uild CRUD API with Deno

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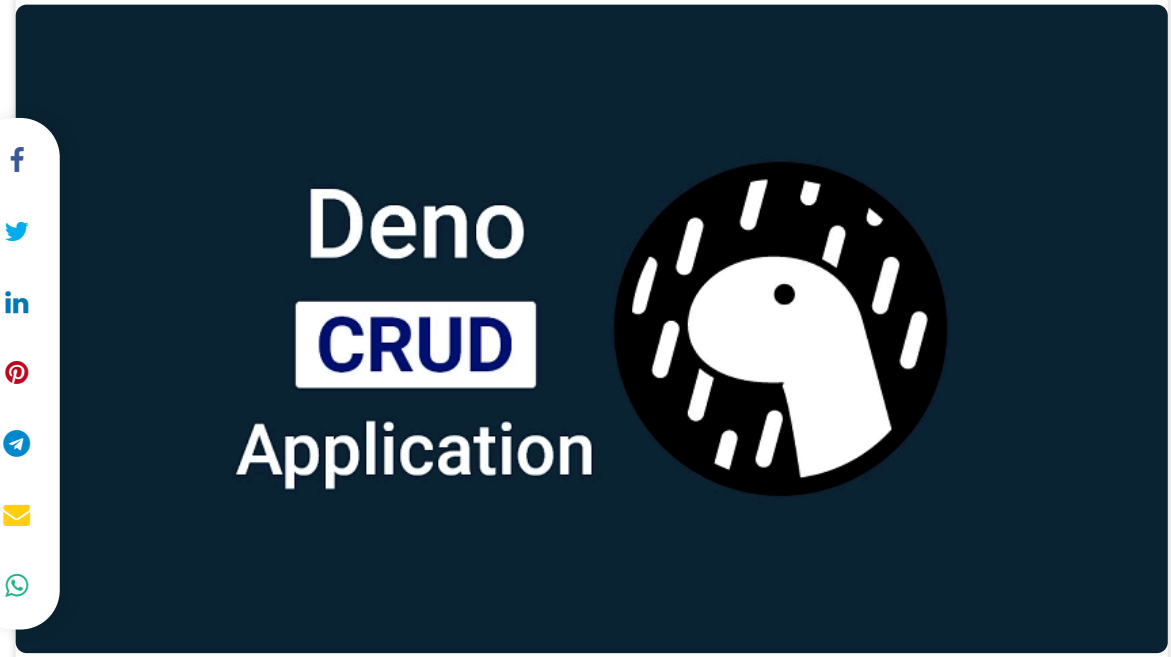
his article, you'll learn how to implement CRUD (Create, Read, Update, and ete) operations with **DenoDB** in Deno. The Deno CRUD API will run on an **Oak** middleware framework and store data in an SQLite database. Nevertheless, the code in this project can be adjusted to work with any DenoDB-supported database like MySQL, SQLite, MariaDB, PostgreSQL, and MongoDB.

To avoid over-complicating the project, we'll query and mutate the database directly in the **CRUD route handlers** instead of using a **CRUD service layer** to handle the communication between the database and the route controllers.

More practice:

- How to Setup and Use MongoDB with Deno
- How to Set up Deno RESTful CRUD Project with MongoDB
- Authentication with Bcrypt, JWT, and Cookies in Deno
- Complete Deno CRUD RESTful API with MongoDB



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Prerequisites

This tutorial is structured in a way to make it easier for beginners to follow but these prerequisites are needed to make the process smoother for you.

- You should have the latest version of **Deno installed** on your machine. If you already have the binary installed, run `deno upgrade` to upgrade to the newest version.
- You should have basic knowledge of JavaScript and TypeScript.
- You should have a basic understanding of CRUD architecture.

Run the Deno CRUD API Locally

1. Navigate to **https://deno.land/manual/getting_started/installation** to install the Deno binary on your system. Run `deno upgrade` to get the newest version of Deno.

2. Visit **https://github.com/wpcodevo/deno-crud-app** to download or clone the Deno CRUD project and open it with an IDE or text editor.

3. Run `deno run -A src/server.ts` to install the project's dependencies and start the Deno Oak HTTP server on port **8000**.

4. Test the CRUD API in an API testing software or set up the frontend application to interact with the Deno API.

Run a React.js App with the Deno CRUD API

For full details about the React.js CRUD app see the post Build a React.js CRUD App Using a RESTful API. But to get up and running quickly just follow the steps below.

1. Install Node.js from **https://nodejs.org** and run `npm install -g yarn` to install the **Yarn** package manager globally.

2. Visit **https://github.com/wpcodevo/reactjs-crud-note-app** to download or clone the React.js CRUD project and open it with an IDE or text editor.

3. Open the integrated terminal in your IDE and run `yarn` or `yarn install` to install the required dependencies.

4. Start the application by running `yarn dev` from the command line in the project root directory.

5. Open **http://localhost:3000/** in a new tab to test the React CRUD app against the Deno CRUD API. **Note:** Accessing the app on the URL `http://127.0.0.1:3000` will result in a site can't be reached or a CORS error.

