Lab 5: Connecting to The Database (DEMO)

This lab will cover the following points:

- Using databases with GraphQL
- Writing database models
- Using Apollo together with Sequelize

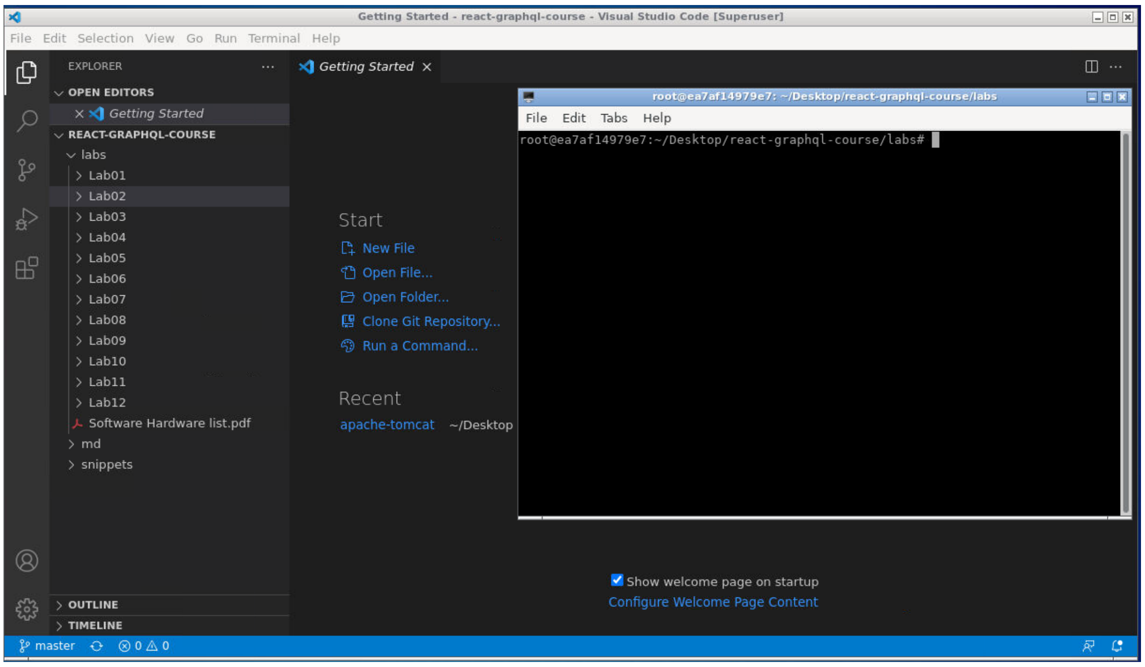
Lab Solution

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

```
cd ~/Desktop/react-graphql-intro/labs/Lab05
```

Run following command to install all required packages:

```
npm install
```



```
root@ea7af14979e7:~/Desktop/react-graphql-course/labs#
```

Start MySQL and phpMyAdmin

```
service mysql start

service apache2 start
```

Running Solution

Run following commands to run application:

```
npm run client:build
```

```
npm run server
```

MySQL and phpMyAdmin

MySQL is already installed and running. Execute the following steps to get MySQL running:

