



Week 14.3

In this offline lecture, Harkirat expands on the previous Next.js lectures by introducing database interactions using `Prisma ORM`, implementing `better fetching` techniques, creating a `singleton Prisma client` instance, and exploring `Server Actions` for executing server-side code directly from components.

What will we cover

Databases

Better Fetches

Singleton Prisma Client

Server Actions

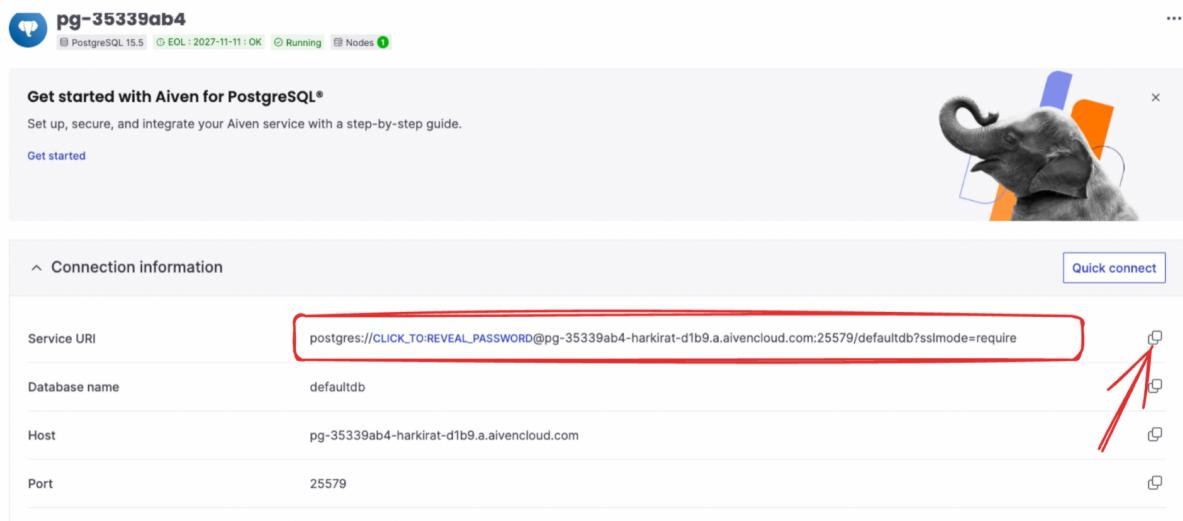
In the last lecture, we covered the basics of building a Next.js application with server-side rendering, API routes, and client-side interactivity. We explored how to fetch data from an API and render it on the server-side, as well as how to create API routes within our Next.js application to handle backend logic. Well, In this lecture, we will dive deeper into more advanced topics related to building a full-stack application with Next.js. Specifically, we will explore the following:

What will we cover

- Databases:** We will learn how to integrate a database with our Next.js application, allowing us to store and retrieve data persistently.
- Better Fetching Techniques:** While we have used basic fetching techniques in this lecture, we will explore more robust and efficient ways to fetch data from APIs, including optimizations and caching strategies.
- Singleton Prisma Client:** We will introduce Prisma, a popular Object-Relational Mapping (ORM) tool, and learn how to create a singleton instance of the Prisma client for efficient database access.
- Server Section:** We will dive into the server-side capabilities of Next.js, including server-side rendering, server components, and server-side data fetching techniques.

Databases

Next.js is a full-stack framework that allows you to build both the frontend and backend components of your application within a single codebase. While Next.js provides built-in support for server-side rendering (SSR) and API routes, it doesn't include a database solution out of the box. This is where third-party tools like Prisma come into play.



The screenshot shows the Aiven PostgreSQL service dashboard for a service named 'pg-35339ab4'. The top navigation bar includes icons for a trash can, a blue circle, and three dots. Below the service name, status indicators show PostgreSQL 15.5, EOL: 2027-11-11: OK, Running, and 1 Node.

The main area features a large elephant icon with the text 'Get started with Aiven for PostgreSQL®' and a 'Get started' button. Below this, there's a section titled 'Connection information' with a 'Quick connect' button. The 'Service URI' field contains the value `postgres://CLICK_TO REVEAL_PASSWORD@pg-35339ab4-harkirat-d1b9.a.aivencloud.com:25579/defaultdb?sslmode=require`, which is highlighted with a red box and a red arrow pointing to it. Other fields in the table include 'Database name' (defaultdb), 'Host' (pg-35339ab4-harkirat-d1b9.a.aivencloud.com), and 'Port' (25579). There are also several small square icons with arrows pointing to the right.

