

WEB AND CLOUD COMPUTING 2017

Project: Uber for Bikes

GROUP 18

Authors

THOM CARRETERO SEINHORST

ALEXANDRU TATAROV

ANASTASIA SEREBRYANNIKOVA

November 4, 2017

1 Introduction

In this project we developed a single page web application "Uber for bikes". The application should enable the Uber functionality for bikes.

The application represents a map on which the positions of bikes are shown. These bikes are used by people for transportation. The users can also see the table with the address information about the bikes. This coordinates of the bikes are streamed from the database and then transformed into addresses using the Google Maps API. The user can book a bike by pressing the corresponding button. When a bike is taken, its corresponding point on the map disappears (because it is no longer available). When the trip is finished the bike appears back on the map.

2 Architecture

In Figure 1, a broad overview of the architecture of the application is given. When the docker swarm mode is used, this structure is duplicated at every node because we use the global mode setting.

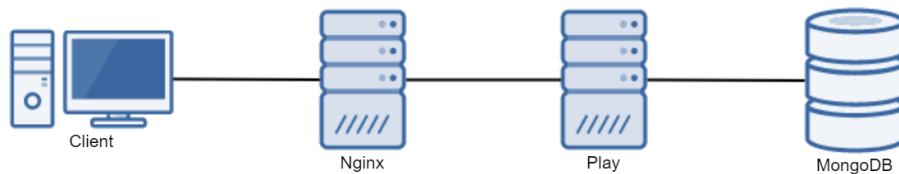


Figure 1: Overview of the architecture of Uber for Bikes

For our webserver we have written the main component in Scala. Scala is a functional programming language supporting high scalability. We used the Play framework which fits our purposes very well as it is designed for developing web applications. As well as this, it ensures the integration with the database and the other components.

For our project we used the MongoDB database with a Scala ReactiveMongo driver. ReactiveMongo provides fully non-blocking and asynchronous I/O operations. ReactiveMongo is designed to avoid any kind of blocking request. Every operation returns immediately, freeing the running thread and resuming execution when it is over.

In the frond-end, AngularJS and Bootstrap are used for providing a nice user interface. The UI serves a simple purpose: Renting and unrenting bikes. The main view of the UI is a Google Maps view. It is currently set to the location

of Groningen, but could eventually be used to show the region where the user resides. In our project we use an external third party service. The service of Google is needed to convert a textural representation of a location into the corresponding geographical representation of the GPS system. This conversion is done via the Google Maps API.

2.1 Docker swarm

Docker swarm is a tool that enables high scalability and fault-tolerance. With Docker swarm, it is possible to run applications on a cluster of virtual or physical machines. If one of the nodes or one of the containers fails the other keep functioning and can handle the requests that are send to them. For every service, there are two modes available, global and replicated. If the replicated mode is used, the user can define the number of replicas of each container. If the global mode is used, every node in the cluster runs one instance of the service. In our application, we use global mode for all the services, which means that if we run our application on two (virtual) machines, each machine will have one instance of every service running on it.

3 Design decisions

3.1 Database

We use MongoDB for our database. We chose to use this database as it is easy to implement and easy to use. We have a MongoDB database with 1 collection, Bikes. The Bikes collection stores all bike locations and their availability. There should be a second database collection, Users, for storing the name, passwords and a list of rented bikes. Due to lack of time, we weren't able to implement this correctly.

Bike	
🔑	ID: INTEGER
📍	CoordsX: FLOAT(10)
📍	CoordsY: FLOAT(10)
🚦	Status: BOOLEAN

Figure 2: Overview of the database

In the docker swarm mode, the Mongo replica set is used to enable sharing of the data between the instances of MongoDB on different hosts. Replica sets provide

redundancy and increase the availability of the data. All write operations are performed to the primary node and then replicated to the secondary nodes, as shown in Figure 4.

