Lab 2: Setting up GraphQL with Express.js

This lab explains the installation process for Express.js, as well as the configuration of our GraphQL endpoint. We will quickly go through all the essential features of Express.js and the debugging tools for our back end.

This lab covers the following points:

- Express.js installation and explanation
- Routing in Express.js
- Middleware in Express.js
- Binding Apollo Server to a GraphQL endpoint
- Serving static assets with Express.js
- Back end debugging and logging

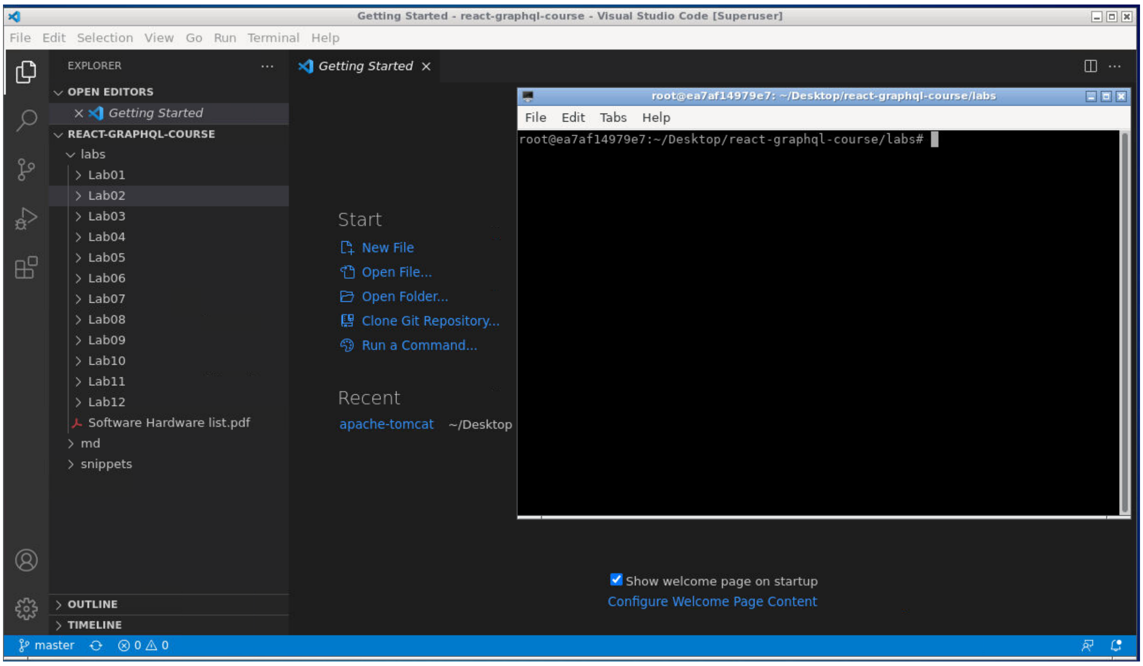
Lab Solution

Complete solution for this lab is available in the following directory:

```
cd ~/Desktop/react-graphql-course/labs/Lab02
```

Install following command to install all required packages:

```
npm install
```



Node.js and Express.js

Installing Express.js is pretty easy. We can use npm in the same way as in the first lab:

```
npm install --save express
```

This command adds the latest version of Express to [package.json].

In the first lab, we created all JavaScript files directly in the [src/client] folder. Now, let's create a separate folder for our server-side code. This separation gives us a tidy directory structure. We will create the folder with the following command:

```
mkdir src/server
```

We can now continue with the configuration of Express.js.

Setting up Express.js

As always, we need a root file loaded with all the main components that combines them to a real application.

Create an [index.js] file in the [server] folder. This file is the starting point for the back end. Here's how we go about it:

1. First, we import [express] from [node_modules], which we just installed. We can use [import] here since our back end gets transpiled by Babel.

```
import express from 'express';
```

2. We initialize the server with the [express] command. The result is stored in the [app] variable. Everything our back end does is executed through this object.

```
const app = express();
```

3. Then, we specify the routes that accept requests. For this straightforward introduction, we accept all HTTP [GET] requests matching any path, by using the [app.get] method. Other HTTP Methods are catchable with [app.post], [app.put], and so on.

```
app.get('*', (req, res) => res.send('Hello World!'));
app.listen(8000, () => console.log('Listening on port 8000!'));
```

To match all paths, you use an asterisk, which generally stands for [any] in the programming environment, as we have done it in the preceding [app.get] line.

