

Next.js Training

Modern React Web Development

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About Me

- **Productboard** (since March 2025)
 - Product Staff Engineer
 - Tech Lead Nucleus Guild, member of FE guild
- **React Experience**
 - React Lover (10+ years)
 - Consultant
 - Courses & Workshops (React, Next.js, QA)
 - Video courses for Skillmea



Agenda

1. Pages Router

1.1. File-Based Routing

1.2. Rendering

1.3. Data fetching

2. App Router

2.1. File-Based Routing

2.2. Rendering

2.3 Data fetching

3. Middleware

4. Environments

5. Configuration & Instrumentation

6. Extra: Styling, Forms, Error Boundaries, MDX, Images, Testing

Pages Router

Pages Router (Legacy)

- Demonstrated in the separate project: **next-guide-pages** (`apps/next-guide-pages`)
- File-based routing in the `pages/` directory
- Each file in `pages/` is a route (e.g., `index.tsx`, `users/[id].tsx`)
- Dynamic routes: `[id].tsx`, catch-all: `[...slug].tsx`
- API routes: `pages/api/`

- Special files for advanced customization:
 - **_app.tsx**: Custom root component for all pages ([see file](#)). Use for global styles, context providers, etc.
 - **_document.tsx**: Customizes the HTML document structure ([see file](#)). Use for meta tags, lang, etc.
 - **_error.tsx**: Custom error page for runtime errors ([see file](#)).
 - **404.tsx**: Custom 404 Not Found page ([see file](#)).
 - **500.tsx**: Custom 500 Internal Server Error page ([see file](#)).

Demos:

- [Homepage \(/\)](#)
- [Users list \(/users\)](#)
- [User detail \(dynamic route\) \(/users/1\)](#)
- [API users route \(/api/users\)](#)
- [Catch-all route \(/ssg\)](#)

API Routes

- Serverless functions as API endpoints in `pages/api/`
- Each file in `api/` is an endpoint (GET, POST, etc.)
- Use the built-in types: `NextApiRequest` and `NextApiResponse` from `next`
- Response helpers: `res.status`, `res.json`, `res.send`, `res.redirect`, `res.revalidate`
- Supports dynamic routes (`pages/api/post/[pid].ts`) and catch-all routes (`pages/api/post/[...slug].ts`)
- TypeScript support for type-safe APIs
- [Official documentation](#)

Example: Basic API Route

```
import type { NextApiRequest, NextApiResponse } from 'next';

export default function handler(req: NextApiRequest, res: NextApiResponse) {
  res.status(200).json({ message: 'Hello from Next.js!' });
}
```

Example: Dynamic API Route

```
// pages/api/post/[pid].ts
import type { NextApiRequest, NextApiResponse } from 'next';

export default function handler(req: NextApiRequest, res: NextApiResponse) {
  const { pid } = req.query;
  res.end(`Post: ${pid}`);
}
```

Example: Catch-all API Route

```
// pages/api/post/[...slug].ts
import type { NextApiRequest, NextApiResponse } from 'next';

export default function handler(req: NextApiRequest, res: NextApiResponse) {
  const { slug } = req.query;
  res.end(`Post: ${Array.isArray(slug) ? slug.join(', ') : slug}`);
}
```

Linking and Navigating

- Next.js provides a built-in `<Link>` component for client-side navigation between routes.
- Using `<Link>` enables fast, seamless transitions without full page reloads, preserving state and improving UX.
- `<Link>` automatically prefetches linked pages in the background for faster navigation (when visible in the viewport).
- Prefer `<Link>` over a plain `<a>` tag for internal navigation. Use `<a>` only for external links.
- You can disable prefetching with the `prefetch={false}` prop.
- `<Link>` works with dynamic routes, catch-all routes, and route groups.

Example:

```
import Link from 'next/link';

export default function Navigation() {
  return (
    <nav>
      <Link href="/about">About</Link>
      <Link href="/blog" prefetch={false}>
        Blog (no prefetch)
      </Link>
      <a href="https://nextjs.org" target="_blank" rel="noopener noreferrer">
        Next.js Docs
      </a>
    </nav>
  );
}
```

- For advanced use cases, you can use the `useRouter`, `usePathname`, and `useSearchParams` hooks from `next/navigation`.
- [Official documentation: Linking and Navigating](#)

Rendering & Data Fetching

- The Pages Router supports multiple rendering and data fetching strategies:
 - **SSR (Server-Side Rendering)**: Use `getServerSideProps` to fetch data on every request.
 - [SSR example \(/ssr\)](#)
 - **SSG (Static Site Generation)**: Use `getStaticProps` (and optionally `getStaticPaths`) to pre-render pages at build time.
 - [SSG example \(/ssg\)](#)

getStaticPaths fallback options:

- `fallback: false` – Only the paths returned by `getStaticPaths` are generated at build time. Any other route will show a 404 page.
- `fallback: true` – New paths not returned by `getStaticPaths` will be rendered on-demand on the first request, then cached for future requests. The page will show a loading state until the content is generated.
- `fallback: 'blocking'` – New paths are rendered on-demand like `true`, but the user will not see a loading state; the server waits until the page is generated and then serves the full page.

