Spring MVC
Security Overview

You will learn how to ...

- Secure Spring MVC Web Apps
- Develop login pages (default and custom)
- Define users and roles with simple authentication
- Protect URLs based on role
- Hide/show content based on role
- Store users, passwords and roles in DB (plain-text -> encrypted)

Practical Results

- Cover the most common Spring Security tasks that you will need on daily projects

- Not an A to Z reference … for that you can see **Spring Security Reference Manual**

http:// /spring-security-reference-manual

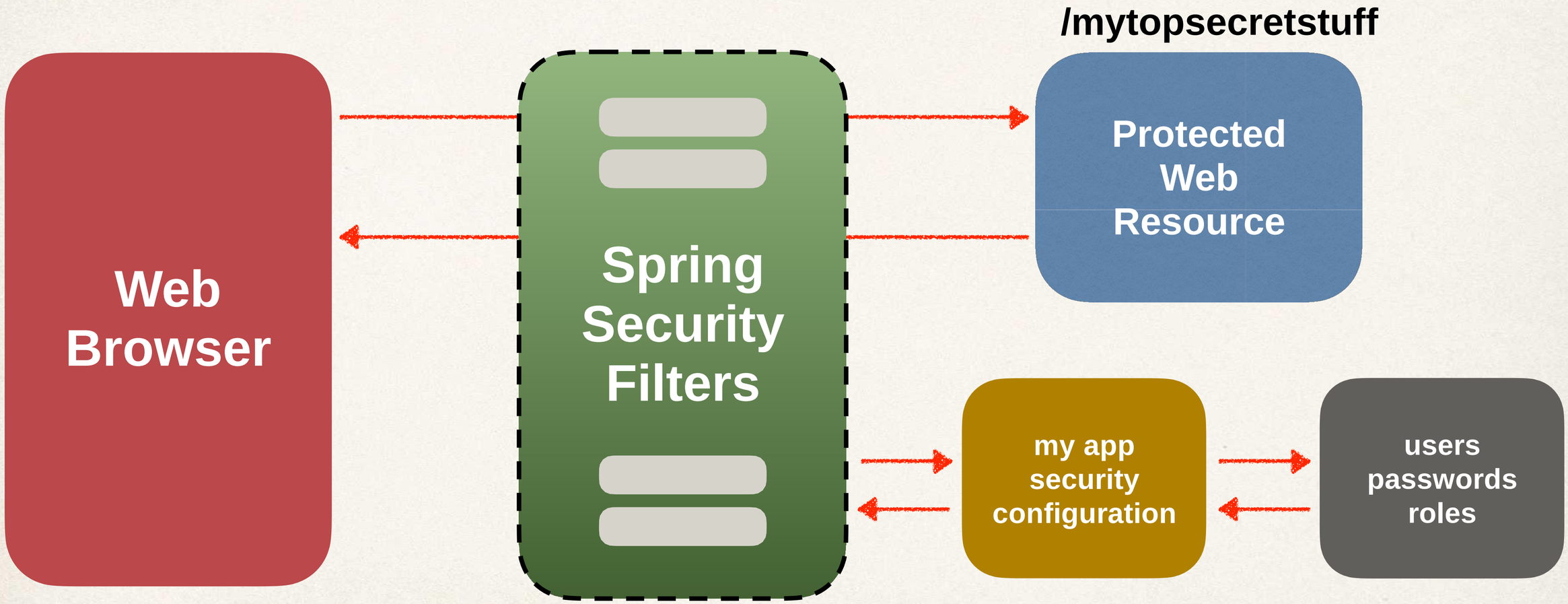
Spring Security Model

- Spring Security defines a framework for security
- Implemented using Servlet filters in the background
- Two methods of securing an app: declarative and programmatic

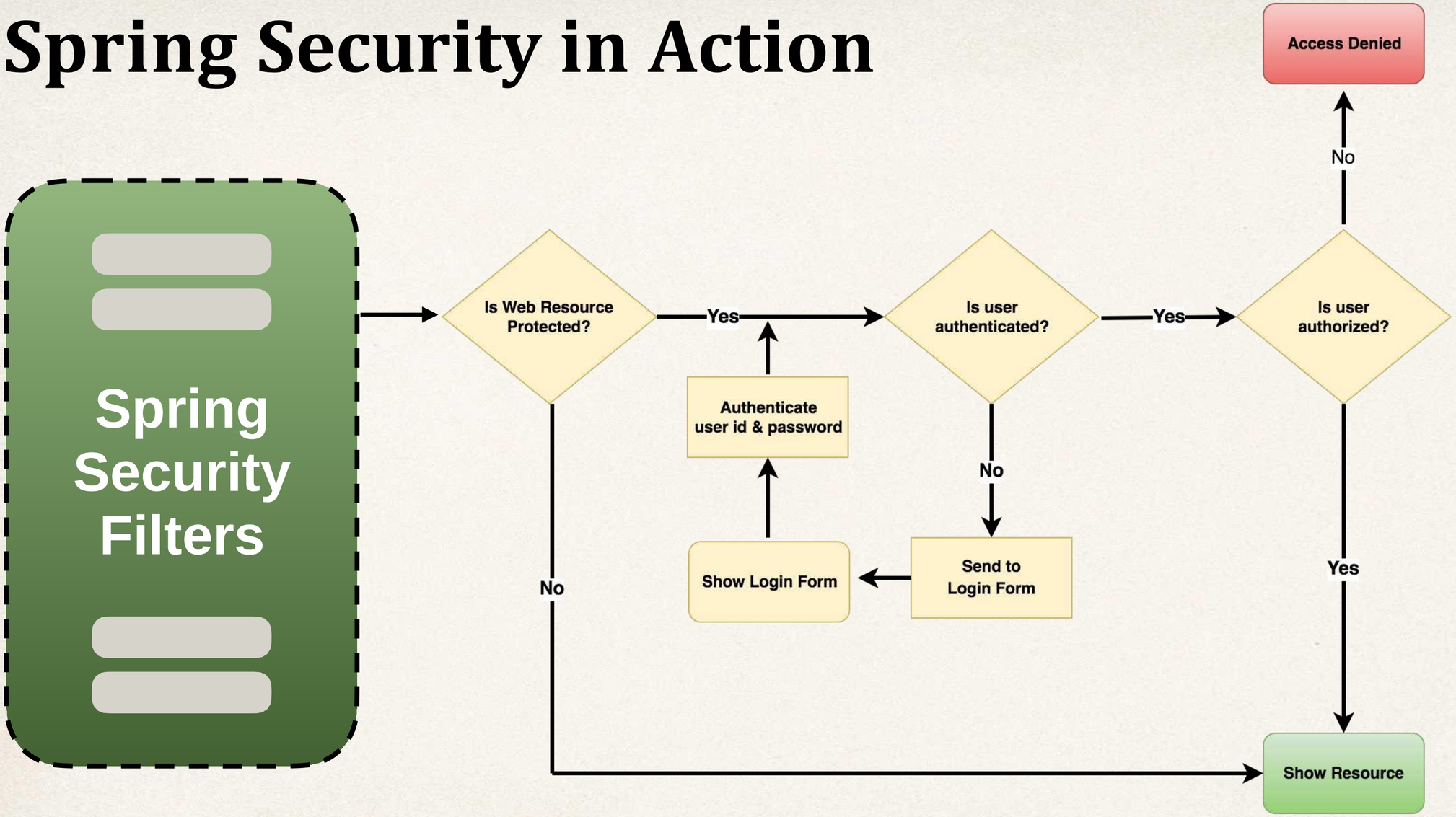
Spring Security with Servlet Filters

- Servlet Filters are used to pre-process / post-process web requests
- Servlet Filters can route web requests based on security logic
- Spring provides a bulk of security functionality with servlet filters

Spring Security Overview



Spring Security in Action



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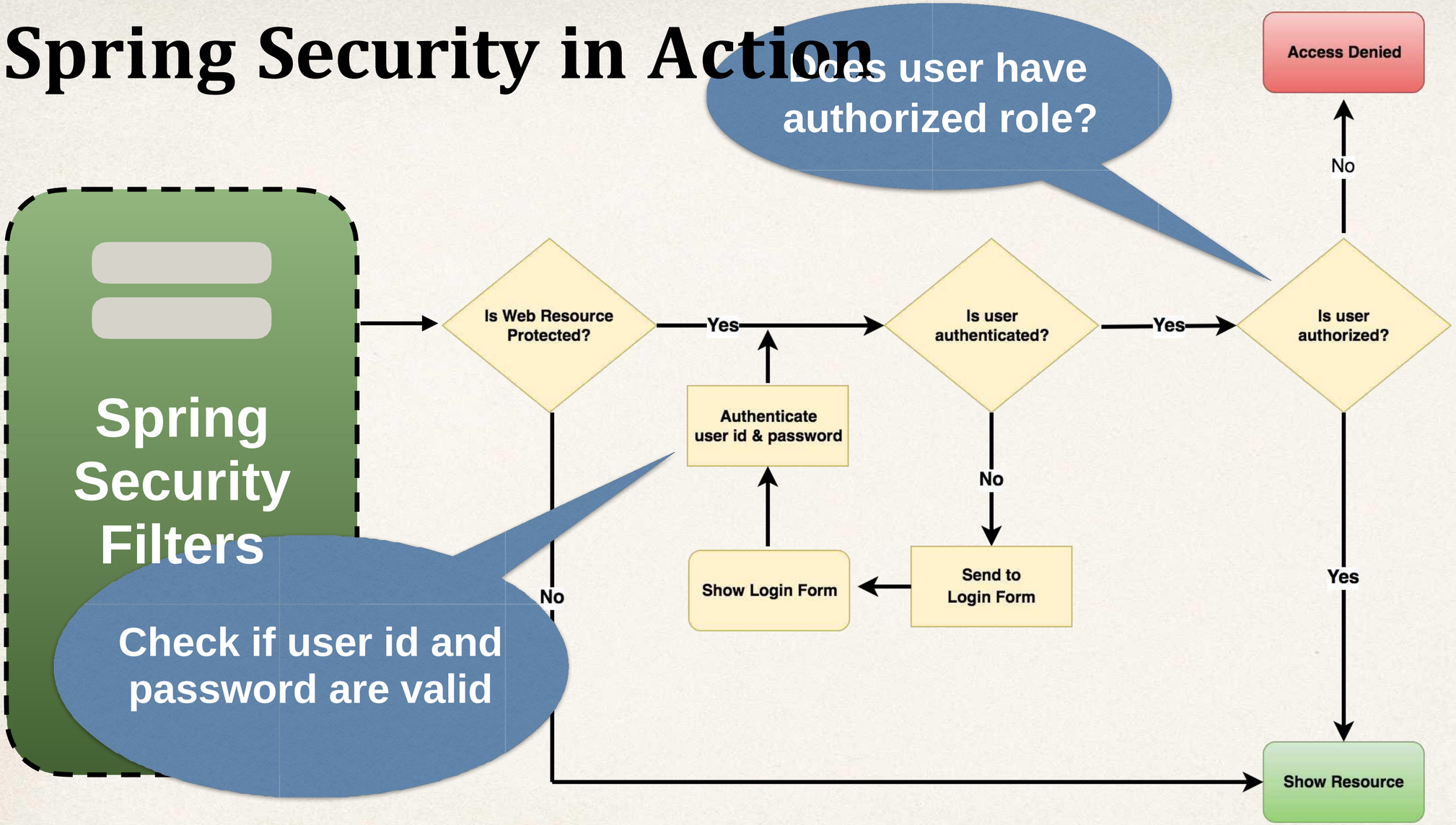