The first parameter for all [app.METHOD] functions are the path to match. From here, you can provide an unlimited list of callback functions, which are executed one by one. We are going to look at this feature later in the *Routing with Express.js* section.

A callback always receives the client request as the first parameter and the response as the second parameter, which the server is going to send. Our first callback is going to use the [send] response method.

The [send] function sends merely the HTTP response. It sets the HTTP body as specified. So, in our case, the body shows [Hello World!], and the [send] function takes care of all necessary standard HTTP headers, such as [Content-Length].

The last step to make our server publicly available is to tell Express.js on which port it should listen for requests. In our code, we are using [8000] as the first parameter of [app.listen]. You can replace [8000] with any port or URL you want to listen on. The callback is executed when the HTTP server binding has finished, and requests can be accepted on this port.

This is the easiest setup we can have for Express.js.

Running Express.js in development

To launch our server, we have to add a new script to our [package.json].

We will add the following line to the [scripts] property of the [package.json] file:

```
"server": "nodemon --exec babel-node --watch src/server src/server/index.js"
```

As you can see, we are using a command called [nodemon]. We need to install it first:

```
npm install --save nodemon
```

Nodemon is an excellent tool for running a Node.js application. It can restart your server when the source changes.

For example, to get the above command working follow the steps below:

1. Furthermore, we must install the [@babel/node] package, because we are transpiling the back end code with Babel, using the [--exec babel-node] option. It allows the use of the [import] statement:

```
npm install --save-dev @babel/node
```

Providing [--watch] as the option following a path or file will permanently track changes on that file or folder and reload the server to represent the latest state of your application. The last parameter refers to the actual file being the starting execution point for the back end.

2. Start the server now:

```
npm run server
```

When you now go to your browser and enter [http://localhost:8000], you will see the text [Hello World!] from our Express.js callback function.

Lab 3 covers how Express.js routing works in detail.

Routing in Express.js

Understanding routing is essential to extend our back end code. We are going to play through some simple routing examples.

In general, routing stands for how an application responds to specific endpoints and methods.

In Express.js, one path can respond to different HTTP methods and can have multiple handler functions. These handler functions are executed one by one in the order they were specified in the code. A path can be a simple string, but also a complex regular expression or pattern.

When using multiple handler functions---either provided as an array or multiple parameters---be sure to pass [next] to every callback function. When you call [next], you hand over the execution from one callback function to the next function in the row. Those functions can also be middleware. We'll cover this in the next section.

Here is a simple example. Replace this with the current [app.get] line:

```
app.get('/', function (req, res, next) {
  console.log('first function');
  next();
}, function (req, res) {
  console.log('second function');
```

```
  res.send('Hello World!');
});
```

When you look at the server logs in the terminal, you will see both [first function] and [second function] printed. If you remove the execution of [next] and try to reload the browser tab, the request will time out. This problem occurs because neither [res.send] nor [res.end], or any alternative is called. The second handler function is never executed when [next] is not run.

As previously discussed, the [Hello World!] message is nice but not the best we can get. In development, it is completely okay for us to run two separate servers: one for the front end and one for the back end.

Serving our production build

We can serve our production build of the front end through Express.js. This approach is not great for development purposes but is useful for testing the build process and seeing how our live application will act.

Again, replace the previous routing example with the following:

```
import path from 'path';

const root = path.join(__dirname, '../../');

app.use('/', express.static(path.join(root, 'dist/client')));
app.use('/uploads', express.static(path.join(root, 'uploads')));
app.get('/', (req, res) => {
  res.sendFile(path.join(root, '/dist/client/index.html'));
});
```

The [path] module offers many functionalities for working with the directory structures.

We use the global [__dirname] variable to get our project's root directory. The variable holds the path of the current file. Using [path.join] with [../../] and [__dirname] gives us the real root of our project.

Express.js provides the [use] function which runs a series of commands when a given path matches. When executing this function without a path, it is executed for every request.

We use this feature to serve our static files (the avatar images) with [express.static]. They include [bundle.js] and [bundle.css], created by [npm run client:build].

In our case, we first pass ['/'] with [express.static] following it. The result of this is that all files and folders in [dist] are served beginning with ['/']. Other paths in the first parameter of [app.use], such as ['/example'], would lead to the result that our [bundle.js] would be downloadable under ['/example/bundle.js'] instead.

For example, all avatar images are served under ['/uploads/'].

We are now prepared to let the client download all necessary files. The initial route for our client is ['/'] specified by [app.get]. The response to this path is [index.html]. We run [res.sendFile] and the file path to return this file---that is all we have to do here.

