitHub Repository

```
Windows PowerShell
PS C:\Temp> git clone git@github.com:mauricedb/concurrent-rendering-adventures-in-react-18.git
Cloning into 'concurrent-rendering-adventures-in-react-18'...
remote: Enumerating objects: 228, done.
remote: Counting objects: 100% (228/228), done.
remote: Compressing objects: 100% (120/120), done.
Receiving objects: 100% (228/228)used 189 (delta 103), pack-reused 0 eceiving objects: 95% (217/228)
Receiving objects: 100% (228/228), 558.64 KiB | 2.10 MiB/s, done.
Resolving deltas: 100% (142/142), done.
PS C:\Temp> |
```



Install NPM Packages

```
Windows PowerShell
PS C:\Temp\concurrent-rendering-adventures-in-react-18> npm ci
npm WARN deprecated flatten@1.0.3: flatten is deprecated in favor of utility frameworks such as lodash.
npm WARN deprecated @hapi/topo@3.1.6: This version has been deprecated and is no longer supported or maintained
npm WARN deprecated @hapi/bourne@1.3.2: This version has been deprecated and is no longer supported or maintained
npm WARN deprecated urix@0.1.0: Please see https://github.com/lydell/urix#deprecated
npm WARN deprecated chokidar@2.1.8: Chokidar 2 will break on node v14+. Upgrade to chokidar 3 with 15x less dependencies.
npm WARN deprecated chokidar@2.1.8: Chokidar 2 will break on node v14+. Upgrade to chokidar 3 with 15x less dependencies.
npm WARN deprecated resolve-url@0.2.1: https://github.com/lydell/resolve-url#deprecated
npm WARN deprecated querystring@0.2.1: The querystring API is considered Legacy. new code should use the URLSearchParams API instead.
npm WARN deprecated sane@4.1.0: some dependency vulnerabilities fixed, support for node < 10 dropped, and newer ECMAScript syntax/features added
npm WARN deprecated @hapi/address@2.1.4: Moved to 'npm install @sideway/address'
npm WARN deprecated rollup-plugin-babel@4.4.0: This package has been deprecated and is no longer maintained. Please use @rollup/plugin-babel.
npm WARN deprecated querystring@0.2.0: The querystring API is considered Legacy. new code should use the URLSearchParams API instead.
npm WARN deprecated babel-eslint@10.1.0: babel-eslint is now @babel/eslint-parser. This package will no longer receive updates.
npm WARN deprecated uuid@3.4.0: Please upgrade to version 7 or higher. Older versions may use Math.random() in certain circumstances, which is
r details.
npm WARN deprecated uuid@3.4.0: Please upgrade to version 7 or higher. Older versions may use Math.random() in certain circumstances, which is
r details.
npm WARN deprecated @hapi/hoek@8.5.1: This version has been deprecated and is no longer supported or maintained
npm WARN deprecated @hapi/joi@15.1.1: Switch to 'npm install joi'
npm WARN deprecated core-js@2.6.12: core-js@<3.3 is no longer maintained and not recommended for usage due to the number of issues. Because of th
ld cause a slowdown up to 100x even if nothing is polyfilled. Please, upgrade your dependencies to the actual version of core-js.

added 1988 packages, and audited 1989 packages in 12s

153 packages are looking for funding
  run 'npm fund' for details

58 vulnerabilities (16 moderate, 42 high)

To address issues that do not require attention, run:
  npm audit fix

To address all issues (including breaking changes), run:
  npm audit fix --force

Run 'npm audit' for details.
PS C:\Temp\concurrent-rendering-adventures-in-react-18>
```

Following Along



```
TS App.tsx M TS UserDetails.tsx M X
src > components > users > TS UserDetails.tsx > ...
11 export function UserDetails({ userId, movieId }: Props) {
12   return (
13     <div>
14       <h4 className="text-center mt-5">User details</h4>
15       <Suspense fallback={<Loading />}>
16         <AccountDetails userId={userId} />
17         <h4 className="text-center mt-5">Favorite movie</h4>
18         <MovieDetails movieId={movieId} />
19       </Suspense>
20     </div>
21   );
22 }
```

- Repository:
<https://github.com/mauricedb/concurrent-rendering-adventures-in-react-18>
- Slides:

React 17





<Suspense />

<Suspense />

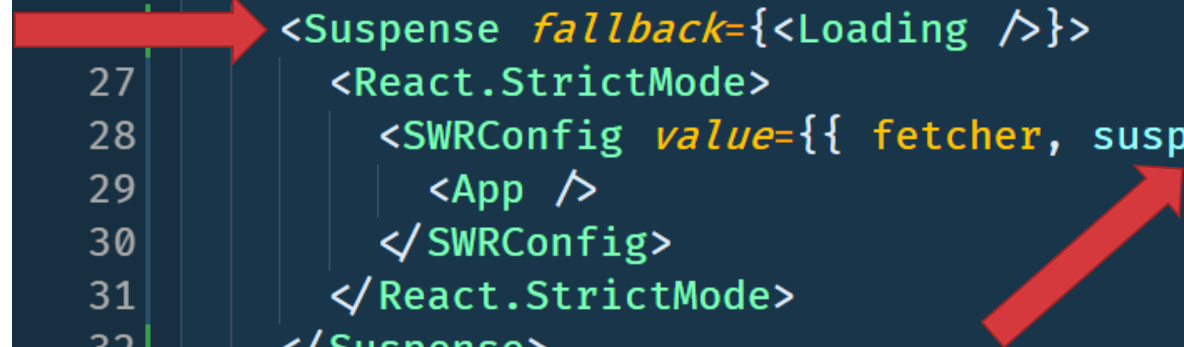
- Allows React to **“suspend”** rendering a component subtree
 - Used when a (grand) child component is not ready to be rendered
 - ECMAScript bundle containing the component isn't loaded yet
 - The data needed for a component to render isn't available yet
- The **“fallback” component** will be rendered instead
 - Replaces the complete children component tree
- Rendering is suspended when **a promise is thrown**
 - And resumed when the promise resolves

SWR and Suspense

- SWR is used in the application to **load data**
 - A convenient hook to fetch data
- SWR makes it easy to **start using suspense**
 - Add `suspense: true` to the `<SWRConfig />`

index.tsx

```
TS index.tsx M x TS UserList.tsx M TS AccountDetails.tsx M TS MovieDetails.tsx M
src > TS index.tsx > ...
24 ReactDOM.render(
25   <ErrorBoundary FallbackComponent={ErrorFallback}>
    <Suspense fallback={<Loading />}>
27     <React.StrictMode>
28       <SWRConfig value={{ fetcher, suspense: true }}>
29         <App />
30       </SWRConfig>
31     </React.StrictMode>
32   </Suspense>
33 </ErrorBoundary>,
34 document.getElementById('root')
35 );
```



UserList.tsx

```
TS index.tsx M TS UserList.tsx M X TS AccountDetails.tsx M TS MovieDetails.tsx M
src > components > users > TS UserList.tsx > ...
6 export function UserList() {
7   const [selectedUser, setSelectedUser] = useState<Account | null>(null);
8   const { data } = useSWR<Account[], Error>(
9     `${process.env.REACT_APP_API_BASE}/accounts`
10  );
11
12  return (
13    <div className="row">
14      <h2 className="text-center mt-5">Users</h2>
15
16      <div className="col-3 g-2">
17        <ul className="list-group">
18          {data?.map((user) => (
19            <li
```


AccountDetails.tsx

```
TS index.tsx M    TS UserList.tsx M    TS AccountDetails.tsx M X    TS MovieDetails.tsx M
src > components > users > TS AccountDetails.tsx > ...
 9  export function AccountDetails({ userId }: Props) {
10    const { data } = useSWR<Account, Error>(
11      `${process.env.REACT_APP_API_BASE}/accounts/${userId}?sleep=1000`
12    );
13
14    const account = data!;
15
16    return (
17      <div className="row">
18        <LabelInput label="Firstname" value={account.firstname} readOnly />
19        <LabelInput label="Surname" value={account.surname} readOnly />
20        <LabelInput label="Email address" value={account.email} readOnly />
21      </div>
22    );
23  }
```

MovieDetails.tsx

```
TS index.tsx M TS UserList.tsx M TS AccountDetails.tsx M TS MovieDetails.tsx M X
src > components > users > TS MovieDetails.tsx > ...
10 export function MovieDetails({ movieId }: Props) {
11   const { data } = useSWR<Movie, Error>(
12     `${process.env.REACT_APP_API_BASE}/top-rated-movies/${movieId}?sleep=500`
13   );
14   const movie = data!;
15
16   return (
17     <div className="row">
18       <LabelInput label="Title" value={movie.title} readOnly />
19       <LabelInput label="Release date" value={movie.release_date} readOnly />
20       <LabelTextarea
21         label="Overview"
22         value={movie.overview}
23         readOnly
24         rows={5}
25       />
26     </div>
27   );
28 }
```

The Result





`<Suspense />` & Errors

<Suspense /> & Errors

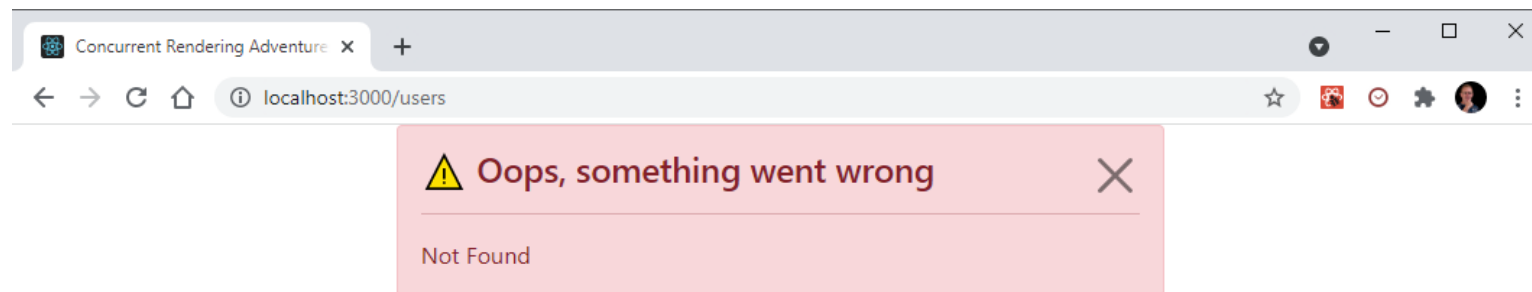
- If a suspense resource **fails** to load an **error is thrown**
 - When requesting it during the render()
- Catch the error using an **ErrorBoundary**
 - Just like other runtime errors in React lifecycle functions
- Error boundaries **can be nested**
 - Just like suspense boundaries

