Hogeschool van Amsterdam

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Web Frameworks (vt, dt)

Assignment
The Auctioneer

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Study tracks	: HBO-ICT, Software Engineering
Curriculum	: year 2, terms 1 & 2
Study guide	: vt: https://studiegids.hva.nl/co/hbo-ict-se-vt/100000026/049209 dt: https://studiegids.hva.nl/co/hbo-ict-se-dt/100000040/049531
Course materials	: vt: https://dlo.mijnhva.nl/d2l/home/197976 dt: https://dlo.mijnhva.nl/d2l/home/223020

Versions

Version	Date	Author	Description
19.25	2 Dec 2019	John Somers	Spring-Boot assignments up to 4.5
20.1	2 Sep	John Somers	Simplification, Content shuffle Upgrade to Angular 10
20.2	20 Sep	John Somers	Revisited 3.5 – 3.7, 4.1 – 4.5
20.3	2 Nov	John Somers	Siblings, PUT, references

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1 Introduction

This document provides a casus description and a number of assignments for practical exercise along with the course Web Frameworks. The assignments are incremental, building some parts of the solution of the casus. Later assignments cannot be completed or tested without building part of the earlier assignments.

Relevant introduction and explanation about the technologies to be used in these assignments can be found in videos at https://learning.oreilly.com/home/.

The frontend is well covered by Maximilian Schwarzmüller in:

O'Reilly-1. 'Angular 8 – The Complete Guide'

The backend is well covered by Ranga Karanam in:

O'Reilly-2. Mastering Java Web Services and REST API with Spring Boot

O'Reilly-3. Master Hibernate and JPA with Spring Boot in 100 Steps

Consult the study guide and the study materials for specific directions and playlists that are relevant for each of the following assignments.

2 The casus

The casus involves a web application that goes by the name 'The Auctioneer'. This application provides its users a platform at which they can buy goods and offer goods for sale by auction.

2.1 Use cases

Visitors can search and navigate the site anonymously to see whether there is anything of their interest. Only registered users can actually post a bid or offer something for sale. The auction of an item proceeds along the following workflow:

1. The seller posts an advertisement for an item, providing a description, possibly some pictures and a final date-time of the closure of the auction.
2. When the seller is happy about the advertisement, the item is published and visible for visitors.
3. A logged-on visitor, who is interested in the item posts a bid, which is higher than the previous bid on the item. When overbid, the same visitor can rebid. Bidders can also withdraw their bid. Sellers can also withdraw their offer. Sellers cannot bid on their own offers.
4. At the date-time of closure of the auction, the highest bidder is awarded the item, and a payment request goes out. The highest bidder can still withdraw his bid, at which case the next highest bidder is awarded the item and another payment request goes out. Sellers cannot withdraw anymore at this stage.
5. If the payment has been made, the delivery is initiated.
6. If the buyer has confirmed receipt of the delivery, the money is transferred to the seller and the auction workflow is closed.

Offered items are organised in Categories. E.g. 'Antiques', 'Cars', 'Books' could be categories available to sellers to register items. Categories can have sub-categories, sub-

categories can have sub-sub-categories etc. Items on offer can be registered in multiple categories. Visitors can filter on categories when they search for items.

Normal accounts can only change offers and bids which they own. Sellers can also remove bids on their offers that appear not trustworthy. Some accounts have administrator privileges. Those accounts have update access to all data in the system. They can intervene with the standard auction workflow of all items and they also manage the Categories. They can set and withdraw administrator privileges on other accounts.

2.2 Class diagram

Below you find a navigable class diagram of the functional model that has been designed for 'The Auctioneer'. This diagram only includes the main entities, attributes and some operations. For a full implementation additional classes, attributes or operations may be required. That is up to you to resolve!

The Offer class registers all items on offer. The auctionStatus attribute of an offer tracks the status of the workflow of an offer, as it is described above.

For sake of readability we have not included constructor and getter or setter methods in this diagram. Our public property attributes should be implemented in Java with private member variables and public getters and setters.

The valueHighestBid attribute is a derived attribute which can be calculated from all Bids made on an offer.

The arrow tips of the associations indicate 'navigable relations'. Some are bi-directional, others are uni-directional. I.e.:

- Bi-directional navigability: Every Account knows which Offers it has made and for every Offer we know the seller Account.
- Uni-directional navigability: Every Offer knows in which Categories it is listed, but a Category does not have knowledge of all its Offers.

This design of navigability is based on expected requirements from the use case scenario's above. From a data modelling perspective, you may find some redundancy in the navigability, but those will prove beneficial from an implementation performance perspective. It may be that your specific implementation approach requires additional or different relations or navigability. In any case: good software design aspires high cohesion and low coupling!

Navigability is implemented with (private) association attributes. E.g. Account.offers realises the navigability of the 'sells' relation. It provides the list of all Offers that have been proposed for sale by a given Account. Offer.seller realises the navigability the other way around. It provides the seller Account of a given Offer.

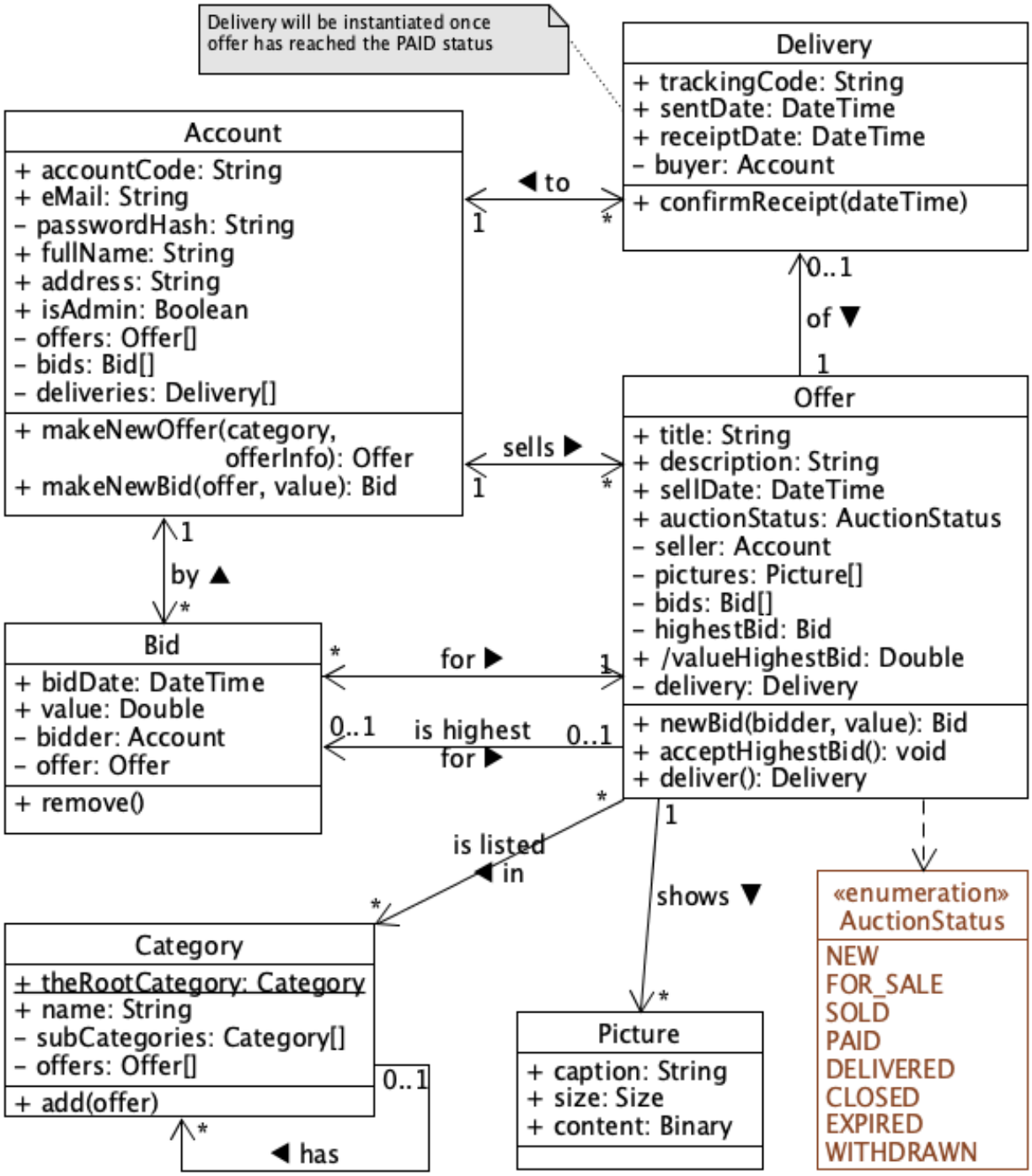


Figure 1: Navigable Class Diagram 'The Auctioneer'

2.3 Layered Logical Architecture

Figure 2 depicts the designated full-stack, layered logical architecture of 'the Auctioneer'. The frontend user interface layer shows the Model-View-Controller interdependencies of your Single-Page web application. The UI Service package provides the adaptors connecting the frontend with the backend RESTful web service.

The Functional Model is shared between the frontend and the backend, indicating that a single consistent model of the business entities shall be implemented. As you will be using different programming languages in for the frontend and the backend, you also will provide a two (consistent) implementations of this functional model.

The REST Service will integrate the Hibernate Object-to-Relational Mapper (ORM) by means of Dependency Injection of Repository Services. (One for each class in the Functional Model).

The H2 in-memory Database Management component will be used for testing purposes. The production configuration of your application would be expected to run with MySQL RDBMS.

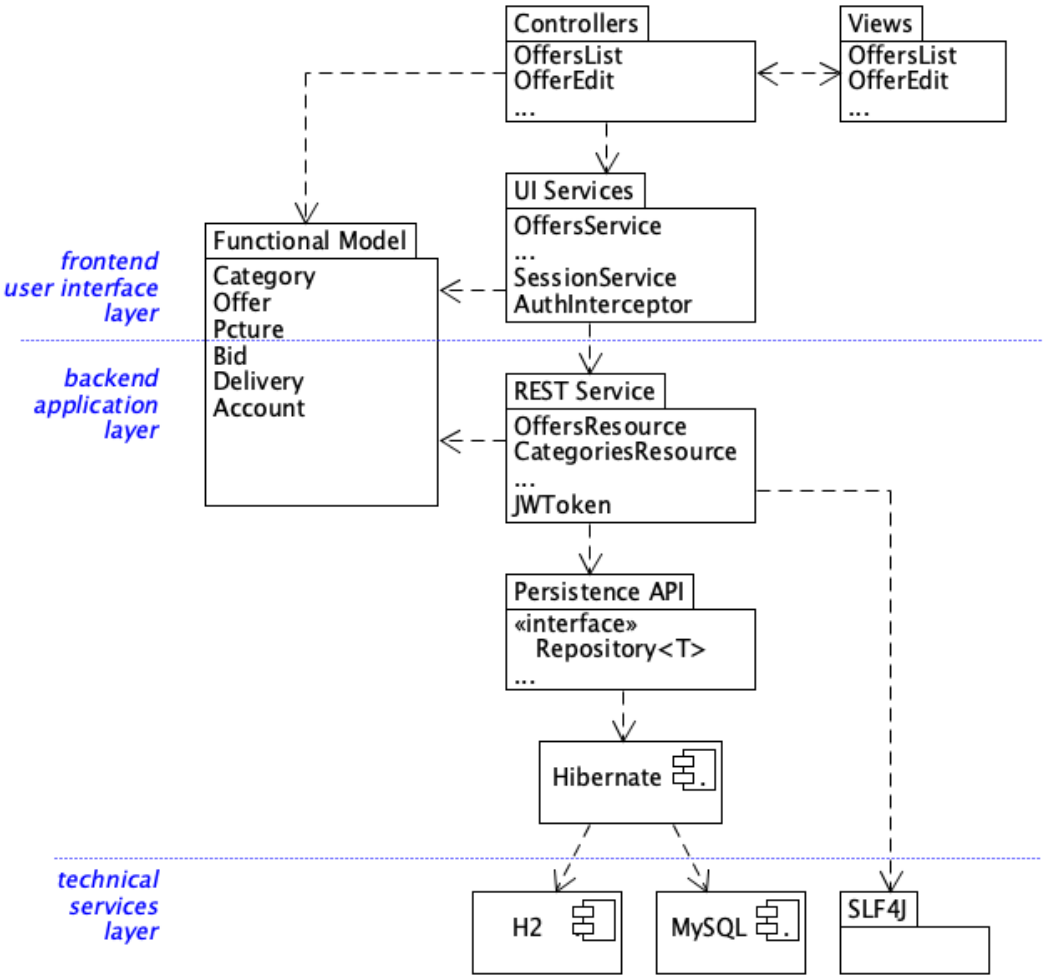


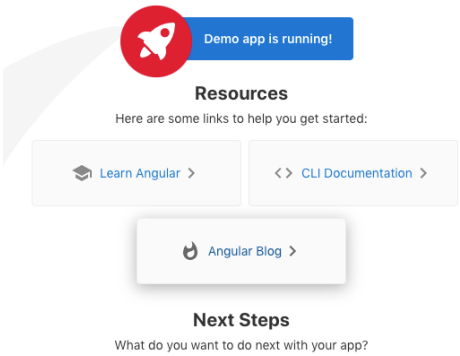
Figure 2: Full-stack Logical Architecture

3 First term assignments: Angular 10 and Spring Boot

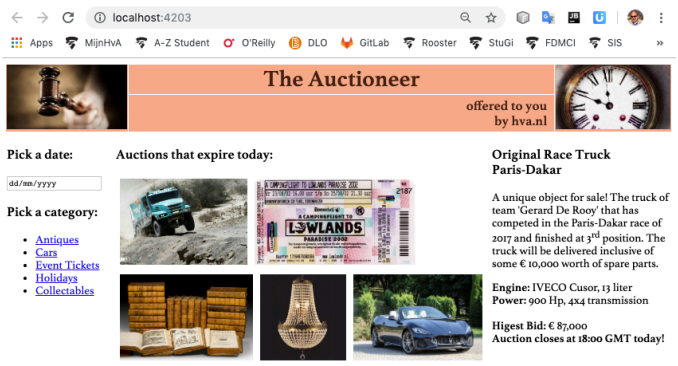
3.1 The Auctioneer Home Page

In this assignment you explore the setup of an Angular project, review its component structure and you (re-)practice some HMTL and CSS by populating the templates of a header and welcome page of your application.

