Università di Trento

Web Architectures

Assignment 5

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1 Introduction

The fifth assignment is about creating an application where tourists can book and aprtmand or a hotel room, depending on its availability. On this application, the user can search for accommodtions by giving the start- and end-date, and the number of persons. Then, the user should see a list of all available results, where the user can select one accommodation and confirm the reservation.

The application is composed of the following parts:

- Business-logic
- Web-application
- Database

The business-logic is supposed to be implemented using EJB and EJB-patterns. All EJBs must be deployed on a wildfly application server. The web-application must be implement using Servlets. It should not be deployed using wildfly and must run outside of the wildfly application server. H2 must be used as the database. A routine must be implemented to write default data to the database.

2 Implementation

This section describes the most important parts of the implementation of the application.

2.1 Database Routine

A database routine needs to be implemented to seed the database, that is supposed to be used in the application. This routine is not implemented as a EJB, instead, it will run as a standalone Java application. The accommodations, as well as the occupancies of accommodatios are given by the task description.

The following technologies are used to implement the database routine:

- Hibernate
- JPA

2.1.1 Entities

Figure 1 visualizes the UML diagram of the entities, used for the database. Overall, the database is used to save the following information:

- Accommodations which represent either an apartment or a hotel
- Occupancy, represents the availability of an accommodation entity for a specific day
- Reservation which represent a single reservation made by a user

Accommodations Two types of accommodations exists for this application: Apartments and Hotels. All accommadtions have a name, and a daily price. Additionally, an apartment has a final cleaning fee, an a number of maximum persons. A hotel has a rating of start, a number of free places, and a price for extra half-board.

To implement the entities, an ApartmentEntity, and a HotelEntity have been implemented. Both classes inherit from the abstract AccommodationEntity class.

Occupancies Each accommodation needs an occupancy information for a specific date. The occupancy information describes if an accommodation is available on a specific date. The difference between an apartment and a hotel is, that a hotel has a specific number of reservation, and an aprtment is either available or unavaible, independetly of the number of persons.

To implement the occupancies, a parent class called HotelOccupancy exists, that includes only the date. Additionally, a class called ApartmentOccupancy saves the occupancies information for a hotel, which includes a boolean value