Setup Deno

First and foremost, navigate to your Desktop or any location and create a new folder named `deno-crud-app`. After that, open the newly-created folder with an IDE or code editor (for this tutorial, I'll use **VS Code**).

```
mkdir deno-crud-app
cd deno-crud-app && code .
```

To avoid getting unnecessary warnings and red squiggly lines in VS Code, create a `.vscode` folder in the root directory and within the `.vscode` folder, create a **settings.json** file, and add the following configurations.

.vscode/settings.json

```
{
  "deno.enable": true,
  "deno.unstable": true
}
```

The above settings will tell VS Code to prepare the workspace for Deno development.

By default, Deno doesn't have a package manager registry like **NPM** or **Yarn**. So, in order to load third-party modules into the project, we have to use URL imports.

However, to avoid scattering URL imports all over our code, we'll simulate a `package.json` file by creating a `src/deps.ts` file to manage all the third-party modules from a centralized location. To do that, create an **src** folder in the root directory. Within the **src** folder, create a `deps.ts` file and add the following dependencies.

src/deps.ts

```
export {
  Application,
  helpers,
  Router,
} from "https://deno.land/x/oak@v11.1.0/mod.ts";
export type {
  Context,
  RouterContext,
} from "https://deno.land/x/oak@v11.1.0/mod.ts";
export * as logger from "https://deno.land/x/oak_logger@1.0.0/mod.ts";
export { z } from "https://deno.land/x/zod@v3.19.1/mod.ts";
export {
  Database,
  SQLite3Connector,
  Model,
  DataTypes,
} from "https://deno.land/x/denodb@v1.1.0/mod.ts";
export { oakCors } from "https://deno.land/x/cors@v1.2.2/mod.ts";

```

- `oak` – A middleware framework for handling HTTP with Deno
- `oak_logger` – An HTTP request middleware logger for Deno oak.
- `zod` – A schema validation library with static type inference
- `denodb` – An ORM for Deno that supports MySQL, SQLite, MariaDB, PostgreSQL, and MongoDB.
- `cors` – A CORS middleware for Deno

h that out of the way, we are now ready to create the entry point of our plication and set up the Deno Oak HTTP server. Create a new file named `server.ts` in the **src** folder and add the following contents.

src/server.ts

```ts
import { Application, Router } from "./deps.ts";
import type { RouterContext } from "./deps.ts";

const app = new Application();
const router = new Router();

router.get<string>("/api/healthchecker", (ctx: RouterContext<string>) => {
  ctx.response.body = {
    status: "success",
    message: "Build a CRUD API with Deno and DenoDB",
  };
});

app.use(router.routes());
app.use(router.allowedMethods());

app.addEventListener("listen", ({ port, secure }) => {
  console.log(
    `🚀 Server started on ${secure ? "https://" : "http://"}localhost:${port}`
  );
});

const port = 8000;
app.listen({ port });
```

First, we imported the dependencies from the `src/deps.ts` file. As you already know, Oak is the web framework we'll use to build the REST API.

Then, we created an instance of the Oak application class with `new Application()` and assigned it to an `app` variable.

Then, we created an Oak router and added a `/api/healthchecker` route to the middleware pipeline of the router.

Then, we registered the router in the application using `app.use(router.routes())` and allowed the HTTP methods specified in the router.

Then, we added an event listener to the app to log a message in the console when the HTTP server starts listening on the specified port number.

Finally, we called the `app.listen()` method to listen on port **8000** for incoming connections.

To start the Deno HTTP server, we can use the `deno` CLI but since Deno doesn't come with a hot-reloading feature, we'll have to install the **Denon** package which will help us restart the HTTP server upon every file change.

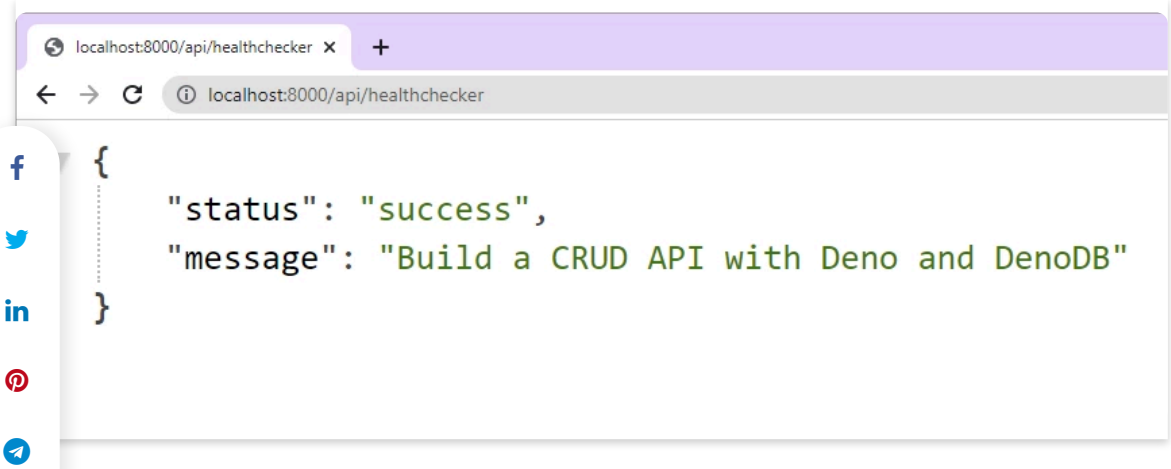
Install the Denon package globally with this command:

```
deno install -qAf --unstable https://deno.land/x/denon/denon.ts
```