Use `false` for small/finite sets of pages, `true` or `'blocking'` for large or dynamic sets where not all paths are known at build time.

- [getStaticPaths details](#)

- **Client-side Fetching:** Use React hooks like `useEffect` to fetch data on the client after the page loads.
 - [CSR example \(/csr\)](#)
- You can combine these strategies as needed for your use case.
- See also: [Next.js Data Fetching Docs](#)

App Router

App Router (Modern)

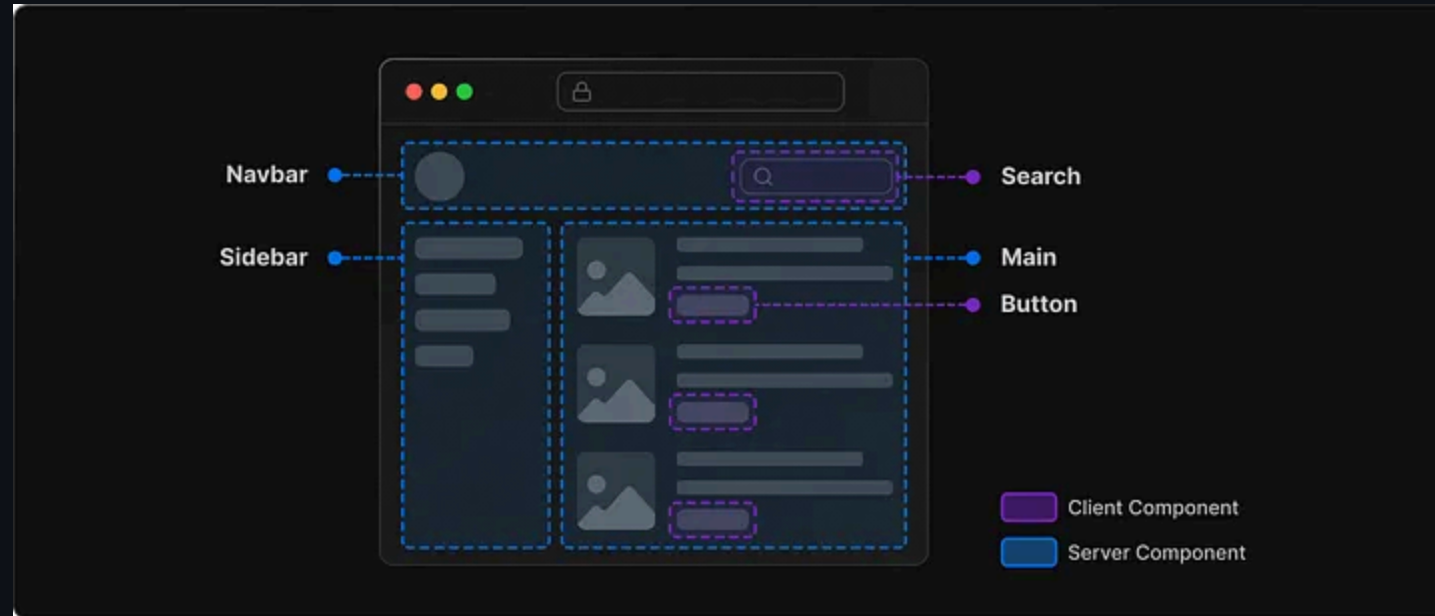
- File-based routing in `src/app/`
- Each folder with `page.tsx` = a route
- Supports layouts, nested routes, dynamic routes, catch-all routes
- **Layout:**
 - [Root layout.tsx](#) – defines the main structure, shared UI, and providers for the whole app.
- **Loading UI:**
 - You can add `loading.tsx` to any route folder for custom loading skeletons.
 - [API loading](#)
 - [Dashboard loading](#)
 - [Blog post loading](#)
- [Official Project Structure documentation](#)

Rendering & Data Fetching

Server vs Client Components

Server Components are rendered on the server and sent as HTML to the client, while Client Components are rendered in the browser. In Next.js App Router, **Server Components are the default**—you only need to use Client Components when you need interactivity, browser APIs, or React hooks like `useState`, `useEffect`, etc.

- Server Components improve performance by reducing the amount of JavaScript sent to the client.
- Client Components are needed for interactivity (event handlers, state, browser APIs).
- You can mix Server and Client Components on the same page.
- Mark a component as client by adding `"use client"` at the top of the file.