index.tsx

```
TS index.tsx X
src > TS index.tsx > ...
24 ReactDOM.render(
    <ErrorBoundary FallbackComponent={ErrorFallback}>
26     <Suspense fallback={<Loading />}>
27         <React.StrictMode>
28             <SWRConfig value={{ fetcher, suspense: true }}>
29                 <App />
30             </SWRConfig>
31         </React.StrictMode>
32     </Suspense>
33 </ErrorBoundary>,
34 document.getElementById('root')
35 );
```



The Result



UserDetails.tsx

```
TS UserDetails.tsx M X
src > components > users > TS UserDetails.tsx > ...
12 export function UserDetails({ userId, movieId }: Props) {
13   return (
14     <div>
15       <SuspenseList revealOrder="together">
16         <h4 className="text-center mt-5">User details</h4>
17         <Suspense fallback={<Loading />}>
18           <ErrorBoundary FallbackComponent={ErrorFallback}>
19             <AccountDetails userId={userId} />
20           </ErrorBoundary>
21         </Suspense>
22         <h4 className="text-center mt-5">Favorite movie</h4>
23         <Suspense fallback={<Loading />}>
24           <ErrorBoundary FallbackComponent={ErrorFallback}>
25             <MovieDetails movieId={movieId} />
26           </ErrorBoundary>
27         </Suspense>
28       </SuspenseList>
29     </div>
30   );
31 }
```


The Result

Concurrent Rendering Adventure x +

localhost:3000/users

Concurrent Adventures Users Prime Numbers

Users

Lupe Hansen
Spears McMahon
Lopez Walton
Norris Leonard
Freda Lowery
Kate Hickman
Irwin Reese
Kirk Keller
Galloway McClain
Donovan Beasley

User details

⚠️ Oops, something went wrong ✕

Not Found

Favorite movie

Title

The Shawshank Redemption

Release date

1994-09-23

Overview

Framed in the 1940s for the double murder of his wife and her lover, upstanding banker Andy Dufresne begins a new life at the Shawshank prison, where he puts his accounting skills to work for an amoral warden. During his long



Nesting `<Suspense />`

Nesting <Suspense />

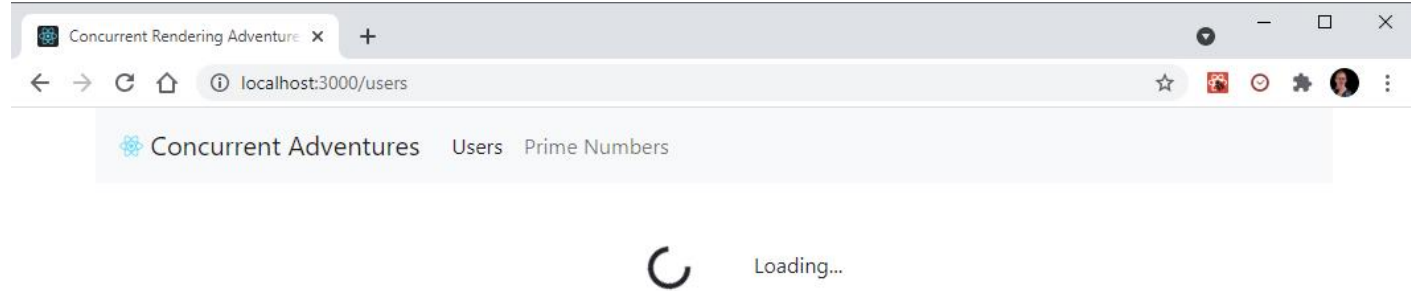
- Multiple suspense components **can be nested**
- React will use **the closest parent** <Suspense /> component
 - Very useful to control what part of the UI is replaced by a fallback
- 📁 There is a behavior change in React 18 with null fallback 📁

App.tsx

```
TS App.tsx M x
src > TS App.tsx > ...

 8  function App() {
 9      return (
10          <div className="container">
11              <BrowserRouter>
12                  <NavBar />
13                  <Suspense fallback={<Loading />}>
14                      <AppRoutes />
15                  </Suspense>
16              </BrowserRouter>
17          </div>
18      );
19  }
```

The Result



MovieDetails.tsx

```
TS App.tsx M TS UserDetails.tsx M x
src > components > users > TS UserDetails.tsx > ...
11 export function UserDetails({ userId, movieId }: Props) {
12   return (
13     <div>
14       <h4 className="text-center mt-5">User details</h4>
15       <Suspense fallback={<Loading />}>
16         <AccountDetails userId={userId} />
17         <h4 className="text-center mt-5">Favorite movie</h4>
18         <MovieDetails movieId={movieId} />
19       </Suspense>
20     </div>
21   );
22 }
```

The Result



Concurrent Rendering Adventure x +

localhost:3000/users

Concurrent Adventures Users Prime Numbers

Users

User details

C Loading...