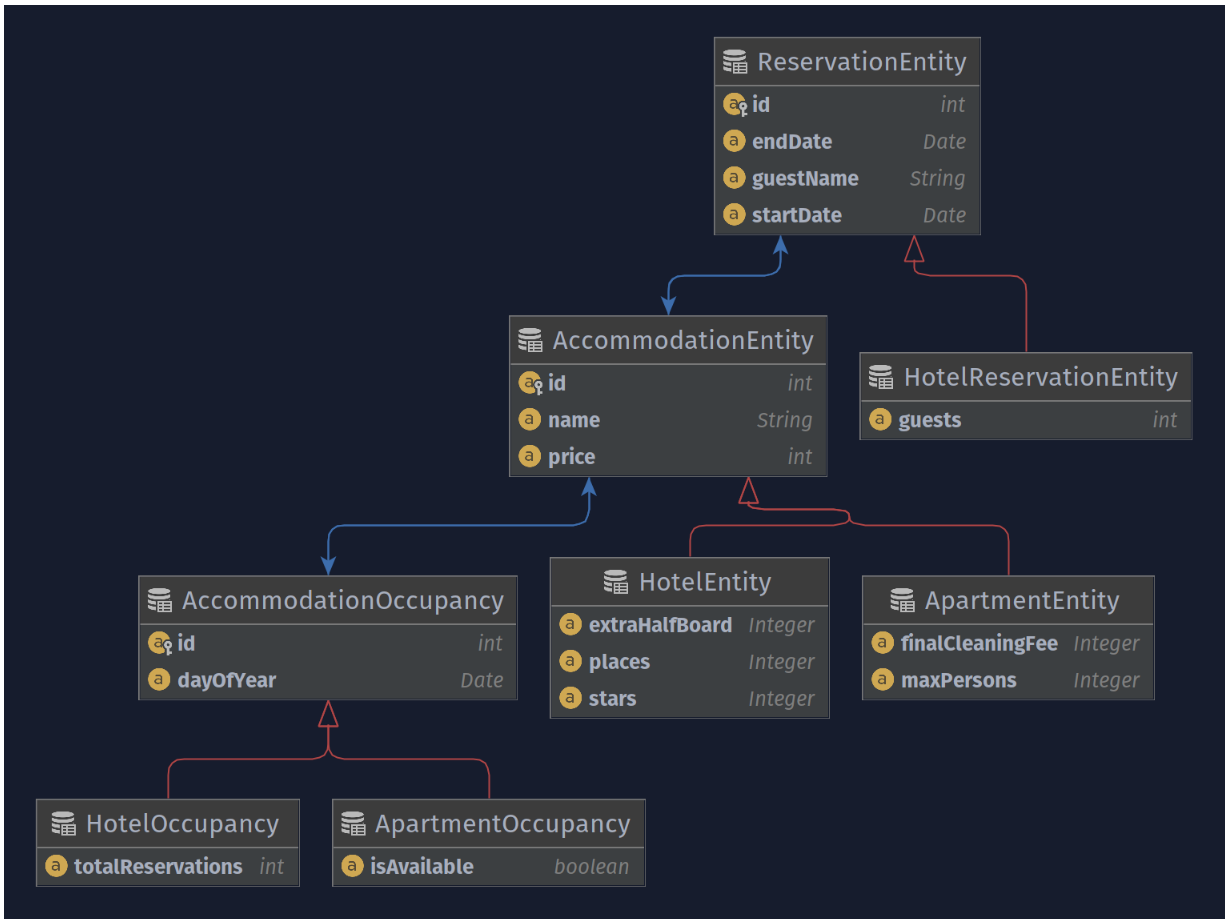


Figure 1: UML diagram of all database entities

called isAvailable that specifies, if the aprtment is avaiable for the specific date or not. Furthemore, a class called HotelEntity represent the occupancy of a hotel, which is a number of reservation for a specific date.

Reservations A user can make reservation that are saved to the database. A reservation consists of a start date and an end date that represent the date interval of the stay, and the name of the guest. These informations are saved by the ReservationEntity. Additionally, a classes called HotelReservationEntity, which inherits the ReservationEntity, is used to save the number of guests for on reservation of a hotel. An apartment does not need extra information, because it is either avaible or not, which is represented by the existance of a ReservationEntity in the table for the specific apartment for a specific date interval.

2.2 Enterprise Java Beans

The business logic of this application is implemented using EJB 3. It is composed of three parts:

- `LocalDatabaseBean`
- `AccommodationService`

- `ReservationService`

All services are part of a single Maven project called *WebServices*.

Each part (service) is an independent Baen. The client is able to lookup the Bean given an address and invoke methods on it. Only the Accommodation Service and the Reservation Service is available for the client. The Database Service is implemented using a local bean, because it is not intended, for the user, to interact with the database directly.

2.2.1 LocalDatabaseBean

The `LocalDatabaseBean` is used to interact with the H2 database. It initiates the `EntityManager`, given by JPA, bu establishing a connection to a JTA datasource. Other services can use the Database Service to send queries and receive results from the database.

As mentioned before, the Database Service is implemented as a `LocalBean`. Other Beans can interact with the Database Service using the Code-Injection pattern, which is shown in Listing 1.

```java
@Stateless
@Remote(ReservationService.class)
public class ReservationBean implements ReservationService  {

    @EJB()
    private LocalDatabaseBean databaseBean;

    ...

}
```

Listing 1: Usage of the `LocalDatabaseBean` using Code-Injection

2.2.2 AccommodationService

The Accommodation is used by the client to interact with the `AccommdationEntity` and its child classes `ApartmentEntity`, and `HotelEntity`. It uses the Local-DatabaseBean to send HQL queries to the H2 database.

Except from receiving accommodations based on specific properties, the most interesting part about the AccommodationService is how it receives available accommodations in a specific date range, given a number of guests. The idea is, that the number of occurencies of an accommadtion which is available in the specific date range, has to be qual the number of days of the given date range.

```sql
SELECT a.accommodation
FROM AccommodationOccupancyEntity a
WHERE (
  ((a.isAvailable IS TRUE AND a.accommodation.maxPersons >= 2)
  OR
  ((a.accommodation.places - a.totalReservations) >= 2))
)
```

```
AND a.dayOfYear BETWEEN '2022-02-01' AND '2022-02-09'
GROUP BY a.accommodation.id
HAVING COUNT(*) = 9
```

Listing 2: Example of a HQL query to receive all available accommodations

Listing 2 show an example HQL query implementation to get all available accommodations between 1. February 2022 and 10. February 2022 for 2 guests. As described before, the `AccommodationOccupancyEntity` saves the occupancies of each accommodation for specific dates. Therefore, it is necessary to check for apartments if it is available, and has enough places for the number of guests. For hotels, it is necessary to check if the existing number of reservations minus the available places of that hotel is lower or equal the number of guests. These constraints are checked for the range between the start date (1. February 2022) and the end date minus one day (9. February 2022). It is necessary to substract one day, because the guests will not stay for that day, and therefore the availability information for that day is unrelated. After that it is important, thte the count of numbers of the accommodation, in that specific date range, is euqal to the number of days between the start and end date.