Be sure to execute [npm run client:build] first. Otherwise, you will receive an error message that these files were not found. Furthermore, when running [npm run client], the [dist] folder is deleted, so you have to rerun the build process.

Refreshing the browser now presents you with the *post* feed and form from Lab 1.

The next section focuses on the great functionality of middleware functions in Express.js.

Using Express.js middleware

Express.js provides great ways to write efficient back ends without duplicating code.

Every middleware function receives a request, a response, and [next]. It needs to run [next] to pass control further to the next handler function. Otherwise, you will receive a timeout. Middleware allows us to pre- or post-process the request or response object, execute custom code, and much more. We previously covered a simple example of handling requests in Express.js.

Express.js can have multiple routes for the same path and HTTP method. The middleware can decide which function should be executed.

The following code is an easy example showing what can generally be accomplished with Express.js:

1. The root path ['/'] is used to catch any request.

```
app.get('/', function (req, res, next) {
```

2. We randomly generate a number with [Math.random] between 1 and 10.

```
var random = Math.random() * (10 -1) + 1;
```

3. If the number is higher than [5], we run the [next('route')] function to skip to the next [app.get] with the same path.

```
if (random > 5) next('route')
```

This route will log us ['second'].

4. If the number is lower than [0.5], we execute the [next] function without any parameters and go to the next handler function. This handler will log us ['first'].

```
  else next()
}, function (req, res, next) {
  res.send('first');
})

app.get('/', function (req, res, next) {
  res.send('second');
})
```

You do not need to copy this code as it is just an explanatory example. This functionality can come in handy when covering special treatments such as admin users and error handling.

Installing important middleware

For our application, we have already used one built-in Express.js middleware: [express.static]. Throughout this course, we continue to install further middleware:

```
npm install --save compression cors helmet
```

Now, execute the [import] statement on the new packages inside the server [index.js] file so that all dependencies are available within the file:

```
import helmet from 'helmet';
import cors from 'cors';
import compress from 'compression';
```

Let's see what these packages do and how we can use them.

Express Helmet

Helmet is a tool that allows you to set various HTTP headers to secure your application.

We can enable the Express.js Helmet middleware as follows in the server [index.js] file:

```
app.use(helmet());
app.use(helmet.contentSecurityPolicy({
  directives: {
    defaultSrc: ["'self'"],
    scriptSrc: ["'self'", "'unsafe-inline'"],
    styleSrc: ["'self'", "'unsafe-inline'"],
    imgSrc: ["'self'", "data:", "*.amazonaws.com"]
  }
}));
app.use(helmet.referrerPolicy({ policy: 'same-origin' }));
```

We are doing multiple things here at once. We add some **XSS(Cross-Site-Scripting)** protection tactics and remove the [X-Powered-By] HTTP header and some other useful things just by using the [helmet()] function in the first line.

ProTip

You can look up the default parameters, as well as other functionalities of Helmet, at, https://github.com/helmetjs/helmet. Always be conscious when implementing security features and do your best to verify your attack protection methods.

Furthermore, to ensure that no one can inject malicious code, we are using the [Content-Security-Policy] HTTP header or, in short, CSP. This header prevents attackers from loading resources from external URLs.

As you can see, we also specify the [imgSrc] field, which tells our client that only images from these URLs should be loaded, including **Amazon Web Services** (**AWS**). We will see how to upload images to it in Lab 7, of this course.

Read more about CSP and how it can make your platform more secure at, https://helmetjs.github.io/docs/csp/.

The last enhancement is to set the [Referrer] HTTP header only when making requests on the same host. When going from domain A to domain B, for example, we do not include the referrer, which is the URL the user is coming from. This enhancement stops any internal routing or requests being exposed to the internet.

It is important to initialize Helmet very high in your Express router so that all responses are affected.

Compression with Express.js

Enabling compression for Express.js saves you and your user bandwidth, and this is pretty easy to do. The following code must also be added to the server [index.js] file:

```
app.use(compress());
```

This middleware compresses all responses going through it. Remember to add it very high in your routing order so that all requests are affected.

ProTip

Whenever you have middleware like this, or multiple routes matching the same path, you need to check the initialization order. The first matching route is executed unless you run the [next] command. All routes that are defined afterward will not be executed.

CORS in Express.js

We want our GraphQL API to be accessible from any website, app, or system. A good idea might be to build an app or offer the API to other companies or developers so that they can use it. When using APIs via Ajax, the main problem is that the API needs to send the correct [Access-Control-Allow-Origin] header.