Lupe Hansen
Spears McMahon
Lopez Walton
Norris Leonard
Freda Lowery
Kate Hickman
Irwin Reese
Kirk Keller
Galloway McClain
Donovan Beasley



Parallel <Suspense />

Parallel <Suspense />

- Multiple suspense boundaries can **suspend in parallel**
 - React will suspend them all and show multiple fallback components
- If you want to **render a component while others are still loading**
- **Multiple suspending components** in a **single <Suspense/>** is also fine
 - Will resume when all resource promises are resolved

MovieDetails.tsx

```
TS UserDetails.tsx M x
src > components > users > TS UserDetails.tsx > ...
11 export function UserDetails({ userId, movieId }: Props) {
12   return (
13     <div>
14       <h4 className="text-center mt-5">User details</h4>
15       <Suspense fallback={<Loading />}>
16         <AccountDetails userId={userId} />
17       </Suspense>
18       <h4 className="text-center mt-5">Favorite movie</h4>
19       <Suspense fallback={<Loading />}>
20         <MovieDetails movieId={movieId} />
21       </Suspense>
22     </div>
23   );
24 }
```

The Result



Concurrent Rendering Adventure x +

localhost:3000/users

Concurrent Adventures Users Prime Numbers

Users

User details

Loading...

Favorite movie

Loading...

Lupe Hansen
Spears McMahon
Lopez Walton
Norris Leonard
Freda Lowery
Kate Hickman
Irwin Reese
Kirk Keller
Galloway McClain
Donovan Beasley

React 18



React 18

- React 18 is still in alpha/preview version right now
 - Daily publish to NPM using the **@next** and the **@alpha** tags
- `npm install react@next react-dom@next --force`

package.json

```
{ } package.json ×  
{ } package.json > ...  
5   "dependencies": {  
6     "bootstrap": "^5.1.1",  
7     "react": "^18.0.0-alpha-bdd6d5064-20211001",  
8     "react-dom": "^18.0.0-alpha-bdd6d5064-20211001",  
9     "react-error-boundary": "^3.1.3",  
10    "react-router-dom": "^6.0.0-beta.5",  
11    "swr": "^1.0.1",  
12    "web-vitals": "^1.1.2"  
13  },
```

index.tsx



```
package.json M TS index.tsx M X
src > TS index.tsx > ...
24 ReactDOM.createRoot(document.getElementById('root')!).render(
25   <ErrorBoundary FallbackComponent={ErrorFallback}>
26     <Suspense fallback={<Loading />}>
27       <React.StrictMode>
28         <SWRConfig value={{ fetcher, suspense: true }}>
29           <App />
30         </SWRConfig>
31       </React.StrictMode>
32     </Suspense>
33   </ErrorBoundary>
34 );
```



New hooks

New hooks

- `useDeferredValue()`
 - Returns a deferred version of the value that may lag behind
- `useTransition()`
 - Avoid undesirable states when waiting for content
- `useMutableSource()`
 - Enables React components to safely and efficiently read from a mutable external source in Concurrent Mode
 - Avoids tearing
- `useOpaqueIdentifier()`
 - Can be used to generate unique ID's in an SSR-safe way



useOpaqueIdentifier()

useOpaqueIdentifier()

- Can be used to generate unique ID's in a SSR-safe way
- 👉 Still prefixed with `unstable_` 👉

LabelInput.tsx

```
TS LabelInput.tsx M x TS LabelTextarea.tsx M
src > components > users > TS LabelInput.tsx > ...
9 export function LabelInput({ label, value, ...rest }: Props) {
10   const id = unstable_useOpaqueIdentifier();
11
12   return (
13     <div className="mb-3">
14       <label htmlFor={id} className="form-label">
15         {label}
16       </label>
17       <input id={id} className="form-control" value={value} { ...rest} />
18     </div>
19   );
20 }
```

The Result



Concurrent Rendering Adventure x +

localhost:3000/users

Concurrent Adventures Users Prime Numbers

Users

Lupe Hansen	
Spears McMahon	Firstname
Lopez Walton	Lupe
Norris Leonard	Surname
Freda Lowery	Hansen
Kate Hickman	Email address
Irwin Reese	lupehansen@plutorque.com
Kirk Keller	
Galloway McClain	
Donovan Beasley	