All right! Let's start the Deno HTTP server.

```
denon run --allow-net --allow-read --allow-write --allow-env src/server.ts
```

Once the server is listening on port 8000, go to **http://localhost:8000/api/healthchecker** to access the health checker route we just defined.



etup an SQLite Database with DenoDB

n this section, you'll set up DenoDB to store, retrieve, and manage data in an SQLite database. Even though we'll use SQLite as the dialect in this tutorial, you can visit **https://eveningkid.com/denodb-docs/docs/guides/connect-database** to use a supported database connector or client for your dialect.

Connect the App to the Database

DenoDB uses **Deno SQLite** for SQLite support. To connect and manage the SQLite database, we'll import the **SQLite3Connector** from the `src/deps.ts` file and create a new connector.

Next, we'll create a new database with the connector and assign it to a `db` variable. The `db` variable will contain methods for linking and synchronizing the models to the database.

So, create a `connectDB.ts` file in the **src** folder and add the following code snippets.

src/connectDB.ts

```
import { Database, SQLite3Connector } from "./deps.ts";

const connector = new SQLite3Connector({
  filepath: "./database.sqlite",
});

const db = new Database(connector);


```

```
export default db;
```

reate the Database Model

dels represent tables in a SQL database and documents in a NoSQL database. e models will have methods for creating and reading documents or records from underlying NoSQL or SQL database respectively.

eate a **models** folder in the **src** directory and create a `note.model.ts` file in the odels" folder. Open the `note.model.ts` file and add the following code.

src/models/note.model.ts

```
import { Model, DataTypes } from "../deps.ts";

class NoteModel extends Model {
  static table = "notes";

  static fields = {
    id: { type: DataTypes.INTEGER, primaryKey: true },
    title: { type: DataTypes.STRING, unique: true },
    content: { type: DataTypes.STRING },
    category: { type: DataTypes.STRING, allowNull: true },
    createdAt: { type: DataTypes.DATETIME, allowNull: true },
    updatedAt: { type: DataTypes.DATETIME, allowNull: true },
  };
}

export default NoteModel;
```

Let's evaluate the above code. First, we imported the **Model** class and the **DataTypes** utility from the `src/deps.ts` file.

Then, we inherited the Model class to create a NoteModel class and used the static `table` property to change the name of the underlying SQL table. The NoteModel class will be translated into an SQL table by DenoDB.

Then, we defined the fields that DenoDB will convert into columns using the static `fields` property.

Finally, we exported the NoteModel from the file.

Create the Request Validation Schemas

important to validate incoming request data before they even reach the route ndlers. There is a saying that you don't trust user inputs even if you know the rs of the application. Validating the incoming data will prevent users from ding garbage values to the database.

lidation Schemas

w let's create the Zod validation schemas and infer types from them. So, create **chema** folder in the **src** directory and create a **note.schema.ts** file within the **schema** folder. After that, open the newly-created `note.schema.ts` file and add the following schemas.

src/schema/note.schema.ts

```
import { z } from "../deps.ts";

export const createNoteSchema = z.object({
  body: z.object({
    title: z.string({
      required_error: "Title is required",
    }),
    content: z.string({
      required_error: "Content is required",
    }),
    category: z.string().optional(),
  }),
});

const params = {
  params: z.object({
    noteId: z.string(),
  }),
};

export const getNoteSchema = z.object({
  ...params,
});

export const updateNoteSchema = z.object({
  ...params,
  body: z
    .object({
      title: z.string(),
      content: z.string(),
      category: z.string(),
    })
```

```
    .partial(),
});

export const deleteNoteSchema = z.object({
```

ddleware to Validate the Request Bodies

w that we've defined the validation schemas, let's create a middleware that Oa use to validate the incoming request body before calling the next middleware he middleware pipeline if there weren't any validation errors.

s middleware will accept a schema as an argument, parse the schema and urn validation errors to the client if any of the rules defined in the schema was lated.

To do that, create a `validate.ts` file in the **src** folder and add the following content.

src/validate.ts

```ts
import { z, RouterContext, helpers } from "./deps.ts";

const validate =
  (schema: z.AnyZodObject) =>
  async (ctx: RouterContext<string>, next: () => any): Promise<void> => {
    try {
      schema.parse({
        params: ctx.params,
        query: helpers.getQuery(ctx),
        body: await ctx.request.body().value,
      });

      await next();
    } catch (err) {
      if (err instanceof z.ZodError) {
        ctx.response.status = 400;
        ctx.response.body = {
          status: "fail",
          error: err.errors,
        };
        return;
      }
      await next();
    }
  };
export default validate;
```

Add the CRUD Middleware Functions

In this section, you'll create CRUD functions that the Oak router will use to perform the CRUD operations against the database. We'll create the Oak router in a ment after defining all the route handlers.

begin, create a **controllers** folder in the **src** directory and create a `te.controller.ts` file in the "**controllers**" folder. After that, open the newly-ated **note.controller.ts** file and add the following imports.