For example, if you build the API, publicize it under [https://api.example.com], and try to access it from [https://example.com] without setting the correct header, it won't work. The API would need to set at least [example.com] inside the [Access-Control-Allow-Origin] header to allow this domain to access its resources. It seems a bit tedious, but it makes your API open to cross-site requests which you should always be aware of.

Allow **CORS (Cross-origin resource sharing)** requests with the following command to the [index.js] file:

```
app.use(cors());
```

This command handles all of the problems we usually have with cross-origin requests at once. It merely sets a wildcard with [*] inside of [Access-Control-Allow-Origin], allowing anyone from anywhere to use your API, at least in the first instance. You can always secure your API by offering API keys or by only allowing access to logged-in users. Enabling CORS only allows the requesting site to receive the response.

Furthermore, the command also implements the [OPTIONS] route for the whole application.

The [OPTIONS] method or request is made every time we use [Cross-origin resource sharing]. This action is what's called a **preflight request**, which ensures that the responding server trusts you. If the server does not respond correctly to the [OPTIONS] preflight, the actual method, such as [POST], will not be made by the browser at all.

Our application is now ready to serve all routes appropriately and respond with the right headers.

We can move on now and finally set up a GraphQL server.

Combining Express.js with Apollo

First things first; we need to install the Apollo and GraphQL dependencies:

```
npm install --save apollo-server-express graphql graphql-tools
```

Apollo offers an Express.js-specific package that integrates itself into the web server. There is also a standalone version without Express.js. Apollo allows you to use the available Express.js middleware. In some scenarios, you may need to offer non-GraphQL routes to proprietary clients who do not implement GraphQL or are not able to understand JSON responses. There are still reasons to offer some fallbacks to GraphQL. In those cases, you can rely on Express.js, since you are already using it.

Create a separate folder for services. A service can be GraphQL or other routes:

```
mkdir src/server/services/
mkdir src/server/services/graphql
```

Our GraphQL service must handle multiple things for initialization. Let's go through all of them one by one:

1. We require the [apollo-server-express] and [graphql-tools] packages.

```
import { ApolloServer } from 'apollo-server-express';
import { makeExecutableSchema } from 'graphql-tools';
```

2. We must combine the GraphQL schema with the [resolver] functions. We import the corresponding schema and resolver functions at the top from separate files. The GraphQL schema is the representation of the API, that is, the data and functions a client can request or run. Resolver functions are the implementation of the schema. Both need to match 100 percent. You cannot return a field or run a mutation that is not inside the schema.\

```
import Resolvers from './resolvers';
import Schema from './schema';
```

3. The [makeExecutableSchema] function of the [graphql-tools] package merges the GraphQL schema and the resolver functions, resolving the data we are going to write. The [makeExecutableSchema] function throws an error when you define a query or mutation that is not in the schema. The resulting schema is executable by our GraphQL server resolving the data or running the mutations we request.\

```
const executableSchema = makeExecutableSchema({
  typeDefs: Schema,
  resolvers: Resolvers
});
```

4. We pass this as a [schema] parameter to the Apollo Server. The [context] property contains the [request] object of Express.js. In our resolver functions, we can access the request if we need to.\

```
const server = new ApolloServer({
  schema: executableSchema,
  context: ({ req }) => req
});
```

5. This [index.js] file exports the initialized server object, which handles all GraphQL requests.\

```
export default server;
```

Now that we are exporting the Apollo Server, it needs to be imported somewhere else, of course. I find it convenient to have one [index.js] file on the services layer so that we only rely on this file if a new service is added.

Create an [index.js] file in the [services] folder and enter the following code:

```
import graphql from './graphql';

export default {
  graphql,
};
```

The preceding code requires our [index.js] file from the [graphql] folder and re-exports all services in one big object. We can define further services here if we need them.

To make our GraphQL server publicly accessible to our clients, we are going to bind the Apollo Server to the [/graphql] path.

Import the services [index.js] file in the [server/index.js] file as follows:

```
import services from './services';
```

The [services] object only holds the [graphql] index. Now we must bind the GraphQL server to the Express.js web server with the following code:

```
const serviceNames = Object.keys(services);

for (let i = 0; i < serviceNames.length; i += 1) {
  const name = serviceNames[i];
  if (name === 'graphql') {
    services[name].applyMiddleware({ app });
  } else {
    app.use(`/${name}`, services[name]);
  }
}
```

For convenience, we loop through all indexes of the [services] object and use the index as the name of the route the service will be bound to. The path would be [/example] for the [example] index in the [services] object. For a typical service, such as a REST interface, we rely on the standard [app.use] method of Express.js.