Security Concepts

- Authentication
  - Check user id and password with credentials stored in app / db
- Authorization
  - Check to see if user has an authorized role

Declarative Security

- Define application's security constraints in configuration
  - All Java config: @Configuration
- Provides separation of concerns between application code and security

Programmatic Security

- Spring Security provides an API for custom application coding

- Provides greater customization for specific app requirements

Enabling Spring Security

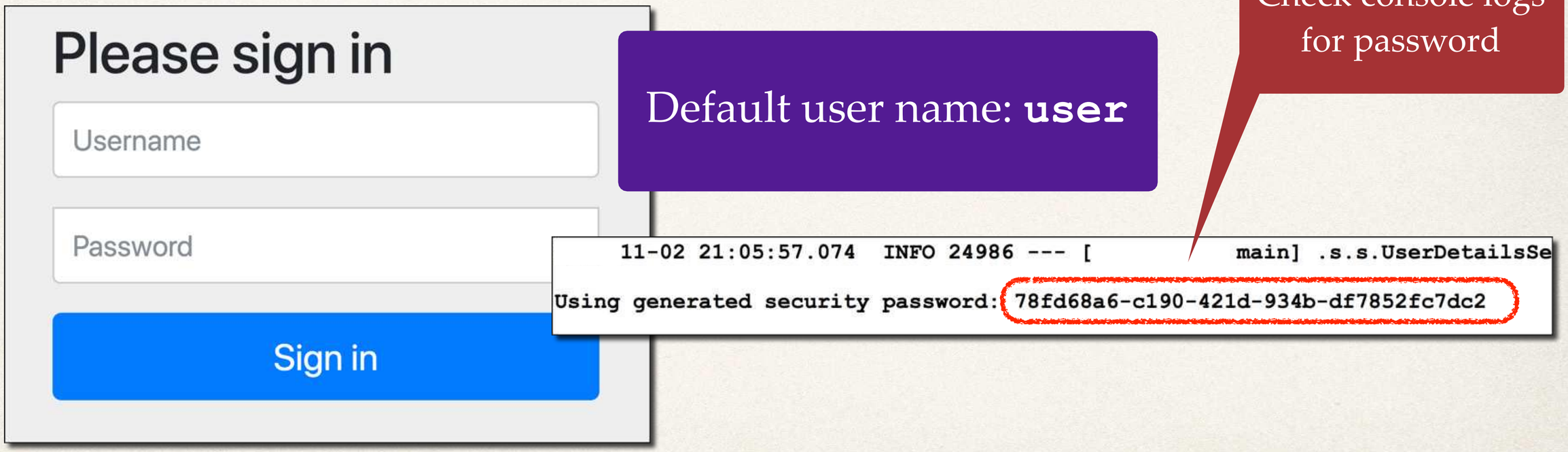
1. Edit **`pom.xml`** and add **`spring-boot-starter-security`**

```
<dependency>
  <groupId>org.springframework.boot</groupId>
  <artifactId>spring-boot-starter-security</artifactId>
</dependency>
```

2. This will ***automagically*** secure all endpoints for application

Secured Endpoints

- Now when you access your application
- Spring Security will prompt for login



Different Login Methods

- HTTP Basic Authentication

- Default login form
  - Spring Security provides a default login form

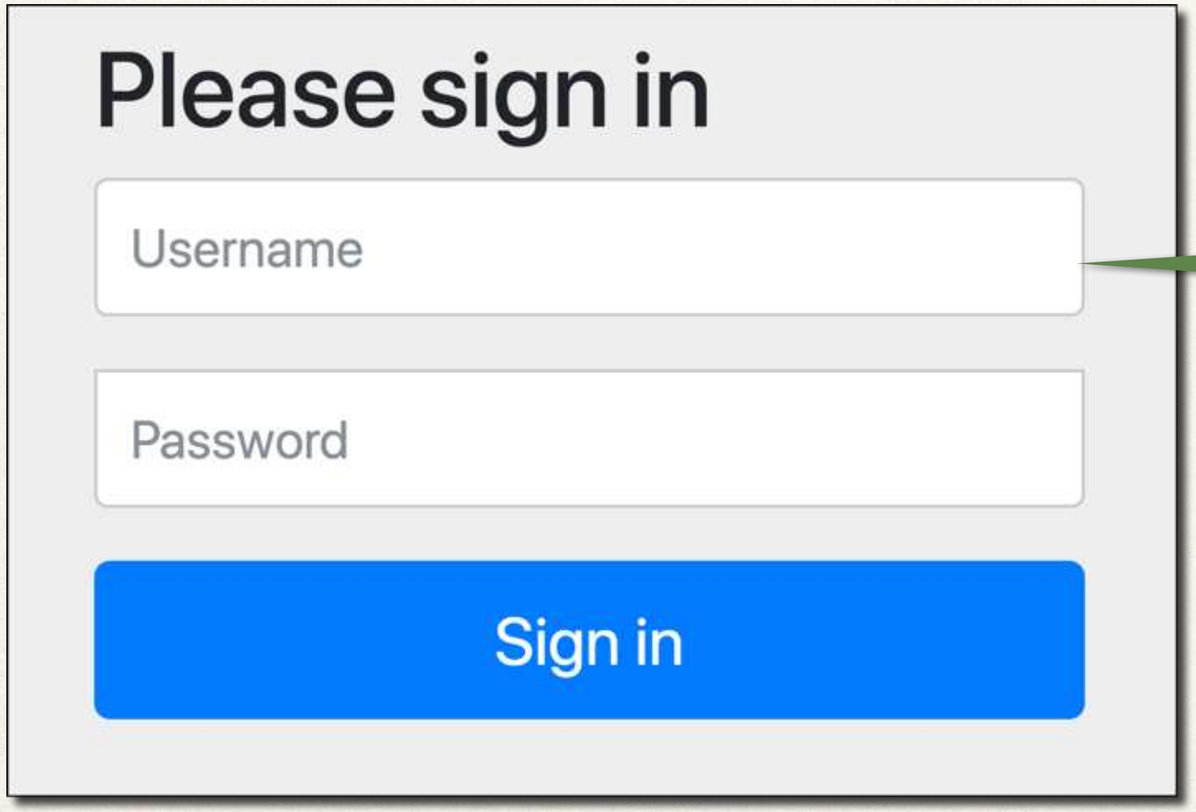
- Custom login form
  - your own look-and-feel, HTML + CSS