User details

Firstname

Lupe

Surname

Hansen

Email address

lupehansen@plutorque.com

Favorite movie

Title

The Shawshank Redemption

Release date

1994-09-23

Using `<SuspenseList />`

Orchestrating `<Suspense />` boundaries

Using <SuspenseList />

- **<SuspenseList />** will let you control how multiple **<Suspense />** components **render their fallback**
 - The order in which child components show when ready
 - If multiple child fallbacks components are displayed

UserDetails.tsx

```
TS UserDetails.tsx M x TS UserList.tsx M
src > components > users > TS UserDetails.tsx > ...
11 export function UserDetails({ userId, movieId }: Props) {
12   return (
13     <div>
14       <SuspenseList revealOrder="together">
15         <h4 className="text-center mt-5">User details</h4>
16         <Suspense fallback={<Loading />}>
17           <AccountDetails userId={userId} />
18         </Suspense>
19         <h4 className="text-center mt-5">Favorite movie</h4>
20         <Suspense fallback={<Loading />}>
21           <MovieDetails movieId={movieId} />
22         </Suspense>
23       </SuspenseList>
24     </div>
25   );
26 }
```


The Result



Concurrent Rendering Adventure x +

localhost:3000/users

Concurrent Adventures Users Prime Numbers

Users

User details

Loading...

Favorite movie

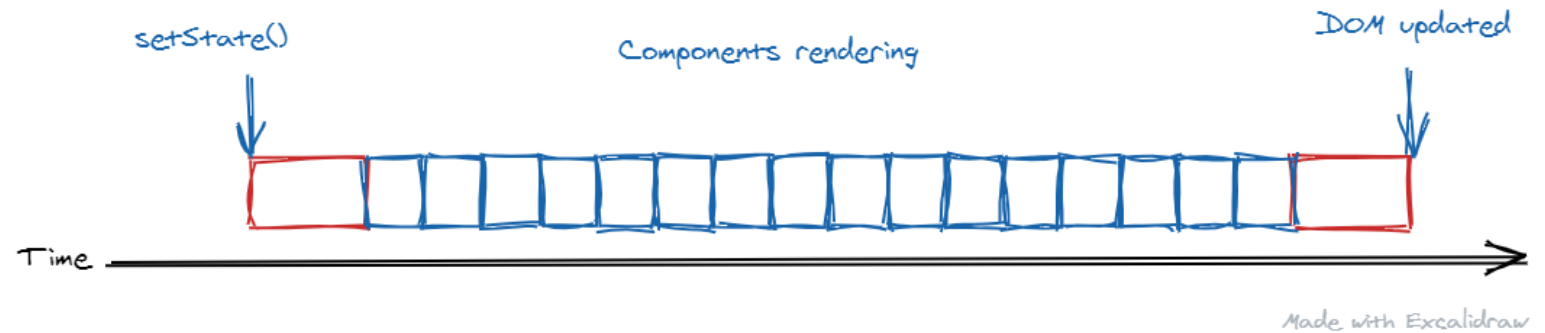
Loading...

Lupe Hansen
Spears McMahon
Lopez Walton
Norris Leonard
Freda Lowery
Kate Hickman
Irwin Reese
Kirk Keller
Galloway McClain
Donovan Beasley