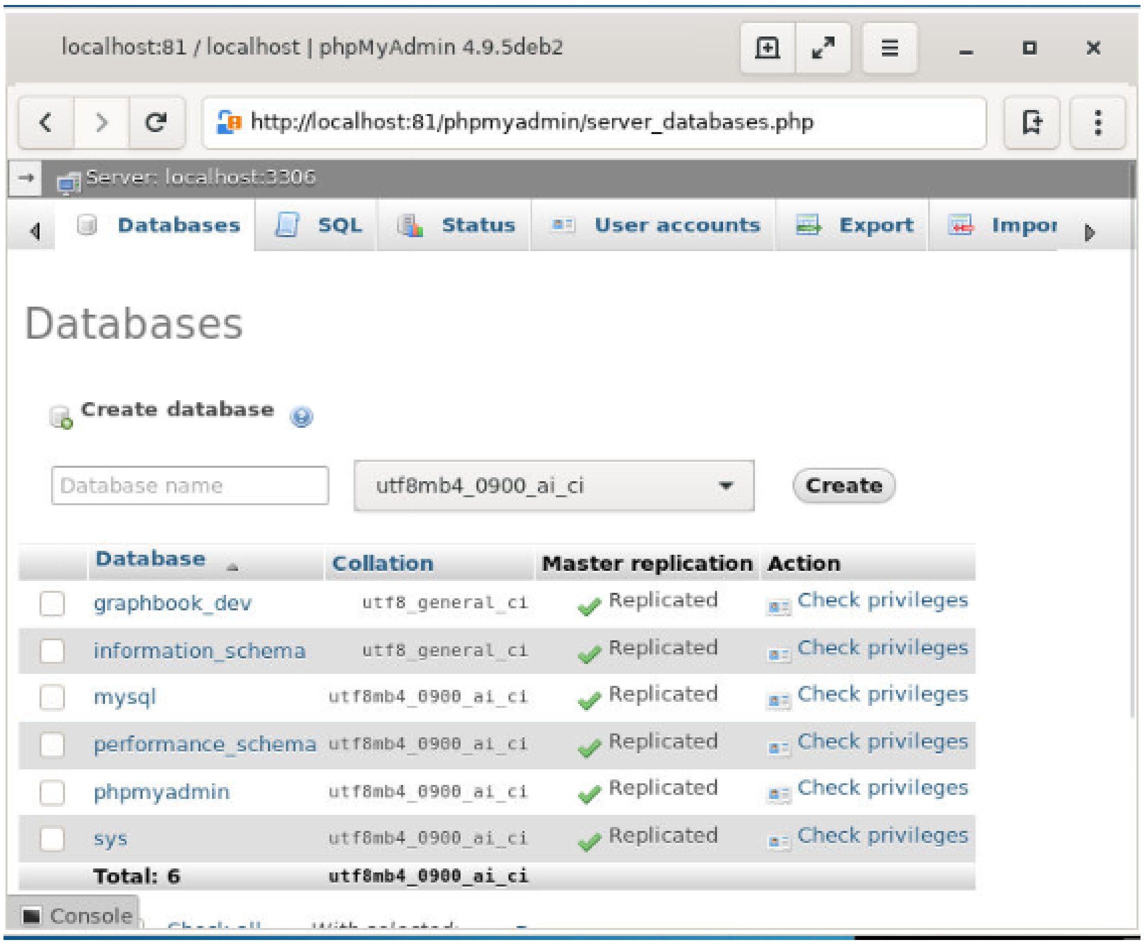
1. Verify that mysql server is running:

```
service mysql status
```

2. User called `devuser` has been created for development with password `PASSWORD`.

PhpMyAdmin (Optional)

We can now visit phpMyAdmin under [http://localhost:81/phpmyadmin] and log in with the devuser. It should look like the following screenshot:



Databases

utf8mb4_0900_ai_ci

	Database	Collation	Master replication	Action
	graphbook_dev	utf8_general_ci	✓ Replicated	Check privileges
	information_schema	utf8_general_ci	✓ Replicated	Check privileges
	mysql	utf8mb4_0900_ai_ci	✓ Replicated	Check privileges
	performance_schema	utf8mb4_0900_ai_ci	✓ Replicated	Check privileges
	phpmyadmin	utf8mb4_0900_ai_ci	✓ Replicated	Check privileges
	sys	utf8mb4_0900_ai_ci	✓ Replicated	Check privileges
	Total: 6	utf8mb4_0900_ai_ci		

Connecting to a database with Sequelize

Inside of the `index.js` database, we have established a connection to our database with Sequelize. Internally, Sequelize relies on the [mysql2] package, but we do not use it on our own, which is very convenient:

```
import Sequelize from 'sequelize';

const sequelize = new Sequelize('graphbook_dev', 'devuser', 'PASSWORD', {
 host: 'localhost',
  dialect: 'mysql',
  operatorsAliases: false,
  pool: {
    max: 5,
    min: 0,
    acquire: 30000,
    idle: 10000,
  },
});

export default sequelize;
```

Using a configuration file with Sequelize

For this, we have created a new `index.js` file inside a separate folder (called `config`), next to the `database` folder in following directory:

Action: Review File: `~/Desktop/react-graphql-intro/labs/Lab05/src/server/config/index.js`

```
module.exports = {
  "development": {
    "username": "devuser",
    "password": "PASSWORD",
    "database": "graphbook_dev",
    "host": "localhost",
    "dialect": "mysql",
    "operatorsAliases": false,
    "pool": {
      "max": 5,
      "min": 0,
      "acquire": 30000,
      "idle": 10000
    }
  },
  "production": {
    "host": process.env.host,
    "username": process.env.username,
    "password": process.env.password,
    "database": process.env.database,
    "logging": false,
    "dialect": "mysql",
    "operatorsAliases": false,
    "pool": {
      "max": 5,
      "min": 0,
      "acquire": 30000,
      "idle": 10000
    }
  }
}
```

We can remove the configuration that we hardcoded earlier and replace the contents of our `index.js` database file to require our [configFile], instead.