2.2.3 ReservationService

To read from and write to the reservation table of the database, the ReservationService is used. It allows to persist new reservations to the database, and to get all reservations for a specific customer name.

When adding a new reservation to the database, the `ReservationService` is also responsible to update the occupancies (mentioned in XY) of the selected accommodation. Then, it is necessary to add the number of guests, of the new reservation, to each entry of the accommodation occupancy.

Additionally, the ReservationService provides an interface to calculate the price of a reservation for either a Hotel or an Apartment.

2.2.4 Build Process

The project is build using the `maven-ejb-plugin` maven plugin to create a EJB-Jar file. Then, the artifact can be built using the `mvn clean build` command.

Listing 3 shows the configuration of the `maven-ejb-plugin` plugin.

```
<packaging>ejb</packaging>
...
<build>
  <finalName>${artifactId}.${version}</finalName>
  <plugins>
    <plugin>
      <groupId>org.apache.maven.plugins</groupId>
      <artifactId>maven-ejb-plugin</artifactId>
      <version>3.1.0</version>
    </plugin>
  </plugins>
```

```
</build>
```

Listing 3: `maven-ejb-plugin` plugin configuration

2.3 Web Application

2.3.1 Search

2.3.2 Results

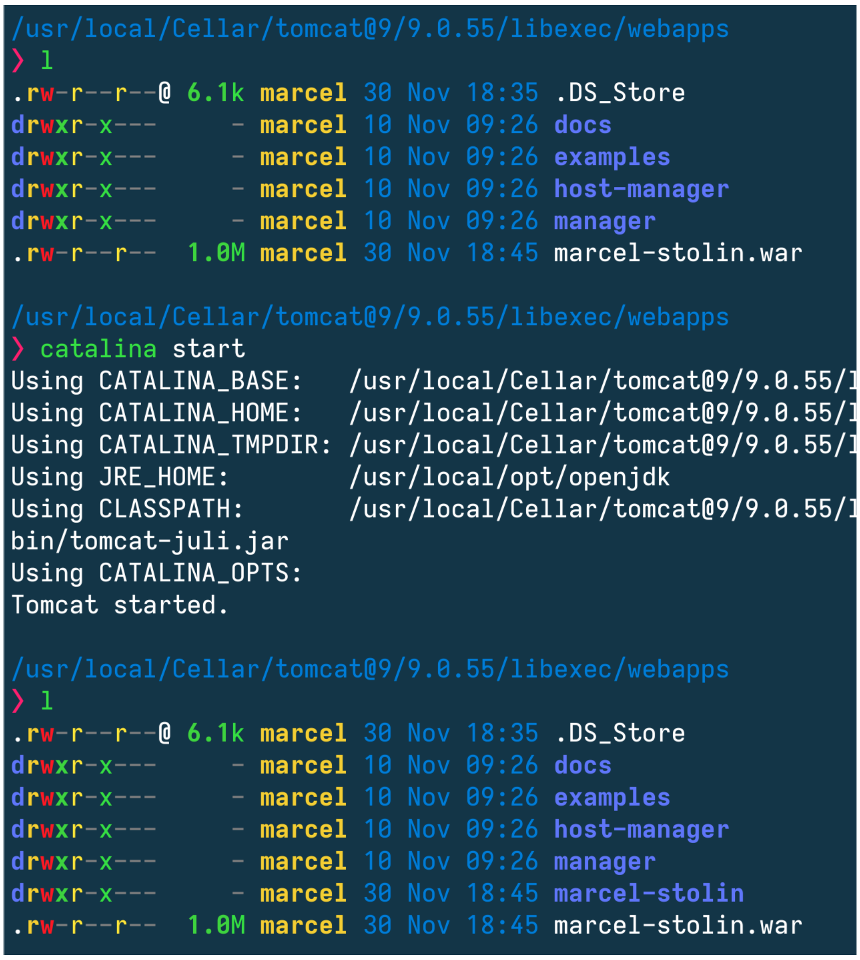
2.3.3 Reservation Summary

2.3.4 Reservation Confirm

2.3.5 My Reservations

3 Deployment

This section explains the deployment of the application. The only requirement to run this application is to have *Tomcat 9* installed. Figure 2 illustrates the process of deploying the `marcel-stolin.war` file using *Tomcat*.



```
/usr/local/Cellar/tomcat@9/9.0.55/libexec/webapps
❯ l
.rw-r--r--@ 6.1k marcel 30 Nov 18:35 .DS_Store
drwxr-x---     - marcel 10 Nov 09:26 docs
drwxr-x---     - marcel 10 Nov 09:26 examples
drwxr-x---     - marcel 10 Nov 09:26 host-manager
drwxr-x---     - marcel 10 Nov 09:26 manager
.rw-r--r--  1.0M marcel 30 Nov 18:45 marcel-stolin.war

/usr/local/Cellar/tomcat@9/9.0.55/libexec/webapps
❯ catalina start
Using CATALINA_BASE:   /usr/local/Cellar/tomcat@9/9.0.55/l
Using CATALINA_HOME:   /usr/local/Cellar/tomcat@9/9.0.55/l
Using CATALINA_TMPDIR: /usr/local/Cellar/tomcat@9/9.0.55/l
Using JRE_HOME:        /usr/local/opt/openjdk
Using CLASSPATH:       /usr/local/Cellar/tomcat@9/9.0.55/l
bin/tomcat-juli.jar
Using CATALINA_OPTS:
Tomcat started.

/usr/local/Cellar/tomcat@9/9.0.55/libexec/webapps
❯ l
.rw-r--r--@ 6.1k marcel 30 Nov 18:35 .DS_Store
drwxr-x---     - marcel 10 Nov 09:26 docs
drwxr-x---     - marcel 10 Nov 09:26 examples
drwxr-x---     - marcel 10 Nov 09:26 host-manager
drwxr-x---     - marcel 10 Nov 09:26 manager
drwxr-x---     - marcel 30 Nov 18:45 marcel-stolin
.rw-r--r--  1.0M marcel 30 Nov 18:45 marcel-stolin.war
```

Figure 2: Deployment process using `marcel-stolin.war`

1. The first step, is to copy the `marcel-stolin.war` file to the `webapps/` folder of the *Tomcat* installation.
This can be done using `$ cp marcel-stolin.war TOMCAT_DIRECTORY/webapps`.

2. Next, the remaining step is to start the *Tomcat* server using `$ catalina start`. Tomcat will automatically extract the `marcel-stolin.war` to a directory called `marcel-stolin/`.

3. After that, the application is available via `http://localhost:8080/marcel-stolin/`. Figure 3 shows the list page, and Figure 4 shows the detail page of one parliament member using Firefox.