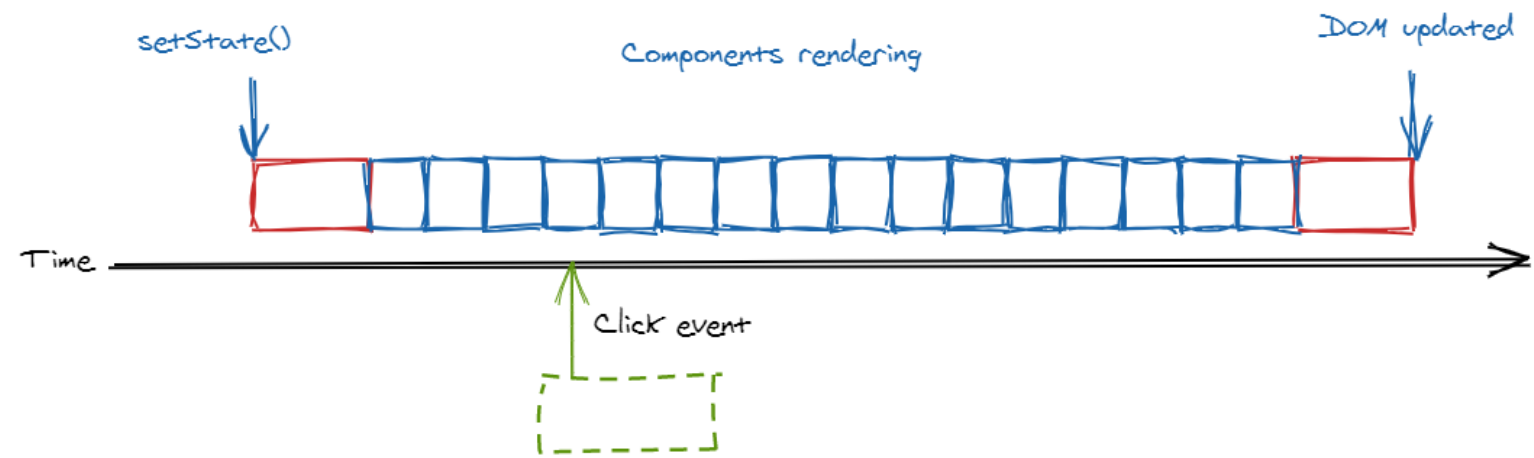


Concurrent Mode

React 17 rendering components

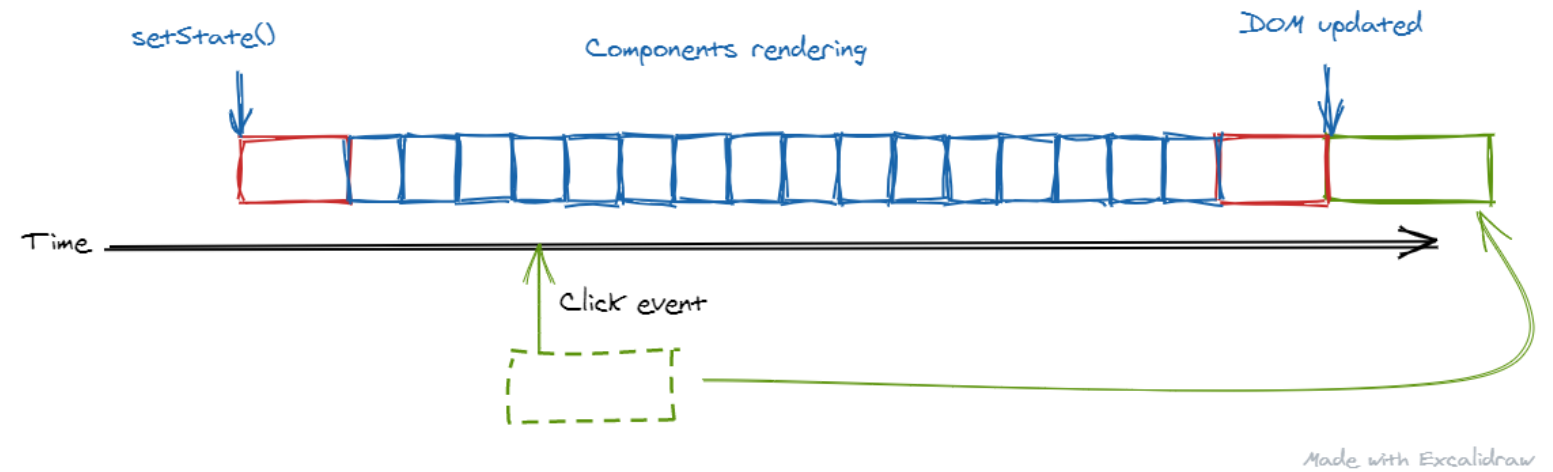


User click event

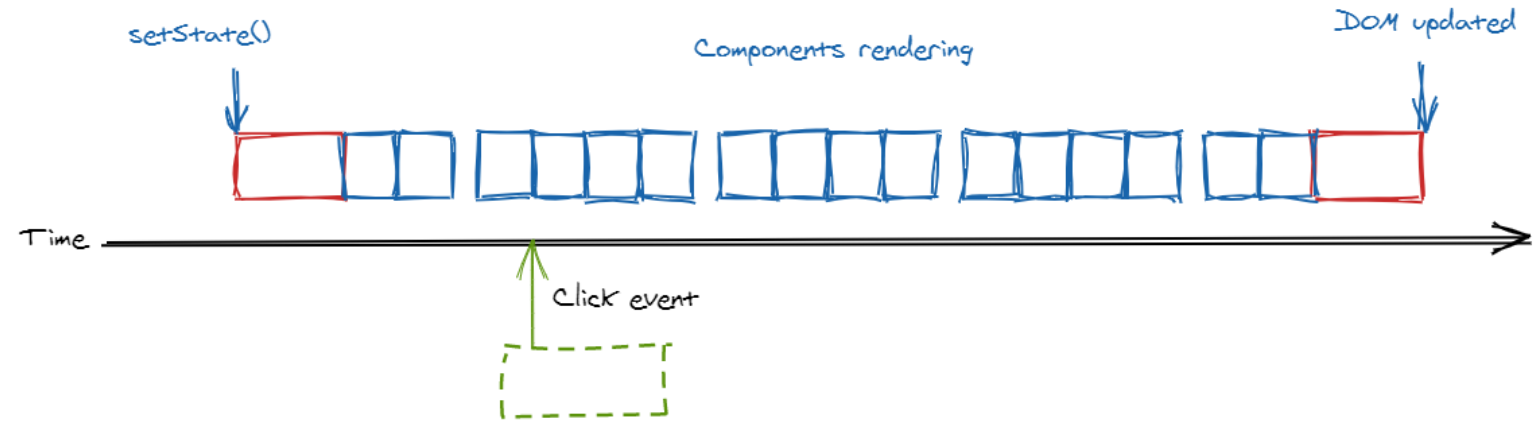


Made with Excalidraw

Event running

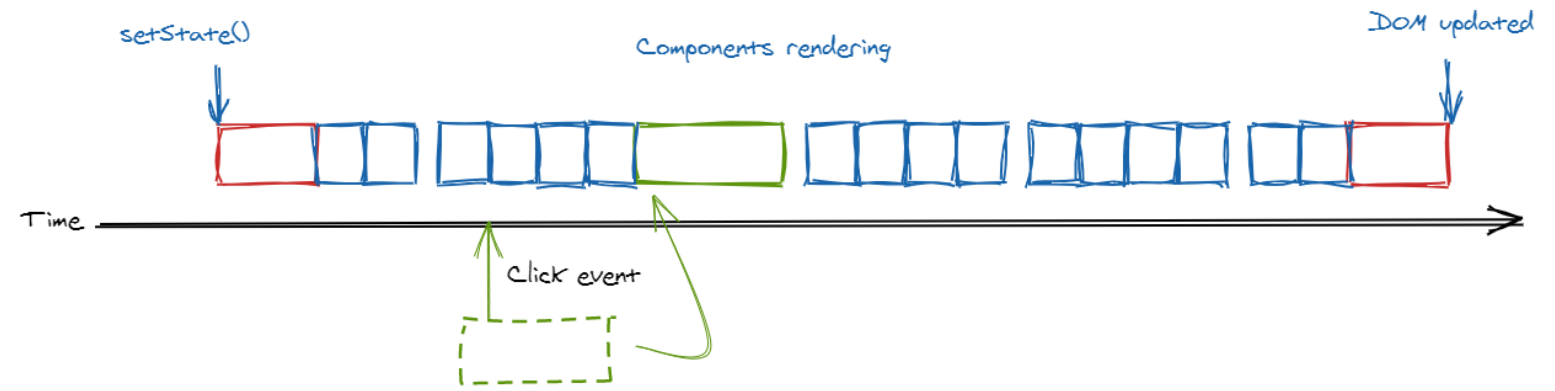


React 18 Concurrent mode



Made with Excalidraw

Event running with concurrent mode



Made with Excalidraw



startTransition()

To defer lower priority work

PrimeNumbers.tsx

```
TS PrimeNumbers.tsx M X
src > components > primes > TS PrimeNumbers.tsx > ...
You, 2 minutes ago | 1 author (You)
1 { startTransition, useState } from 'react';
2 import { CheckNumber } from './CheckNumber';
3 import { PrimeRange } from './PrimeRange';
4
5 const defaultValue = 250;
6
7 export function PrimeNumbers() {
8   const [maxPrime, setMaxPrime] = useState(defaultValue);
9   const values = new Array(maxPrime).fill(null);
10
11   return (
12     <div className="row">
13       <h2 className="text-center mt-5">Prime Numbers</h2>
14       <PrimeRange
15         defaultValue={defaultValue}
16         onChange={(value) => startTransition(() => setMaxPrime(value))}
17       />
18
19       <div className="row row-cols-auto g-2">
20         {values
21           .filter((_, index) => index < 10_000)
22           .map((_, index) => {
23             return <CheckNumber key={index} value={maxPrime - index} />;
24           })}
25       </div>
26     </div>
27   );
28 }
```

The Result



Concurrent Rendering Adventure x +

localhost:3000/primes

Concurrent Adventures Users Prime Numbers

Prime Numbers

100,000

87,229 ✗	87,228 ✗	87,227 ✗	87,226 ✗	87,225 ✗
87,224 ✗	87,223 ✓	87,222 ✗	87,221 ✓	87,220 ✗
87,219 ✗	87,218 ✗	87,217 ✗	87,216 ✗	87,215 ✗
87,214 ✗	87,213 ✗	87,212 ✗	87,211 ✓	87,210 ✗
87,209 ✗	87,208 ✗	87,207 ✗	87,206 ✗	87,205 ✗
87,204 ✗	87,203 ✗	87,202 ✗	87,201 ✗	87,200 ✗

Using `useTransition()`

To defer lower priority work and know about pending updates

Using useTransition()