Action: Review File: `~/Desktop/react-graphql-intro/labs/Lab05/src/server/database/index.js`

This should look like the following code snippet:

```
import Sequelize from 'sequelize';
import configFile from '../config/';

const env = process.env.NODE_ENV || 'development';
const config = configFile[env];

const sequelize = new Sequelize(config.database, config.username,
 config.password, config);

const db = {
  sequelize,
};

export default db;
```

Writing database models

Currently, we have two GraphQL entities: [User] and [Post]. We have created the first model for our posts. Created two new folders (one called [models], and the other, [migrations]) next to the [database] folder:

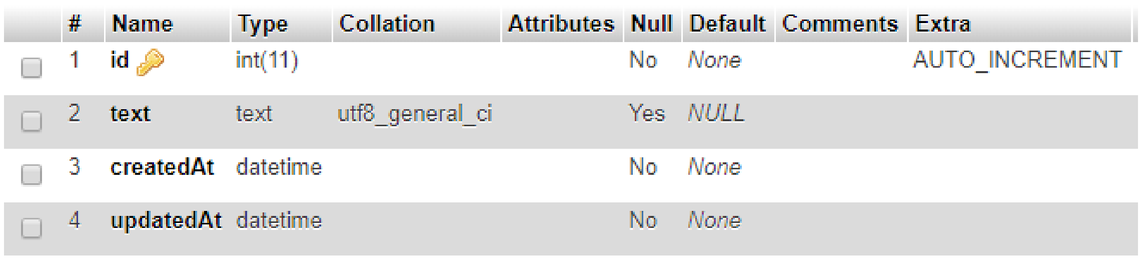
Action: Review Folder: `~/Desktop/react-graphql-intro/labs/Lab05/src/server/models`

Database migrations

Database migrations have been executed already in MYSQL database:

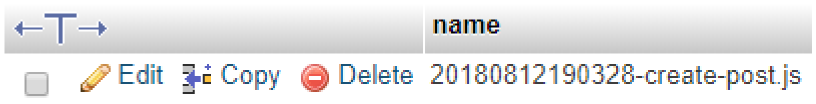
Action: Review Folder: `~/Desktop/react-graphql-intro/labs/Lab05/src/server/migrations`

Look inside of phpMyAdmin. Here, you will find table, called [Posts]. The structure of the table should look as follows:



	#	Name	Type	Collation	Attributes	Null	Default	Comments	Extra
☐	1	id	int(11)			No	None		AUTO_INCREMENT
☐	2	text	text	utf8_general_ci		Yes	NULL		
☐	3	createdAt	datetime			No	None		
☐	4	updatedAt	datetime			No	None		

Every time that you use Sequelize and its migration feature, you will have an additional table, called [SequelizeMeta]. The contents of the table should look as follows:



←T→	name
Edit Copy Delete	20180812190328-create-post.js

Importing models with Sequelize

Action: Review File: `~/Desktop/react-graphql-intro/labs/Lab05/src/server/models/index.js`

Review `index.js` file in the [models] folder, it will have following code:

```
import Sequelize from 'sequelize';
if (process.env.NODE_ENV === 'development' || true) {
  require('babel-plugin-require-context-hook/register')()
}

export default (sequelize) => {
  let db = {};

  const context = require.context('.', true, /^\.\/(?!index\.js).*\.js$/,
   'sync')
  context.keys().map(context).forEach(module => {
    const model = module(sequelize, Sequelize);
    db[model.name] = model;
  });

  Object.keys(db).forEach((modelName) => {
    if (db[modelName].associate) {
      db[modelName].associate(db);
    }
  });

  return db;
};
```

To summarize what happens in the preceding code, we search for all files ending with [.js] in the same folder as the current file, and load them all with the [require.context] statement. In development, we must execute the [babel-plugin-require-context-hook/register] hook to load the [require.context] function at the top.