HTTP Basic Authentication

Built-in Dialog from browser

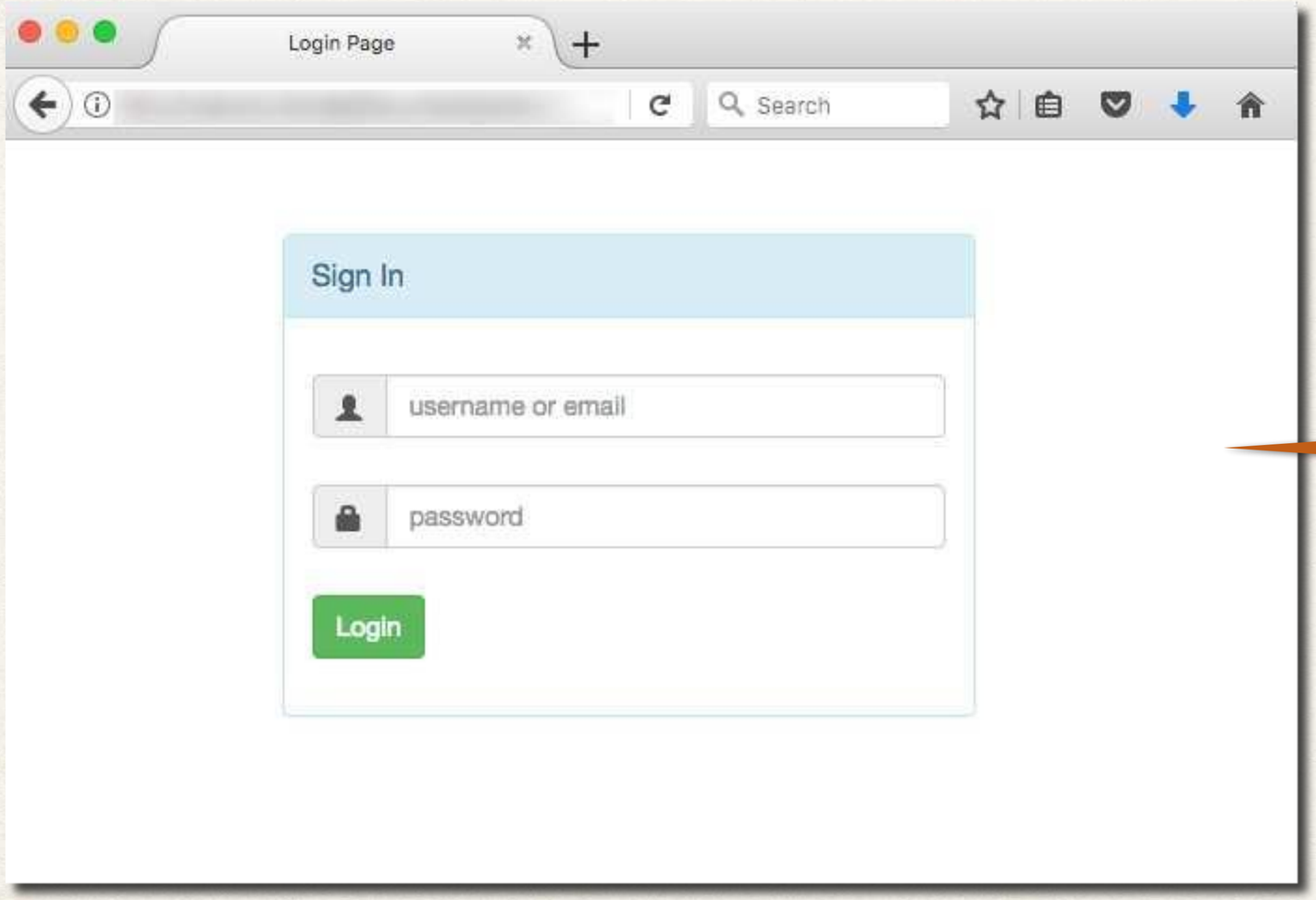
bleh!

Spring Security - Default Login Form



Good for quick start

Your Own Custom Login Form



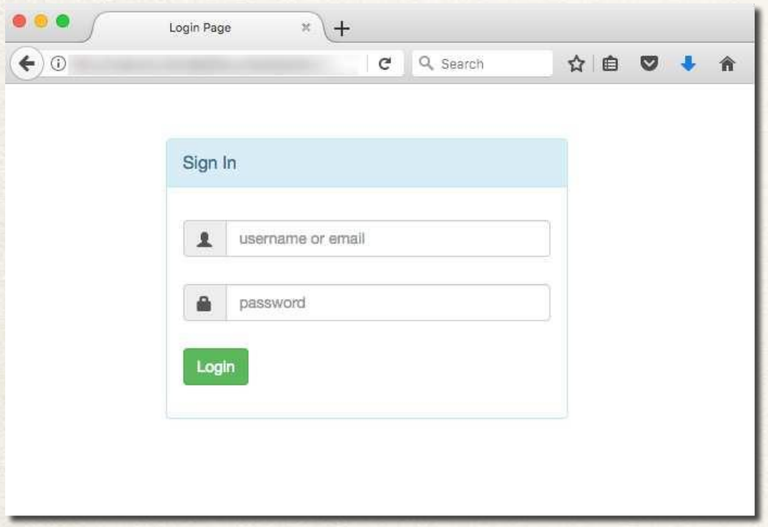
Your own custom
look-and-feel
HTML + CSS

Spring Security Demo

Recap of our Game Plan

- Secure Spring MVC Web Apps
- Develop login pages (default and custom)
- Define users and roles with simple authentication
- Protect URLs based on role
- Hide/show content based on role
- Store users, passwords and roles in DB (plain-text -> encrypted)

Our Example



/

Home Page

role: EMPLOYEE

/leaders

Leadership Retreat Page

role: MANAGER

/systems

Admin Holiday Cruise

role: ADMIN

luv2code

Spring MVC Security
Project Setup

Development Process

Step-By-Step

1. Create project at Spring Initializr website
    1. Add Maven dependencies for Spring MVC Web App, Security, Thymeleaf
2. Develop our Spring controller
3. Develop our Thymeleaf view page

Step 1: Add Maven dependencies for Spring MVC Web App

File: pom.xml

```
...
<dependency>
   <groupId>org.springframework.boot</groupId>
   <artifactId>spring-boot-starter-web</artifactId>
</dependency>

<dependency>
   <groupId>org.springframework.boot</groupId>
   <artifactId>spring-boot-starter-thymeleaf</artifactId>
</dependency>

<dependency>
   <groupId>org.springframework.boot</groupId>
   <artifactId>spring-boot-starter-security</artifactId>
</dependency>

<dependency>
   <groupId>org.thymeleaf.extras</groupId>
   <artifactId>thymeleaf-extras-springsecurity6</artifactId>
</dependency>
...
```

Spring MVC web support

Thymeleaf view support

Spring Security support

Thymeleaf Security support

Step 2: Develop our Spring Controller

File: DemoController.java

```
@Controller
public class DemoController {

    @GetMapping("/")
    public String showHome() {

        return "home";
    }

}
```

src/main/resources/templates/home.html

Step 3: Develop our Thymeleaf view page

File: src/main/resources/templates/home.html

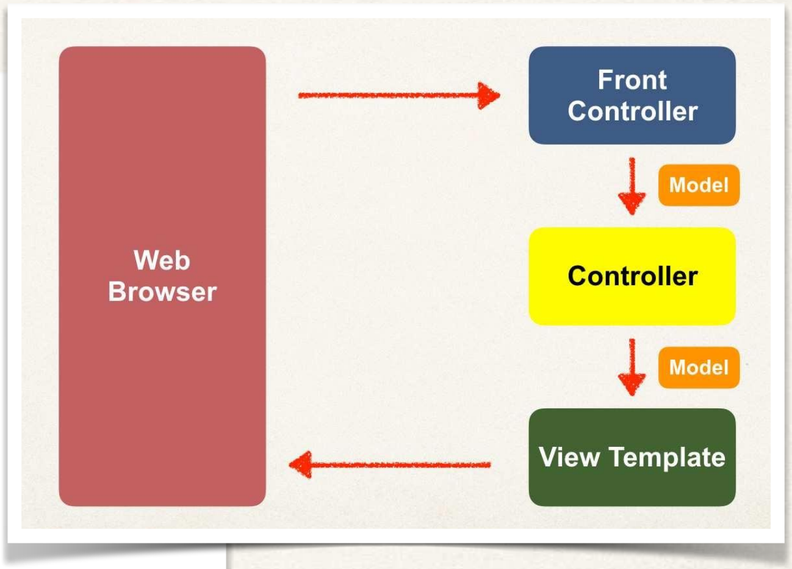
```
<html>

<body>

    Welcome to the    company home page!

</body>

</html>
```



Get Fresh Web Session

- Option 1:
  - Start new web browser
- Option 2:
  - In web browser and open new Private / Incognito window

Configuring Basic Security

Our Users

User ID	Password	Roles
john	test123	EMPLOYEE
mary	test123	EMPLOYEE, MANAGER
susan	test123	EMPLOYEE, MANAGER, ADMIN

We can give ANY names for user roles

Development Process

Step-By-Step

1. Create Spring Security Configuration (@Configuration)

2. Add users, passwords and roles

Step 1: Create Spring Security Configuration

File: DemoSecurityConfig.java

```
import org.springframework.context.annotation.Configuration;

@Configuration
public class DemoSecurityConfig {

  // add our security configurations here …

}
```