Since the Apollo Server is kind of special, when binding it to Express.js, we need to run the [applyMiddleware] function provided by the initialized Apollo Server and avoid using the [app.use] function of Express.js. Apollo automatically binds itself to the [/graphql] path because it is the default option. You could also include a [path] parameter if you want it to respond from a custom route.

Two things are missing now: the schema and the resolvers. The schema is next on our to-do list.

Writing your first GraphQL schema

Let's start by creating a [schema.js] inside the [graphql] folder. You can also stitch multiple smaller schemas to one bigger schema. This would be cleaner and would make sense when your application, types, and fields grow. For this course, one file is okay and we insert the following code into the [schema.js] file:

```
const typeDefinitions = `
  type Post {
    id: Int
    text: String
  }

  type RootQuery {
    posts: [Post]
  }

  schema {
    query: RootQuery
  }
`;

export default [typeDefinitions];
```

The preceding code represents a basic schema, which would be able to at least serve the fake posts array from Lab 1, excluding the users.

First, we define a new type called [Post]. A [Post] type has [id] as [Int] and [text] as [String].

For our GraphQL server, we need a type called [RootQuery]. The [RootQuery] type wraps all of the queries a client can run. It can be anything from requesting all posts, all users, or posts by just one user, and so on. You can compare this to all [GET] requests as you find them with a common REST API. The paths would be [/posts], [/users], and [/users/ID/posts] to represent the GraphQL API as a REST API. When using GraphQL, we only have one route, and we send the query as a JSON-like object.

The first query we will have is going to return an array of all of the posts we have got.

If we query for all posts and want to return each user with its corresponding post, this would be a sub-query that would not be represented in our [RootQuery] type but in the [Post] type itself. You will see how it is done later.

At the end of the JSON-like schema, we add [RootQuery] to the [schema] property. This type is the starting point for the Apollo Server.

Later, we are going to add the mutation key to the schema where we implement a [RootMutation] type. It is going to serve all of the actions a user can run. Mutations are comparable to the [POST], [UPDATE], [PATCH], and [DELETE] requests of a REST API.

At the end of the file, we export the schema as an array. If we wanted to, we could push other schemas to this array to merge them.

The last thing missing here is the implementation of our resolvers.

Implementing GraphQL resolvers

Now that the schema is ready, we need the matching resolver functions.

Create a [resolvers.js] file in the [graphql] folder as follows:

```
const resolvers = {
  RootQuery: {
    posts(root, args, context) {
      return [];
    },
  },
};

export default resolvers;
```

The [resolvers] object holds all types as a property. We set up [RootQuery], holding the [posts] query in the same way as we did in our schema. The [resolvers] object must equal the schema but recursively merged. If you want to query a subfield, such as the user of a post, you have to extend the [resolvers] object with a [Post] object containing a [user] function next to [RootQuery].

If we send a query for all posts, the [posts] function is executed. There, you can do whatever you want, but you need to return something that matches the schema. So, if you have an array of [posts] as the response type of [RootQuery], you cannot return something different, such as just one post object instead of an array. In that case, you would receive an error.

Furthermore, GraphQL checks the data type of every property. If [id] is defined as [Int], you cannot return a regular MongoDB [id] since these ids are of type [String]. GraphQL would throw an error too.

ProTip

GraphQL will parse or cast specific data types for you if the value type is matching. For example, a [string] with the value of [2.1] is parsed to [Float] without any problems. On the other hand, an empty string cannot be converted to [Float], and an error would be thrown. It is better to directly have the correct data types, because this saves you casting and also prevents unwanted problems.

Our [posts] query will return an empty array, which would be a correct response for GraphQL. We will come back to the [resolver] functions later, but it is okay for the moment. You should be able to start the server again.

Sending GraphQL queries

We can test this query using any HTTP client, such as Postman, Insomnia, or any you are used to. This course covers HTTP clients in the next section of this lab. If you want to send the following queries on your own, you can read the next section and come back here.

You can test our new function when you send the following JSON as a [POST] request to [http://localhost:8000/graphql]:

```
{
  "operationName": null,
  "query": "{
    posts {
      id
      text
    }
  }",
  "variables": {}
}
```

The [operationName] field is not required to run a query, but it is great for logging purposes.

The [query] object is a JSON-like representation of the query we want to execute. In this example, we run the [RootQuery] posts and request the [id] and [text] fields of every post. We do not need to specify [RootQuery] because it is the highest layer of our GraphQL API.

The [variables] property can hold parameters such as user the ids by which we want to filter the posts, for example. If you want to use [variables], they need to be defined in the query by their name too.