Action: Review File: `~/Desktop/react-graphql-intro/labs/Lab05/src/server/database/index.js`

Now, we want to use our models. Go back to the `index.js` database file and import all models through the aggregation `index.js` file that we just created:

```
import models from '../models';
```

Before exporting the [db] object at the end of the file, we need to run the [models] wrapper to read all model [.js] files. We pass our Sequelize instance as a parameter, as follows:

```
const db = {
  models: models(sequelize),
  sequelize,
};
```

We create the global database instance in the `index.js` file of the root server folder. Add the following code:

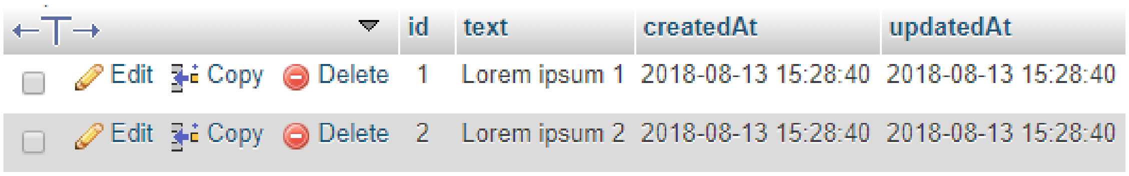
```
import db from './database';
```

Seeding data with Sequelize

Seeds have been executed already in MYSQL database:

Action: Review Folder: `~/Desktop/react-graphql-intro/labs/Lab05/src/server/seeders`

The following screenshot shows a filled [Posts] table:



		id	text	createdAt	updatedAt
☐	Edit Copy Delete	1	Lorem ipsum 1	2018-08-13 15:28:40	2018-08-13 15:28:40
☐	Edit Copy Delete	2	Lorem ipsum 2	2018-08-13 15:28:40	2018-08-13 15:28:40

You can start the server with following commands:

```
cd ~/Desktop/react-graphql-intro/labs/Lab05

npm run server
```

After that, execute the GraphQL posts query from Lab 4 again:

```
{
  posts {
    id
    text
    user {
      avatar
      username
    }
  }
}
```

The output will look as follows:

```
{
  "data": {
    "posts": [{
      "id": 1,
      "text": "Lorem ipsum 1",
      "user": null
    },
    {
      "id": 2,
      "text": "Lorem ipsum 2",
      "user": null
    }]
  }
}
```

Mutating data with Sequelize

Requesting data from our database via the GraphQL API works. Now comes the tough part: adding a new post to the [Posts] table.

Before we start, we must extract the new database model from the [db] object at the top of the exported function in our [resolvers.js] file:

```
const { Post, User } = db.models;
```

We have to edit the GraphQL resolvers to add the new post. Replace the old [addPost] function with the new one, as shown in the following code snippet:

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

  return User.findAll().then((users) => {
    const usersRow = users[0];

    return Post.create({
      ...post,
    }).then((newPost) => {
      return Promise.all([
        newPost.setUser(usersRow.id),
      ]).then(() => {
        return newPost;
      });
    });
  });
},
```

Action: Review File: `~/Desktop/react-graphql-intro/labs/Lab05/src/server/services/graphql/resolvers.js`

As always, the preceding mutation returns a promise. The promise is resolved when the deepest query has been executed successfully. The execution order is as follows:

1. We retrieve all users from the database through the [User.findAll] method.
2. We insert the post into our database with the [create] function of Sequelize. The only property that we pass is the post object from the original request, which only holds the text of the post. MySQL autogenerates the [id] of the post.
3. The post has been created, but the [userId] was not set.

You could also directly add the user ID in the [Post.create] function. The problem here is that we did not establish the model associations on the JavaScript side. If we return the created post model without explicitly using [setUser] on the model instance, we cannot use the [getUser] function until we create a new instance of the post model.

So, to fix this problem, we run the [create] function, resolve the promise, and then run [setUser] separately. As a parameter of [setUser], we statically take the ID of the first user from the [users] array.

We resolve the promise of the [setUser] function by using an array surrounded by [Promise.all]. This allows us to add further Sequelize methods later on. For example, you could add a category on each post, too.

4. The returned value is the newly created post model instance, after we have set the [userId] correctly.

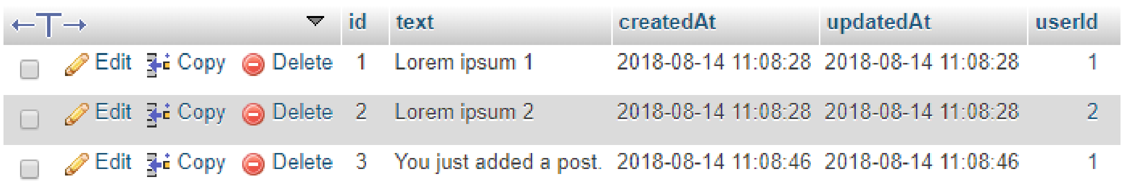
Everything is set now. To test our API, we are going to use Postman again. We need to change the [addPost] request. The [userInput] that we added before is not needed anymore, because the backend statically chooses the first user out of our database. You can send the following request body:

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

Your GraphQL schema must reflect this change, so remove the [userInput] from there, too:

```
addPost (
  post: PostInput!
): Post
```

Running the [addPost] GraphQL mutation now adds a post to the [Posts] table, as you can see in the following screenshot:



	id	text	createdAt	updatedAt	userId
Edit Copy Delete	1	Lorem ipsum 1	2018-08-14 11:08:28	2018-08-14 11:08:28	1
Edit Copy Delete	2	Lorem ipsum 2	2018-08-14 11:08:28	2018-08-14 11:08:28	2
Edit Copy Delete	3	You just added a post.	2018-08-14 11:08:46	2018-08-14 11:08:46	1

We have rebuilt the example from the last lab, but we are using a database in our backend. To extend our application, we are going to add two new entities.

Chat Table

The following screenshot shows how your database should look now:

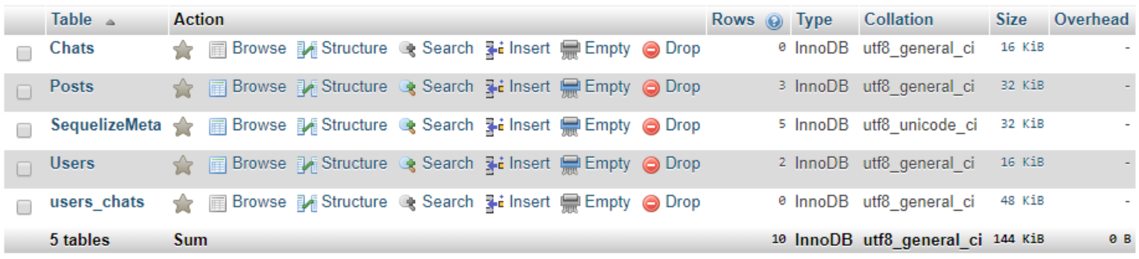
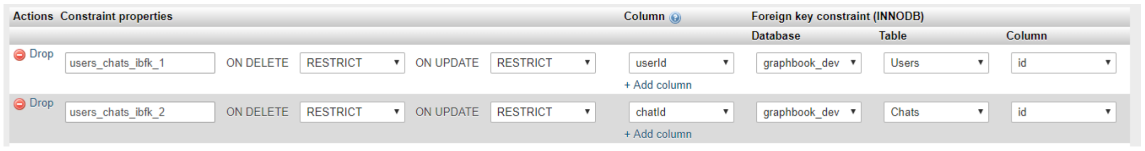


	Table	Action						Rows	Type	Collation	Size	Overhead
☐	Chats	Browse	Structure	Search	Insert	Empty	Drop	0	InnoDB	utf8_general_ci	16 KiB	-
☐	Posts	Browse	Structure	Search	Insert	Empty	Drop	3	InnoDB	utf8_general_ci	32 KiB	-
☐	SequelizeMeta	Browse	Structure	Search	Insert	Empty	Drop	5	InnoDB	utf8_unicode_ci	32 KiB	-
☐	Users	Browse	Structure	Search	Insert	Empty	Drop	2	InnoDB	utf8_general_ci	16 KiB	-
☐	users_chats	Browse	Structure	Search	Insert	Empty	Drop	0	InnoDB	utf8_general_ci	48 KiB	-
	5 tables	Sum						10	InnoDB	utf8_general_ci	144 KiB	0 B

You should see two foreign key constraints in the relation view of the [users_chats] table. The naming is done automatically:



Actions	Constraint properties					Column	Foreign key constraint (INNODB)		
							Database	Table	Column
Drop	users_chats_ibfk_1	ON DELETE	RESTRICT	ON UPDATE	RESTRICT	userId + Add column	graphbook_dev	Users	id
Drop	users_chats_ibfk_2	ON DELETE	RESTRICT	ON UPDATE	RESTRICT	chatId + Add column	graphbook_dev	Chats	id

Chats and messages in GraphQL

We have introduced some new entities with messages and chats. Let's include those in our Apollo schema. In the following code, you can see an excerpt of the changed entities, fields, and parameters of our GraphQL schema:

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

type Post {
  id: Int
  text: String
  user: User
}

type Message {
  id: Int
  text: String
  chat: Chat
  user: User
}

type Chat {
  id: Int
  messages: [Message]
  users: [User]
}

type RootQuery {
  posts: [Post]
  chats: [Chat]
}
```