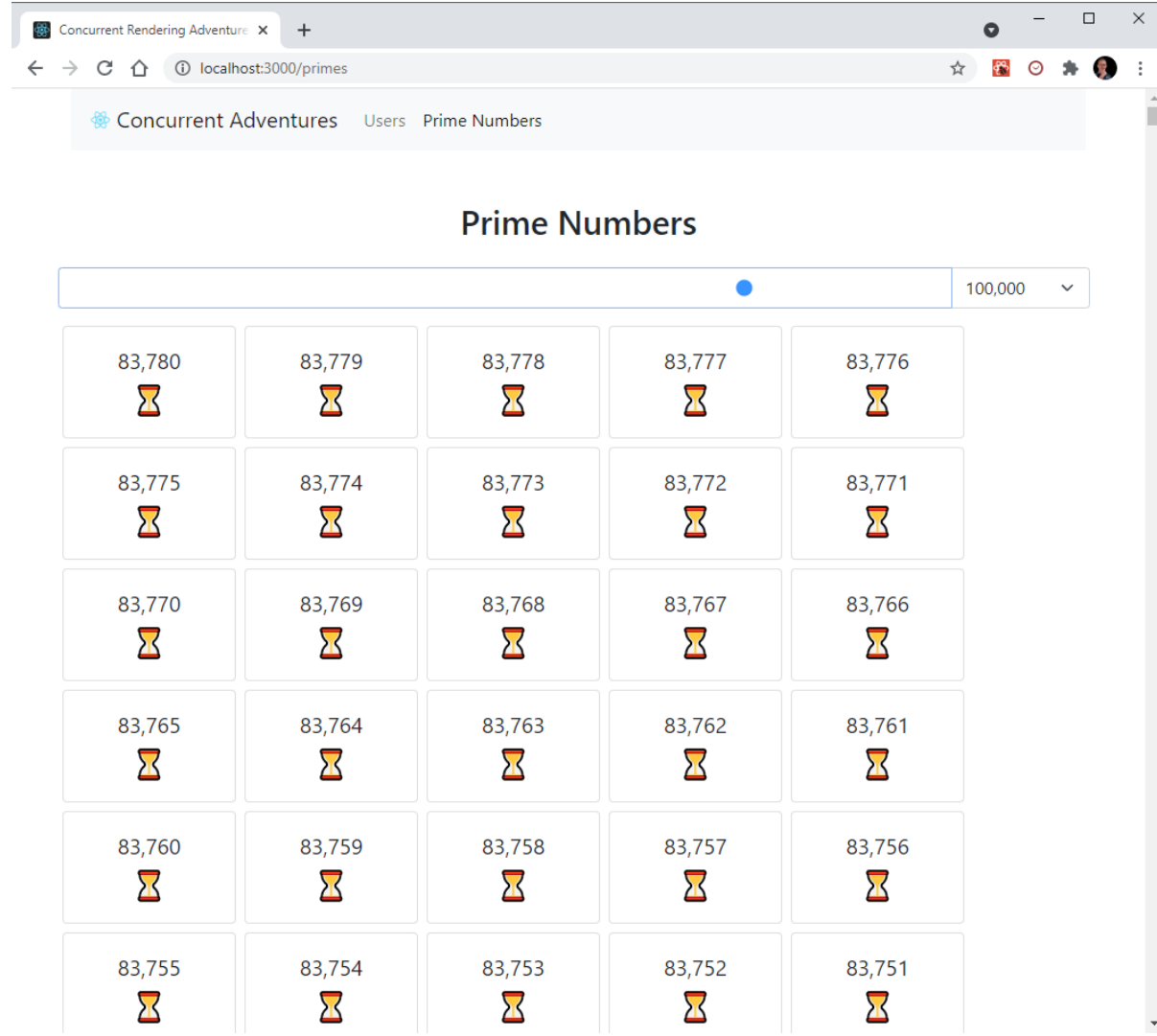
- The **useTransition() hook** can be used to control how React renders when components suspend
 - Prevent the fallback component being rendered immediately
- The **new components will be rendered** when:
 - Their resources are ready
 - The timeout is expired
- The “old” UI can use the **isPending** state when rendering

PrimeNumbers.tsx

```
TS PrimeNumbers.tsx M X TS CheckNumber.tsx M
src > components > prime > TS PrimeNumbers.tsx > ...
1 { useTransition, useState } from 'react';
2 import { CheckNumber } from './CheckNumber';
3 import { PrimeRange } from './PrimeRange';
4
5 const defaultValue = 250;
6
7 export function PrimeNumbers() {
8   const [isPending, startTransition] = useTransition();
9   const [maxPrime, setMaxPrime] = useState(defaultValue);
10   const values = new Array(maxPrime).fill(null);
11
12   return (
13     <div className="row">
14       <h2 className="text-center mt-5">Prime Numbers</h2>
15       <PrimeRange
16         defaultValue={defaultValue}
17         onChange={(value) => startTransition(() => setMaxPrime(value))}
18       />
19
20       <div className="row row-cols-auto g-2">
21         {values
22           .filter((_, index) => index < 10_000)
23           .map((_, index) => {
24             return (
25               <CheckNumber
26                 key={index}
27                 value={maxPrime - index}
28                 isPending={isPending}
29               />

```

The Result



startTransition() vs useTransition()

startTransition()

- Can be used anywhere
- No additional renders

useTransition()

- Needs to be used in a functional component
- One additional render with `isPending`

Conclusion

- You can use **<Suspense />** today
 - Suspend when lazily loading components and/or **fetching data**
 - Handle error with an **<ErrorBoundary />**
 - **Nest and/or parallelize** as needed
- **Concurrent mode**
 - **Coming soon** to a React application near you
 - Can make large applications **more responsive**
 - Render a React 18 application using **createRoot()**
 - Use **<SuspenseList />** to orchestrate **<Suspense />** components
 - **Defer work** with **startTransition()** and/or **useTransition()**

Maurice de Beijer

@mauricedb

maurice.de.beijer
@gmail.com

