TIE-23526 Web Architectures - Group project work repository

Project plan

Course project group information

Vilhelmi Lehtonen, 268600, vilhelmi.lehtonen@tuni.fi
Tommi Mikkola, 266986, tommi.mikkola@tuni.fi
Tommi Brusila, 266200, tommi.brusila@tuni.fi
Group name: Double T & V
Gitlab repo URL: https://course-gitlab.tuni.fi/webarch-2021/double-t-and-v

Working during the project

Due to all group members having very tight schedules, no strict timetable was created for the project. However, by dividing the project into sensible tasks in Gitlab board, each member was able to work independently and effectively. All of the members work in the software industry so this way of working is exremely familiar to the members. The issues were self-assigned.

By looking into the project description we realized, that implementing the mandatory parts would not pose significant challenges and could be done quite easily. Due to this fact and due to other work, we did not take the project on immediately. Only big thing that was unfamiliar to us was RabbitMQ, into which we put extra exploration and investigation. So, in the beginning we would purposly not invest too many hours into the project, but we would focus our effort in the later weeks.

After dividing the project into sensible chunks, we discussed our roles in the project. Below are the main responsibilities and hours to be committed for the project. Naturally these responsibilities mixed up during the project, as someone was done with a feature and could help out with another one. The biggest workload in our mind was the frontend so Tommi B would focus mainly on that. All members are familiar with React and would help out when needed.

- Tommi M (6h/week): Server A, docker-compose, and database
- Tommi B (6h/week): Frontend, helping hand in Server A
- Vilhelmi (6h/week): server-b, RabbitMQ, documentation

For version control, it was decided that each Gitlab task would be implemented more or less in separate feature branches. The idea was that when the feature would be finished, the ticket would be closed and the feature merged into develop branch. The purpose of this was to keep the dev branch as a functioning test branch and to avoid merge conflicts. This procedure was followed quite loosely as some featured would be required by others and would be merged when needed. There was big dependancy between components.

Below is a rough estimate on how the project was to be carried out schedulewise:

Initial timetable:

- Week 12: Start of the project. Repositories created.

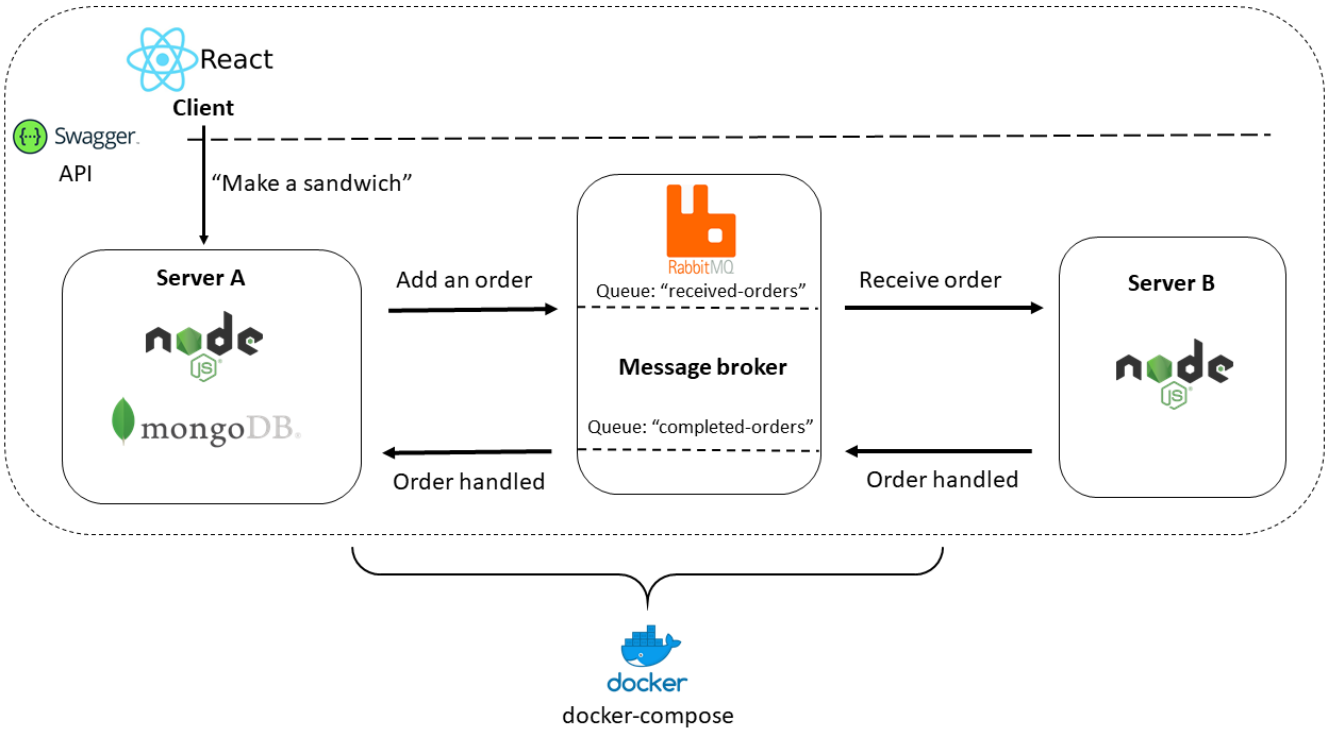
- Week 13: Working on other projects and also dayjobs.
- Week 14: Creating initial files and branches for the components. Setting up environments. Mid-project check-in
- Week 15: Devceloping server-a, server-b, client, and rabbitmq.
- Week 16: Implementing database, styling the frontend. Starting documentation.
- Week 17: Implementing voluntary parts if enough time. Decorating the frontend. Cleaning up code. Finishing documentation.