Action: Review File: `~/Desktop/react-graphql-intro/labs/Lab05/src/server/services/graphql/schema.js`

Take a look at the following short changelog of our GraphQL schema:

- The [User] type received an [id] field, thanks to our database.
- The [Message] type is entirely new. It has a text field like a typical message, and user and chat fields, which are requested from the referenced tables in the database model.
- The [Chat] type is also new. A chat has a list of messages that are returned as an array. These can be queried through the chat ID saved in the message table. Furthermore, a chat can have an unspecified number of users. The relationships between users and chats are saved in our separate join table, as stated previously. The interesting thing here is that our schema does not know anything about this table; it is just for our internal use, to save the data appropriately in our MySQL server.
- I have also added a new [RootQuery], called [chats]. This query returns all of a user's chats.

Action: Review File: `~/Desktop/react-graphql-intro/labs/Lab05/src/server/services/graphql/resolvers.js`

These factors should be implemented in our resolvers, too. Our resolvers should look as follows:

```
Message: {
  user(message, args, context) {
    return message.getUser();
  },
  chat(message, args, context) {
    return message.getChat();
  },
},
Chat: {
  messages(chat, args, context) {
    return chat.getMessages({ order: [['id', 'ASC']] });
  },
  users(chat, args, context) {
    return chat.getUsers();
  },
},
RootQuery: {
  posts(root, args, context) {
    return Post.findAll({order: [['createdAt', 'DESC']]});
  },
  chats(root, args, context) {
    return User.findAll().then((users) => {
      if (!users.length) {
        return [];
      }

      const usersRow = users[0];

      return Chat.findAll({
        include: [{
          model: User,
          required: true,
          through: { where: { userId: usersRow.id } },
        },
        {
          model: Message,
        }],
      });
    });
  },
},
```

You can send this GraphQL request to test the changes:

```
{
  "operationName":null,
  "query": "{ chats { id users { id } messages { id text user { id username
  } } } }",
  "variables":{}
}
```

Try to run the GraphQL [chats] query as follows:

```
{
  "data": {
    "chats": [{
      "id": 1,
      "users": [
        {
          "id": 1
        },
        {
          "id": 2
        }
      ],
      "messages": [
        {
          "id": 1,
          "text": "This is a test message.",
          "user": {
            "id": 1,
            "username": "Test User"
          }
        },
        {
          "id": 2,
          "text": "This is a second test message.",
          "user": {
            "id": 2,
            "username": "Test User 2"
          }
        },
        {
          "id": 3,
          "text": "This is a third test message.",
          "user": {
            "id": 2,
            "username": "Test User 2"
          }
        }
      ]}
    ]
  }
}
```

Great! Now, we can request all of the chats that a user participates in, and get all referenced users and their messages.

Now, we also want to do that for only one chat. Follow these instructions to get it done:

1. Add a [RootQuery] chat that takes a [chatId] as a parameter:

```
chat(root, { chatId }, context) {
  return Chat.findById(chatId, {
    include: [{
      model: User,
      required: true,
    },
    {
      model: Message,
    }],
  });
},
```

With this implementation, we have the problem that all users can send a query to our Apollo server, and in return, get the complete chat history, even if they are not referenced in the chat. We will not be able to fix this until we have implemented authentication.