1. Install Prisma

First, we need to install the Prisma package in our Next.js project:

```
npm install prisma
```

2. Initialize Prisma Schema

Next, we need to initialize the Prisma schema, which defines the structure of our database:

```
npx prisma init
```

This command will create a new directory called `prisma` with a `schema.prisma` file inside it.

3. Define the User Model

Open the `schema.prisma` file and define a simple `User` model:

```
model User {
    id      Int      @id @default(autoincrement())
    username String  @unique
    password String
}
```

This model defines a `User` table with three fields: `id` (auto-incrementing primary key), `username` (unique string), and `password` (string).

For starting a PostgreSQL instance, you can check out PlanetScale, Neon.tech, and Aiven, which are managed database providers that offer PostgreSQL as a service.

4. Configure the Database Connection

Replace the `DATABASE_URL` value in the `.env` file with your PostgreSQL database connection URL:

```
DATABASE_URL="postgresql://johndoe:randompassword@localhost:5432/mydb?schema=public"
```

Make sure to replace the placeholders with your actual database credentials.

5. Migrate the Database

Run the following command to create the initial migration and apply it to your database:

```
npx prisma migrate dev --name init_schema
```

This command will create a new migration file and apply the changes to your database.

6. Generate the Prisma Client

Next, we need to generate the Prisma client, which provides an interface to interact with our database:

```
npx prisma generate
```

This command will generate the Prisma client based on the defined models in the `schema.prisma` file.

7. Update the Sign Up Route

Now, let's update the sign-up route in `app/api/user/route.ts` to store user data in the database:

```
import { NextRequest, NextResponse } from 'next/server';
import { prisma } from '@/lib/prisma'; // Import the Prisma client

export async function POST(req: NextRequest) {
  const body = await req.json();
  // Add validation logic here (e.g., using Zod)

  const user = await prisma.user.create({
    data: {
      username: body.username,
```

```
        password: body.password,  
    },  
});  
  
console.log(user.id);  
  
return NextResponse.json({ message: 'Signed up' });  
}
```

In this updated code, we import the Prisma client and use the `prisma.user.create` method to create a new user in the database with the provided `username` and `password`.

8. Update the GET Endpoint

We can also update the GET endpoint to retrieve user data from the database:

```
import { NextResponse } from 'next/server';  
import { prisma } from '@/lib/prisma';  
  
export async function GET() {  
    const user = await prisma.user.findFirst({});  
    return NextResponse.json({ name: user?.username, email: u  
ser?.username });  
}
```

In this example, we use the `prisma.user.findFirst` method to retrieve the first user from the database and return their `username` as both the `name` and `email` properties.

Better Fetches

In the previous implementation, we were fetching user details by making an HTTP request to our API route (`/api/user`). While this approach works, it introduces an unnecessary network round-trip, as we're sending a request from the server back to the server itself.

A better solution is to directly interact with the database from our server component, eliminating the need for an API route and reducing the overhead of making an HTTP request.

Here's how we can implement this better solution:

1. Import the Prisma Client

First, we need to import the Prisma client from the `@prisma/client` package:

```
import { PrismaClient } from "@prisma/client";
```

2. Create a Prisma Client Instance

Next, we create a new instance of the Prisma client:

```
const client = new PrismaClient();
```

3. Update the `getUserDetails` Function

Now, we can update the `getUserDetails` function to directly interact with the database using the Prisma client:

```
async function getUserDetails() {
  try {
    const user = await client.user.findFirst({});
    return {
      name: user?.username,
      email: user?.username,
    };
  } catch (e) {
    console.log(e);
  }
}
```

In this updated function, we use the `client.user.findFirst` method to retrieve the first user from the database. We then return an object containing the `name` and `email` properties, which are derived from the `username` field of the retrieved user.