For developers who are not used to tools like Postman, there is also the option to open the GraphQL endpoint in a separate browser tab. You will be presented with a GraphQLi instance made for sending queries easily. Here, you can insert the content of the [query] property and hit the play button. Because we set up Helmet to secure our application, we need to deactivate it in development. Otherwise, the GraphQLi instance is not going to work. Just wrap the Helmet initialization inside this [if] statement:

```
if(process.env.NODE_ENV === 'development')
```

This short condition only activates Helmet when the environment is in development. Now you can send the request with GraphQLi or any HTTP client.

The resulting answer of [POST] should look like the following code snippet:

```
{
  "data": {
    "posts": []
```

```
  }
}
```

We received the empty posts array as expected.

Going further, we want to respond with the fake data we statically wrote in our client to come from our back end. Copy the [posts] array from [App.js] above the [resolvers] object. We can respond to the GraphQL request with this filled [posts] array.

Replace the content of the [posts] function in the GraphQL resolvers with this:

```
return posts;
```

You can rerun the [POST] request and receive both fake posts. Apparently, the response does not include the user object we have in our fake data. We must define a user property on the [post] type in our schema to fix this issue.

Using multiples types in GraphQL schemas

Let's create a [User] type and use it with our posts. First, add it somewhere to the schema:

```
type User {
  avatar: String
  username: String
}
```

Now that we have a [User] type, we need to use it inside the [Post] type. Add it to the [Post] type as follows:

```
user: User
```

The [user] field allows us to have a sub-object inside our posts with the post's author information.

Our extended query to test this looks like the following:

```
"query":"{
  posts {
    id
    text
    user {
      avatar
      username
    }
  }
}"
```

You cannot just specify the user as a property of the query. Instead, you need to provide a sub-selection of fields. This is required whenever you have multiple GraphQL types stacked inside each other. Then, you need to select the fields your result should contain.

Running the updated query gives us the fake data, which we already have in our front end code; just the [posts] array as it is.

We have made good progress with querying data, but we also want to be able to add and change data.

Writing your first GraphQL mutation

One thing our client already offered was to add new posts to the fake data temporarily. We can realize this in the back end by using GraphQL mutations.

Starting with the schema, we need to add the mutation as well as the input types as follows:

```
input PostInput {
  text: String!
}

input UserInput {
  username: String!
  avatar: String!
}

type RootMutation {
  addPost (
    post: PostInput!
    user: UserInput!
  ): Post
}
```

GraphQL inputs are not more than types. Mutations can use them as parameters inside requests. They may look weird, because our current output types look almost the same. However, it would be wrong to have an [id] property on [PostInput], for example, since the back end chooses the id and the client cannot give it. Consequently, it does make sense to have separate objects for input and output types.

The [addPost] function receiving our two new required input types---[PostInput] and [UserInput], is a new feature here. Those functions are called mutations, since they mutate the current state of the application. The response to this mutation is an ordinary [Post] object. When creating a new post with the [addPost] mutation, we will directly get the created post from the back end in response.

The exclamation mark in the schema tells GraphQL that the field is a required parameter.

The [RootMutation] type corresponds to the [RootQuery] type and is an object that holds all of our GraphQL mutations.

The last step is to enable the mutations in our schema for the Apollo Server:

```
schema {
  query: RootQuery
  mutation: RootMutation
}
```

ProTip

Usually, the client does not send the user with the mutation. This is because the user is authenticated first, before adding a post, and through that, we already know which user initiated the Apollo request. However, we can ignore this for the moment and implement authentication later in Lab 6.

The [addPost] resolver function needs to be implemented now in the [resolvers.js] file.

Add the following [RootMutation] object to the [RootQuery] in [resolvers.js]:

```
RootMutation: {
  addPost(root, { post, user }, context) {
    const postObject = {
```

```
      ...post,
      user,
      id: posts.length + 1,
    };
    posts.push(postObject);
    return postObject;
  },
},
```

This resolver extracts the `post` and `user` objects from the mutation's parameters, which are passed in the second argument of the function. Then, we build the `postObject` variable. We want to add our `posts` array as property by destructuring the `post` input and adding the `user` object. The `id` field is just the length of the `posts` array plus one.

The `postObject` variable looks like a `post` from the `posts` array now. Our implementation does the same as the front end is already doing. The return value of our `addPost` function is the `postObject`. To get this working, you need to change the initialization of the `posts` array from `const` to `let`. Otherwise, the array will be static and unchangeable.