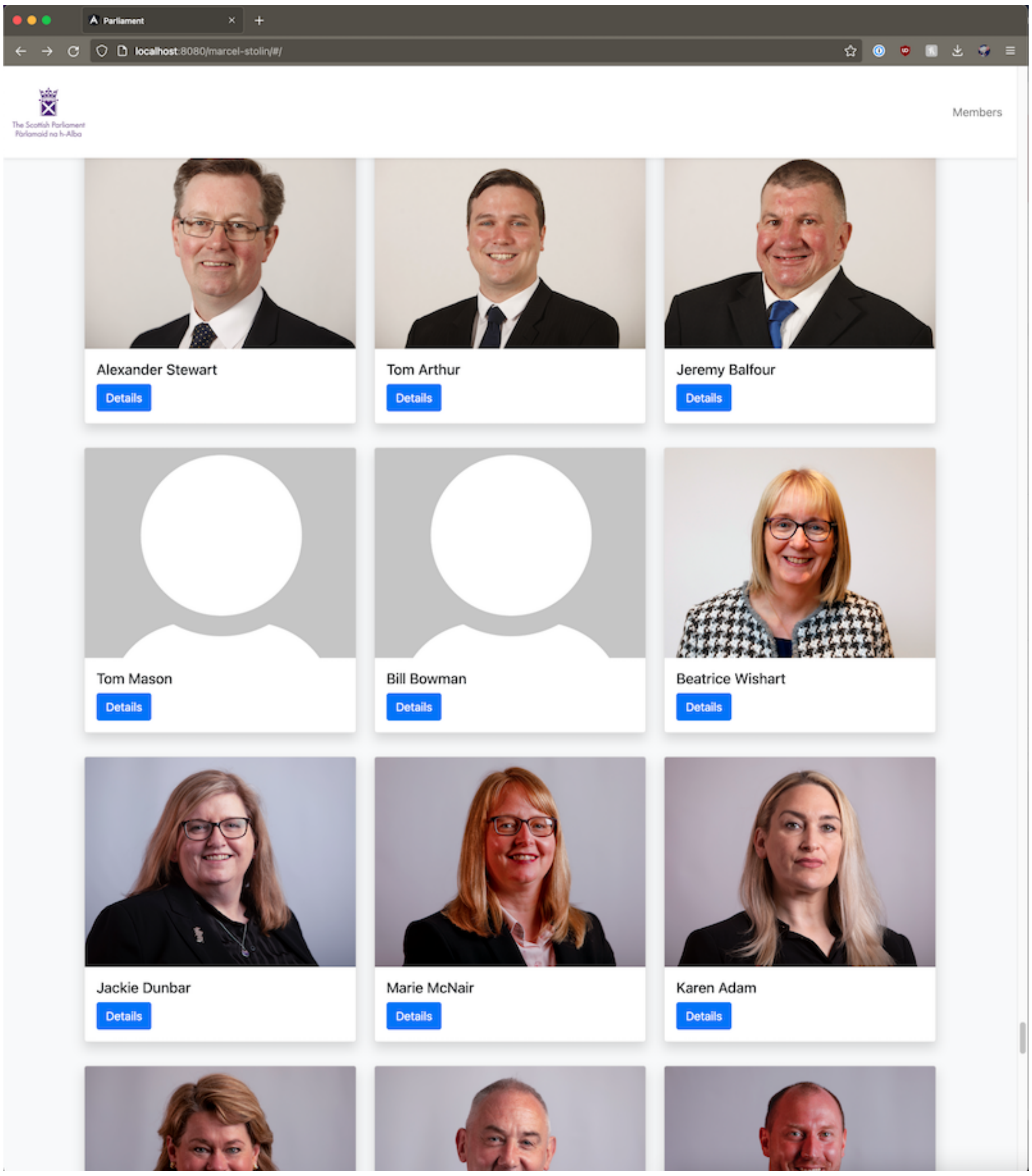