/controllers/note.controller.ts

```
import { RouterContext } from "../deps.ts";
import NoteModel from "../models/note.model.ts";
import type {
  CreateNoteInput,
  UpdateNoteInput,
} from "../schema/note.schema.ts";
```

CREATE Route Middleware

The first task in CRUD is to create a new record. To do this, we'll create a middleware (route handler or controller) that Oak will evoke when a **POST** request is made to the `/api/notes` endpoint.

So, open the `src/controllers/note.controller.ts` file and add the following code after the import statements.

src/controllers/note.controller.ts

```
const createdAt = new Date();
const updatedAt = createdAt;

const payload = {
  title,
  content,
```

```
    response.status = 201;
    response.body = {
      status: "success",
      note,
    };
  } catch (error) {
    if ((error.message as string).includes("UNIQUE constraint failed")) {
      response.status = 409;
      response.body = {
        status: "fail",
        message: "Note with that title already exists",
      };
      return;
    }
    response.status = 500;
    response.body = { status: "error", message: error.message };
    return;
  }
};
```

Here, we extracted the title, category, and content from the request body by callin the `request.body()` method and accessing the data via the `.value` property.

Next, we defined the **createdAt** and **updatedAt** fields before calling the `NoteModel.create()` method to add the data to the database. Since the **create** method available on a model only returns the ID of the newly-created record instead of the complete record, we had to make another query with the **lastInsertId** to retrieve the record.

Also, since we added a unique constraint on the title field, DenoDB will return an error if the unique constraint was violated. So, we had to handle such errors in the catch block and return a nicely formatted error message to the client.

UPDATE Route Middleware

At this point, we have the logic for creating new records. Now let's create a route handler to update an existing record in the database. This route middleware will be evoked when a **PATCH** request is made to the `/api/notes/:noteId` endpoint.

src/controllers/note.controller.ts

```
// [...] UPDATE Route Middleware
const updateNoteController = async ({
  params,
  request,
```

```
    response,
  }: RouterContext<string>) => {
    try {
      const payload: UpdateNoteInput["body"] = await request.body().value;

      const { affectedRows } = (await NoteModel.where("id", params.noteId).upda
        {
          ...payload,
          updatedAt: new Date(),
        }
      )) as unknown as { affectedRows: number };

      if (affectedRows === 0) {
        response.status = 404;
        response.body = {
          status: "fail",
          message: "No note with that Id exists",
        };
        return;
      }

      const note = await NoteModel.where("id", params.noteId).first();

      response.status = 200;
      response.body = {
        status: "success",
        note,
      };
    } catch (error) {
      response.status = 500;
      response.body = { status: "error", message: error.message };
```

Here, we extracted the incoming data from the request body and assigned it to a **payload** variable.

Then, we called the `NoteModel.where()` method to find the record that matches the ID and evoked the `.update()` method on the query to update the fields of the found record.

Since the `.update()` method only returns an **affectedRows** variable that indicates the number of rows that were updated, we had to fire another query to fetch the newly-updated record.

Single READ Route Middleware

The second task in CRUD is to fetch a record. To do that, we'll create a route handler that Oak will call to retrieve a single record when a **GET** request is made to the `/api/notes/:noteId` endpoint.

Here, we'll extract the `noteId` from the request URL parameters and construct a query with the **WHERE** clause. After that, we'll evoke the `.first()` method to retrieve the first record of the current query.

/controllers/note.controller.ts

```
// [...] Single READ Route Middleware
const findNoteController = async ({
  params,
  response,
}: RouterContext<string>) => {
  try {
    const note = await NoteModel.where("id", params.noteId).first();

    if (!note) {
      response.status = 404;
      response.body = {
        status: "success",
        message: "No note with that Id exists",
      };
      return;
    }

    response.status = 200;
    response.body = {
      status: "success",
      note,
    };
  } catch (error) {
    response.status = 500;
    response.body = { status: "error", message: error.message };
    return;
  }
};
```

Multiple READ Route Middleware

Here, we'll implement another **READ** operation but this time, we'll return a list of selected records. That means this route handler will have a pagination feature where a user can specify **page** or **limit** parameters in the request URL.

src/controllers/note.controller.ts

```
// [...] Multiple READ Route Middleware
const findAllNotesController = async ({
  request,
  response,
}: RouterContext<string>) => {
  try {
```

```
    const page = request.url.searchParams.get("page");
    const limit = request.url.searchParams.get("limit");
    const intPage = page ? parseInt(page) : 1;
    const intLimit = limit ? parseInt(limit) : 10;
    const skip = (intPage - 1) * intLimit;

    const notes = await NoteModel.offset(skip).limit(intLimit).get();

    response.status = 200;
    response.body = {
      status: "success",
      results: notes.length,
      notes,
    };
  } catch (error) {
    response.status = 500;
    response.body = { status: "error", message: error.message };
    return;
  }
};
```

Let's evaluate the above code. **First**, we extracted the page and limit parameters from the request URL and parsed them into integers.