You can run this mutation via your preferred HTTP client like this:

```
{
  "operationName": null,
  "query": "mutation addPost($post : PostInput!, $user: UserInput!) {
    addPost(post : $post, user: $user) {
      id
      text
      user {
        username
        avatar
      }
    }
  }",
  "variables": {
    "post": {
      "text": "You just added a post."
    },
    "user": {
      "avatar": "/uploads/avatar3.png",
      "username": "Fake User"
    }
  }
}
```

Here, we are using the [variables] property to send the data we want to insert in our back end. We need to pass them as parameters within the [query] string. We define both parameters with a dollar sign and the awaited data type inside the [operation] string. Those variables marked with a dollar sign can then be mapped into the actual action we want to trigger on the back end. Again, we need to send a selection of fields our response should have.

The result will have a [data] object including an [addPost] field. The [addPost] field holds the post, which we send with our request.

Query the posts again, and you will see that there are now three posts. Great, it worked!

As with our client, this is only temporary until we restart the server. Next, we'll cover the various ways to debug your back end properly.

Back end debugging and logging

There are two things that are very important here: the first is that we need to implement logging for our back end in case we receive errors from our users, and the second is that we need to look into Postman to debug our GraphQL API efficiently.

So, let's get started with logging.

Logging in Node.js

The most popular logging package for Node.js is called [winston]. Configure [winston] by following the steps below:

1. Install [winston] with npm:

```
npm install --save winston
```

2. We create a new folder for all of the helper functions of the back end:

```
mkdir src/server/helpers
```

3. Then, insert a [logger.js] file in the new folder with the following content:

```
import winston from 'winston';

let transports = [
  new winston.transports.File({
    filename: 'error.log',
    level: 'error',
  }),
  new winston.transports.File({
    filename: 'combined.log',
    level: 'verbose',
  }),
];

if (process.env.NODE_ENV !== 'production') {
  transports.push(new winston.transports.Console());
}

const logger = winston.createLogger({
  level: 'info',
  format: winston.format.json(),
  transports,
});

export default logger;
```

This file can be imported everywhere where we want to log.

In the preceding code, we defined the standard [transports] for [winston]. A transport is nothing more than the way in which [winston] separates and saves various log types in different files.

The first [transport] generates an [error.log] file where only real errors are saved.

The second transport is a combined log where we save all other log messages, such as warnings or info logs.

If we are running the server in a development environment, which we are currently doing, we add a third transport. We will also directly log all messages to the console while developing on the server.

Most people who are used to JavaScript development know the difficulty with [console.log]. By directly using [winston], we can see all messages in the terminal, but we do not need to clean the code from [console.log] either, as long as the things we log make sense, of course.

To test this, we can try the [winston] logger in the only mutation we have.

In [resolvers.js], add this to the top of the file:

```
import logger from '../../helpers/logger';
```

Now, we can extend the [addPost] function by logging the following:

```
logger.log({ level: 'info', message: 'Post was created' });
```

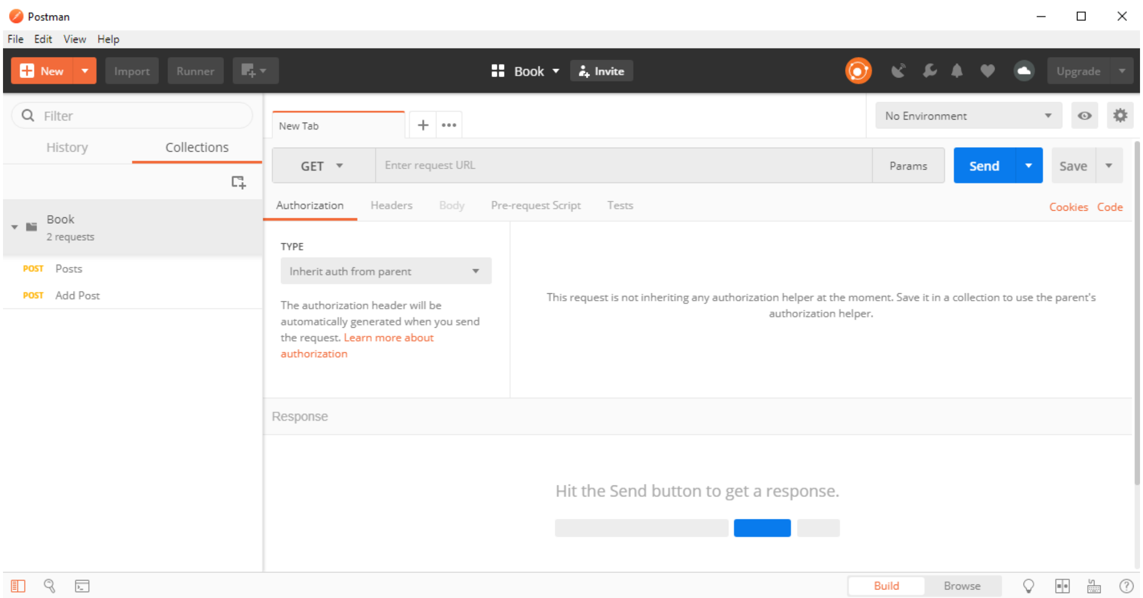
When you send the mutation now, you will see that the message was logged to the console.