4. Keep the `Home` Component Unchanged

The `Home` component remains unchanged, as it still receives the user data from the `getUserDetails` function:

```

export default async function Home() {
  const userData = await getUserDetails();

  return (
    <div className="flex flex-col justify-center h-screen">
      <div className="flex justify-center">
        <div className="border p-8 rounded">
          <div>Name: {userData?.name}</div>
          {userData?.email}
        </div>
      </div>
    </div>
  );
}

```

By directly interacting with the database from our server component, we eliminate the need for an API route and the overhead of making an HTTP request. This approach is more efficient and reduces the overall complexity of our application.

Singleton Prisma Client

Why a Singleton Prisma Client?

In a Next.js development environment, the `next dev` command clears the Node.js cache on each run. This behavior can lead to the creation of multiple instances of the Prisma client due to hot reloading, which can quickly exhaust the database connections, as each Prisma client instance holds its own connection pool.

To avoid this issue, it's recommended to create a singleton instance of the Prisma client, ensuring that only one instance is created and reused throughout the application's lifecycle.

Creating the Singleton Prisma Client

1. Create a `db/index.ts` file

First, create a new file called `index.ts` inside a `db` directory at the root of your project.

2. Import the Prisma Client

Import the `PrismaClient` from the `@prisma/client` package:

```
import { PrismaClient } from '@prisma/client';
```

3. Define a function to create the Prisma Client instance

Define a function `prismaClientSingleton` that creates a new instance of the Prisma client:

```
const prismaClientSingleton = () => {
  return new PrismaClient();
};
```

4. Declare a global variable for the Prisma client

Declare a global variable `prisma` that will hold the singleton instance of the Prisma client:

```
declare global {
  var prisma: undefined | ReturnType<typeof prismaClientSingleton>;
}
```

5. Create the singleton instance

Create the singleton instance by checking if the `prisma` global variable is already defined. If not, call the `prismaClientSingleton` function to create a new instance:

```
const prisma = globalThis.prisma ?? prismaClientSingleton();
```

6. Assign the instance to the global variable (development only)

In the development environment, assign the created instance to the `prisma` global variable to ensure it's reused across hot reloads:

```
if (process.env.NODE_ENV !== 'production') globalThis.prisma = prisma;
```

7. Export the singleton instance

Finally, export the `prisma` instance as the default export:

```
export default prisma;
```

Here's the complete `db/index.ts` file:

```
import { PrismaClient } from '@prisma/client';

const prismaClientSingleton = () => {
  return new PrismaClient();
};

declare global {
  var prisma: undefined | ReturnType<typeof prismaClientSin
gleton>;
}

const prisma = globalThis.prisma ?? prismaClientSingleton
();

export default prisma;

if (process.env.NODE_ENV !== 'production') globalThis.prism
a = prisma;
```

Updating Prisma Client Imports

After creating the singleton instance, you need to update all imports of the Prisma client throughout your application to use the singleton instance from the `db/index.ts` file:

```
import client from '@/db';
```

By following this approach, you ensure that only a single instance of the Prisma client is created and reused throughout your Next.js application, preventing the exhaustion of database connections and improving overall performance and stability.

Server Actions

Server Actions are a powerful feature introduced in Next.js 13 that allow you to execute server-side code directly from your components, without the need for creating dedicated API routes. This can simplify your codebase and improve developer experience by providing a more intuitive way to handle data mutations and form submissions.

Here's how you can implement Server Actions in your Next.js application:

1. Create an Actions File

First, create a new file called `actions/user.ts` (or any other appropriate name and location) to define your Server Actions.

```
// actions/user.ts
"use server"; // This directive marks the file as containing Server Actions

import client from "@/db";

export async function signup(username: string, password: string) {
  // You can add validation logic here (e.g., using Zod)
  const user = await client.user.create({
    data: {
      username,
      password,
    },
  });

  console.log(user.id);

  return "Signed up!";
}
```

In this example, we define a `signup` function that takes `username` and `password` as input, creates a new user in the database using the Prisma client, and returns a success message.