Then, we created a statement to calculate the skip or offset value and assigned it to a **skip** variable.

Then, we constructed a new query with the `.offset()` method and passed the number of records to skip as an argument to it.

Next, we evoked the `.limit()` method to limit the number of results returned from the query and called the `.get()` method to execute the query.

DELETE Route Middleware

The last task in CRUD is to delete a record. To do this, we'll create a route controller that will be evoked to remove a record from the database when a **DELETE** request is made to the `/api/notes/:noteId` endpoint.

Here, we'll extract the `noteId` from the request URL parameters and construct a new database query with the **WHERE** clause. After that, we'll evoke the `.delete()` method to delete the record that matches that ID.

src/controllers/note.controller.ts

```ts
// [...] DELETE Route Middleware
const deleteNoteController = async ({
  params,
  response,
}: RouterContext<string>) => {
  try {
    const note = (await NoteModel.where(
      "id",
      params.noteId
    ).delete()) as unknown as { affectedRows: number };

    if (note.affectedRows === 0) {
      response.status = 404;
      response.body = {
        status: "fail",
        message: "No note with that Id exists",
      };
      return;
    }

    response.status = 204;
  } catch (error) {
    response.status = 500;
    response.body = { status: "error", message: error.message };
    return;
  }
};
```

Complete CRUD Route Middleware

src/controllers/note.controller.ts

```ts
import { RouterContext } from "../deps.ts";
import NoteModel from "../models/note.model.ts";
import type {
  CreateNoteInput,
  UpdateNoteInput,
} from "../schema/note.schema.ts";

// [...] CREATE Route Middleware
const createNoteController = async ({
  request,
  response,
}: RouterContext<string>) => {
  try {
    const { title, category, content }: CreateNoteInput = await request.body(
      .value;

    const createdAt = new Date();
    const updatedAt = createdAt;

    const payload = {
```

```
      title,
      content,
      category: category ? category : "",
      createdAt,
      updatedAt,
    };
    const { lastInsertId } = (await NoteModel.create(payload)) as unknown as
      affectedRows: number;
      lastInsertId: number;
    };

    const note = await NoteModel.where("id", lastInsertId).first();

    response.status = 201;
    response.body = {
      status: "success"
```

Create the CRUD Routes

Now that we've created all the route handlers, let's configure the server to process requests from these routes:

- `/api/notes` – **GET**, **POST**
- `/api/notes/:noteId` – **GET**, **PATCH**, **DELETE**

To do this, we'll add five routes to the Oak router middleware pipeline that the server will use to perform the CRUD operations. Each middleware route will call a route controller to handle the incoming request.

Create a `routes` folder in the `src` directory and within the `routes` folder, create a `note.routes.ts` file and add the following code snippets.

src/routes/note.routes.ts

```
import { Router } from "../deps.ts";
import noteController from "../controllers/note.controller.ts";
import { createNoteSchema, updateNoteSchema } from "../schema/note.schema.ts";
import validate from "../validate.ts";

const router = new Router();

router.get<string>("/", noteController.findAllNotesController);
router.post<string>(
  "/",
  validate(createNoteSchema),
  noteController.createNoteController
);
router.patch<string>(
  "/:noteId",
```

```
  validate(updateNoteSchema),
  noteController.updateNoteController
);
router.get<string>("/:noteId", noteController.findNoteController);
router.delete<string>("/:noteId", noteController.deleteNoteController);

export default router;
```

te a lot is happening in the above code, let's break it down:

st, we imported the necessary dependencies at the top of the file. This includes Zod schemas, the validation middleware, and the route handlers.

Then, we created a new Oak router and assigned it to a `router` variable.

Next, we defined five routes to evoke the CRUD route controllers we created in the `src/controllers/note.controller.ts` file. In addition, we added the `validate()` request bodies are validated against the rules defined in the schemas before the requests reach the route controllers.

Finally, we exported the **router** from the file.

It's now time to register the CRUD router. To do this, create a `index.ts` file in the **routes** folder and add the code below. We could have registered the routers in the `src/server.ts` file but doing it in a different file will make the server file clean. That means, if you've five routers in your application, you can register all of them in the `src/routes/index.ts` file.

src/routes/index.ts

```
import { Application } from "../deps.ts";
import noteRouter from "./note.routes.ts";

function init(app: Application) {
  app.use(noteRouter.prefix("/api/notes/").routes());
}

export default {
  init,
};
```

Register the CRUD Router

ally, we're now ready to link the database model, sync the models with the tabase, and configure the server to accept cross-origin requests from specific mains.

do this, open the `src/server.ts` file and replace its content with the following:

/server.ts

```
const app = new Application();
const router = new Router();

// Middleware Logger
app.use(logger.default.logger);
app.use(logger.default.responseTime);

app.use(
  oakCors({
    origin: /^.+localhost:(3000|3001)$/,
    credentials: true,
  })
);

router.get<string>("/api/healthchecker", (ctx: RouterContext<string>) => {
  ctx.response.body = {
    status: "success",
    message: "Build a CRUD API with Deno and DenoDB",
  };
});

appRouter.init(app);
app.use(router.routes());
app.use(router.allowedMethods());

app.addEventListener("listen", ({ port, secure }) => {
  console.log(
    `🚀 Server started on ${secure ? "https://" : "http://"}localhost:${port}`
  );
});

const port = 8000;

await db.sync({ drop: true });
console.info("✅ Database connected...");
app.listen({ port });
```

We imported the `db` variable from the `src/connectDB.ts` file and called the `db.link()` method to link the models. If you've more than one model, put them in

the array to link them together.