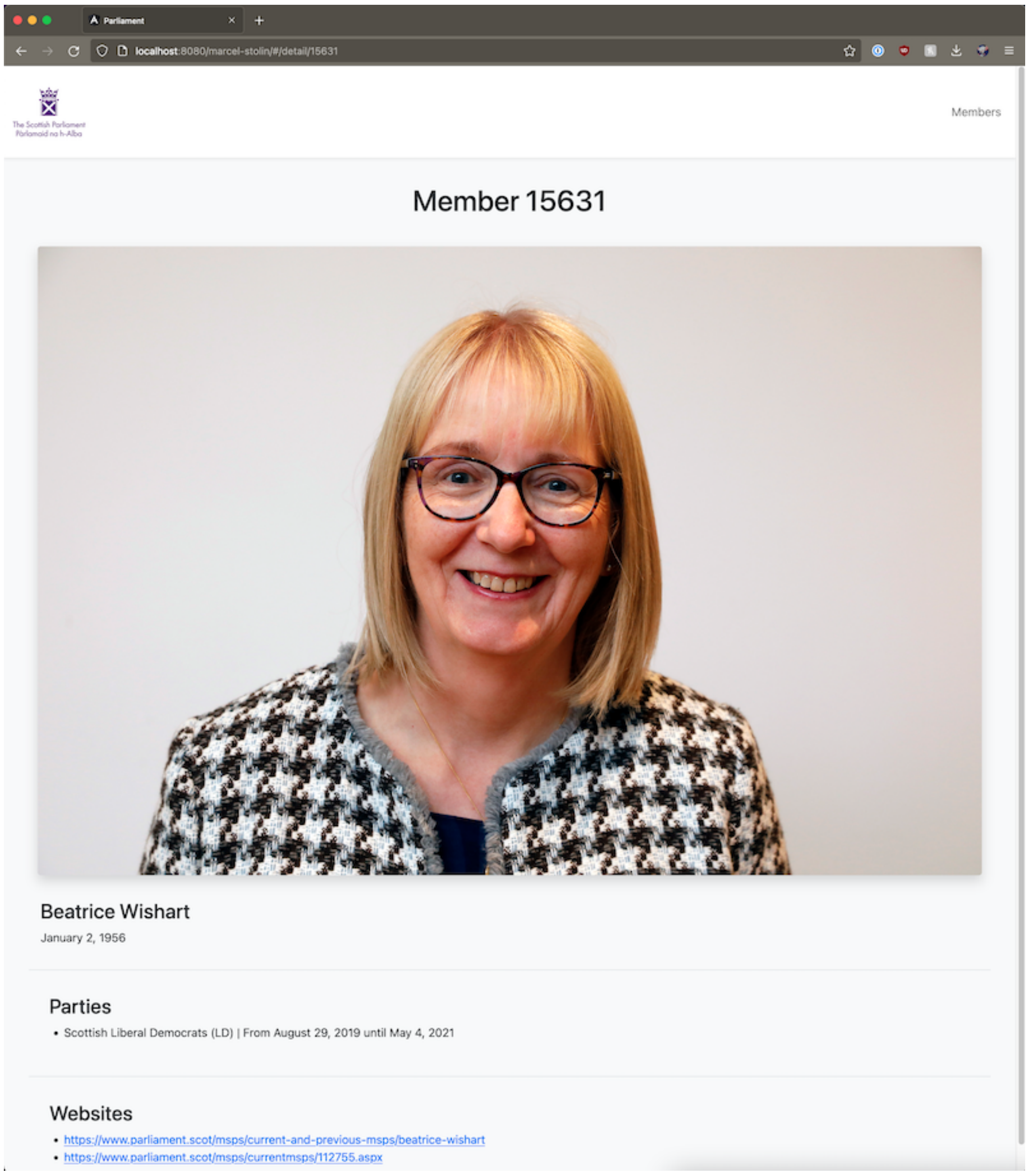