Furthermore, if you look in the root folder of your project, you will see the [error.log] and [combined.log] files. The [combined.log] file should contain the log from the console.

Now that we can log all operations on the server, we should explore Postman to send requests comfortably.

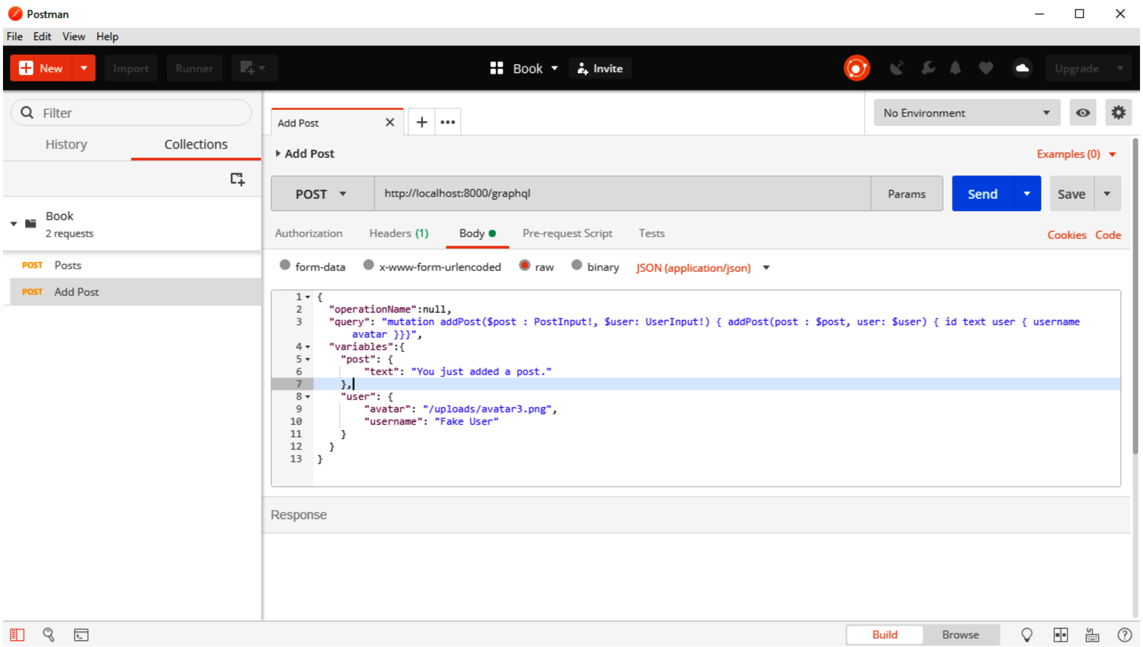
Debugging with Postman

Postman is already installed. Start application from icon on desktop, it should look something like this:



As you can see, I have already created a collection called [Book] in the left-hand panel. This collection includes our two requests: one to request all posts and one to add a new post.

As an example, the following screenshot shows you how the [Add Post] mutation looks in Postman:



The request body looks pretty much like what we saw before.

ProTip

In my case, I need to write the query inline because Postman is not able to handle multi-row text inside JSON. If this is not the case for you, please ignore it.

Be sure to select [application/json] as [Content-Type] next to the [raw] format.

The URL is localhost, including port [8000] as expected.

If you add a new request, you can use the [Ctrl + S] shortcut to save it. You need to select a collection and a name to save it

Summary

At this point, we have set up our Node.js server with Express.js and bound Apollo Server to respond to requests on a GraphQL endpoint. We are able to handle queries, return fake data, and mutate that data with GraphQL mutations.

Furthermore, we can log every process in our Node.js server. Debugging an application with Postman leads to a well-tested API, which can be used later in our front end.

In the next lab, we will learn how to persist data in a SQL server. We will also implement models for our GraphQL types and cover migrations for our database. We need to replace our current [resolver] functions with queries via Sequelize.