2. Add the new query to the GraphQL schema, under [RootQuery]:

```
chat(chatId: Int): Chat
```

3. Send the GraphQL request to test the implementation, as follows:

```
{
  "operationName":null,
  "query": "query($chatId: Int!){ chat(chatId: $chatId) {
    id users { id } messages { id text user { id username } } } }",
  "variables":{ "chatId": 1 }
}
```

We are sending this query, including the [chatId] as a parameter. To pass a parameter, you must define it in the query with its GraphQL data type. Then, you can set it in the specific GraphQL query that you are executing, which is the [chat] query, in our case. Lastly, you must insert the parameter's value in the [variables] field of the GraphQL request.

You may remember the response from the last time. The new response will look much like a result from the [chats] query, but instead of an array of chats, we will just have one [chat] object.

We are missing a major feature: sending new messages or creating a new chat. We will create the corresponding schema, and the resolvers for it, in the next section.

Creating a new chat

New users want to chat with their friends. Creating a new chat is essential, of course.

The best way to do this is to accept a list of user IDs that also allows the creation of group chats. Do this as follows:

Action: Review File: `~/Desktop/react-graphql-intro/labs/Lab05/src/server/services/graphql/resolvers.js`

1. Add the [addChat] function to the [RootMutation] in the [resolvers.js] file, as follows:

```
addChat(root, { chat }, context) {
  logger.log({
    level: 'info',
    message: 'Message was created',
  });
  return Chat.create().then((newChat) => {
    return Promise.all([
      newChat.setUsers(chat.users),
    ]).then(() => {
      return newChat;
    });
  });
},
```

Sequelize added the [setUsers] function to the chat model instance. It was added because of the associations using the [belongsToMany] method in the chat model. There, we can directly provide an array of user IDs that should be associated with the new chat, through the [users_chats] table.

2. Change the schema so that you can run the GraphQL mutation. We have to add the new input type and mutation, as follows:

```
input ChatInput {
  users: [Int]
}

type RootMutation {
  addPost (
    post: PostInput!
  ): Post
  addChat (
    chat: ChatInput!
  ): Chat
}
```

3. Test the new GraphQL [addChat] mutation as your request body:

```
{
  "operationName":null,
  "query": "mutation addChat($chat: ChatInput!) { addChat(chat:
    $chat) { id users { id } }}",
  "variables":{
    "chat": {
      "users": [1, 2]
    }
  }
}
```

You can verify that everything worked by checking the users returned inside of the [chat] object.

Creating a new message

We can use the [addPost] mutation as our basis, and extend it. The result accepts a [chatId] and uses the first user from our database.

Action: Review File: `~/Desktop/react-graphql-intro/labs/Lab05/src/server/services/graphql/resolvers.js`

1. Add the [addMessage] function to the [RootMutation] in the [resolvers.js] file, as follows:

```
addMessage(root, { message }, context) {
  logger.log({
    level: 'info',
    message: 'Message was created',
  });

  return User.findAll().then((users) => {
    const usersRow = users[0];

    return Message.create({
      ...message,
    }).then((newMessage) => {
      return Promise.all([
        newMessage.setUser(usersRow.id),
        newMessage.setChat(message.chatId),
      ]).then(() => {
        return newMessage;
      });
    });
  });
},
```

Action: Review File: `~/Desktop/react-graphql-intro/labs/Lab05/src/server/services/graphql/schema.js`

2. Then, add the new mutation to your GraphQL schema. We also have a new input type for our messages:

```
input MessageInput {
  text: String!
  chatId: Int!
}

type RootMutation {
  addPost (
    post: PostInput!
  ): Post
  addChat (
    chat: ChatInput!
  ): Chat
  addMessage (
    message: MessageInput!
  ): Message
}
```

3. You can send the request in the same way as the [addPost] request:

```
{
   "operationName":null,
   "query": "mutation addMessage($message : MessageInput!) {
     addMessage(message : $message) { id text }}",
   "variables":{
     "message": {
       "text": "You just added a message.",
       "chatId": 1
     }
   }
}
```

Now, everything is set. The client can now request all posts, chats, and messages. Furthermore, users can create new posts, create new chat rooms, and send chat messages.

Summary

Our goal in this lab was to create a working backend with a database as storage, which we have achieved pretty well. We can add further entities and migrate and seed them with Sequelize.

In this lab, we also covered what Sequelize automates for us when using its models, and how great it works in coordination with our Apollo Server.

In the next lab, we will focus on how to use the Apollo React Client library with our backend, as well as the database behind it.