A. Create an Angular 'Single Page Application' project for 'The Auctioneer':
   $ ng new Auctioneer
   or New Project → JavaScript → Angular CLI
   Test your project by running 'start' from the package.json file.
   Open your browser on http://localhost:4200/
   Your application shall show in in the browser as in the image provided here.



B. Setup the src/app/components/mainpage source directory structure and define in there a header component and a home component for the page:
   $ ng g c components/mainpage/header
   $ ng g c components/mainpage/home
   or New → Angular Schematic → Component
   in the context menu of src/app/components/mainpage
   Replace the content of your app.component.html such that is shows the header at the top of the main page, and the home page below that. First practice some plain HTML/CSS to produce a view similar to the picture below by only changing header.component.html, header.component.css, home.component.html, home.component.css and possibly src/styles.css



C. Design the header.component.html template to hold a title, sub-title and two (logo) pictures left and right. Store the pictures in src/assets/images. Make sure the header is responsive such that its pictures use fixed size and the title space scales with the size of the window. The text of the subtitle should be justified to the right.

D. Design the home.component.html to display its content in three columns. The left and right columns have a fixed width, the centre column scales with the window. Provide some extra margin between the images at the centre. When you click an image, a new tab should open and navigate to a related page on the internet. The date input should provide a date picker, but no further action needs to be connected at this stage. The categories are hyperlinks with dummy url-s for now.

E. Add another component ‘nav-bar’ to src/app/components/mainpage. Show this component just below the header in app.component.html. This navigation bar should be able to provide responsive menu items and sub-menus similar to the example picture above. (See also https://www.w3schools.com/howto/howto_css_dropdown_navbar.asp or other examples in that section of w3c tutorials to find inspiration of how to build responsive navigation bars with HTML5/CSS).

Make sure that the Sign-up and Log-in entries stick to the right if you resize your window.
Also apply dynamic color highlighting and sub-menu expansion effects when navigating the menus.

3.2 Offered Articles overviews

In this assignment you explore the TypeScript controller code and data of an angular component. You define model classes to properly define and organise the functional entities of your application. You apply structural directives, all four methods of binding and the principal method of component interaction.

3.2.1 A list of Offers

You apply the *ngFor directive, “String Interpolation binding’ and ‘Event binding’ to connect a simple html view to controller code and data.

A. Retrieve and format today’s date and time into the header.component.ts controller and use ‘interpolation binding’ to display the outcome at the left of the sub-title. (You may want to use the options parameter in the Typescript/Javascript function Date.toLocaleString for this.)

B. Setup the app/models source directory.
Define in there the offer.ts model class. ($ ng g cl models/offer).
Specify the following class attributes:

id: number;	description: string;
title: string	sellDate: Date;
auctionStatus: AuctionStatus;	valueHighestBid: number;

AuctionStatus is a string-based Enum with values “NEW”, “FOR_SALE”, “SOLD”, “PAID”, “DELIVERED”, “CLOSED”, “EXPIRED”, and “WITHDRAWN”.

Within the Offer class, you implement a method:
`public static createRandomOffer():Offer`
which you will use to instantiate some offers with random data for test purposes.
Make sure that each created offer has a unique id starting with 10001
Use Math.random() to randomise the other content of each created offer, i.e.:
Provide a mix of statusses
Provide past and future sellDates
Provide random values for valueHighestBid;
but if status is NEW, valueHighestBid shall be zero.

C. Setup the app/components/offers source directory and define in there an ‘overview1’ component. Create a local list of eight offers. Provide a method `addRandomOffer()` which uses `Offer.createRandomOffer()` to add another offer to the component’s list.

```
export class Overview1Component
    implements OnInit {

    public offers: Offer[];

    constructor() {
    }

    ngOnInit() {
        this.offers = [];
        for (let i = 0; i < 8; i++) {
            this.addRandomOffer()
        }
    }
```

D. Display the offer data within a <table> in the HTML-template of the component.
Use the *ngFor directive on <tr>.
Use ‘interpolation binding’ on the offer properties.

If the status of the offer is 'NEW', the value of the highest bid shall be left blank.
Use CSS to style the table.
Replace the 'home' view in the app-component main view by your offers list view.

E. Add a button at the bottom right of the view with text: 'Add Offer'
use 'event-binding' on the button that binds its 'click'-event to the component function addRandomOffer(). Test your application by adding some offers.

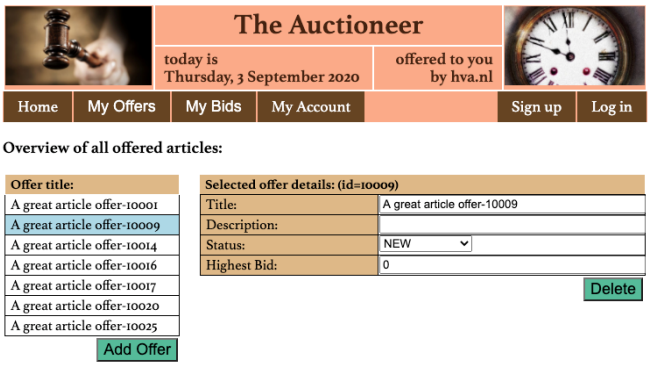
3.2.2 Master / Detail component interaction

In this assignment you apply 'Property binding' and 'Two-way' binding between the html view and the controller data of a component. You explore inter-component interaction by means of event emitters with @Output decorators and @Input decorators on properties.

A. Add two more components 'overview2' and 'detail2' to app/src/components/offers. overview2 shall manage a list of offers displaying only their titles, similar to the offers list of assignment 3.2. Implement the selection mechanism by binding the click event on every row in the titles overview at the left. The overview2 components tracks the 'selectedOffer'. When selectedOffer==null, nothing has been selected yet. Use CSS to highlight the Offer that has been selected in the list.

B. Overview2 embeds a detail2 component in a right panel '<app-detail2>', which shall eventually provide all details of the selected offer. While nothing is selected, the detail2 component shall display a simple message. (Use *ngif with an else alternative for this in the detail2.component.html template)

C. Otherwise, the detail2 component manages an edited Offer. Include the id of the edited offer in the header text of the detail2 component and the other properties below that.
Use appropriate <input type="…"> or <select> elements in its html template that bind to the properties of the edited Offer. (Use two-way binding and don't forget to import the FormsModule.)
(You may omit the Date properties for now, because its two-way binding is more complicated).
Use property binding within the <app-detail2> element of the overview2 template to link the selected Offer in overview2 with the edited Offer in detail2. Use an appropriate @Input decorator in detail2 and test whether you can edit the offers in the list.



When you edit the title of an offer in the detail, also the selected title in the offers list may change instantly.
When you navigate among different offers, any changes that you made to them will

be remembered.
When a new Offer is added via the 'Add Offer' button at the left, that offer should automatically get the selection focus (and be associated with the detail2 component).

D. Add a 'Delete' button to detail2 which the user can click to remove the Offer altogether. Provide an EventEmitter with an @Output decorator rom the detail2 and use eventbinding within the <app-detail2> element of the overview2 template to catch the Angular event. Provide appropriate code in overview2 to find and delete the offer from the list (by id). After deleting an offer, it is also removed from the display at the left, and nothing is selected anymore.
(At https://levelup.gitconnected.com/angular-7-share-component-data-with-other-components-1b91d6f0b93f you find another basic tutorial about @Input and @Output decorators.)

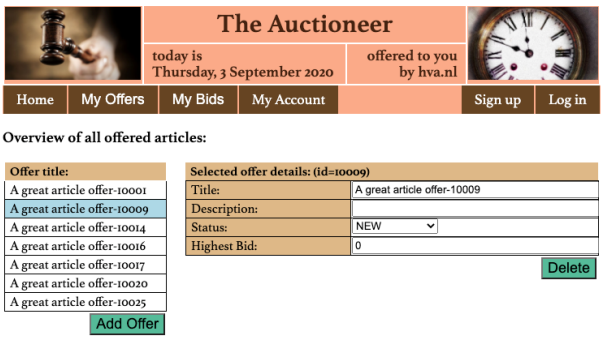
3.3 Using a service and custom two-way binding.

In this assignment you will setup a service to manage offers data that is to be shared and injected into multiple components. Then the lifecycle of the data has become decoupled from the lifetime of the UI components and you can just synchronise the Offer id-s among components without carrying all the data. You will use a true copy of the service's object for the real time editing, such that you can implement a cancel operation on changes and warn for unsaved changes in the form when the selection is about to change.

```
@Injectable({
  providedIn: 'root'
})
export class OffersService {
    public offers: Offer[];

    constructor() {
        this.offers = [];
        for (let i = 0; i < 6; i++) {
            this.addRandomOffer()
        };
    }
    /*
    findAll(): Offer[] {
        // TODO return the list of all offers
    }
    findById(oId: number): Offer {
        // TODO find and return the offer with the specified id
        // return null if none is found
    }

    save(offer: Offer): Offer {
        // TODO replace the offer with the same id with the provided
        // return the old, replaced offer
        // add the new offer if none existed and return null
    }

    deleteById(oId: number): Offer {
        // TODO remove the identified offer from the collection
        // and return the removed instance
        // return null if none existed
    }
    */
```

A. Setup the src/app/services source directory. Create in there an offers service, that will manage the collection (array) of available Offers.
($ ng g s services/offers)
(A single instance of this OffersService will be provided in 'root' and can be injected where needed in all other services or components.)
Implement four basic CRUD operations in your service:
findAll():Offer[] retrieves the list of all offers
findById(id):Offer retrieves one offer, identified by a given id
save(offer):Offer saves an updated or new offer and returns the previous instance with the same id, or null if no such offer existed yet.
deleteById(id):Offer deletes the offer identified by the given id, and returns the offer that was deleted, or null if none existed.
The choice of these signatures of CRUD operations aligns with the functionality of the RESTful web services, and the Java Persistence API which we will use later in the implementation of the backend.

B. Define an overview3 and detail3 component in app/components/offers, which provide similar functionality as overview2 and detail2 of assignment 3.2.2, but now use the CRUD operations of the offers collection as provided by offersService. (Inject the offersService instance into both the overview3 and detail3 components via their constructors).
Overview3 shows a list of titles as provided by the injected offersService.findAll().
Detail3 retrieves the offer to be edited from offersService.findById(id).



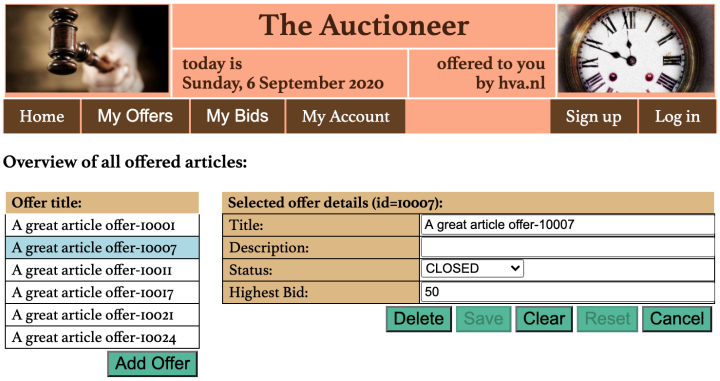
C. Maintain a selectedOfferId in overview3 and an editedOfferId in detail3 and implement two-way custom property binding between them in the <app-detail3> element in the overview3.component.html template:

```
<app-detail3 [(editedOfferId)]="selectedOfferId"></app-detail3>
```

Now either side can change the selected id, and the other side should follow:
1.If the user selects another offer in the list of overview3 at the left, detail3 should follow by loading the selected offer for editing.
2.If the user deletes the offer being edited in the detail3 component at the right, the offer shall be un-selected (e.g. by setting editedOfferId = -1) and also physically removed from the service. As a consequence, it should also disappear from the overview (which has got injected the same offers service).

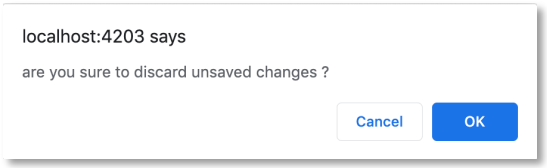
This use of custom two-way binding requires a specific naming convention to be followed for the shared property and the change-event emitter.
(See: https://angular.io/guide/template-syntax#two-way-binding-)
(See: https://angular.io/guide/component-interaction#intercept-input-property-changes-with-a-setter)

Show the new overview3 component from your app-component. Thoroughly test correct behaviour of your solution.



D. Implement additional buttons ‘Save’, ‘Clear’, ‘Reset’ and ‘Cancel’ in detail3 with the following functionality:
‘Save’ will update the offers service with the currently edited offer
‘Clear’ will setup a new clean Offer in the detail3 panel, but retain the offer id.
‘Reset’ will discard all changes and reload the form with the original offer from the offers service.
‘Cancel’ will discard al changes and cancel the edit, where after no details shall be shown and no title shall be selected and highlighted anymore.
(Hint: make sure that detail3 operates on a true copy of the selected Offer and not directly on the data in the service)

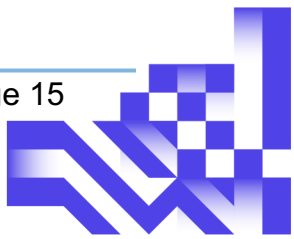
E. Implement unsaved changes detection in the detail3 component that will pop-up a confirmation box when the ‘Delete’, ‘Clear’, ‘Reset’ or ‘Cancel’ button is pressed while the form has unsaved changes.