During the project we had good communication and held weekly meetings where we would catch up with our work. In a project of this size, we really had no difficulty of understanding what each member had been doing. We also had code sessions where each member would be implementing something.

Documentation of the created system

System architecture

System architecture overview



This project features a React frontend. React is a popular Javascript framework and was heavily recommended to be used by the course staff. The client is used by the user to create a sandwich order and ask for sandwich statuses. The client uses Axios, an HTPP client, to communicate with server-a.

Server-a implemets a predefined Swagger-API. When the user chooses to create a order from the client, the request is routed to the correct controller via SwaggerRouter. In this case, the Order controller. This controller then creates a new database entry into MongoDB and also adds the order to a RabbitMQ queue. Server-a keeps track of the newest order ID in the Counter collection in MongoDB and every time and a sandwich is ordered, the counter value is increased by 1 and the value is fetched and stored in the order data as the order ID.

The communication between the server and the RabbitMQ message queue is handled using AMQP application layer protocol. These messages sent by server-a are then subscribed by server-b which then

"completes" the order and sending the order back to another queue. Server-a then listens to this queue for ready orders and updates the status to "ready". Also, the user can view the status for orders from the client.

The entire project is deployed using Docker and specifically docker-compose. Client, server-a, RabbitMQ, MongoDB and server-b have been defined in docker-compose.prod.yaml as services.

Project file structure

```
double T and V
|   README.md
|   docker-compose.yml  # Used by docker-compose to run the multi-container
project
|   docker-compose.prod.yml # Production version
|
└───backend
|   └───rabbitmq  # Empty folder. RabbitMQ is run from a ready-made image
|   |   |   README.md
|   |
|   └───server-a   # Implements the API
|   |   └───api
|   |   |   |   swagger.yaml   # Defines the API
|   |   |
|   |   └───controllers      # Handles the requests directed by the Swagger
router.
|   |   |   |   Order.js     # Handles creation of sandwiches and querying
of sandwich statuses.
|   |   |   |   Sandwich.js  # NOT IMPLEMENTED
|   |   |   |   User.js      # NOT IMPLEMENTED
|   |   |
|   |   └───models
|   |   |   |   counter.js # tracks the newest order ID
|   |   |   |   order.js  # Database model for a sandwich order
|   |   |
|   |   └───rabbit-utils
|   |   |   |   receiveTask.js  # Subscribe to ready orders
|   |   |   |   sendTask.js     # Queue received orders
|   |   |
|   |   └───service     # Control responses to client
|   |   |   |   OrderService.js
|   |   |   |   SandwichService.js
|   |   |   |   UserService.js
|   |   |
|   |   └───utils
|   |   |   |   wait-for-it.sh # Ping and wait a port and execute something
after.
|   |   |   |   writer.js # Help with responses
|   |   |
|   |   |    Dockerfile # Defines server-a docker container and commands.
|   |   |    README.md
|   |   |    db.js      # Database connection
|   |   |    index.js   # Creates server-a. Connects to DB and listens to
```

```
queue.
|   |   |    package-lock.json
|   |   |    package.json
|   |
|   └──server-b
|   |   └──rabbit-utils
|   |   |   |   receiveTask.js  # Subscribe to orders sent from server-a
|   |   |   |   sendTask.js   # Send ready orders to queue.
|   |   |
|   |   └──utils
|   |   |   |   wait-for-it.sh
|   |   |
|   |   |   Dockerfile # Defines server-a docker container and commands.
|   |   |   README.md
|   |   |   index.js  # Server-b. Only listens to queue and adds ready
orders
|   |   |   package.json
|
└──course-documentation
|   |   README.md
|
└──frontend
|   └──public  # Static files
|   └──src     # Application code
|   |   └──components
|   |   |   |   Services.js  # Requests to server-a
|   |   |   |   Landing.js # Functionality
|   |   |   |   style.css
|   |   |
|   |   |   App.css # App styles
|   |   |   App.js  # Main App component
|   |   |   index.js  # Client start point
|   |   |
|   |   Dockerfile # Defines client docker container and commands.
|   |   Dockerfile.prod # Production version container
|   |   README.md
|   |   package-lock.json
|   |   package.json
```