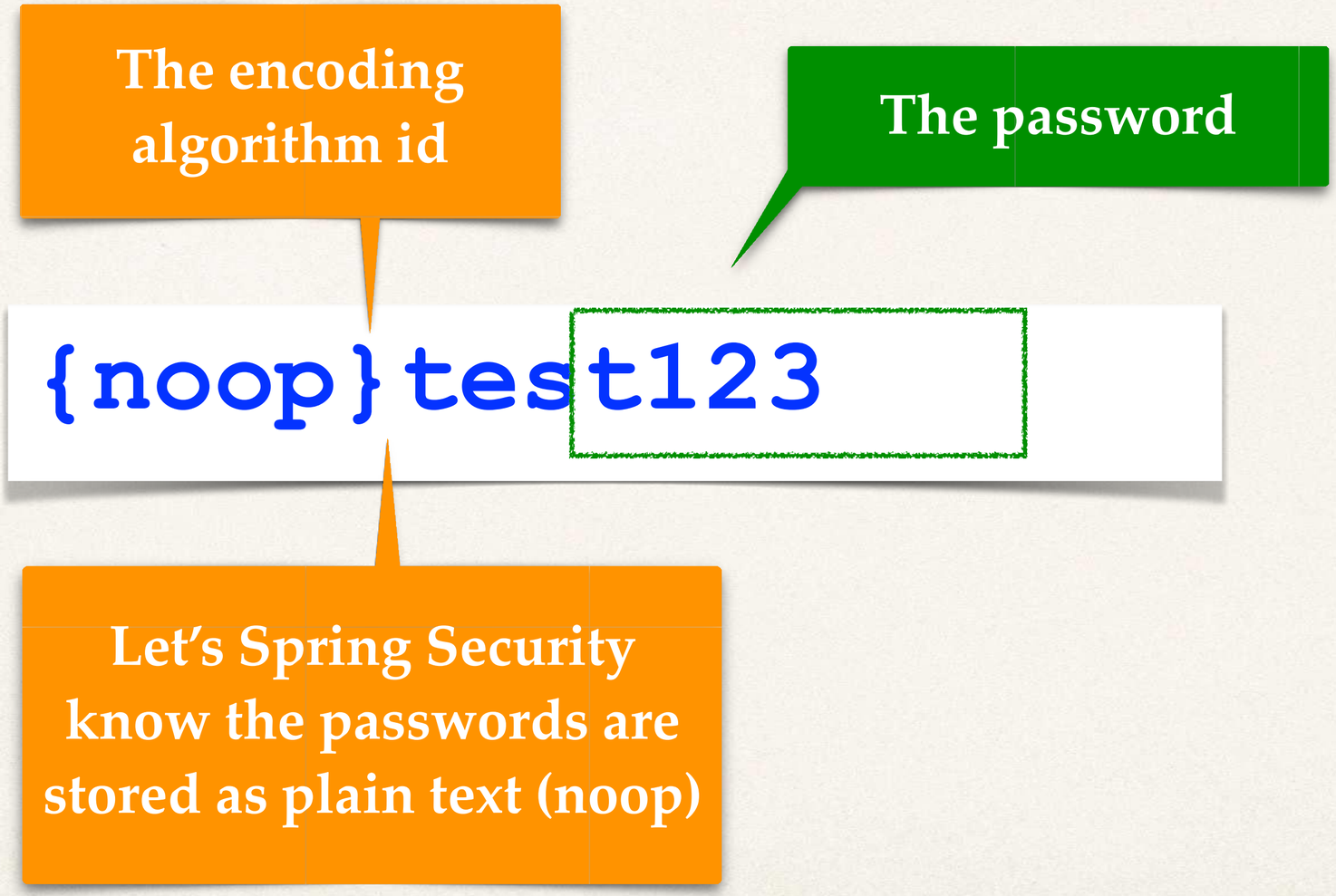
Spring Security Password Storage

- In Spring Security, passwords are stored using a specific format

```
{id}encodedPassword
```

ID	Description
noop	Plain text passwords
bcrypt	BCrypt password hashing
...	...

Password Example



Step 2: Add users, passwords and roles

File: DemoSecurityConfig.java

```
@Configuration
public class DemoSecurityConfig {

    @Bean
    public InMemoryUserDetailsManager userDetailsManager() {

        UserDetails john = User.builder()
                .username("john")
                .password("{noop}test123")
                .roles("EMPLOYEE")
                .build();

        UserDetails mary = User.builder()
                .username("mary")
                .password("{noop}test123")
                .roles("EMPLOYEE", "MANAGER")
                .build();

        UserDetails susan = User.builder()
                .username("susan")
                .password("{noop}test123")
                .roles("EMPLOYEE", "MANAGER", "ADMIN")
                .build();

        return new InMemoryUserDetailsManager(john, mary,
        susan);
    }
}
```

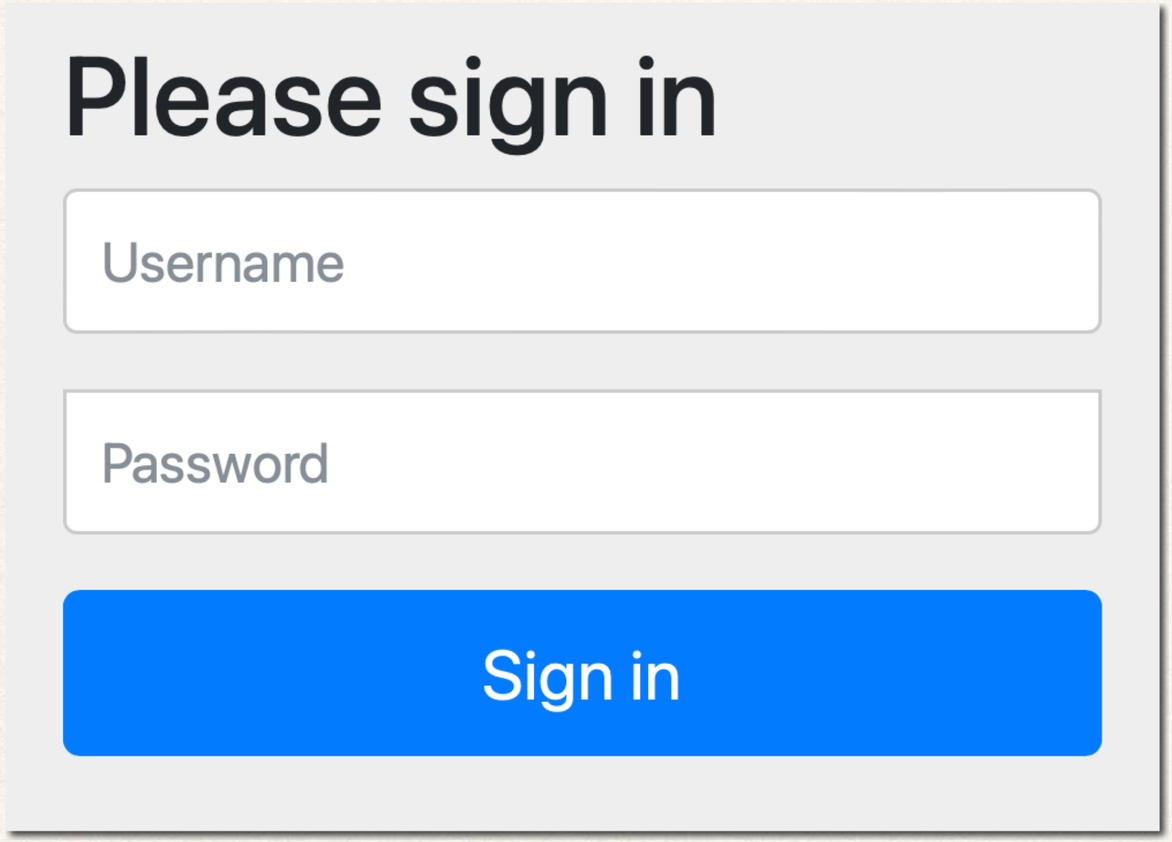
User ID	Password	Roles
john	test123	EMPLOYEE
mary	test123	EMPLOYEE, MANAGER
susan	test123	EMPLOYEE, MANAGER, ADMIN

We will add DB support in later

(plaintext and encrypted)