If the user confirms with ‘OK’ the changes may be discarded. If the user presses ‘Cancel’ the focus shall remain on the earlier selected Offer, and the changes in the form shall be retained.
(Use the JavaScript confirm() function to popup this confirmation box before possible loss of changes.)
(Use object value comparison to check on differences between the edited object and the original object held by the service).
(This unsaved changes protection may not work yet, when another Offer is being selected in the title list, or when the user navigates to a different URL altogether.

That will be added in a later bonus assignment 3.4.3.)

F. Implement '[disabled]' property binding on the 'Save', 'Reset' and 'Delete' buttons, such that 'Save' and 'Reset' are disabled if nothing has been changed yet, and 'Delete' is disabled if there are unsaved changes.
(The other buttons are always enabled.)

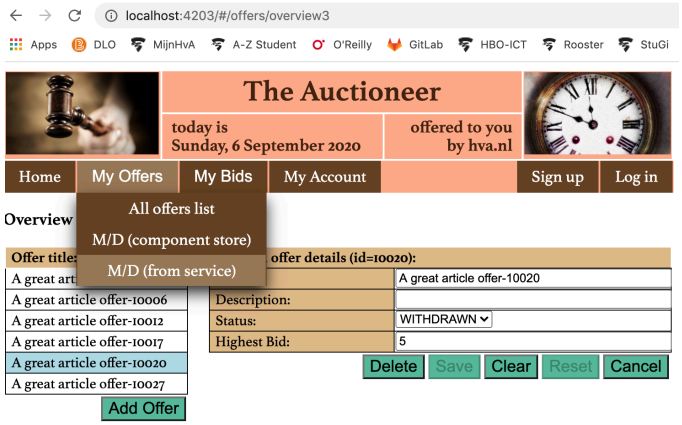


3.4 Page Routing

In these assignments we will provide navigation capabilities to our application, such that all of our pages can be found from a navigation menu bar, and users can bookmark the url-s of specific pages in your application

3.4.1 Basic Routing

First you will configure the router module and connect the four components that you have built in the earlier assignments to your navigation bar.



A. Implement page routing from the app-module.ts and provide routes for the three offers components that you have created in previous assignments:
1. 'home' shows your welcome page of assignment 3.1.
2. 'offers/overview1' shows the offers list of assignment 3.2.1.
3. 'offers/overview2' shows the master/detail of assignment 3.2.2 with the Offers stored in the component.
4. 'offers/overview3' shows the service-based Offers master/detail of assignment 0.

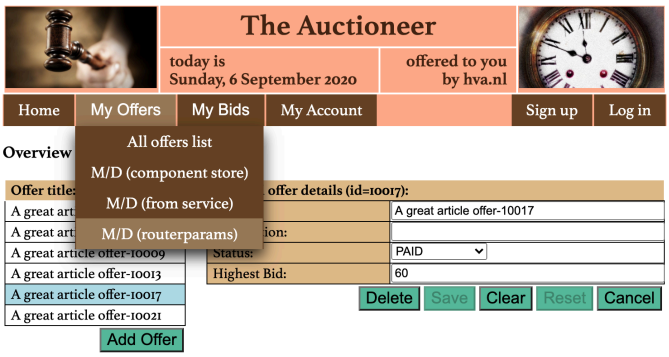
Also provide a redirect from '/' to the 'home' route.
Configure the 'useHash' option to separate the angular routes from the base in the browser's url.
Configure the <router-outlet> in your app component.
Link these options to menu items in your navigation bar.

B. Connect the 'Sign Up' menu item to the 'signup' route and the 'Log in' menu item to the 'login' route, without providing these routes in the routes table.
Add a new 'error' component in src/app/components/mainpage with a simple error message, which indicates that a specified route is not available, just as in the example below. This component should be connected to any unknown route.

3.4.2 Parent / child routing with router parameters.

In order to be able to bookmark or share an URL for editing of specific offer, we will integrate selection of an offer into the router. For that we use parent / child routing with router parameters.

A. Create two new components overview4 and detail4 in src/app/components/offers which can be copies of overview3 and detail3 initially. Connect overview4 to a new route offers/overview4 and also add the route to the 'My Offers' sub-menu.



B. The two-way custom property binding between the Overview4Component.selectedOfferId and Detail4Component.editedOfferId can be removed. Instead, you create a child sub-route ':id' for the detail4 component under the offers/overview4 parent route and also create the child <router-outlet> in the overview4.component.html.
If the user now selects a different *offer* in the list of titles, you call the navigate method on the router towards the sub-route *offer.id*
(For that you need to inject the router and the activatedRoute in the constructor of overview4).

```
onSelect(oId: number) {
    // activate the details page for the given offer Id
    this.router.navigate([oId], { relativeTo: this.activatedRoute });
}
```

C. The detail4 component needs to extract the editedOfferId from the router parameter and retrieve (a copy of) the associated Offer to be edited from the service. The value of the router parameter is available from the activatedRoute. The value of the router parameter may change in the future each time when the user selects different Offer. The detail4 component is instantiated and initialised only once. Hence we must configure it to reinitialise its editedOffer each time when the router parameter is touched. That we achieve by subscribing to the params observable in the activatedRoute.

```
constructor(public offersService: OffersService,
            public router: Router,
            public activatedRoute: ActivatedRoute) {
}

private childParamsSubscription: Subscription = null;

ngOnInit() {
    // get the offer id child parameter from the activated route
    this.childParamsSubscription =
        this.activatedRoute.params
            .subscribe((params: Params) => {
                console.log("detail setup id=" + params['id']);
                // retrieve the offer to be edited from the service
                this.setEditedOfferId(params['id'] || -1);
            });
}

ngOnDestroy() {
    // unsubscribe from the router before disappearing
    this.childParamsSubscription &&
        this.childParamsSubscription.unsubscribe();
}
```

Here you find a snippet of sample code that could do that job. It injects the router and the activatedRoute in the constructor of detail4 and subscribes to the Observable to be notified about any change in the router parameters. In the method setEditedOfferId() you shall then obtain the associated Offer object for editing from the offersService.
(Strictly it is not necessary to unsubscribe from activatedRoute observables, but we do it anyway as a good habit).
(This code does not use the value from activatedRoute.snapshot.params['id']. It appeared that the observable also provides an event immediately after initialisation of the component that is identical to value in the snapshot. You may want to test this to be sure…)

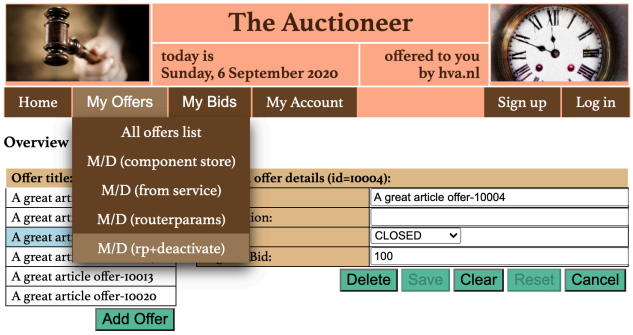
D. Test whether all navigation works fine, and also whether you can drive full navigation of overview4 and detail4 just by editing the url in the browser address bar. It is well possible that the highlighting of the selected offer title in the list will not always follow the URL or the details section. For that you also need to observe the 'id' router parameter in the overview4 component itself at activatedRoute.firstChild.params, and synchronise it with the selectedOfferId.
That is a bit more complicated though, because if no child id has been provided in the route, no detail4 will not have been instantiated yet and activatedRoute.firstChild will be 'undefined' so that you cannot subscribe to its param observable. (You can work around this issue by adding a convenient redirection in the children routes table from the empty root path to a dummy child id, e.g. '-1'.)

E. Fix the 'Save', 'Delete' and 'Cancel' operations in detail4 and unselect the edited offer by navigating to the parent of the activatedRoute without a router parameter. Before, in the detail3 component you would have emitted an event to notify the parent about un-selection of the offer.
If you have done well, the unsaved changes detection as explained in assignment 3.3.E, is still working. Also the '[disabled]' properties on the buttons still work fine as explained in 3.3.F. If these are not working anymore, you should repair them.

3.4.3 [BONUS] Unsaved changes protection with router guard 'canDeactivate'.

It was possible to protect against unintended loss of edited changes while the user was using the controls to navigate within the master / detail overview, but no protection was provided when the user changes the address in the browser manually or navigates to other parts of the application or even to another site. The Angular router provides for configuration of a 'canDeactivate' guard to protect that.

A. Create one new component detail41 in src/app/components/offers which extends the component detail4 of assignment 3.4.2 and reuses in its @Component decorator the templateUrl and styleUrls of detail4. Initially there is no need for a constructor or other methods or attributes in detail41.

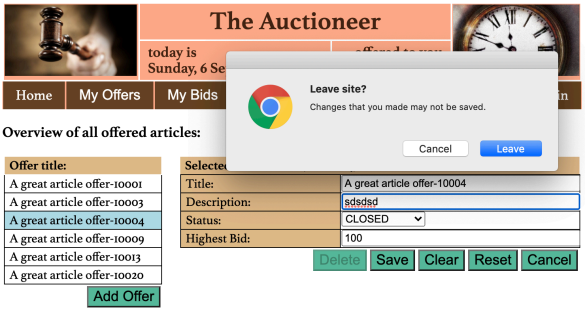


There will be no change in the interaction with overview4, so you can fully reuse that component.
Create a new route 'offers/overview41' that opens overview4 and add a child route which opens the new component detail41. Provide the new route 'offers/overview41' in the 'offers' sub-menu.

B. Implement the CanDeactivateGuardService in src/app/services and the canDeactivate method in the detail41, leveraging your method to check dirtiness. Test whether all navigation within the application now traps changes in your form and make sure the confirmation box never pops up twice (e.g. one time by

canDeactivate and one time by your own checks). Re-test all use of the buttons and also the '[disabled]' properties on them.

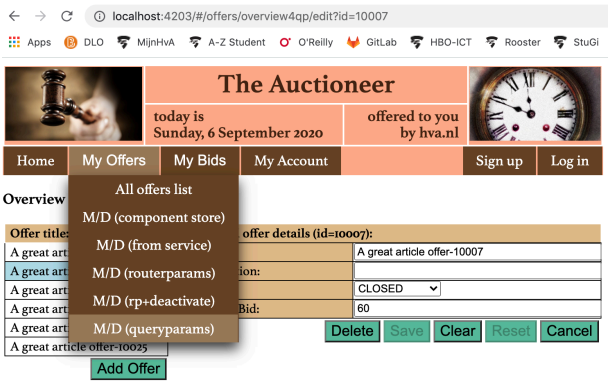
C. Unfortunately, canDeactivate only traps navigation within your application, not if the user navigates to a completely different site. For that, stewdebaker has proposed a nice solution at https://stackoverflow.com/questions/35922071/warn-user-of-unsaved-changes-before-leaving-page. Apply this solution to your implementation and test whether all navigation still works fine, all use of all buttons and also the '[disabled]' properties on the buttons.



3.4.4 *[BONUS] Parent / child communication with query parameters*

A alternative approach to maintain synchronisation of the selected offer Id between the overview master and the details editor component is to use query parameters along with the router instead of router parameters.

A. Create one new component detail4qp in src/app/components/offers which extends the component detail4 of assignment 3.4.2 or detail41 of assignment 3.4.3 and reuses in its @Component decorator the templateUrl and styleUrls of detail4. Initially there is no need for a constructor or other methods or attributes in detail4qp. There will be no change in the interaction with overview4, so you can fully reuse that component.
Create a new route 'offers/overview4qp' that opens overview4 and add a child route with path = 'edit' which opens the new component detail4qp. Provide the new route 'offers/overview4qp' in the 'offers' sub-menu.



B. Now, the detail4qp component needs to extract the editedOfferId from the activatedRoute. For that, you can use similar code as provided with assignment 3.4.2.C, but now subscribe to the 'queryParams' observable instead of the 'params' observable. If you do well, you only need to override ngOnInit and ngOnDestroy in the extended Detail4qpComponent class and inherit all other functionality.

```
onSelect(oId: number) {
    // activate the details page
    this.router.navigate(['edit'], {
            relativeTo: this.activatedRoute,
            queryParams: {id: oId}
        }
    );
}
```

The same applies to the Overview4qpComponent, except that you also may need to override the onSelect method, because child routes have been changed, and query parameters shall be used to pass the selected offer id:

Test whether all navigation and unsaved changes detection still works fine, all use of all buttons and also the '[disabled]' properties on the buttons. (Specifically test the Cancel button both on clean and edited forms.)

3.5 Setup of the Spring-boot application with a simple REST controller.

In the following assignments you will build the backend part of 'The Auctioneer' application as depicted in the full-stack, layered logical architecture of section 2.3. You will use the Spring-Boot technology.
Relevant introduction and explanation about this technology can be found in the video O'Reilly-2 by Ranga Karanam at https://learning.oreilly.com/home/:

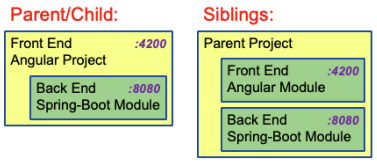
As of assignment 3.7 you will integrate the backend capabilities with your frontend solution of assignment 3.4.

First you create a basic Spring Boot backend application and configure in there a simple REST Controller (O'Reilly-2, Chapter 4, step 4). The controller provides one resource endpoint to access the offers of your application. These offers are actually managed in the Spring-Boot backend by an implementation of an OffersRepository Interface. The OffersRepository is injected into the REST Controller by setter dependency injection (O'Reilly-2, Chapter 3, step 7).