`en, we added the oakCors()` middleware to the middleware pipeline. This will `nfigure the server to accept requests from the provided origins.

`he end of the file, we called db.sync()` method to push the models to the `tabase. This will create the SQL representation of the models in the SQLite `tabase. Also, passing `drop: true` will drop the tables in the database whenever server restarts.

esting the Deno CRUD API

At this point, we are ready to test the Deno CRUD API. Open your terminal and run this command to start the Deno HTTP server.

```
denon run --allow-net --allow-read --allow-write --allow-env src/server.ts
```

Running the above command will start the server on port **8000** and create a `database.sqlite` file in the root directory.

If you decide to test the API with Postman, follow these steps to import the Postman collection I used.

Step 1: Click on the **Import** button in Postman

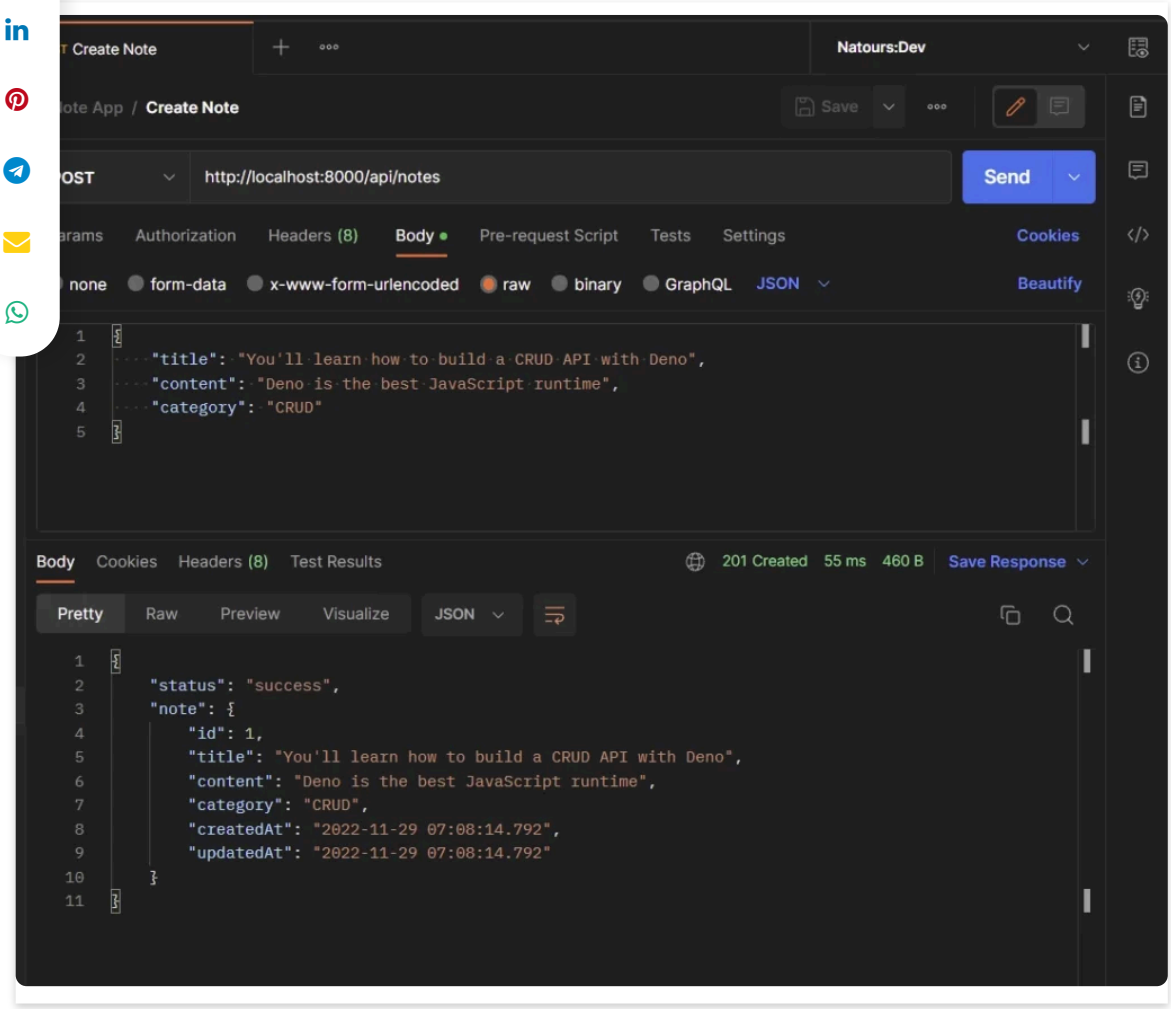
Step 2: Under the **File** tab on the **Import** popup, click on **Choose Files** and navigate to the `Note App.postman_collection.json` file in the Deno CRUD project.