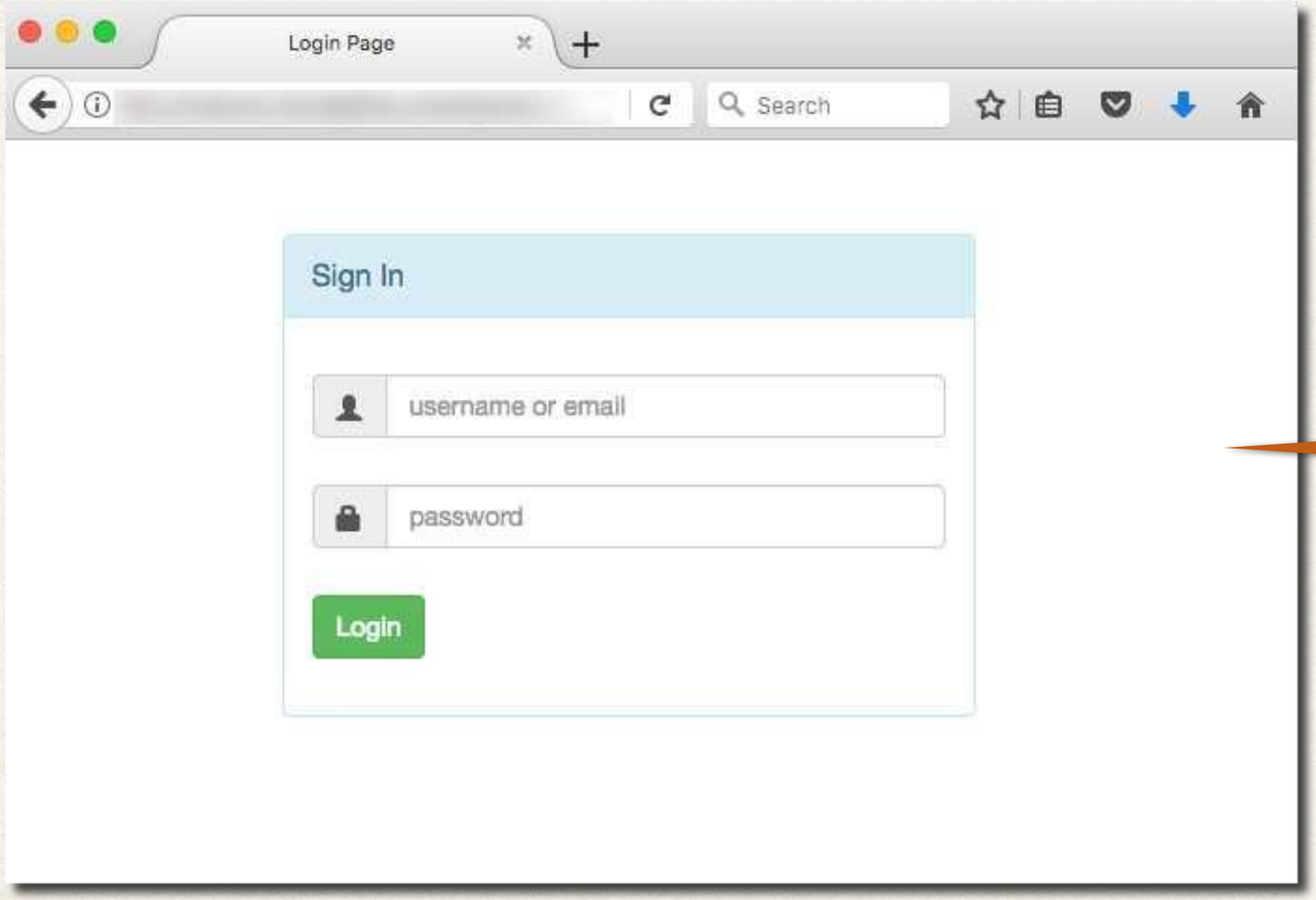
Spring Security - Custom Login Form

Spring Security - Default Login Form



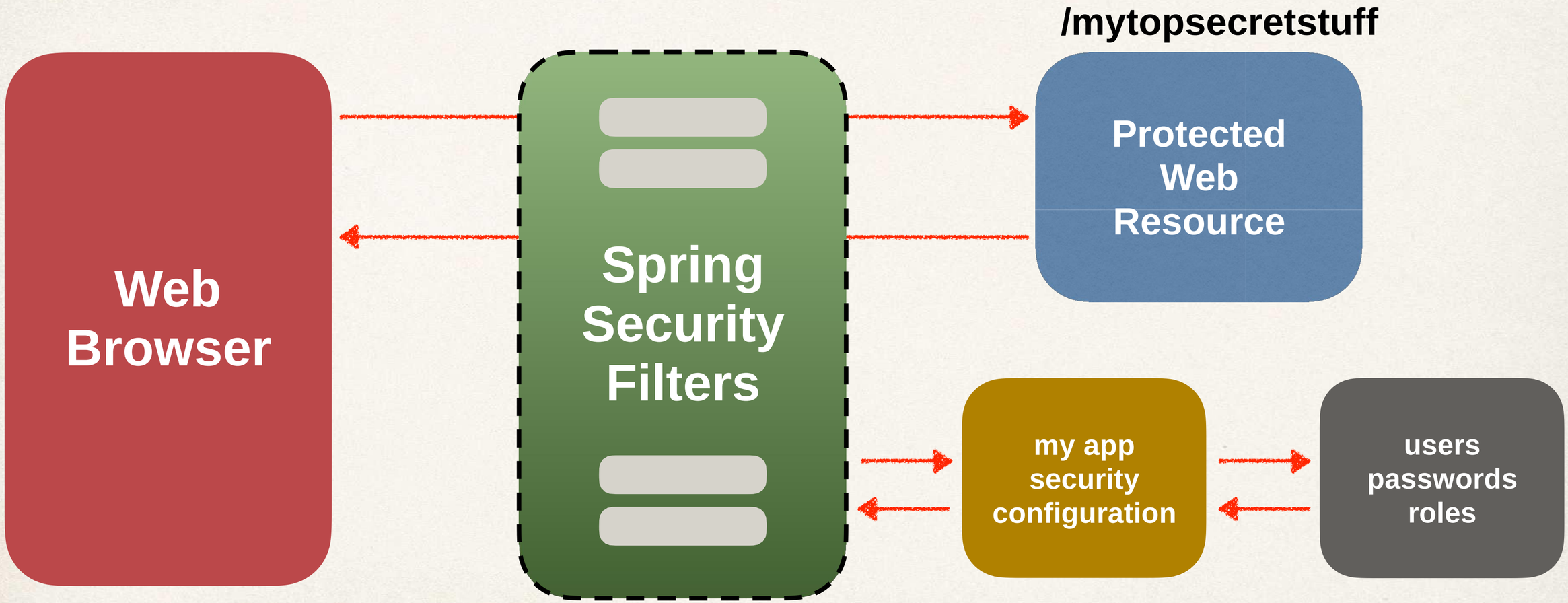
Good for quick start

Your Own Custom Login Form

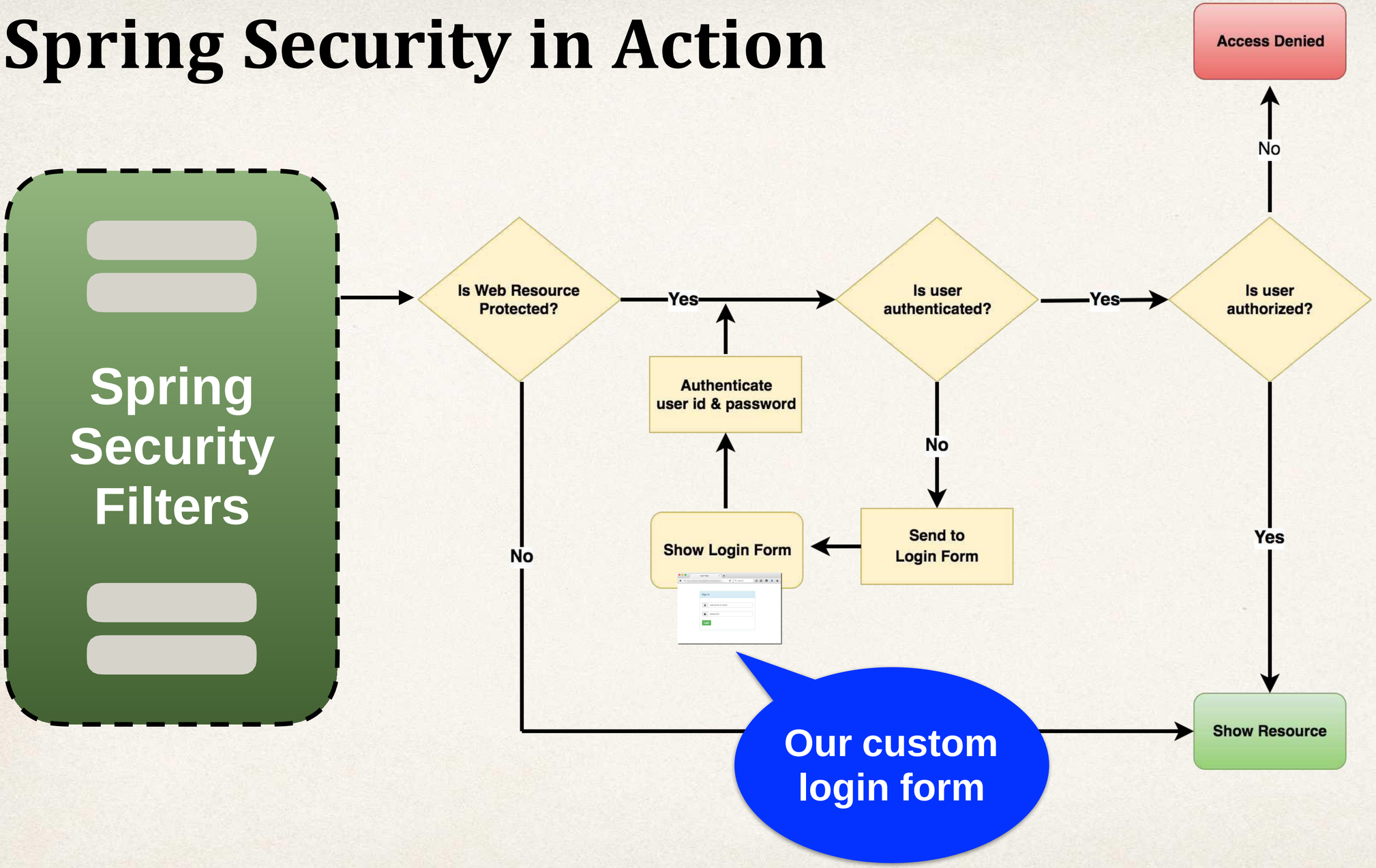


Your own custom
look-and-feel
HTML + CSS

Spring Security Overview



Spring Security in Action



Development Process

Step-By-Step

1. Modify Spring Security Configuration to reference custom login form

2. Develop a Controller to show the custom login form

3. Create custom login form
    - HTML (CSS optional)

Step 1: Modify Spring Security Configuration

File: DemoSecurityConfig.java

```
@Bean
public SecurityFilterChain filterChain(HttpSecurity http) throws Exception {

    http.authorizeHttpRequests(configurer ->
                    configurer
                            .anyRequest().authenticated()
            )
            .formLogin(form ->
                    form
                            .loginPage("/showMyLoginPage")
                            .loginProcessingUrl("/authenticateTheUser")
                            .permitAll()
            );

    return http.build();
}
```

Configure security of web paths in application, login, logout etc

Step 1: Modify Spring Security Configuration

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@Bean
public SecurityFilterChain filterChain(HttpSecurity http) throws Exception {

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                    form
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                            .loginProcessingUrl("/authenticateTheUser")
                            .permitAll()
            );

    return http.build();
}
```

Any request to the app must be authenticated (ie logged in)

Step 1: Modify Spring Security Configuration

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            .formLogin(form ->
                    form
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                            .loginProcessingUrl("/authenticateTheUser")
                            .permitAll()
            );

    return http.build();
}
```

We are customizing the form login process

Step 1: Modify Spring Security Configuration

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            .formLogin(form ->
                    form
                            .loginPage("/showMyLoginPage")
                            .loginProcessingUrl("/authenticateTheUser")
                            .permitAll()
            );

    return http.build();
}
```

Show our custom form at the request mapping

"/showMyLoginPage"

Step 1: Modify Spring Security Configuration

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@Bean
public SecurityFilterChain filterChain(HttpSecurity http) throws Exception {

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            .formLogin(form ->
                    form
                            .loginPage("/showMyLoginPage")
                            .loginProcessingUrl("/authenticateTheUser")
                            .permitAll()
            );

    return http.build();
}
```

Login form should POST data to this URL for processing

(check user id and password)

Step 1: Modify Spring Security Configuration

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```
@Bean
public SecurityFilterChain filterChain(HttpSecurity http) throws Exception {

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                    form
                            .loginPage("/showMyLoginPage")
                            .loginProcessingUrl("/authenticateTheUser")
                            .permitAll()
            );

    return http.build();
}
```

You can give ANY values for this configuration.

Just stay consistent in your app

Step 1: Modify Spring Security Configuration

File: DemoSecurityConfig.java