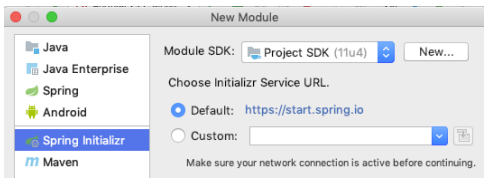
For now, you start with providing an OffersRepositoryMock bean implementation that just tracks an internal array of offers, similar to how you did that before in an Angular service of your FrontEnd. In a later assignment you will provide a 'bean' implementation of this interface that links with H2 or MySql persistent storage via the Hibernate Object-To-Relational Mapper.

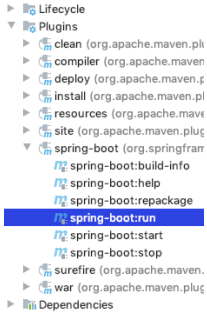
Below you find more detailed explanation of how you can implement the objectives of this assignment.

A. Basically, there are two approaches to combine a frontend and a backend module in an integrated development environment.
i) A backend module within a frontend project.
ii) Two separate projects as siblings in a parent folder.
Here we choose the first approach, because that is a straightforward extension of the work of earlier assignments.
(If you wish to configure CI/CD deployment in a real project the Siblings approach is a better option.)



Create a Spring-Boot application module 'aucserver' within the Single Page Application project.
Use the Spring Initializr plugin.
(You may need to install/activate the Spring plugins first in your Intellij settings/preferences).



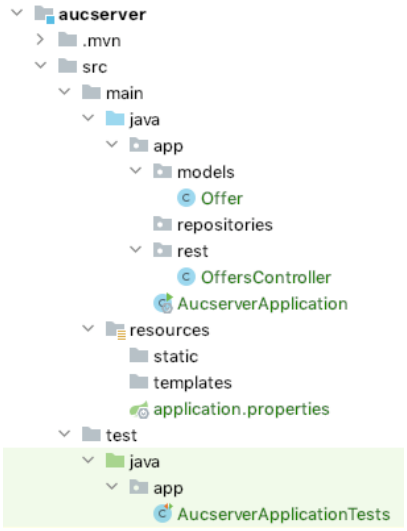


Choose the war format for your deployment package.
Activate the Spring Web dependency in your module.
Also check that Maven framework support is added.
Test your project setup by running the 'spring-boot:run' maven goal.

You may want to configure debug mode or adjust the tomcat portnumber in resources/application.properties:

```
server.port=8083
logging.level.org.springframework = debug
```

B. You may want to tidy-up the source tree of your module, similar to lay-out shown here. Always use the refactoring mode of IntelliJ to move files around such that the dependencies will be fixed. Basic rules for setup are:
   1. Your AucServerApplication class should reside within a non-default package (e.g. 'app'). (Otherwise, the autoconfig component scan may hit issues).
   2. Autoconfiguration searches for beans only in your main application package and its sub-packages (e.g. 'models', 'repositories' and 'rest' in this example).
   3. The package structure under 'test/java' should match the source structure under 'main/java'



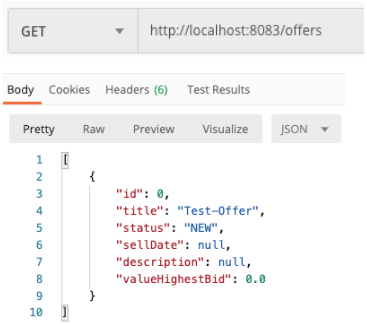
You may need to fix 'Sources root', 'Test sources root' and 'Resources root' designation of marked IntelliJ folders, if those were not picked up automatically.

If you have pulled the back-end source tree from Git, you may find that the Intellij module configuration file is not maintained by Git, and you need to configure the module with File->New->Module From Existing sources.

C. Implement the Offer model class and the OffersController rest controller class, as explained in O'Reilly-2.
Replicate your Offer model from the frontend offer.ts code.
Implement in the OffersController a single method 'getAllOffers()' that is mapped to the '/offers' end-point of the Spring-Boot REST service. This method should return a list with just a single offer like below.

```
public List<Offer> getAllOffers() {
        return List.of(new Offer("Test-Offer"));
```

Run the backend and use PostMan to test your endpoint. (Download and install Postman from https://www.getpostman.com/downloads/)
Your Postman test should deliver the offer like you expect.



D. Define an OffersRepository interface and an OffersRepositoryMock bean implementation class in the repositories package similar to the SortAlgorithm example of Ranga. Spring-Boot should be configured to inject an OffersRepository bean into the OffersController.

The OffersRepositoryMock bean should manage an array of offers, similar to how your Angular OffersService was managing the Offer data. Let the constructor of

OffersRepositoryMock setup an initial array with 7 offers with some random data. The static method to create some random offer can best be implemented in the Offer class itself.

```
public static Offer createRandomOffer() {
    Offer offer = new Offer();

    // TODO put some random values in the offer attributes
```

However, the responsibility for generating and maintaining unique ids should now be implemented in the OffersRepositoryMock class. Later, that responsibility will be moved deeper into the backend to the ORM.

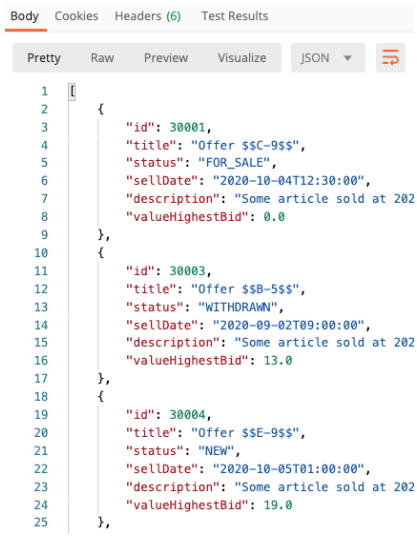
The OffersRepository interface provides one method 'findAll()' that will be used by the endpoint in order to retrieve and return all offers:

```
public interface OffersRepository {
    public List<Offer> findAll();
}
```

```
public List<Offer> getAllOffers() {
        return repository.findAll();
}
```

Make sure you provide the appropriate @RestController, @Component, @Autowired, @RequestMapping and @GetMapping annotations to steer the Spring-Boot configuration and dependency injection.

Test your end-point again with Postman:



3.6 Enhance your REST controller with CRUD operations

In this assignment you will enhance the repository interface and the /offers REST-api with endpoints to create new Offers and get, update or delete specific offers. You will enhance the api responses to include status codes, handle error exceptions and involve a dynamic filter on the response body to be able to restrict content from being disclosed to specific requests.

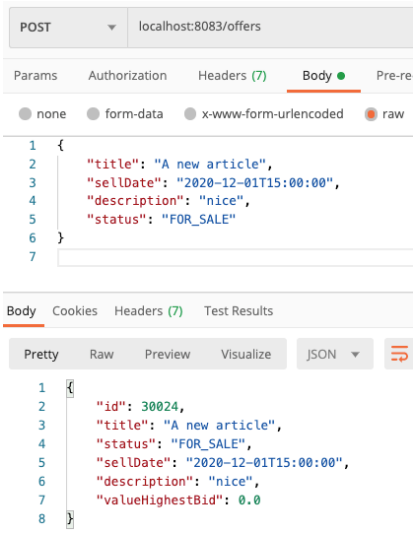
In this assignment you should practice hands-on experience with Spring-Boot annotations @RequestMapping, @GetMapping, @PostMapping, @DeleteMapping, @PathVariable, @RequestBody, @ResponseStatus, @JsonView and @Configuration and classes ResponseEntity, ServletUriComponentsBuilder.

By the end of this assignment, your OffersRepository interface should have evolved to

```
public interface OffersRepository {
    List<Offer> findAll();          // finds all available offers
    Offer findById(long id);        // finds one offer identified by id
                                    // returns null if the offer does not exist
    Offer save(Offer offer);        // updates the offer in the repository identified by offer.id
                                    // inserts a new offer if offer.id==0
                                    // returns the updated or inserted offer with new offer.id
    boolean deleteById(long id);    // deletes the offer from the repository, identified by offer.id ;
                                    // returns whether an existing offer has been deleted
}
```

A. Enhance the OffersRepositoryMock class with actual implementations of all CRUD methods as listed in the OffersRepository interface above.
The ids can be arbitrary long integer numbers, so you may need to implement a linear search algorithm to find and match the a given offer-id with the available offers in the private storage of the OffersRepositoryMock instance.

B. Enhance your REST OffersController with the following endpoints:
- a GET mapping on '/offers/{id}' which uses repo.findById(id) to deliver the offer that is identified by the specified path variable.
- a POST mapping on '/offers' which uses repo.save(offer) to add a new offer to the repository. If an offer with id == 0 is provided, the repository will generate a new unique id for the offer. Otherwise, the given id will be used.
- a PUT mapping on '/offers/{id}' which uses repo.save(offer) to update/replace the stored offer identified by id.
- a DELETE mapping on '/offers/{id}' which uses repo.deleteById(id) to remove the identified offer from the repository.

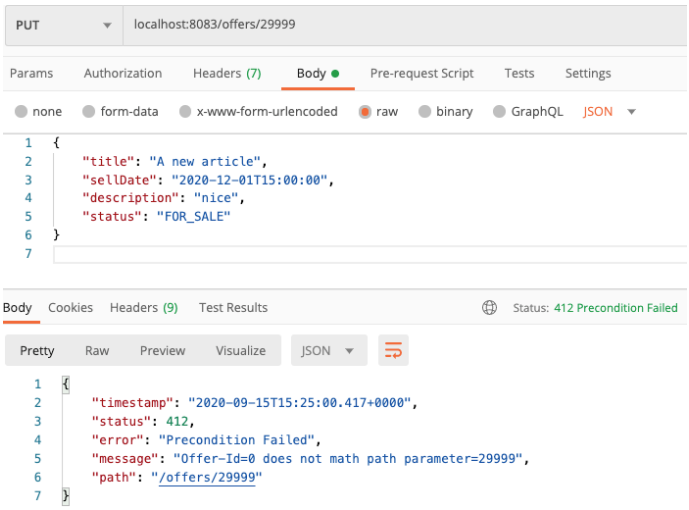


Test the new mappings with postman.

C. Use the ResponseEntity and ServletUriComponentsBuilder classes to return a response status=201 and Location header in the response of your offer creation request. Use the .body() method to actually create the

ResponseEntity such that it also includes the offer with its newly generated id for the client.

Test the mapping with postman.

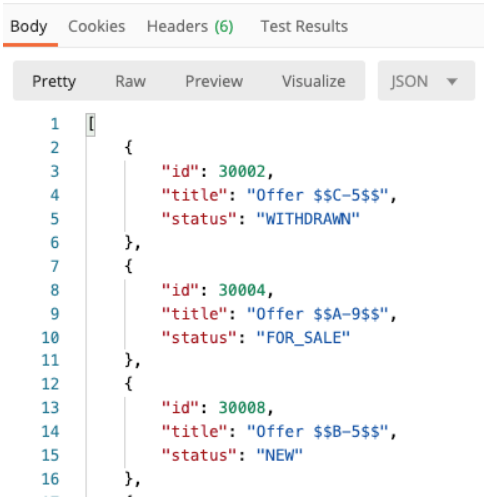


D. Implement Custom Exception handling in your REST OffersController:
- throw a ResourceNotFound exception on get and delete requests with a non-existing id.
- throw a PreConditionFailed exception on a PUT request at a path with an id parameter that is different from the id that is provided with the offer in the request body.

Test the mapping with postman.

E. Implement a dynamic filter on a getOffersSummary() mapping at '/offers/summary', which only returns the id, title and status of every offer. Dynamic filters can most easily be implemented with a @JsonView specification in your Offer class in combination with the same view class annotation at the request mapping in the rest controller.

Test the mapping with postman.



3.7 Connect the FrontEnd with HTTPClient requests

In this assignment you will explore Angular HTTP requests to implement the interaction between your frontend application and the backend REST API. Basically, there are two approaches to this:

i. You refactor the implementation of your service such that it caches relevant offers data from the backend and uses HTTP requests and responses to maintain cache consistency.

ii. You refactor your UI components and the implementation of your service such that the service provides an adaptor for accessing the backend REST API without caching any data. The UI-components will handle the a-synchronous responses from the backend.

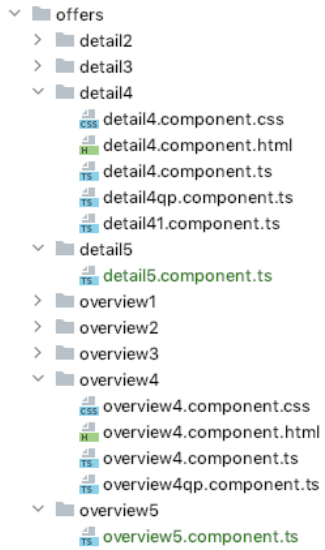
The advantage of option ii) is that your UI will always show up to data information, also if multiple users are accessing the backend concurrently.

The advantage of option i) is that we can address almost all of the interaction within the Angular service, and your UI components only require minimal change.

Below we will provide directives according to option i) but you may choose to implement option ii)

You will add @angular/common/http, rxjs to the frontend and WebMvcConfigurer and @Configuration in the backend.
You will configure the CORS across the full stack to facilitate use of multiple ports for different backend services.

A. Replicate ‘overview4’ and ‘detail4’ components of assignment 3.4 (or bonus versions thereof) into new overview5 and detail5 components.
(As we will apply only minor changes to these components, you only need to replicate the .ts files and may reuse the .html and .css templates).
Replicate the offers.service into a new offers-sb.service. We will be refactoring that service to connect to our backend REST service with http requests.
Change to overview5 and detail5 components to inject the new OffersSbService in their constructors.