Demos:

- [Server component example \(/server-component\)](/server-component)
- [Blog post: Server vs Client Components](#)

What do you need to do?	Server Component	Client Component
Fetch data. Learn more.	✓	⚠
Access backend resources (directly)	✓	✗
Keep sensitive information on the server (access tokens, API keys, etc)	✓	✗
Keep large dependencies on the server / Reduce client-side JavaScript	✓	✗
Add interactivity and event listeners (<code>onClick()</code> , <code>onChange()</code> , etc)	✗	✓
Use State and Lifecycle Effects (<code>useState()</code> , <code>useReducer()</code> , <code>useEffect()</code> , etc)	✗	✓
Use browser-only APIs	✗	✓
Use custom hooks that depend on state, effects, or browser-only APIs	✗	✓
Use React Class components	✗	✓

Demos:

- [Client component demo \(/client-component\)](/client-component)
- [Counter component](#)

Partial Prerendering

- Mix static, server, and client rendering

Demo:

- Static page with client widget

SSR & SSG

- SSR: Server Side Rendering (on request)
- SSG: Static Site Generation (at build time)
- Use `generateStaticParams` for SSG

Demos:

- [Dashboard \(SSR\) \(/dashboard\)](/dashboard)
- [Blog \(SSG\) \(/blog\)](/blog)

The `fetch` function

- Native fetch in server components
- Automatic caching

Demos:

- [Client data fetching \(/client-data-fetching\)](/client-data-fetching)
- [Caching demo \(/caching-demo\)](/caching-demo)

Caching

- By default, fetch requests are **not** cached in Next.js 15+ ([docs](#))
- Enable caching explicitly with `cache: 'force-cache'` or `next.revalidate` for ISR:

```
// Static caching
fetch(url, { cache: 'force-cache' });

// ISR (Incremental Static Regeneration)
fetch(url, { next: { revalidate: 3600 } });
```

- Use `cache: 'no-store'` to always fetch fresh data (SSR)

Demo:

- [Caching demo\(/caching-demo/\)](#)

On-demand Revalidation: `revalidateTag` and `revalidatePath`

- `revalidateTag(tag)` lets you purge the cache for a specific tag on demand. Use it after a mutation (e.g., creating or updating a record) to ensure that data with this tag is refetched on the next request.

- Add tags when fetching data:

```
fetch(url, { next: { tags: ['users'] } });
```

- After a mutation, call on the server:

```
import { revalidateTag } from 'next/cache';  
revalidateTag('users');
```

-
- `revalidatePath(path)` purges the cache for a specific path (page or API endpoint). Use it when you want to revalidate a particular page after a data change.

- See examples in the project:
 - [User Form Server Action \(revalidateTag\) \(/user-form-server-action\)](#)
 - [Database Demo \(revalidatePath\) \(/database-demo\)](#)
- More in the docs: [revalidateTag](#), [revalidatePath](#)

Connecting to Database and Filesystem

- Use Prisma for DB, Node APIs for filesystem

Demos:

- [Database demo \(/database-demo\)](#)
- [Prisma schema](#)

Tip: To explore and edit your database visually, you can use Prisma Studio:

```
yarn prisma studio
```

API Routes

- In the App Router, API routes are implemented as **Route Handlers** using `route.ts` (or `route.js`) files inside the `app` directory.
- Each route handler can export HTTP methods as functions: `GET`, `POST`, `PUT`, `DELETE`, etc.
- You can use either the default Node.js runtime or opt-in to the Edge runtime by exporting `export const runtime = 'edge'`.
- Use the `NextRequest` object to access request data (body, query, headers, cookies).
- Use the `NextResponse` object to send responses.

- Route handlers are colocated with your routes, and support dynamic segments, catch-all, and route groups.
- **Difference from Pages Router:** No need for `api/` prefix in the URL, and you have full control over HTTP methods and runtime.
- [Official documentation: Route Handlers](#)

Example: Basic GET and POST handler

```
// app/api/hello/route.ts
import { NextRequest, NextResponse } from 'next/server';

export async function GET(request: NextRequest) {
  return NextResponse.json({ message: 'Hello from App Router!' });
}

export async function POST(request: NextRequest) {
  const data = await request.json();
  // process data...
  return NextResponse.json({ received: data });
}
```

- For dynamic API routes, use `[param]` or `[...slug]` in the folder name, just like for pages.
- You can also use middleware and Edge runtime for advanced use cases.