```
@Bean
public SecurityFilterChain filterChain(HttpSecurity http) throws Exception {

    http.authorizeHttpRequests(configurer ->
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            )
            .formLogin(form ->
                    form
                            .loginPage("/showMyLoginPage")
                            .loginProcessingUrl("/authenticateTheUser")
                            .permitAll()
            );

    return http.build();
}
```

Allow everyone to see login page.
No need to be logged in.

Step 1: Modify Spring Security Configuration

File: DemoSecurityConfig.java

```
@Bean
public SecurityFilterChain filterChain(HttpSecurity http) throws Ex

    http.authorizeHttpRequests(configurer ->
                    configurer
                            .anyRequest().authenticated()
            )
            .formLogin(form ->
                    form
                            .loginPage("/showMyLoginPage")
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                            .permitAll()
            );

    return http.build();
}
```

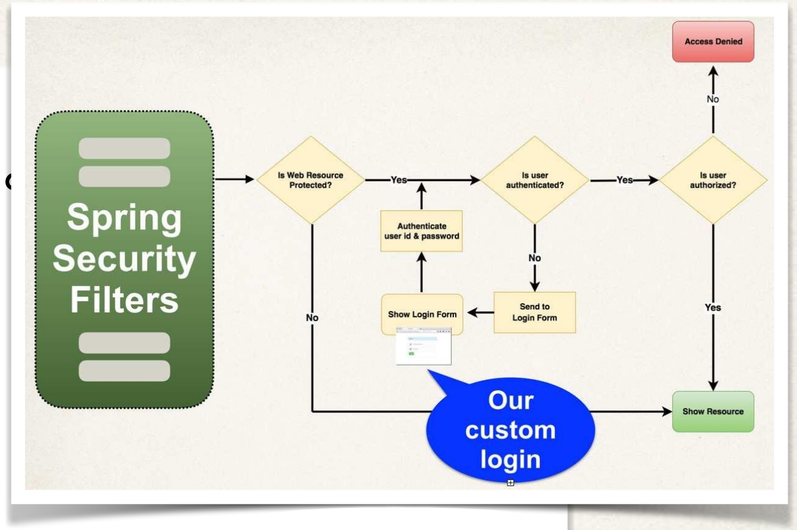

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Step 1: Modify Spring Security Configuration

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            .formLogin(form ->
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                            .permitAll()
            );

    return http.build();
}
```

TO DO
We need to create a controller for this request mapping

"/showMyLoginPage"

Step 1: Modify Spring Security Configuration

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                    form
                            .loginPage("/showMyLoginPage")
                            .loginProcessingUrl("/authenticateTheUser")
                            .permitAll()
            );

    return http.build();
}
```

No Controller Request Mapping required for this.
We get this for free :-)

Step 2: Develop a Controller to show the custom login form

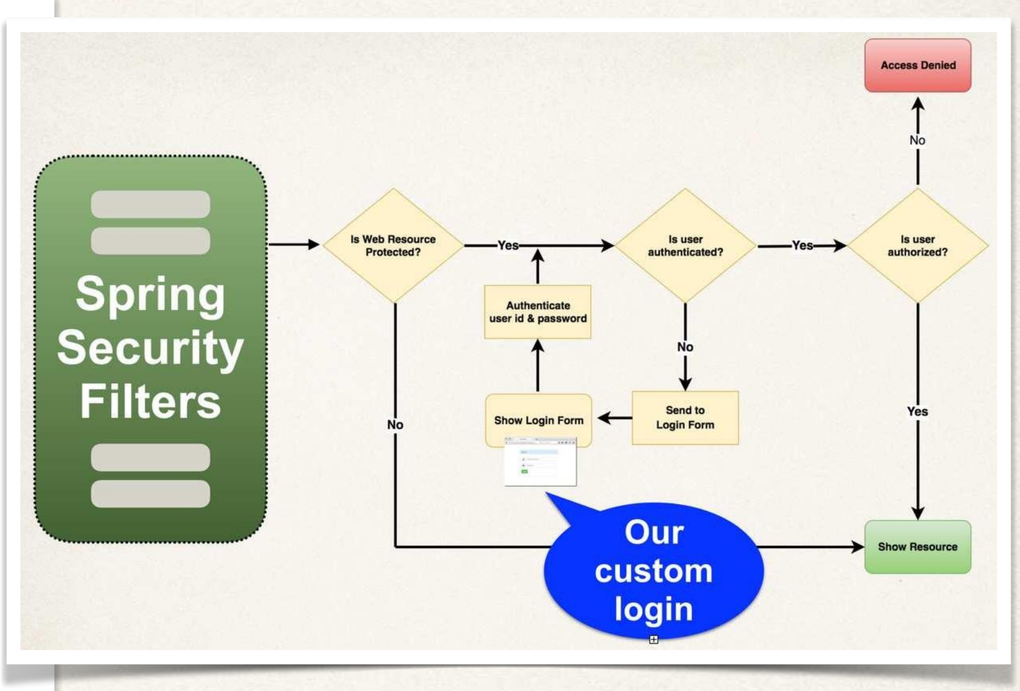
File: LoginController.java

```
@Controller
public class LoginController {

  @GetMapping("/showMyLoginPage")
  public String showMyLoginPage() {

    return "plain-login";

  }
}
```



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  }
}
```

```
.loginPage("/showMyLoginPage")
.loginProcessingUrl("/authenticateTheUser")
.permitAll()
```

Step 2: Develop a Controller to show the custom login form

File: LoginController.java

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@Controller
public class LoginController {

  @GetMapping("/showMyLoginPage")
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    return "plain-login";

  }
}
```

```
.loginPage("/showMyLoginPage")
.loginProcessingUrl("/authenticateTheUser")
.permitAll()
```

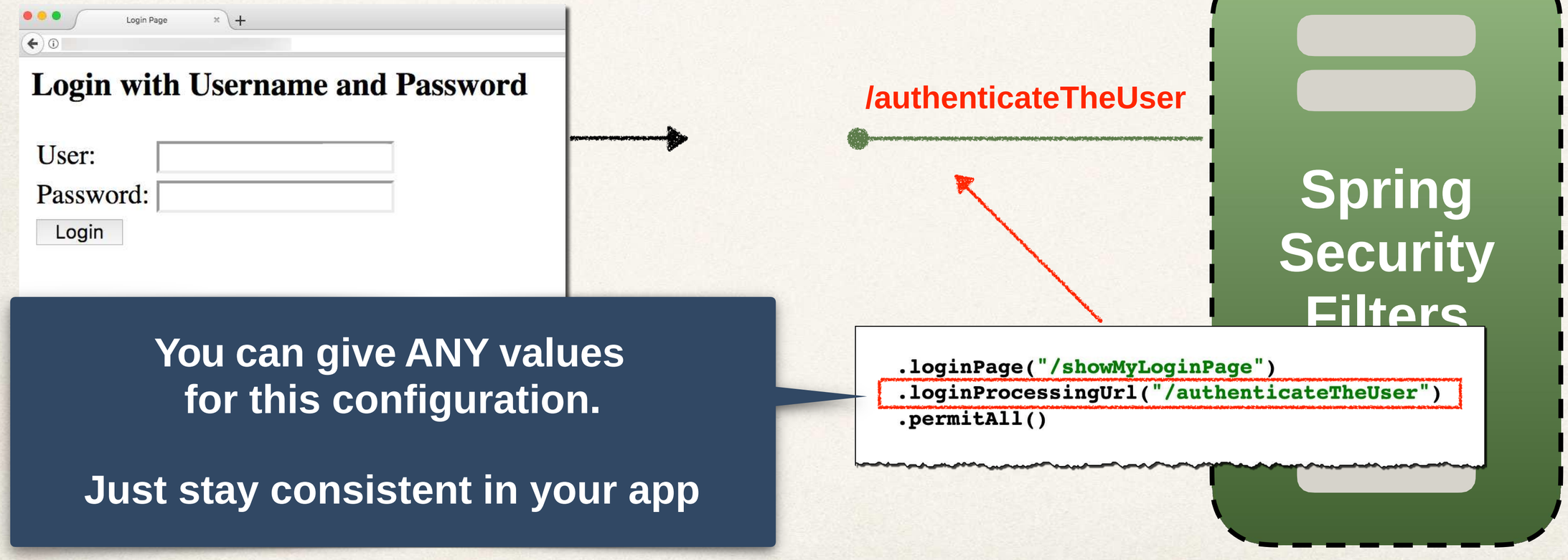
View name

TO DO
We need to create this file

src/main/resources/templates/plain-login.html

Step 3: Create custom login form

- Send data to login processing URL: **/authenticateTheUser**



Step 3: Create custom login form

- Send data to login processing URL: **/authenticateTheUser**
- Login processing URL will be handled by Spring Security Filters
- You get it for free … no coding required

This is Spring Security magic … LOL

Step 3: Create custom login form

- Send data to login processing URL: **/authenticateTheUser**
  - Must **POST** the data

```
<form action="#" th:action="@{/authenticateTheUser}"
              method="POST">
    ...
</form>
```

```
.loginPage("/showMyLoginPage")
.loginProcessingUrl("/authenticateTheUser")
.permitAll()
```

Step 3: Create custom login form

- Spring Security defines default names for login form fields
  - User name field: **username**
  - Password field: **password**


```
User name: <input type="text" name="username" />

Password: <input type="password" name="password" />
```

Step 3: Create custom login form

Pull It All Together

File: src/main/resources/templates/plain-login.html

```
…
<form action="#" th:action="@{/authenticateTheUser}"
            method="POST">

  <p>
    User name: <input type="text" name="username" />
  </p>

  <p>
    Password: <input type="password" name="password" />
  </p>

  <input type="submit" value="Login" />

</form>
…
```

Step 3: Create custom login form

Pull It All Together

File: src/main/resources/templates/plain-login.html

```
...
<form action="#" th:action="@{/authenticateTheUser}"
            method="POST">