2. Update the Sign Up Component

Next, update your `Signup` component to use the `signup` Server Action instead of making an API request.

```
// components/Signup.tsx
"use client"; // Mark this component as a client component

import { signup } from "@/actions/user";
import { useRouter } from "next/router";
import { ChangeEventHandler, useState } from "react";

export function Signup() {
  const [username, setUsername] = useState("");
  const [password, setPassword] = useState("");
  const router = useRouter();

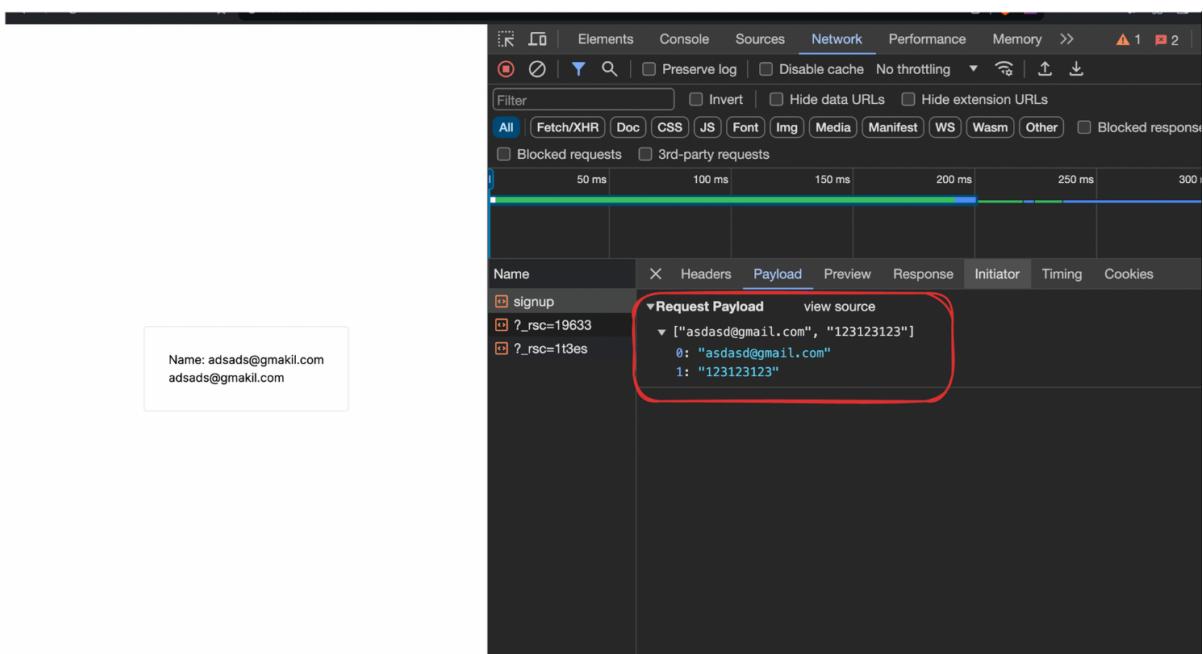
  return (
    <div className="h-screen flex justify-center flex-col">
      {/* ... */}
      <button
        onClick={async () => {
          const response = await signup(username, password);
          localStorage.setItem("token", response);
          router.push("/");
        }}
        type="button"
        className="mt-8 w-full text-white bg-gray-800 focus:ring-4 focus:ring-gray-300 font-medium rounded-lg text-sm px-5 py-2.5 me-2 mb-2"
      >
        Sign up
      </button>
    </div>
  );
}
```

In this updated component, we import the `signup` Server Action and call it when the user clicks the "Sign up" button. The response from the Server Action is

stored in `localStorage` as a token, and the user is redirected to the home page (`/`).

3. Check the Network Tab

When you run your application and sign up with a new username and password, you should see the user's ID logged in the console, and the network tab should not show any API requests. Instead, the Server Action is executed on the server, and the response is returned directly to the client component.



Benefits of Server Actions

Using Server Actions in your Next.js application provides several benefits:

- 1. Single Function for Client and Server Components:** Server Actions can be used in both client and server components, reducing code duplication and improving consistency.
- 2. Typed Responses:** Server Actions provide typed responses on the frontend, similar to tools like tRPC, improving type safety and developer experience.
- 3. Seamless Form Integration:** Server Actions can be seamlessly integrated with forms, simplifying the process of handling form submissions and data mutations.

4. **Improved Security:** Server Actions execute on the server, reducing the risk of client-side vulnerabilities and providing better security for sensitive operations.
5. **Simplified Development:** By eliminating the need for dedicated API routes, Server Actions can simplify your codebase and improve developer productivity.

However, it's important to note that Server Actions still rely on HTTP requests under the hood, but they provide a more intuitive and streamlined developer experience by abstracting away the complexities of creating and managing API routes.