Route Groups & Segmented Sections

- In the App Router, you can separate sections using parentheses folders, e.g., `(marketing)`.
- Allows you to separate, for example, public and internal parts of the site, or marketing pages.
- **Example:**
 - [Marketing group](#)
- [Official documentation](#)

Parallel Routes & Slots

- Parallel routes allow you to render multiple independent parts of the page (slots) at the same time.
- Each slot is a folder starting with `@` (e.g., `@feed`, `@notifications`).
- Slots can also be nested.
- **Examples:**
 - [Main parallel-demo](#)
 - [Feed slot](#)
 - [Notifications slot](#)
 - [Nested slot feed/archive](#)
- [Official documentation](#)

Conditional Routes & Slots

- Conditional routes allow you to dynamically change content based on a segment (e.g., user role).
- Slots like `@admin` , `@user` within a dynamic folder `[role]` .
- **Examples:**
 - [Conditional routes demo](#)
 - [Admin slot](#)
 - [User slot](#)
- [Official documentation](#)

Server Actions

- Server Actions allow you to call server logic directly from a component/form without writing an API route.
- Secure, type-safe, runs only on the server.
- **Examples:**
 - [User form server action](#)
 - [Progressive enhancement form](#)
 - [Database demo server actions](#)
- [Official documentation](#)

Progressive Enhancement

- Progressive enhancement means the form works even without JavaScript – validation and processing happen on the server.
- In Next.js, you can combine this with Server Actions.
- Benefits: better accessibility, SEO, fallback for older browsers.
- **Examples:**
 - [Progressive enhancement form](#)
 - [Server action](#)
- [Official documentation](#)

Error Boundaries & Error Handling

- Next.js App Router has special files for error boundaries:
 - `error.tsx` – error boundary for a specific route
 - `global-error.tsx` – global error boundary for the whole app ([global-error.tsx](#))
 - `not-found.tsx` – page for 404 errors ([not-found.tsx](#))
- **Examples:**
 - [error.tsx](#)
 - [global-error.tsx](#)
 - [not-found.tsx](#)
- [Official documentation](#)

4. Middleware

- Code that runs before a request is completed
- `src/app/middleware.ts`
- Use for auth, redirects, logging

Demos:

- [Middleware file](#)
- [Middleware demo page \(/middleware-demo\)](#)

5. Environments

Node.js vs. Edge

- Next.js can run on Node.js or Edge runtime
- Use `export const runtime = 'edge'` in a route/middleware

Demo:

- [Runtime demo \(/runtime-demo\)](/runtime-demo)

Different Types of API Routes (Edge/Node, request info)

- Next.js allows you to write API routes for different runtimes:
 - **Edge runtime:** faster, limited API (e.g., no fs)
 - **Node runtime:** full access to Node.js API
- You can also get request info (headers, cookies, etc.)
- **Examples:**
 - [API route Edge](#)
 - [API route Node](#)
 - [API request info](#)
- [Official documentation](#)

Passing Data Between Environments

- Use props, API endpoints, cookies

Demo:

- [Runtime demo](#)

6. Configuration & Instrumentation

Next Config

Next.js allows you to configure various aspects of your application using the `next.config.js` or `next.config.ts` file.

- Mode settings (strict mode, experimental features)
- Image, headers, file types, build options
- **Redirects and Rewrites**

Redirects and Rewrites

- **Redirects** let you send users from one URL to another (e.g., when migrating content or changing site structure).
- **Rewrites** let you map an incoming request path to a different destination path on the server, without changing the URL in the browser (e.g., for API proxying or pretty URLs).

Example from the project:

```
// apps/next-guide-app/next.config.ts
// Redirects
async redirects() {
  return [
    {
      source: '/old-blog',
      destination: '/blog',
      permanent: true,
    },
  ];
},
// Rewrites
async rewrites() {
  return [
    {
      source: '/api/legacy/:path*',
      destination: '/api/:path*',
    },
  ];
},
```

Instrumentation

- Instrumentation allows you to monitor performance, log, or connect OpenTelemetry.
- In Next.js, add an `instrumentation.js` or `instrumentation.ts` file to `app/`.
- Runs only on the server at process startup.
- **Examples:**
 - [instrumentation.js](#)
 - [Instrumentation demo page](#)
- [Official documentation](#)
- **Demos:**
 - [Instrumentation demo \(/instrumentation-demo\)](#)
 - [instrumentation.js example](#)

7. Extra

- **Styling:** See [globals.css](#)
- **Forms and Validation:**
 - [Progressive enhancement form](#)
 - [User form with server action](#)
- **Error Boundaries:**
 - [Error boundary example](#)
- **MDX:**
 - [MDX demo](#)
 - [MDX layout](#)
 - [MDX components](#) – custom React components for use in MDX content
- **Image Component:**
 - [Image demo \(/image-demo\)](#)

Q&A / Discussion

- What challenges have you faced with Next.js?
- Which feature are you most excited to try?
- Any questions about the examples or exercises?

Thank You!

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[GitHub Repo](#)

[My Website](#)