  <p>
    User name: <input type="text" name="username" />
  </p>

  <p>
    Password: <input type="password" name="password" />
  </p>

  <input type="submit" value="Login" />

</form>
...
```

```
.loginPage("/showMyLoginPage")
.loginProcessingUrl("/authenticateTheUser")
.permitAll()
```

Step 3: Create custom login form

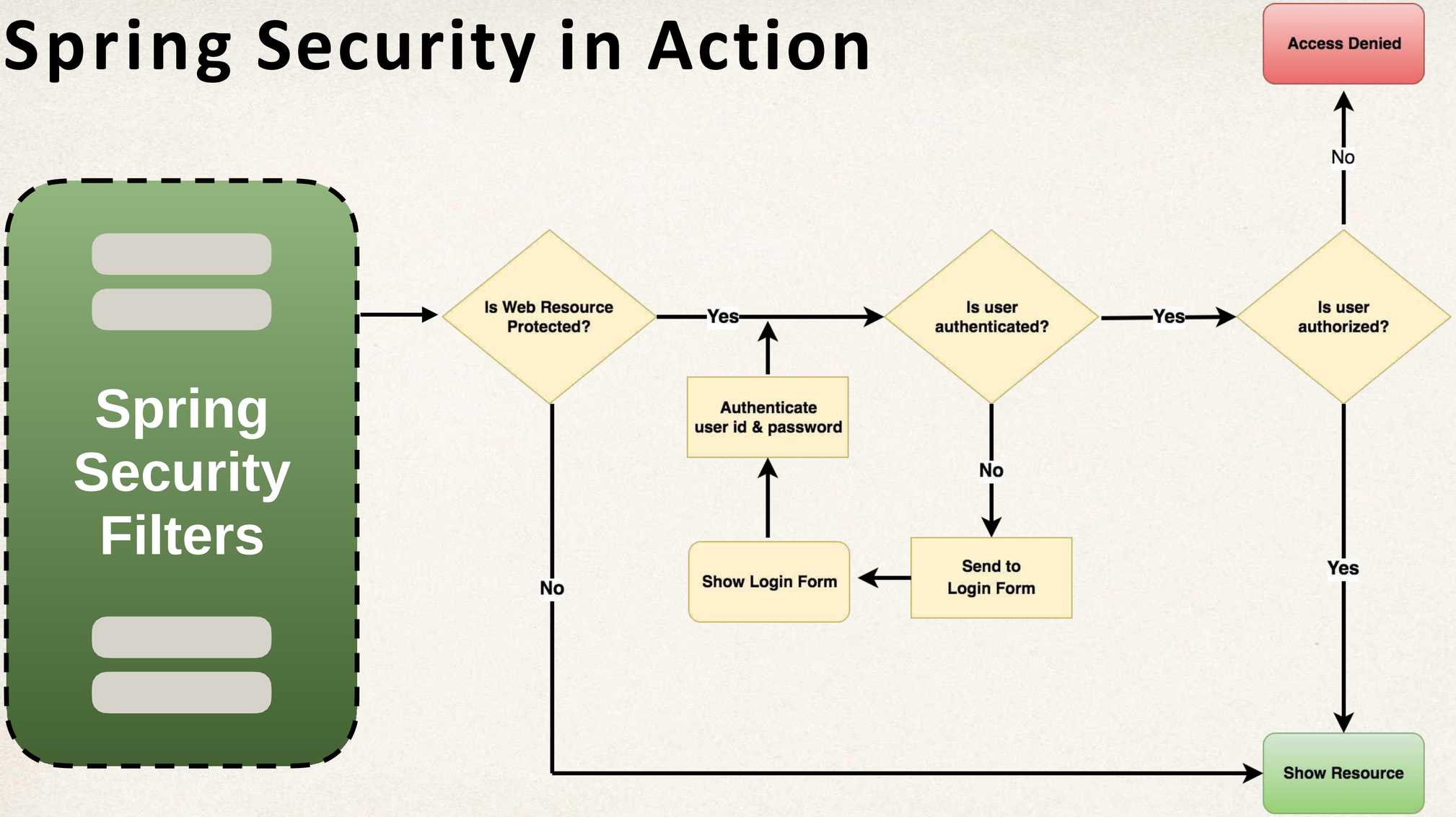
Pull It All Together

File: src/main/resources/templates/plain-login.html

```
...
<form action="#" th:action="@{/authenticateTheUser}"
            method="POST">

  <p>
    User name: <input type="text" name="username" />
  </p>

  <p>
    Password: <input type="password" name="password" />
  </p>

  <input type="submit" value="Login" />

</form>
...
```

```
.loginPage("/showMyLoginPage")
.loginProcessingUrl("/authenticateTheUser")
.permitAll()
```

Spring Security in Action



More Info on Context Path

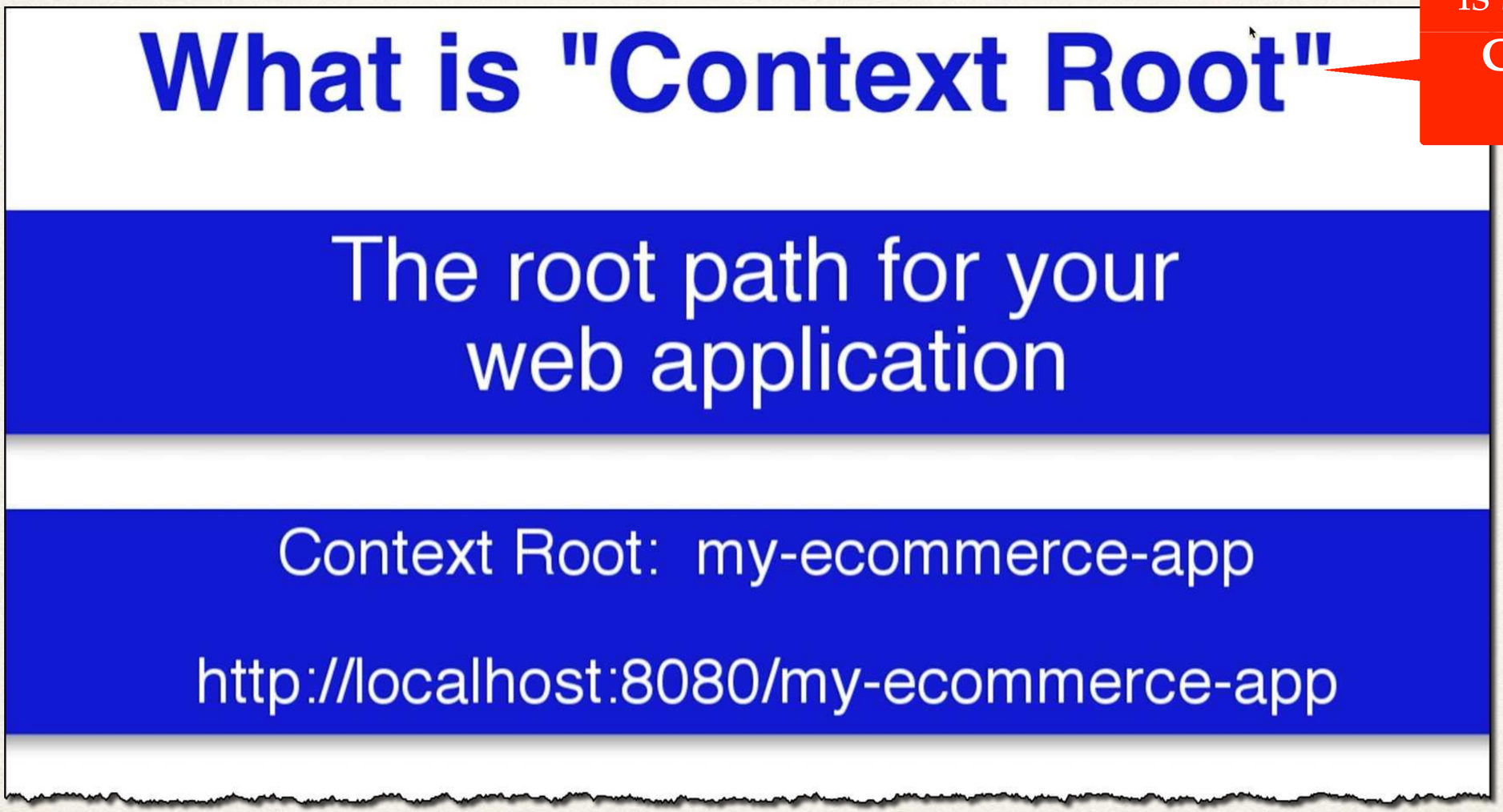
What is this???

The @ symbol

```
<form action="#"
            th:action="@{/authenticateTheUser}"
            method="POST">

  ...
```

More Info on Context Path

Context Path
is same thing as
Context Root



More Info on Context Path

Gives us access to context path dynamically

```
<form action="#"
            th:action="@{/authenticateTheUser}"
            method="POST">