Create a new route offers/overview5 in your router module, and configure that route in your navigation-bar.
First test whether your overview5 is still working in the same way as the original overview4

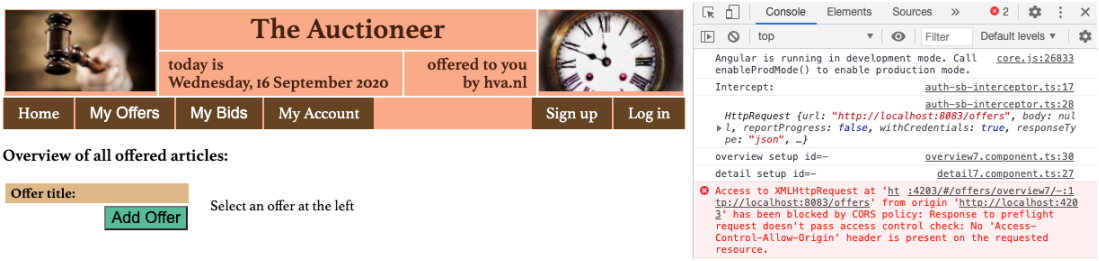
B. Provide HttpClient (from "@angular/common/http") in your app-module.ts and inject its instance into OffersSbService.
Add a private method
restGetOffers(): Observable<Offer[]>
to the OffersSbService.
This method issues an http get request to your backend endpoint for all offers

(http://localhost:8080/offers), and handles the response by caching all retrieved offers in the local array in the service.
Call this method from the constructor of the OffersSbService, such that upon instantiation of this singleton service object, it is immediately populated with data from the backend.
For now, make sure that any error conditions from the http requests are logged onto the browser console.

Notice, that the Json response of an http request gives you all offer data, but does not deliver a true Offer object as per your models/offer.ts class definition. These Json data objects do not know their methods…
A systemic way to address this issue is to provide and use a static method 'trueCopy' in the Offer class, that converts an Offer object with data fields only into a true Offer instance that has been created with a constructor, and got its data fields replicated with use of the Object.assign helper method.

```
public static trueCopy(offer:Offer): Offer {
    return offer == null ? null : Object.assign(new Offer(), offer);
}
```

C. Launch both the Spring-boot backend and the Angular frontend and verify whether the backend-offers appear in your new frontend overview5.
It is well possible that you run into a CORS issue (make sure you log the errors that you may get from an http request).

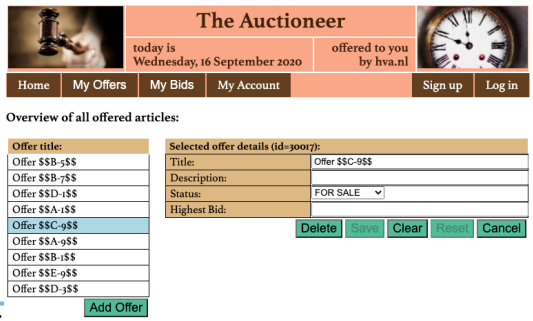


If your backend REST service is provided from a different port (8080) than your frontend UI site (4200), you must configure your backend to provide Cross Origin Resource Sharing (see https://en.wikipedia.org/wiki/Cross-origin_resource_sharing).
For that, add a global configuration class to your backend which implements the WebMvcConfigurer interface. In this class you need to implement addCorsMappings.

```
@Override
public void addCorsMappings(CorsRegistry registry) {
    registry.addMapping("/**")
            .allowedOrigins("http://localhost:4203", "http://localhost:4200")
```

Make sure that the class is found during the Spring Boot component scan and automatically instantiated.

D. Now, your OffersSbService should initialise properly and your Overview5 component should be able to show an offers list that was retrieved from the backend.
if you select an offer, you should see its



details, and the offer-id that was generated in the backend.
Implement additional private methods in OffersSbService:

restPostOffer(offer): Observable<Offer>
restPutOffer(offer): Observable<Offer>
restDeleteOffer(offerId): void

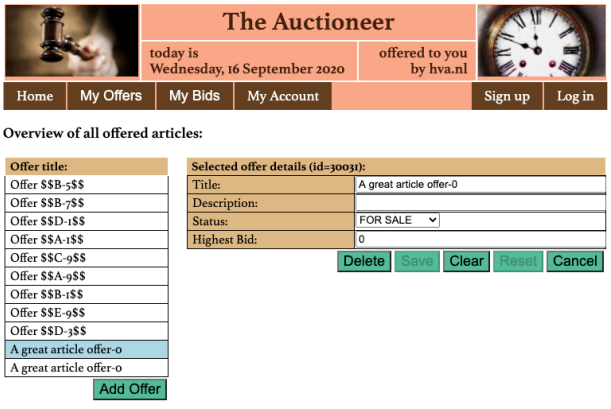
which use http requests and responses to interact with backend, and maintain a consistent state of the local offers array within the service.
Call upon these methods from your service methods save(offer) and deleteById(offerId) which are still being used behind the buttons of your UI components.

E. Depending on your implementation, you may hit three challenges:

1. The Add Offer button in the Overview5Component is expected to create an offer with some random content and then post that to the backend. Now the backend should assign it its unique id and return the updated and saved offer in the response. Consequently, the Overview5Component can only select that new offer after the response has been returned, because it needs the offer-Id for tracking the selection. One way to address that is to let the OffersSbService.addRandomOffer() method return the observable of the http-request, and have the Overview5Component.onAddOffer() method also subscribe to that observable and only select the new offer after the response has been delivered.

2. In specific cases you may wish to subscribe multiple times to the same observable that is returned from an http request. (E.g. both in the service and in the UI component.) By default, that has a nasty side effect that the request itself will then also be issued multiple times, once for each subscriber. At https://blog.angulartraining.com/how-to-cache-the-result-of-an-http-request-with-angular-f9aebd33ab3 you can read how to prevent that with a .pipe(shareReplay(1)) operator suffix on the request.

3. If you reload the page, it may occur that your Detail5Component initialises before the service has loaded the offers, and that your edit panel remains empty. Of course, the user can work around by reselecting the offer in the overview, but that is not 'user friendly'. You can resolve the issue with some retry code in Detail5Component using setTimeout, but that is not elegant either. Here shows the disadvantage of the cacheing service approach. Yet, if you read all articles about proper use of rxjs in Angular, then also the adaptor approach seems to incur a lot of complexity…



Test your implementation, verifying add update and delete operations, and also verify that a page refresh (which reloads your frontend application) is able to retrieve again all data that is still held by the backend.

4 Second term assignments: JPA and Authentication

In these assignments you will expand the backend part of 'The Auctioneer' application as depicted in the full-stack, layered logical architecture of section 2.3. You will implement the Java Persistence API to connect the backend to a relational database. Also, full stack authentication and security will be addressed with JSON Web Tokens.

Relevant introduction and explanation about this technology can be found in O'Reilly-3 at https://learning.oreilly.com/home/:

These assignments build upon your full-stack solution as you have delivered at the end of assignment 3.7

4.1 JPA and ORM configuration

In this assignment you will configure data persistence in the backend using the Hibernate ORM and the H2 RDBMS. You will implement a repository that leverages the Hibernate EntityManger in transactional mode in order to ensure data integrity across multiple updates.

By the end of this assignment you will have implemented the Offer and Bid classes including its one-to-many relationship. Your REST API can add bids to offers. It will produce error responses on bids for offers that are not FOR_SALE and bids that do not exceed the existing highest bid on the Offer.

Relevant introductions into the topics you find in O'Reilly-3 chapters 3 and 5.

In this assignment you should practice hands-on experience with Spring-Boot annotations @Entity, @Id, @GeneratedValue @OneToMany @ManyToOne @Repository @PersistenceContext @Primary @Transactional @JsonManagedReference @JsonBackReference and classes EntityManager and TypedQuery.

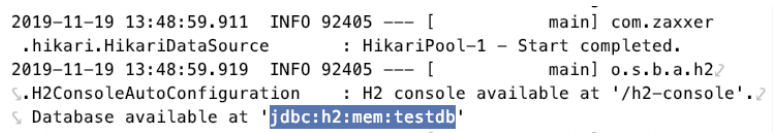
4.1.1 Configure a JPA Repository

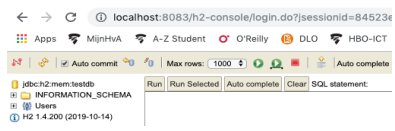
A. First update your pom.xml to include the additional dependencies for 'spring-boot-starter-data-jpa' and 'h2' similar to the demonstration of a project setup in O'Reilly-3.Ch3.
(Do not include the JDBC dependency).
Also enable the H2 console in application.properties, and make sure the logging level is at least 'info' so that Spring shows its configuration parameters when it starts.
Enable

```
spring.jpa.show-sql=true
logging.level.org.hibernate.type=trace
```

in application.properties such that you can trace the SQL queries being fired.

Relaunch the server app, and use the h2-console to check-out that H2 is running.





(Retrieve your proper JDBC URL from the spring start-up log.)
(Spring Boot has auto-configured the H2 data source for you.)

(You do not need to create tables or load data into the database using plain SQL)

B. Upgrade your Offer class to become a JPA entity, identified by its id attribute. Configure the annotations which will drive adequate auto-generation of unique ids by the persistence engine.

Create a new implementation class OffersRepositoryJpa of your OffersRepository interface. This new class should get injected an entity manager that provides you with access to the persistence context of the ORM. Use this entity manager to first implement the save method of your new repository. (Other methods will come later.)

Configure transactional mode for all methods of OffersRepositoryJpa.

If you now run the backend you might get a NonUniqueBeanDefinitionException, because you may have two implementation classes of the OfferRepository interface: OffersRepositoryMock and OffersRepositoryJpa.
(The tutorial on Spring Dependency Injection explains how to fix that with @Primary. Alternatively, you can explore the use of @Qualified.)

Test the creation of an offer with postman doing a post at localhost:8080/offers. Verify the associated SQL statements in the Spring Boot log and use the h2-console to verify whether the offer ended up in H2.

You may want to explore the use of the @Enumerated annotation to drive the format of the registration of the status in the database.

```
Hibernate: call next value for offer_ids
Hibernate: insert into offer (description, sell_date, status, title, id)
 values (?, ?, ?, ?, ?)
```

SELECT * FROM OFFER;

ID	DESCRIPTION	SELL_DATE	STATUS	TITLE
30001	Some article sold at 2020-08-26T05:00:00	2020-08-26 05:00:00	WITHDRAWN	Offer $$B-7$$

C. Also implement and test the other three methods of your OffersRepository interface (deleteById, findById and findAll). Use a JPQL named query to implement the findAll method.
The use of JPQL is explained in O'Reilly-3.Ch5.Step15, and -.Ch10. In assignment 4.2 you will explore JPQL in full depth. For now you can use the example given here to implement OffersRepositoryJpa.findAll()

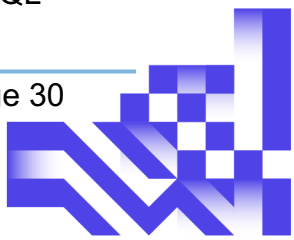
```
@Override
public List<Offer> findAll() {
    TypedQuery<Offer> query =
            this.entityManager.createQuery(
                    "select o from Offer o", Offer.class);
    return query.getResultList();
}
```

Test your new repository with postman.

D. Inject the offers repository into your main application class and implement the CommandLineRunner interface (as shown byO'Reilly-3.Ch3.Step6).

```
@Transactional
@Override
public void run(String... args)  {
    System.out.println("Running CommandLine Startup");
    this.createInitialOffers();
```

From the run() method you can automate the loading of some initial test data during startup of the application.
This approach is preferred above the use of SQL scripts in the H2 backend, because the details of the generated H2 SQL



schema will change as you progress your Java entities.
This CommandLineRunner initialisation will also work with your Mock repository implementation.

Make sure to configure transactional mode on the command line runner:

```
private void createInitialOffers() {
    // check whether the repo is empty
    List<Offer> offers = this.offersRepo.findAll();
    if (offers.size() > 0 ) return;
    System.out.println("Configuring some initial offer data");

    for (int i = 0; i < 9; i++) {
        // create and add a new offer with random data
        Offer offer = Offer.createRandomOffer();
        //offer.setId(11*i);
        offer = this.offersRepo.save(offer);

        // TODO maybe some more initial setup later
```

4.1.2 Configure a one-to-many relationship

A. Now is the time to introduce a second entity. Make a new model class 'Bid' identified by an attribute named 'id' (long) and with one attribute named 'value'(double).
A Bid is associated with one Offer.
An Offer is associated with many Bids.
Declare the corresponding association attributes in both classes and make sure they are initialised in their constructors.
Also provide the JPA @ManyToOne and @OneToMany attributes as explained in O'Reilly-3.Ch8

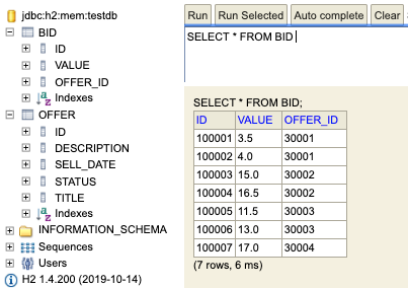
Provide some additional functional methods in Offer that are related to Bids:

```
/**
 * retrieves the latest bid that has been added to this offer
 * @return  null if the offer has no bids
 */
@JsonIgnore
public Bid getLastestBid() {

/**
 * Add a new higher bid to the offer
 * Do not add the new bid, if it is lower than the latest bids on this offer
 * @param newBid
 * @return  false if newBid has a lower or equal value compared to the latest bid.
 */
public boolean addHigherBid(Bid newBid) {
```

```
/**
 * obtain the value of the highest (=latest) bid on the offer
 * @return  0.0 if the offer has no bids.
 */
public double getValueHighestBid() {

/**
 * @return  the number of bids registered with the offer
 */
public int getNumberOfBids() {
```

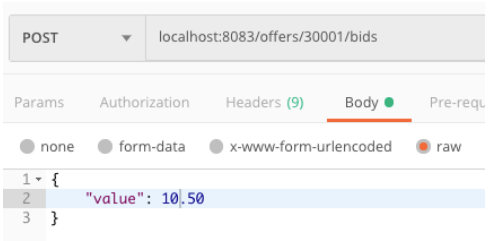
B. Implement a BidsRepositoryJpa similar to your OffersRepositoryJpa.
You should not like this kind of code duplication and worry about all the work to come when 10+ more entities need implementation of the Repository Interface needs extension…!!! That may motivate you to implement an approach of the (optional) bonus assignment 4.1.3 and create one, single generalized repository for all your entities.
But, for this course you also may keep it simple and straightforward and just replicate the OffersRepository code….