Step 3: Choose the `Note App.postman_collection.json` file and click on the **Import** button under the **Import Elements** tab in Postman to add the new collection.

If you are using **Thunder Client** in VS Code, you can import the same collection to test the API.

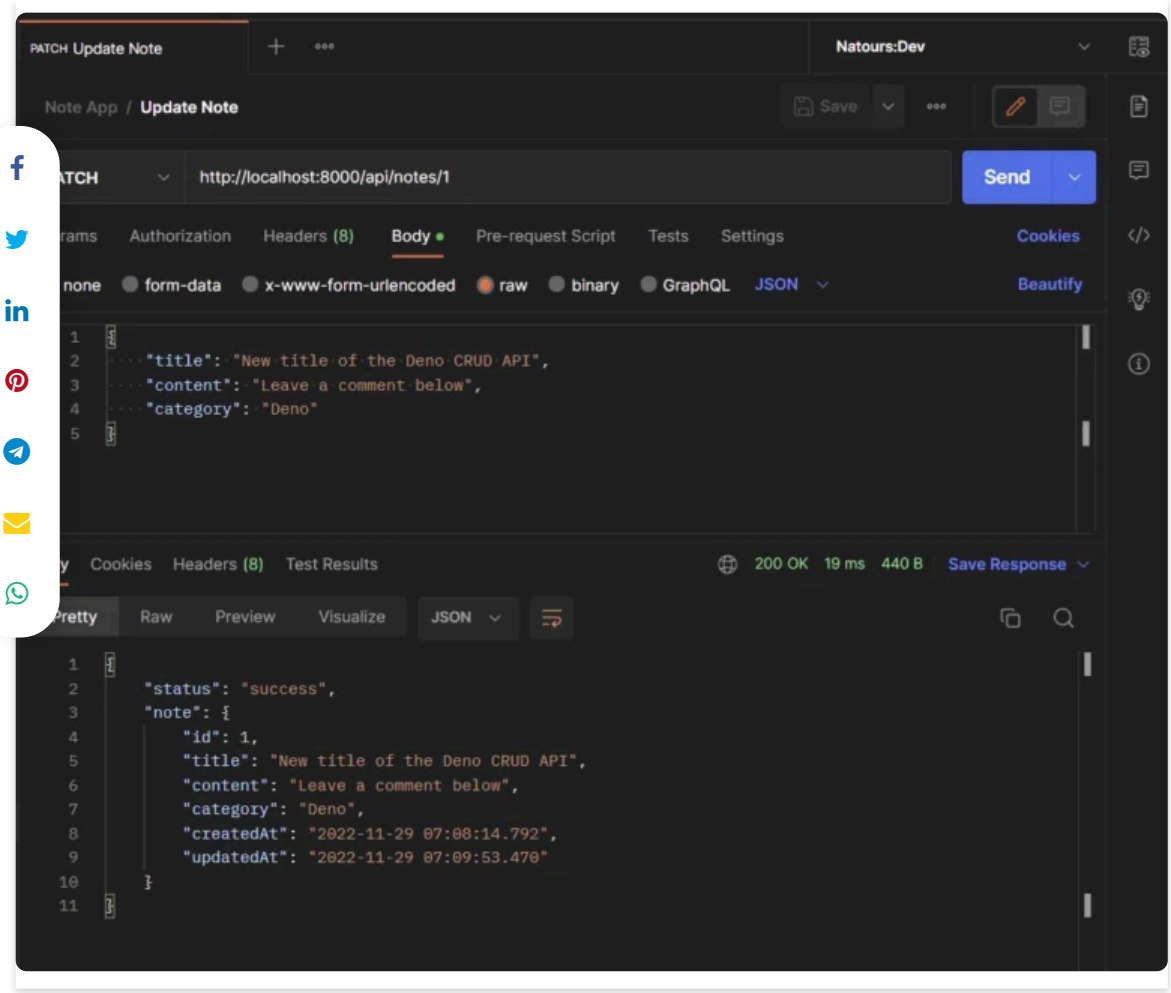
Create a New Record

To create a new record, add the JSON object and make a **POST** request to the `http://localhost:8000/api/notes` endpoint. The Deno API will then validate the uest payload against the schema rules, add the new record to the database, d return the newly-created record.



Update a Record

To update an existing record, edit the JSON object and make a **PATCH** request to the `http://localhost:8000/api/notes/:noteId` endpoint. The Deno API will then retrieve the ID of the record from the request parameters, validate the request body against the schema rules, and update the record that matches that ID in the database.



Get a Single Record

To retrieve a single record, make a **GET** request to the `http://localhost:8000/api/notes/:noteId` endpoint. The Deno API will retrieve the record's ID from the request parameter and query the database to retrieve the record that matches that ID.

Get Multiple Record

To get all the records, make a **GET** request to the `http://localhost:8000/api/notes?page=1&limit=10` endpoint. Since the API has a pagination feature, you can provide page and limit numbers to retrieve a selected list of the records. By default, the API will return only **10 records** if the page and limit parameters were not provided in the request URL.