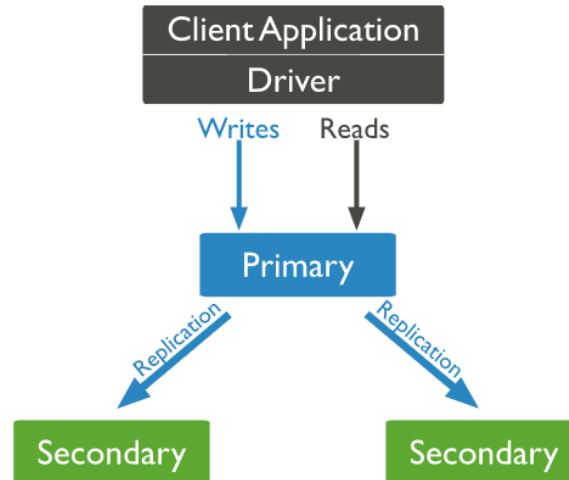


Figure 3: Replica sets in MongoDB

As opposed to the other services that are deployed in the docker swarm mode, MongoDB needs some additional configuration. Docker cannot take care of initializing the replica set and making sure that the data is correctly replicated among different nodes. This means that we have to manage the replica set by ourselves. If the replica set is configured manually there is a high risk that if one of the MongoDB instances goes down and appears again, its IP address will be different and the replica set will need to be reconfigured (the new IP address of the node should be added and the old one removed). This may cause the read and write operations to fail, which is not what we want. So we have found a way to deal with this problem. We have a separate container (called controller) that maintains the replica set up and running and updates the configuration whenever necessary. This container does not need replication and is deployed only once on the manager node. So the backend, when deployed in the swarm mode, looks as it is represented in ??.



Figure 4: MongoDB replication in docker swarm mode

3.2 Webserver

We chose Play as the framework for back-end development of our application mostly because it supports asynchronous I/O. There were two main causes for choosing Scala: the first is the possibility to learn a new programming language and the second is professor's incentive to use Scala for back-end development. In the end we succeeded in building a working back-end. We benefited from online completed projects we found on the internet as it aided our understanding and development of the final product. During the development we had difficulties

connecting our database with Play as well as using WebSockets for live data streaming.

3.3 Client

Angular is a framework for building Web single-page applications and Bootstrap is an easy to use front-end web framework for designing web applications. These are the main reasons why we chose to use these frameworks. Other advantage of using Angular is its highly readable and comprehensive code. It was an important factor because we wanted something that will take as little time to learn as possible. We created the project using Angular Cli and used components to create the navigation bar, map component, and two (login and registration) forms (unfortunately not seen in the final layout). Even if it is not linked to framework itself, we found useful the large community of developers using Angular as online answers helped us solve most encountered problems.

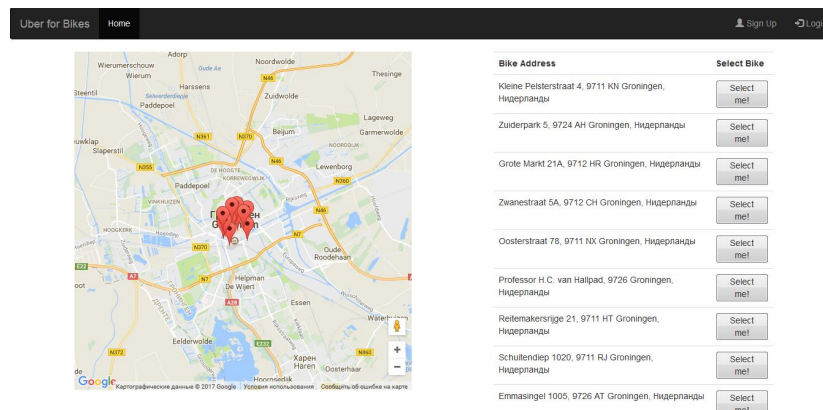


Figure 5: Application layout

4 Discussion

In this chapter we review and reflect on the project.

In the beginning of the project we started with developing an UI. We used a nginx webserver, but we struggled to put it in a docker container and connect it to the back-end. It took us some time to figure it out how exactly to connect these parts. We managed to retrieve data from the database and to present it in the UI. We chose to use Angular as a framework for our UI.

It took us some time to set up the back-end with Play and Scala. Since the programming language Scala was new to all of us, we had to put some effort into it to understand how Scala works.

4.1 Angular

Angular proved to be the easiest component of the project. However not everything was straight-forward. One tricky part was using Ajax calls to retrieve information about available bikes and displaying it. We needed a little more time than expected to use the values from *.subscribe()* in some other function.

4.2 Scala

Scala was completely new for all of us. We were lucky enough to find a project that had some similar functionalities. Using that project as a guideline, we implemented a part of our own back-end functionality that communicates with front-end and the database. The biggest issues we encountered at using Scala was implementing WebSockets.

4.3 Docker

Docker appeared to be an extremely nice tool for developing applications. With docker, it has become very easy to separate the infrastructure decisions from internal application issues. Docker was pretty easy to learn and quite easy to use. The documentation appears to be more or less comprehensive and docker itself seems to be pretty user-friendly. The main issues that we had in this part were mainly connected to deploying certain containers and setting the right configurations for all of them and not to the docker logic in general.

Docker swarm mode is very useful and its logic is easy to understand. It enables fault tolerance in a very intuitive and straightforward way by replicating the services among different nodes in the cluster or even within a single node. Getting acquainted with Docker definitely was one of the best things to do during this course.

4.4 Future work

One important part of the project that is missing is the login and register part for users of the application. Users should be able to create an account and to login. When a user is logged in, they can rent a bike and see their history of rented bikes. Due to the difficulties we encountered there was not enough time to implement this correctly.