C. Extend the initialisation in the command-line-runner of task 4.1.1-D to add a few bids to every offer and save them in the repository.
Consider the JPA life-cycle of managed objects within the transactional context in each of the steps of your code:
Make sure that at the end of the method (=transaction) all ('attached') offers only include 'attached' bids.
Test your application and review the database schema in the H2 console. Check its foreign keys and review the contents of the BID table:



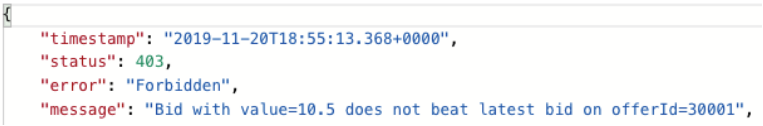
D. Re-test the REST API at localhost:8080/offers with postman:
You may find a response like here with endless recursion in the JSON structure. For now, investigate the use of @JsonManagedReference and @JsonBackReference to fix that.
With (optional) bonus assignment 4.2.2 you can practice a better solution with custom Json serializers.

E. Implement a POST mapping on the /offers/{offerId}/bids REST endpoint. This mapping should add a new bid to the offer. An error response should be provided if 1) the offer does not have status 'FOR_SALE' or 2) the bid value is not higher than the latest(=highest) bid on the offer.



In other cases the bid should be created and added to the offer, and a creation success status code should be returned.

Test your new end-point with postman:



4.1.3 [BONUS] Generalized Repository

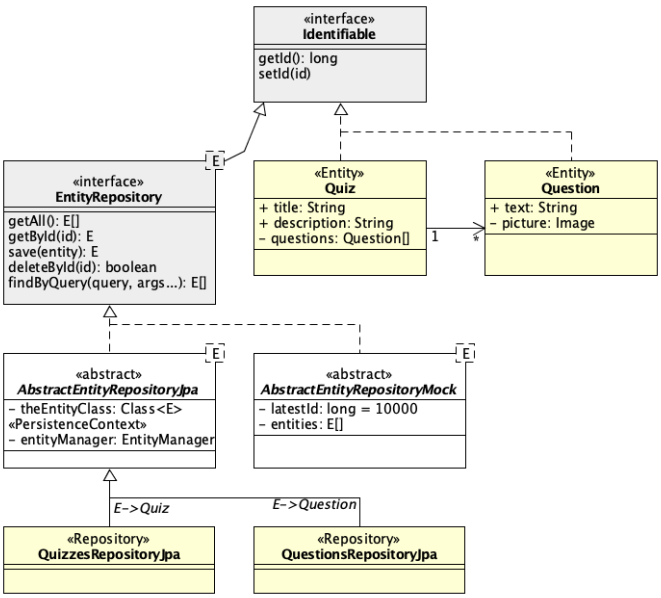
Implementing similar repositories for different entities calls for a generic approach. Actually, Spring already provides a (magical) generic interface JpaRepository<E, ID> and its implementation SimpleJpaRepository<E, ID>. The E generalises the Entity type ID the type of the Identification of the Entity. Such generalisation could provide all repositories that you need.

However, in this course, we require you to implement your own repository for the purpose of learning and developing true understanding. That is no excuse for code duplication though, so we challenge you to develop your own generic repository.

The SimpleJpaRepository<E, ID> class uses the JPA metadata of the annotations to figure out what are the identifying attributes of an entity. That is too complex for the scope of this course.

Also, the generalization of the identification type ID to non-integer datatypes would require custom implementation of unique id generation by the hibernate ORM. We don't want to go there either…

In the class diagram here, you find a specification of a simplified approach of implementing an EntityRepository<E> interface in a generic way, but assuming that all your entities are identified by the 'long' data type. (Replace in this diagram and the code snippets below the Quiz entity by your Offer entity and the Question entity by your Bid entity).



This approach can be realised as follows:

A. Let every entity implement an interface 'Identifiable' providing getId() and setId() Unidentified instances of entities will have id == 0L

```
public interface Identifiable {
    long getId();
    void setId(long id);
```

```
@Entity
public class Quiz implements Identifiable

@Entity
public class Question implements Identifiable
```

B. Specify a generic EntityRepository interface:

```
public interface EntityRepository<E extends Identifiable> {
    List<E> findAll();          // finds all available instances
    E findById(long id);        // finds one instance identified by id
                                // returns null if the instance does not exist
    E save(E entity);           // updates or creates the instance matching entity.getId()
                                // generates a new unique Id if entity.getId()==0
    boolean deleteById(long id); // deletes the instance identified by entity.getId()
                                // returns whether an existing instance has been deleted
```

C. Implement once the abstract class AbstractEntityRepositoryJpa with all the repository functionality in a generic way:

```
@Transactional
public abstract class AbstractEntityRepositoryJpa<E extends Identifiable>
        implements EntityRepository<E> {

    @PersistenceContext
    protected EntityManager entityManager;

    private Class<E> theEntityClass;

    public AbstractEntityRepositoryJpa(Class<E> entityClass) {
        this.theEntityClass = entityClass;
        System.out.println("Created " + this.getClass().getName() +
                "<" + this.theEntityClass.getSimpleName() + ">");
    };
```

You will need ‘theEntityClass’ and its simple name to provide generic implementations of entity manager operations and JPQL queries.

D. Provide for every entity a concrete class for its repository:

```
@Repository("QUIZZES.JPA")
public class QuizzesRepositoryJpa
        extends AbstractEntityRepositoryJpa<Quiz> {

    public QuizzesRepositoryJpa() { super(Quiz.class); };
}
```

E. And inject each repository into the appropriate REST controllers by the type of the generic interface:

```
@Autowired // injects an implementation of QuizzesRepository here.
private EntityRepository<Quiz> quizzesRepo;
```


4.2 JPQL queries and custom JSON serialization

In this assignment you will explore JPQL queries. You will extend the /offers REST endpoint to optionally accept a request parameter '?title=XXX' or '?status=XXX' or '?minBidValue=999', and then filter the list of offers being returned to meet the specified criterium. You will pass the filter as part of a JPQL query to the persistence context, such that only the offers that actually meet the criteria will retrieved from the backend.

In the bonus assignment you will customize the Json serializer with Full and Shallow serialisation modes to prevent endless recursion of the serialization on bi-directional navigability between classes.

In this assignment you should practice hands-on experience with Spring-Boot annotations @NamedQuery, @RequestParameter, @JsonView and @JsonSerialize.

4.2.1 JPQL queries

A. Extend your repository interface(s) and implementations with an additional method 'findByQuery()':

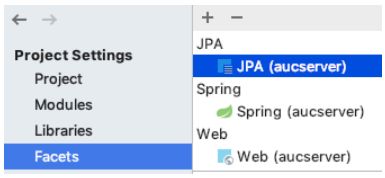
```
List<E> findByQuery(String jpqlName, Object... params);
                                // finds all instances from a named jpql-query
```

(Here we assume you use the generic repository interface)

This method should accept the name of a predefined query which may include specification of (multiple) ordinal (positional) query parameters. At https://www.objectdb.com/java/jpa/query/parameter you find a concise explanation how to go about ordinal query parameters. The implementation of findByQuery should assign each of the provided params[] values to the corresponding query parameter before submitting the query.

B. Design three named JPQL queries:
"Offer_find_by_status": finds all offers of a given status
"Offer_find_by_title": finds all offers that have a given sub-string in their title
"Offer_find_by_minBidValue": finds all offers that have a bid above a given minimum value
Use an ordinal(positional) query parameter as a place-holder for the parameter value to be provided.
Use the @NamedQuery annotation to specify these named JPQL queries within your Offer.java entity class.

(If you are troubled by a mal-functioning inspection module of IntelliJ on your JPQL language, verify whether you have a default JPA facet configuration in your project structure)



C. Extend your GetMapping on the "/offers" REST end-point to optionally accept a '?title=XXX' or '?status=XXX' or '?minBidValue=999' request parameter.

If no request parameter is provided, the existing functionality of returning all offers should be retained.
If more than one request parameter is specified, an error response should be returned, indicating that at most one parameter can be provided.
If the '?status=XXX' parameter is provided, with a status string value that does not match the AuctionStatus enumeration, an appropriate error response should be returned.

In the other cases the requested offers should be retrieved from the repository, using the appropriate named query and the specified parameter value.
You may want to explore the impact of the @Enumerated annotation for the status attribute of an offer.

Test the behaviour of your end-point with postman:

localhost:8083/offers?title=$$A


```
[
    {
        "id": 30005,
        "title": "Offer $$A-5$$",
        "sellDate": "2019-12-08T04:30:00",
        "status": "FOR_SALE",
        "numberOfBids": 3,
        "valueHighestBid": 20.5
    },
    {
        "id": 30006,
        "title": "Offer $$A-1$$",
        "sellDate": "2019-11-05T20:00:00",
        "status": "CLOSED",
        "numberOfBids": 1,
        "valueHighestBid": 17.5
    }
]
```


localhost:8083/offers?minBidValue=20.5


```
[
    {
        "id": 30003,
        "title": "Offer $$D-7$$",
        "sellDate": "2019-12-08T08:00:00",
        "status": "NEW",
        "numberOfBids": 2,
        "valueHighestBid": 22.0
    },
    {
        "id": 30004,
        "title": "Offer $$C-9$$",
        "sellDate": "2019-12-01T18:00:00",
        "status": "FOR_SALE",
        "numberOfBids": 1,
        "valueHighestBid": 26.5
    }
]
```


localhost:8083/offers?status=done


```
"timestamp": "2019-11-21T16:56:34.774+0000",
"status": 400,
"error": "Bad Request",
"message": "status=done is not a valid auction status value",
```


localhost:8083/offers?status=for_sale&minBidValue=100


```
"timestamp": "2019-11-21T16:54:45.446+0000",
"status": 400,
"error": "Bad Request",
"message": "Can only handle one request parameter filter=, status= or minBidValue=",
```


4.2.2 [BONUS] Custom JSON Serializers

Bidirectional navigation, and nested entities easily give rise to endless Json structures.

These can be broken by placing @JsonBackreference or @JsonIgnore annotations at association attributes that should be excluded from the Json. But this is not always acceptable, because depending on the REST resource being queried you may or may not need to include specific info.

Another option is to leverage @JsonView classes, but again these definitions are static and do not recognise the starting point of your query: I.e.:

a) if you query an Offer, you want full information about the offer but probably only shallow information about its bids.
b) If you query a Bid, you want full information about the bid, but only shallow information about the offer.
c) It gets even more complicated with recursive relations.

At https://www.tutorialspoint.com/jackson_annotations/index.htm you find a tutorial about all Jackson Json annotations that can help you to drive the Json serializer and deserializer by annotations in your model classes.

At https://stackoverflow.com/questions/23260464/how-to-serialize-using-jsonview-with-nested-objects#23264755 you find a nice article about combining @JsonView classes with custom Json serializers that may solve all your challenges with a comprehensive, single generic approach:

A. Below you find a helper class that provides two Json view classes 'Shallow' and 'Summary' and a custom serializer 'ShallowSerializer'.

```
public class CustomJson {

    public static class Shallow { }
    public static class Summary extends Shallow { }

    public static class ShallowSerializer extends JsonSerializer<Object> {
        @Override
        public void serialize(Object object, JsonGenerator jsonGenerator,
                              SerializerProvider serializerProvider)
                throws IOException, JsonProcessingException {
            ObjectMapper mapper = new ObjectMapper()
                    .configure(MapperFeature.DEFAULT_VIEW_INCLUSION, false)
                    .setSerializationInclusion(JsonInclude.Include.NON_NULL);

            // fix the serialization of LocalDateTime
            mapper.registerModule(new JavaTimeModule())
                    .configure(SerializationFeature.WRITE_DATES_AS_TIMESTAMPS, false);

            // include the view-class restricted part of the serialization
            mapper.setConfig(mapper.getSerializationConfig()
                    .withView(CustomJson.Shallow.class));

            jsonGenerator.setCodec(mapper);
            jsonGenerator.writeObject(object);
        }
    }
```

The elements of this class are then used as follows to configure the serialization of Offer.bids:

```
@JsonView(CustomJson.Summary.class)
@JsonSerialize(using = CustomJson.ShallowSerializer.class)
private List<Bid> bids = null;
```

The consequence is:

1) the bids list will only get serialized for unrestricted offer mappers and mappers that specify the CustomJson.Summary view.
2) when bids are serialized (as part of an offer serialization) its serialization will be shallow (and not recurse back into its own offer…)

Extend this CustomJson class with a similar implementation of the custom SummarySerializer and the UnrestrictedSerializer internal classes which serialize to Summary view and default view respectively.

B. Apply these view classes and serializers to relevant attributes in the Offer and Bid model classes.
Apply the Summary view class to the localhost:8080/offers and localhost:8080/offers/{offerId}/bids end-points.
Implement unrestricted end-points at localhost:8080/offers/{offerId} and localhost:8080/offers/{offerId}/bids/{bidId}.