Used technologies

- Node.js: An asynchronous Javascript runtime. Used for server-a and server-b.
- React: A Javascript framework for building interactive Single-Page Applications. React only re-renders the components that are uppdated without loading the entire page.
- RabbitMQ: An open-source message broker that is AMQP compliant among others. Enables asynchronous messaging and message queueing.
- AMQP: Advanced Message Queuing Protocol. Application layer protocol for communicating with the RabbitMQ. The protocol is client agnostic meaning that any client can be used with the protocol.
- Swagger: API development and documentation tool. It uses OpenAPI specification, which creates a RESTful interface for developing and consuming an API.
- MongoDB: Is a NoSQL database that uses JSON-like documents.

- Mongoose: ODM library for MongoDB
- Docker (docker-compose): A tool for defining and running multi-container Docker applications.

For the frontend, we decided to go with the recommended option. We all have previous with React and could have also gone with some other option such as Angular.js or Vue.js. However, we decided not to do so due to course recommendation and for our convinience.

For the backend framework, node.js was effectively the only option, as a lot of JavaScript code was already implemented. Other options could have been Deno, which is quite a new arrival. Deno is supposed to be simpler and a more light approach and supports JavaScript and Typescript. It also claims to be secure by default. This would have had a moderate learning curve coming from Node but choosing Node was quite a no-brainer for us.

Storing the order status data was something where we gave thought to many different options. The requirement was that the statuses would not have to be preserved between server resets. We gave a thought to node-persist, which is a localStorage on the server side. However, we still decided to go for an actual database for the purpose that if we were to implement the User and Sandwich models we would definitely need a database. We debated between PostgreSQL and MongoDB and decided to go with the latter due to the JSON-like documents and begin a bit "lighter" in our opinion. Even though we did not declare any volumes for the MongoDB, the mongo image itself declares volumes for /data/db and /data/configdb in containers, which cover database data.

Changing RabbitMQ, AMQP, Swagger and Docker to alternative technologies were not an option. The entire project could be hosted in the cloud of course, but this was not necessary in this project. If one would like to deploy the project for everyone to see, then taking the project to cloud would be the way to go.

How the produced system can be tested

NOTE : This project has been tested using Docker version 20.10 and docker-compose version 1.29.0. Please use Docker this version, or other version that supports multi-stage builds.

1. To check Docker and compose version:

```
docker --version
docker-compose --version
```

2. Clone or download the project at: https://course-gitlab.tuni.fi/webarch-2021/double-t-and-v

3. Navigate to the project folder and run the project with:

```
cd double-t-and-v
docker-compose -f docker-compose.prod.yml up
```

4. Starting the project will take some time. The client will start on port 3001. All ports are visible in the docker-compose.prod.yml file. These ports have to be free in order for the project to work.

Learning during the project

Tommi M: I have created SPA applications before with similar MERN combo, and this was really good way to refresh my memory because I had forgot some little details about creating SPA applications. I also learned a lot of theory about containerization and how the system architecture can be effectively implemented with Docker and Docker-compose. There were a lot of new things that I did not know about the benefits of containerization. The Swagger API documentation gave a new perspective on how the methods, models and other things should be implemented properly when developing the application.

Tommi B: In the start of the project I learned a lot about Docker and Docker Compose, even though I didn't do as much with them as the rest of the group. In the rest of the project I learned a lot about React as I was mainly working with the frontend, but while helping Tommi M with the server A, I learned a lot about Swagger module and Node. I also got to deepen my knowledge about Swagger API documentation and CORS.

Vilhelmi: Working with Docker during this project has significantly imporved my understanding of it and docker-compose. The relationships with the services and Dockerfiles are much cleare than before. I believe that this project has helped me to dockerize future coding projects. RabbitMQ was completely new to me and the group. Investigating that has helped to understand a bit about message brokers and AMQP-protocol.