Delete a Record

To delete a record, make a **DELETE** request to the `http://localhost:8000/api/notes/:noteId` endpoint. The Deno API will extract the record's ID from the request parameters and query the database to remove the record that matches that ID.

Conclusion

Congrats on making it to the end. In this article, you learned how to create a CRUD API with Deno and DenoDB. Take it as a challenge and add authentication to the Deno CRUD API so that only authenticated users can access certain routes.

You can find the complete source code of the Deno CRUD API on **GitHub**.

Download Source Code

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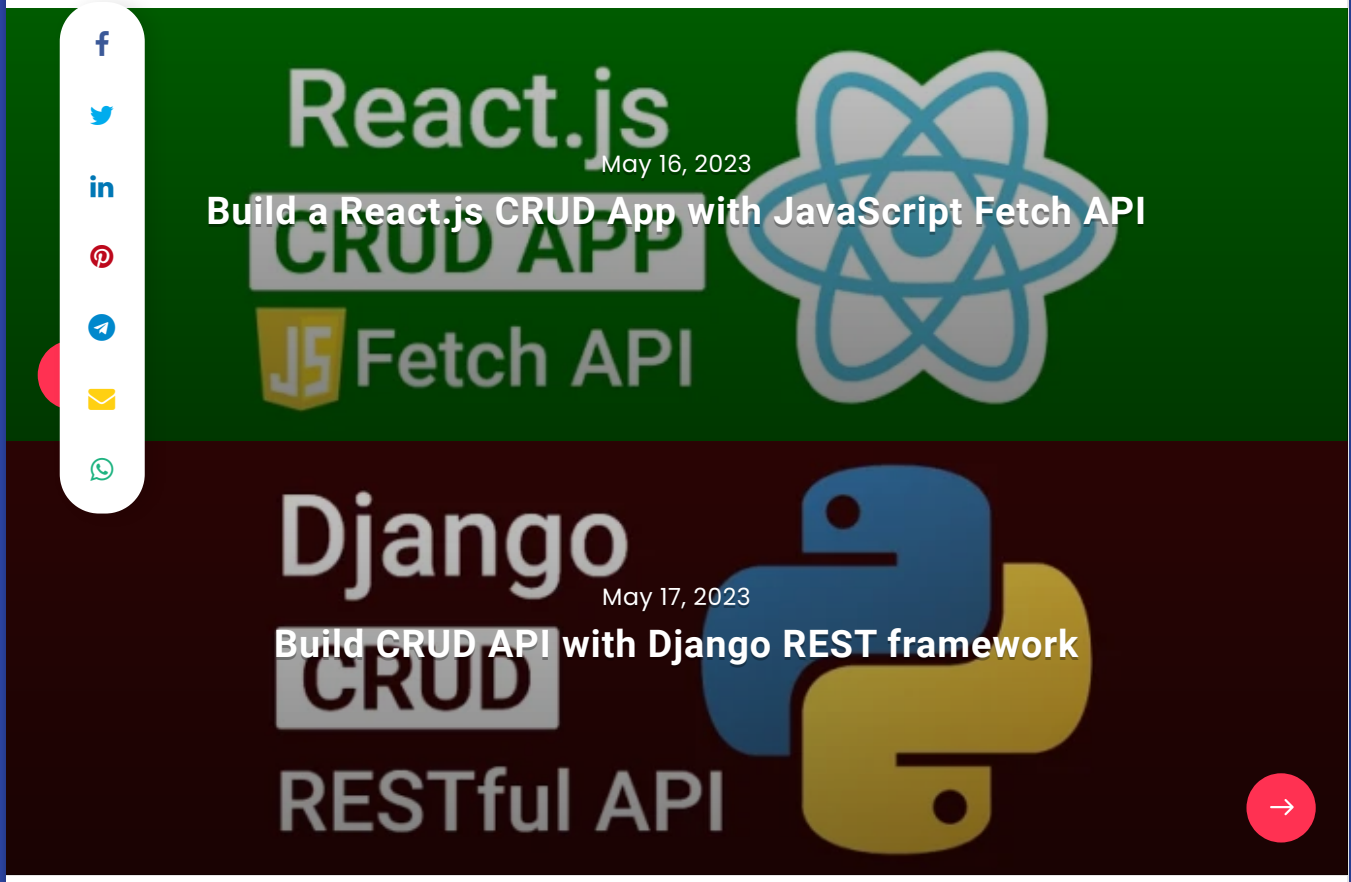

3 Comments

Mark Constable on February 10, 2023

It would be wonderful if you could create a Deno Fresh frontend app to go along with this Build CRUD API with Deno backend.

Reply

Edem on February 10, 2023

Thank you for your suggestion! I'm glad to hear that you would find a Deno Fresh frontend app useful.

I'll definitely consider adding that in the future. Your feedback is greatly appreciated and helps me to create better content.

Reply

Mark Constable on February 10, 2023

Excellent. I will certainly keep an eye out for your Fresh CRUD frontend post.

Reply

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