Test your end-points with postman:

localhost:8083/offers


```
[
    {
        "id": 30001,
        "title": "Some article s.a.
            2019-11-02T14:00:00",
        "sellDate": "2019-11-02T14:00:00",
        "status": "CLOSED",
        "numberOfBids": 1,
        "valueHighestBid": 23.5
    },
    {
        "id": 30002,
        "title": "Some article s.a.
            2019-11-30T23:00:00",
        "sellDate": "2019-11-30T23:00:00",
        "status": "NEW",
        "numberOfBids": 1,
        "valueHighestBid": 2.0
    },
```


localhost:8083/offers/30001


```
{
    "id": 30001,
    "title": "Some article s.a.
        2019-12-07T22:30:00",
    "sellDate": "2019-12-07T22:30:00",
    "description": null,
    "status": "FOR_SALE",
    "bids": [
        {
            "id": 100001,
            "value": 24.0
        },
        {
            "id": 100002,
            "value": 24.5
        },
        {
            "id": 100003,
            "value": 26.0
        }
    ],
    "numberOfBids": 3,
    "valueHighestBid": 26.0
}
```


localhost:8083/offers/30001/bids/100001


```
{
    "id": 100001,
    "value": 11.0,
    "offer": {
        "id": 30001,
        "title": "Some article s.a.
            2019-12-13T15:00:00",
        "status": "NEW"
    }
}
```


4.3 Backend security configuration, JSON Web Tokens (JWT)

In this assignment you will secure the access to your backend.
The Spring framework includes an extensive security module. However, that module is rather difficult to understand and use in first encounter. For our purpose, we will explore the basic use of JSON Web Tokens (JWT) and implement a security interceptor filter at the backend.
Our backend security configuration involves two components:
1. A REST controller at '/authenticate' which provides for user registration and user login.
This end-point will be 'in-secure', i.e. open to all clients: also to non-authenticated clients.
After successful login, a security token will be added into the response to the client.
2. A security filter that guards all incoming requests.
This filter will extract the security token from the incoming request, if included.
Only requests with a valid security token may pass thru to the secure parts of the REST service.

By the end of this assignment you will have further explored annotations @RequestBody, @RequestAttribute, @Value and classes ObjectNode, Jwts, Jws<Claims>, SignatureAlgorithm

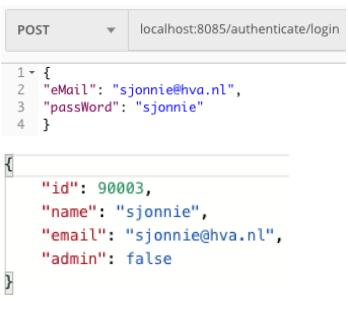
4.3.1 The /authenticate controller.

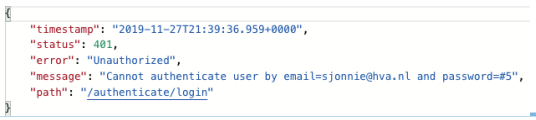
A. First create a new REST controller class 'AuthenticateController' in the 'rest' package.
Map the controller onto the '/authenticate' endpoint.
Provide a POST mapping at '/authenticate/login' which takes two parameters from the request body: eMail(String) and passWord(String)

Any request mapping can specify only one @RequestBody parameter.
You may want to import and use the class ObjectNode from com.fasterxml.jackson.databind.node.ObjectNode. It provides a container for holding and accessing any Json object that has been passed via the request body.

Full user account management will be addressed in the bonus assignment 4.6
For now we accept successful login if the provided password is the same as the user name before the @ character in the email address.
Throw a new 'UnAuthorizedException' if login fails.
Return a new User object with 'Accepted' status after successful login.
(Create a new entity 'User' in your models package. A User should have attributes 'id'(long), 'name'(String), 'eMail'(String), 'hashedPassWord'(String) and 'admin'(boolean). Extract the name from the start of the eMail address and use a random id).

Test your endpoint with postman:





B. After successful login we want to provide a token to the client.
Include the Jackson JWT dependencies into your pom.xml.

```
<!-- JWT jackson -->
<dependency>
    <groupId>io.jsonwebtoken</groupId>
    <artifactId>jjwt-api</artifactId>
    <version>0.10.7</version>
</dependency>
<dependency>
    <groupId>io.jsonwebtoken</groupId>
    <artifactId>jjwt-impl</artifactId>
    <version>0.10.7</version>
</dependency>
<dependency>
    <groupId>io.jsonwebtoken</groupId>
    <artifactId>jjwt-jackson</artifactId>
    <version>0.10.7</version>
    <scope>runtime</scope>
    <exclusions>
        <exclusion>
            <groupId>com.fasterxml.jackson.core</groupId>
            <artifactId>jackson-databind</artifactId>
        </exclusion>
    </exclusions>
</dependency>
<!-- end JWT jackson -->
```

Create a utility class JWToken, which will store all attributes associated with the authentication and authorisation of the user (the 'payload') and implement the functionality to encrypt and decrypt this information into token strings.

Below is example code of how you can encode a JWToken string encrypting the user identification and his (admin) authorization.

```
public class JWToken {

    private static final String JWT_USERNAME_CLAIM = "sub";
    private static final String JWT_USERID_CLAIM = "id";
    private static final String JWT_ADMIN_CLAIM = "admin";

    private String userName = null;
    private Long userId = null;
    private boolean admin = false;

    public String encode(String issuer, String passPhrase, int expiration) {
        Key key = getKey(passPhrase);

        String token = Jwts.builder()
                .claim(JWT_USERNAME_CLAIM, this.userName)
                .claim(JWT_USERID_CLAIM, this.userId)
                .claim(JWT_ADMIN_CLAIM, this.admin)
                .setIssuer(issuer)
                .setIssuedAt(new Date())
                .setExpiration(new Date(System.currentTimeMillis() + expiration * 1000))
                .signWith(key, SignatureAlgorithm.HS512)
                .compact();

        return token;
    }

    private static Key getKey(String passPhrase) {
        byte hmacKey[] = passPhrase.getBytes(StandardCharsets.UTF_8);
        Key key = new SecretKeySpec(hmacKey, SignatureAlgorithm.HS512.getJcaName());
        return key;
    }
```

The passPhrase is the private key to be used for encryption and decryption.
You can configure passphrase, issuer and expiration times in the application.properties file and then inject them into your APIConfig bean using the @Value annotation:

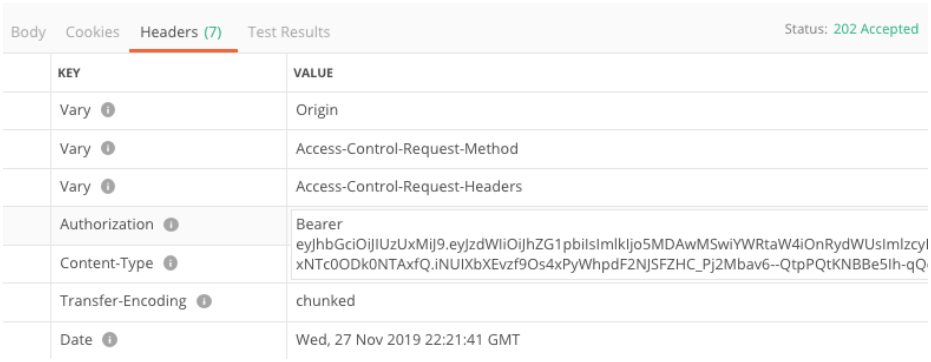
```
    // JWT configuration that can be adjusted from application.properties
    @Value("${jwt.issuer:private company}")
    private String issuer;

    @Value("${jwt.pass-phrase:This is very secret information for my privat
    private String passPhrase;

    @Value("${jwt.duration-of-validity:1200}") // default 20 minutes;
    public int tokenDurationOfValidity;
```


At https://jwt.io/ you can verify your token strings after you have created them.

You add the token to the response of a successful login request with

```
return ResponseEntity.accepted()
        .header(HttpHeaders.AUTHORIZATION, "Bearer " + tokenString)
        .body(user);
```

This puts the token in a special 'Authorization' header.
Test with postman whether your authorization header is included in the response:



4.3.2 The request filter.

A. The next step is to implement the processing of the tokens from all incoming requests. If a request does not provide a valid token, then the request should be rejected.

For that you implement a request filter component:

```
@Component
public class JWTRequestFilter extends OncePerRequestFilter

    // path prefixes that will be protected by the authentication filter
    private static final Set<String> SECURED_PATHS =
            Set.of("/offers", "/bids", "/users");
```

Because your filter class is a Spring Boot Component bean, it will be autoconfigured into the filter chain of the Spring Boot http request dispatcher, and hit every incoming http request.

This filter class requires implementation of one mandatory method, which does all the filter work:

```
@Override
public void doFilterInternal(HttpServletRequest request,
                             HttpServletResponse response,
                             FilterChain chain) throws IOException, ServletException {

    String servletPath = request.getServletPath();

    // OPTIONS requests and non-secured area should pass through without check
    if (HttpMethod.OPTIONS.matches(request.getMethod()) ||
            SECURED_PATHS.stream().noneMatch(servletPath::startsWith)) {

        chain.doFilter(request, response);
        return;
    }
```


It is important to let ‘pre-flight’ OPTIONS requests pass through without burden. Angular will issue these requests without authorisation headers. The Spring framework will handle them.

Also you want to limit the security filtering to the mappings that matter to you. The paths ‘/authenticate’, ‘/h2-console’, ‘/favicon.ico’ should not be blocked by any security. In above code snippet we use the set ‘SECURED_PATHS’ to specify which mappings need to be secured.

Test with postman whether the filter is activated on your SECURED_PATHS and not affecting the other paths.

B. Thereafter we let the filter pick up the token from the ‘Authorization’ header and decrypt and check it. If the token is missing or not valid, you throw an UnAuthorizedException which will abort further processing of the request:

```
JWToken jwToken = null;

// get the encrypted token string from the authorization request header
encryptedToken = request.getHeader(HttpHeaders.AUTHORIZATION);

// block the request if no token was found
if (encryptedToken != null) {
    // remove the "Bearer " token prefix, if used
    encryptedToken = encryptedToken.replace("Bearer ", "");

    // decode the token
    jwToken = JWToken.decode(encryptedToken, this.passPhrase);
}

// Validate the token
if (jwToken == null) {
    throw new UnAuthorizedException("You need to logon first.");
}
```

Again, the magic is in the use of the Jackson libraries, decoding the token string:

```
public static JWToken decode(String token, String passPhrase) {
    try {
        // Validate the token
        Key key = getKey(passPhrase);
        Jws<Claims> jws = Jwts.parser().setSigningKey(key).parseClaimsJws(token);
        Claims claims = jws.getBody();

        JWToken jwToken = new JWToken(
                claims.get(JWT_USERNAME_CLAIM).toString(),
                Long.valueOf(claims.get(JWT_USERID_CLAIM).toString()),
                (boolean) claims.get(JWT_ADMIN_CLAIM)
        );

        return jwToken;

    } catch (ExpiredJwtException | MalformedJwtException |
            UnsupportedJwtException | IllegalArgumentException e) {
        return null;
    }
}
```

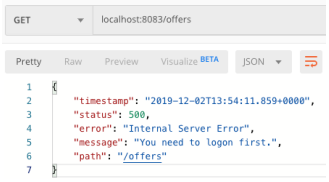
This decode method uses the same JWToken attributes and getKey method that were also shown earlier along with the encode method.

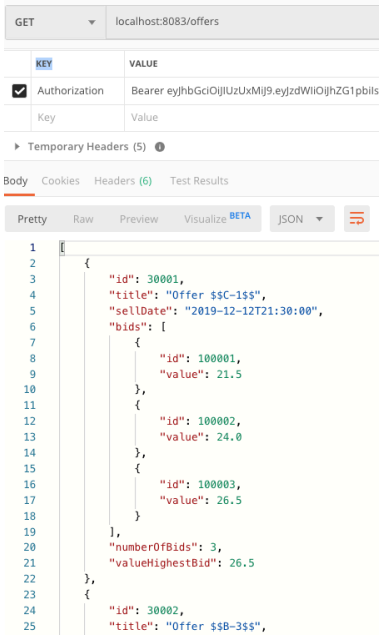
If all has gone well, we add the decoded token information into an attribute of the request and allow the request to progress further down the chain:

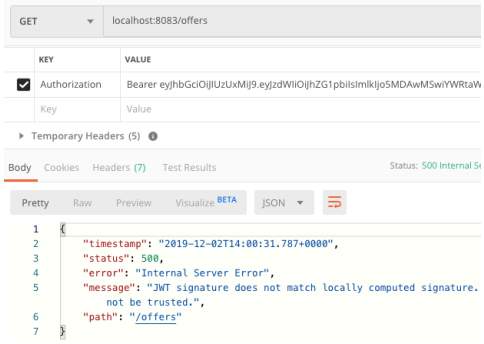
```
// pass-on the token info as an attribute for the request
request.setAttribute(JWToken.JWT_ATTRIBUTE_NAME, jwToken);

chain.doFilter(request, response);
```

Later, we can access the token information again from any REST controller by use of the @RequestAttribute annotation in front of a parameter of a mapping method. Then we can actually verify specific authorization requirements of the user that has issued the request.

Test your set-up with postman:
First try a get request without an Authorization Header.
Then try again with a correct header in the request.
Then try with a corrupt token (e.g. append XXX at the end of the token…)







C. Now, all may be working from postman, but it will not yet work cross-origin with your Angular client….

For that you need to further expand your global configuration of Spring Boot CORS to allow sharing of relevant headers and credentials:

```
@Configuration
public class APIConfig implements WebMvcConfigurer {

        @Override
        public void addCorsMappings(CorsRegistry registry) {
            registry.addMapping("/**")
                .allowCredentials(true)
                .allowedHeaders(HttpHeaders.AUTHORIZATION, HttpHeaders.CONTENT_TYPE)
                .exposedHeaders(HttpHeaders.AUTHORIZATION, HttpHeaders.CONTENT_TYPE)
                .allowedMethods("GET", "POST", "PUT", "DELETE")
                .allowedOrigins("http://localhost:4805");
        }
}
```


4.4 Frontend authentication, and Session Management

With a backend that is capable of authenticating users and providing tokens for smooth and authorised access of secured REST end-points you now can integrate this security into your Angular user interface.
See also http://jasonwatmore.com/post/2018/10/29/angular-7-user-registration-and-login-example-tutorial for a mini-tutorial of a secured project.