Figure 3: List page



Member 15631

Beatrice Wishart

January 2, 1956

Parties

- Scottish Liberal Democrats (LD) | From August 29, 2019 until May 4, 2021

Websites

- https://www.parliament.scot/msps/current-and-previous-msps/beatrice-wishart
- https://www.parliament.scot/msps/currentmsps/112755.aspx

Figure 4: Detail page

4 Comments and Notes

This section describes the problems encountered during the development of the application.

4.1 Routing

A requirement was to deploy the *Angular* application on a *Tomcat* webserver. However, *Angular* redirects all requests to the `index.html`. For example, requesting the page `http://localhost:8080/marcel-stolin/detail/1735` will not work, because a directory `detail/1735` does not exist. Then, the *Tomcat* web server responses a 404 error page.

The solution to this problem, is to use the `HashLocationStrategy`[1]. Listing 4 shows how it is implemented in the application. Then, the previously mentioned URL can be accessed via `http://localhost:8080/marcel-stolin/#/detail/1735`.

```
const routes: Routes = [
  { path: '', component: MemberListComponent },
  { path: 'detail/:memberId', component: MemberDetailComponent }
];

@NgModule({
  imports: [RouterModule.forRoot(routes, {useHash: true})],
  exports: [RouterModule]
})
```

Listing 4: Application routing configuration of `app-routing.module.ts`

4.2 Building the Angular Application

Another problem is how to build the *Angular* application. A *JS-Servlet* project requires static files (e.g.: HTML files, Javascript libraries) to be located at `PROJECT\_ROOT/src/main/webapp`. Therefore, whenever the angular application is built, the output has to be saved in this directory.

To solve this issue, *Angular* allows to define the `outputPath` for the application when using `ng build`. Listing 5 shows the `angular.json` configuration.

```
...
"build": {
  "builder": "@angular-devkit/build-angular:browser",
  "options": {
    "outputPath": "../../webapp",
...
```

Listing 5: `angular.json` configuration

[1] `https://angular.io/api/common/HashLocationStrategy`

Additionally, it is important to define the *base-href*, that defines the path where the application is located on the web server. This application is supposed to be available via the path `/marcel-stolin` (e.g.: `http://localhost:8080/marcel-stolin/`).

Therefore, the command `$ ng build --base-href /marcel-stolin/` has to be used to build the application.