4.4.1 Sign-on and session management.

A. Create a new SessionSbService that will provide an adapter (interface) to the backend for logon and sign-up. This SessionSbService will cache the information of the currently logged-on user, such as the username and the JWT authentication token that will be provided by the backend.

   In the subsequent steps you will implement the following methods in this service:
   signOn(eMail:string, password:string)
   logs on to the backend, and retrieves user details and the JWT authentication token from the backend.
   signOff()
   discards user details and the JWT authentication token from the session (and local browser storage).
   isAuthenticated(): boolean
   indicates whether a user has been logged on into the session or not.
   getTokenFromSessionStorage(): string
   retrieves the JWT authentication token and user details from the session (or local browser storage).
   saveTokenIntoSessionStorage(token: string, username: string)
   saves the JWT authentication token and user details into the session (and local browser storage).

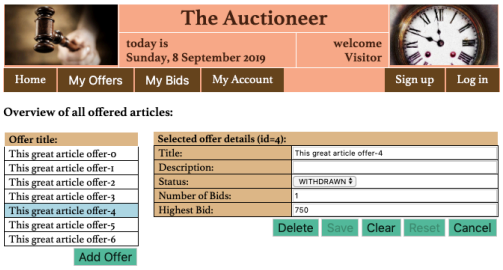
   First implement the signOn method as indicated here. The http.post in the signon uses a special option {observe: 'response'} which gives you access to the complete response of the request, including the headers. Without this option, the observable would only expose the body of the response. You need access to the headers to be able to extract the authentication token from the Authorization header.
   As a consequence you also need to do a bit more work to extract the user name from the response body.

   At this stage, there is no need to decode the JWT token. Just save it in a private

```
@Injectable({
  providedIn: 'root'
})
export class SessionSbService {
    public readonly BACKEND_AUTH_URL = "http://localhost:8084/authenticate";

    public currentUserName: string = null;

    constructor(private http: HttpClient) {
        this.getTokenFromSessionStorage();
    }

    signIn(email: string, password: string): Observable<any> {
        console.log("login " + email + "/" + password);
        let signInResponse =
            this.http.post<HttpResponse<User>>(this.BACKEND_AUTH_URL + "/login",
                {eMail: email, passWord: password},
                {observe: "response"}).pipe(shareReplay(1));
        signInResponse
            .subscribe(
                response => {
                    console.log(response);
                    this.saveTokenIntoSessionStorage(
                        response.headers.get('Authorization'),
                        (response.body as unknown as User).name
                    );
                },
                error => {
                    console.log(error);
                    this.saveTokenIntoSessionStorage(null, null);
                }
            )
        return signInResponse;
    }
```

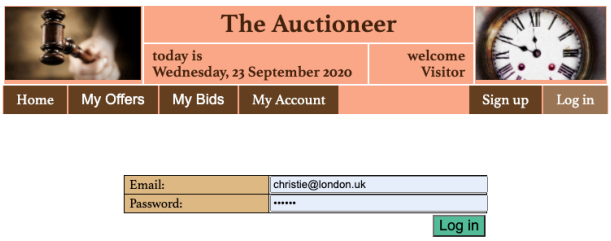
instance variable of the service for use in future requests.

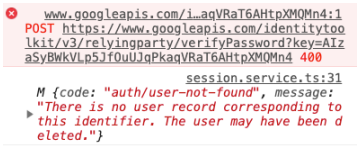
Also implement the signOff() method in this service.



B. Create a new component header-sb in src/app/components/mainpage which can be a copy of the original header component initially. inject the SessionService into your header-sb component
Welcome the currently logged-in user in the sub-title in this header at the right. If no user is logged-in, a 'Visitor' shall be welcomed.
Use this header in your app-component and retest your application.

C. Add a new component 'sign-on' to src/app/components/mainpage and connect it to a new 'login' route, which should be invoked from the 'Log in' menu item on the navigation bar.
Provide a form in which the user can enter e-mail and password and a Log in button to submit the request.





Use the signOn method of the service which should actually login the user and have the username displayed in the header. For now its is sufficient that any authentication errors are logged at the browser console.

D. Create a new component nav-bar-sb in src/app/components/mainpage, which can be a copy of nav-bar initially. Use this new navigation bar in your app-component. Adjust the visibility of the menu items in the navigation bar such that
a) Menu items 'Sign Up' and 'Log in' are visible only when no user is logged in yet (and user name Visitor is displayed).
b) Menu item 'Log out' is visible when a user has been logged in.
Connect the click-event of the 'Log out' option to the signOff() method in the session service.

4.4.2 HTTP requests with authentication tokens and use of browser storage.

Even if the user has been logged on, http requests towards the secured end-points of the backend will not be accepted yet, because sofar we did not add the JWT authentication token yet to any request. In this assignment you will configure the frontend to automatically add the JWT token to every outgoing HTTP request to inform the backend about the authentication and authorisation status of the user. For that you provide the HTTP_INTERCEPTORS service.

A. Create a new class auth-interceptor in src/app/services which implements the HttpInterceptor interface from '@angular/common/http'.
Inject the SessionSbService into this interceptor such that it can use the token of the current user.
The 'intercept' method of the interceptor shall add the token into the Authorization header of the request.

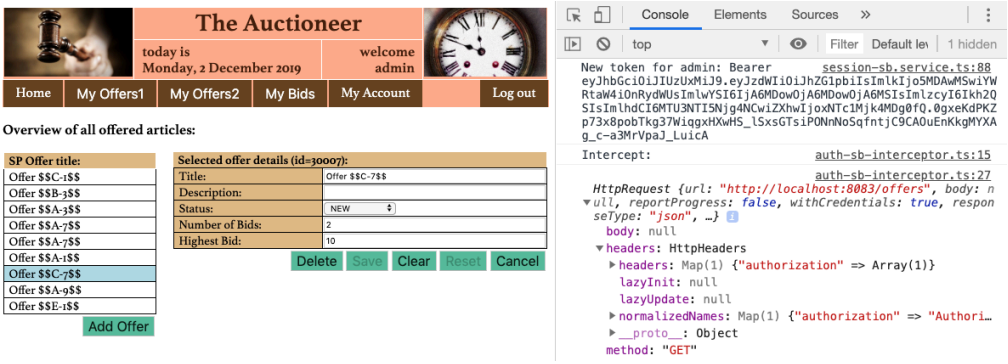
```
@Injectable()
export class AuthSbInterceptor implements HttpInterceptor {

    constructor(private session: SessionSbService) { }

    intercept(req: HttpRequest<any>, next: HttpHandler): Observable<HttpEvent<any>> {

        let token = this.session.getTokenFromSessionStorage();

        if (token != null) {
            // TODO clone the request, adding the token in the Authorization header
            // pass on the cloned request to the next handler

        } else {
            // just forward the request to the next handler
            return next.handle(req);
        }
    }
```

Requests are immutable, so you cannot change them. You add the token by cloning the request and then adding the token as part of that operation. Then you forward the cloned request. The code snippet provided here should get you going…

Make sure you provide the interceptor from app.module.ts:

```
{ provide: HTTP_INTERCEPTORS,
    useClass: AuthSbInterceptor, multi: true },
```

Re-test your application and verify that visitors cannot change data, while authenticated users can. Incluse console.log output in your interceptor and verify that the token is passed along with the request.



B. It would be nice if your token and username is preserved in the frontend also if you reload your page. That can be achieved by using browser sessionStorage and/or localStorage.
Below code snippet picks up your token from the sessionStorage and if that's gone, tries to pick up a token from localStorage.

```
private readonly BS_TOKEN_NAME = "AUC_SB_AUTH_TOKEN";

// allow for different user sessions from the same computer
getTokenFromSessionStorage(): string {
    let token = sessionStorage.getItem(this.BS_TOKEN_NAME);
    if (token == null) {
        token = localStorage.getItem(this.BS_TOKEN_NAME);
        sessionStorage.setItem(this.BS_TOKEN_NAME, token);
    }
```

sessionStorage stores key value pairs for a single tab in the browser. If you reload the page, the values are preserved. If you close the tab or the browser, those values are gone.
localStorage stores key value pairs that are shared across all tabs. Even if you restart the browser, the values are

preserved. (However, different brands of browsers chrome, firefox, edge, etc. do not share their stores).

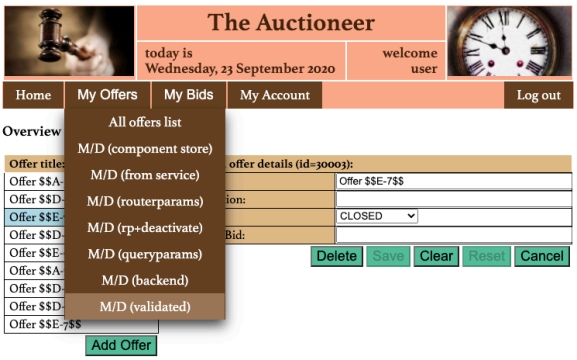
Also implement the saveTokenIntoSessionStorage() to save tokens in sessionStorage and/or localStorage and integrate that in your authentication handling. Also, find a way include the username into the session- and localStorage items,
Demonstrate that you can run two parallel sessions in different tabs of the same browser, which each are logged on with a different account.

C. Having your tokens in localStorage opens your application to the 'Cross-Site Request Forgery (CSRF vulnerability 8A in OWASP-2013). Keeping tokens in sessionStorage only prevents that vulnerability if you also ensure that your application never opens an external page into its tab. For that you need a robust 'leaving the site'-guard in your Angular frontend. (See bonus assignment 3.4.3.) And first of all, you also need to implement use of the https protocol.
All that is beyond the scope of this assignment.

4.5 Template Driven Form validation.

With the FormsModule in Angular you can track the status of user input and implement input validation.

In this assignment you will appy basic HTML5 input validation options s.a. required, minlength and pattern. You also explore the @ViewChild decorator and use the ng-valid, ng-invalid, ng-dirty and ng-pristine CSS classes for tracking the status of your form.



A. Create one new component detail51 in src/app/components/offers which starts as a copy of detail5 of assignment 3.7 (Reusing the templates of detail4)
There will be no change in the interaction with overview5, so you can fully reuse that component without need for replication: create a new route 'offers/overview51' that opens overview5 and add a child route ':id' which opens the new component detail51. Provide the new route 'offers/overview51' in the 'offers' sub-menu.

B. Redesign the editing form of detail51 to leverage the Angular FormsModule, i.e.
1. Use a <form> tag with a local reference to the NgForm to group your input controls.
2. Add the NgForm object attribute to the component class. Use the @ViewChild() decorator to bind this attribute to the local reference in the <form> tag.
(As of Angular 8, @ViewChild has got an extra options parameter: provide {static:false})

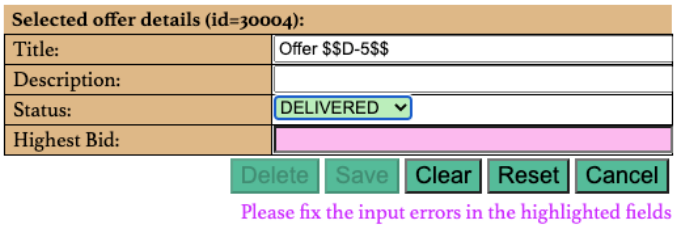
```
@ViewChild('editForm', {static: false})
private detailForm: NgForm;
```

3. Register your <input> controls with the ngModel and a name attribute.
4. Provide an appropriate type on every <input> tag ("text", "number", etc.)

It is recommended to
5. Not provide the (ngSubmit) event binding in the <form> tag.
6. Not mark any <input> or <button> tags with type="submit" or type="reset"
7. Disable the default behaviour of the enter key by adding (keydown.enter)="$event.preventDefault()" to the <form>-tag.
(We have seen router guards generating submit events that act on your forms)

C. Add build-in HTML5 validators to the <input> tags in the template. Use at least:
- required
- minlength
- pattern

If the status of your offer is 'SOLD', 'PAID', 'DELIVERED' or 'CLOSED', also a Highest Bid shall have been provided in the form.
If there is no Highest Bid provided, it shall not be possible to change the status to 'PAID'



D. Specify CSS styling rules that highlight every invalid input field with some ‘negative’ color.
Specify CSS styling rules that highlight every dirty and valid input field with some ‘positive’ color (indicating what has been changed).
Make sure that dirty colors are reset after the ‘Save’ or ‘Reset’ button has been hit, or when you have navigated to a different Offer. (You may want to use the ‘markAsPristine’ method for that.)
Provide some error message if the form is invalid and also disable the Save button in that case.

4.6 [BONUS] Full User Account Management.

A. Implement the User Repository in the backend. Also store the hashed passwords.
   Implement the 'authenticate/register' endpoint to register a new user account.
   Add an active (Boolean) attribute to the User entity; newly registered accounts are in-active initially.

B. Generate a unique activation code for each newly registered user account, and email a link that refers to /authenticate/activate/{activationCode} to the user that has registered the account. Record an expiration dateTime for the activation.
   Implement the activate mapping:
   1. Use a named query to retrieve the User entity by activation code from the repository.
   2. Check the expiration date/Time and activate the account if ok.

C. Implement a '/users' end-point where users can retrieve and update User profiles.
   admin users can get and update all attributes of all accounts.
   Regular users can only retrieve the info of their own account, and cannot update their active or admin attributes.
   Use the userId in the Authorization token to identify the requesting user.

4.7 [BONUS, TODO] Inheritance and performance optimization

Apply Inheritance
Apply Fetch types LAZY, EAGER, Deep Query
Apply Cascade types ALL, PERSIST, DELETE
Provide a MySQL implementation
Apply Performance tuning, first and second level cache