  ...
```

Why use Context Path?

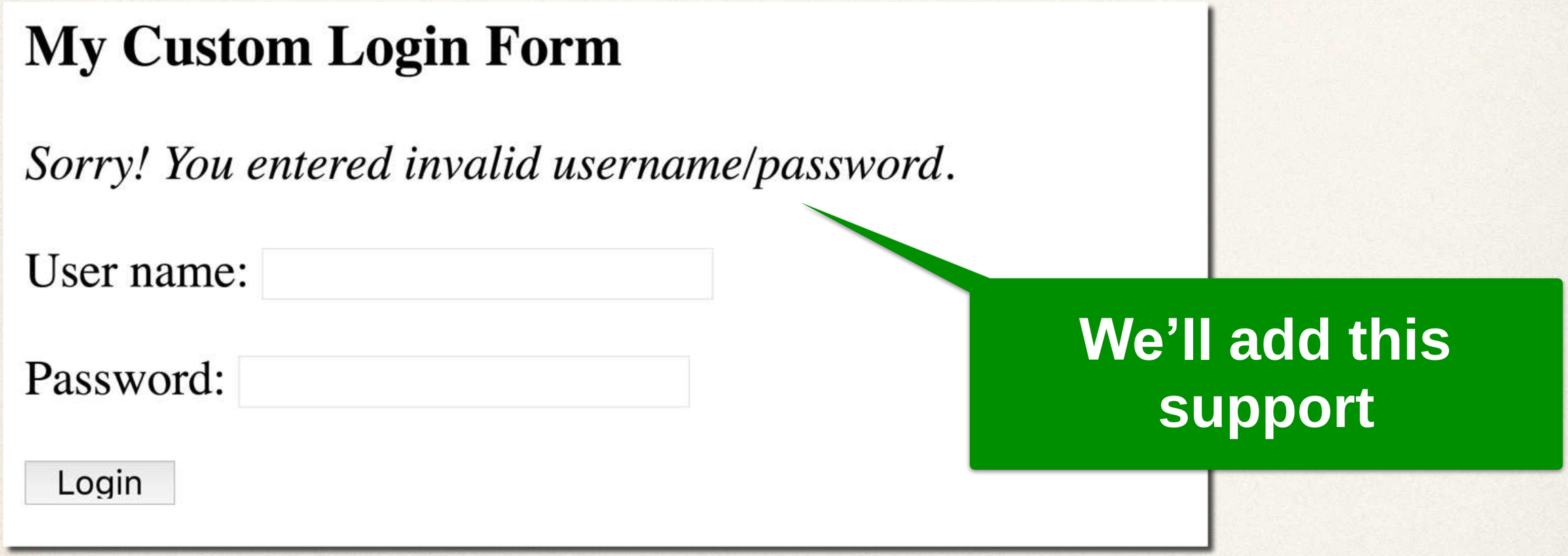
- Allows us to dynamically reference context path of application
- Helps to keep links relative to application context path
- If you change context path of app, then links will still work
- Much better than hard-coding context path …

Spring Security - Show Login Error

No error message for failed login - What???

No error message???

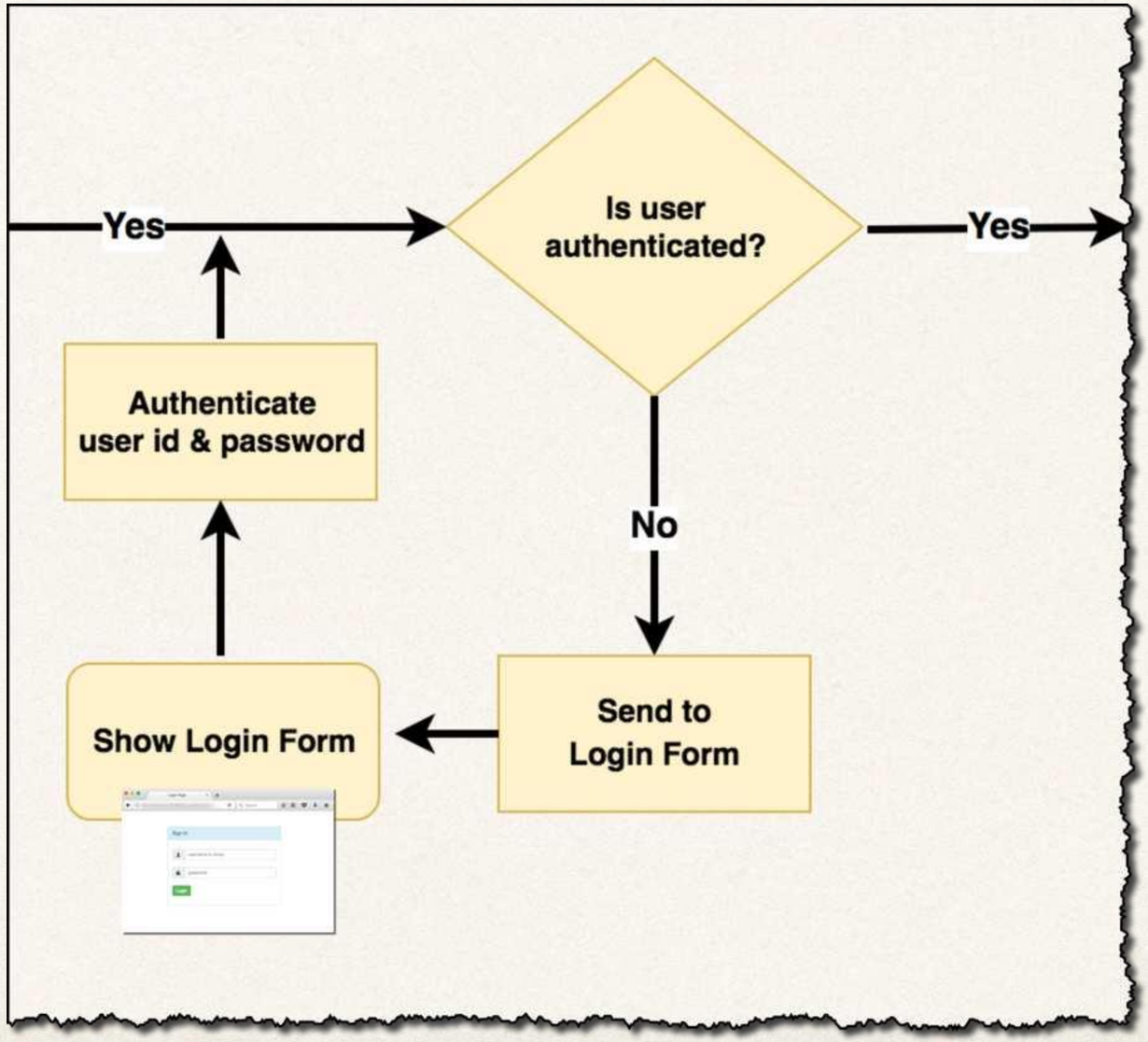
We need an error message … ASAP!!!



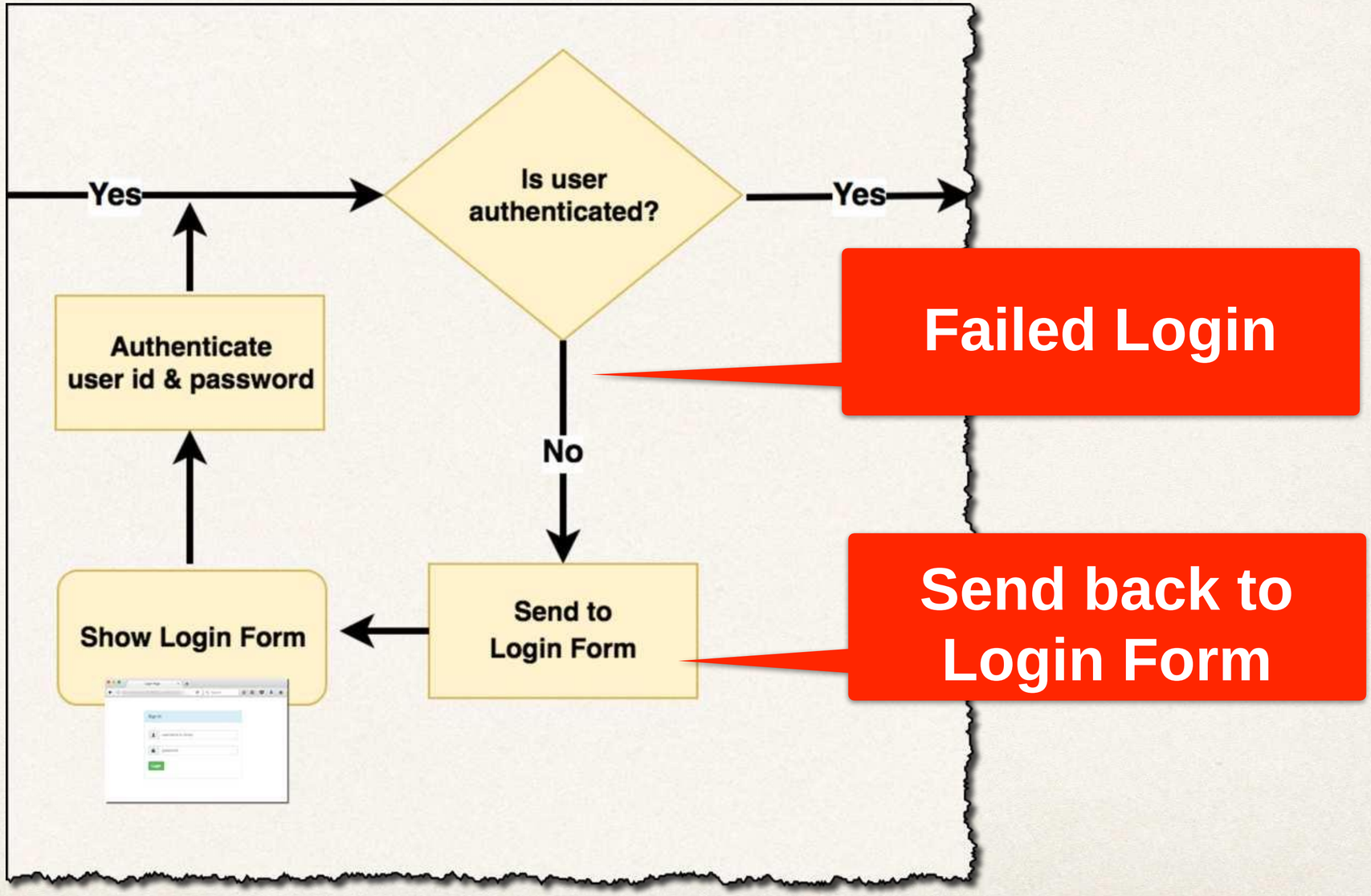
Failed Login

- When login fails, by default Spring Security will …
- Send user back to your login page
- Append an error parameter: **`?error`**

Failed Login

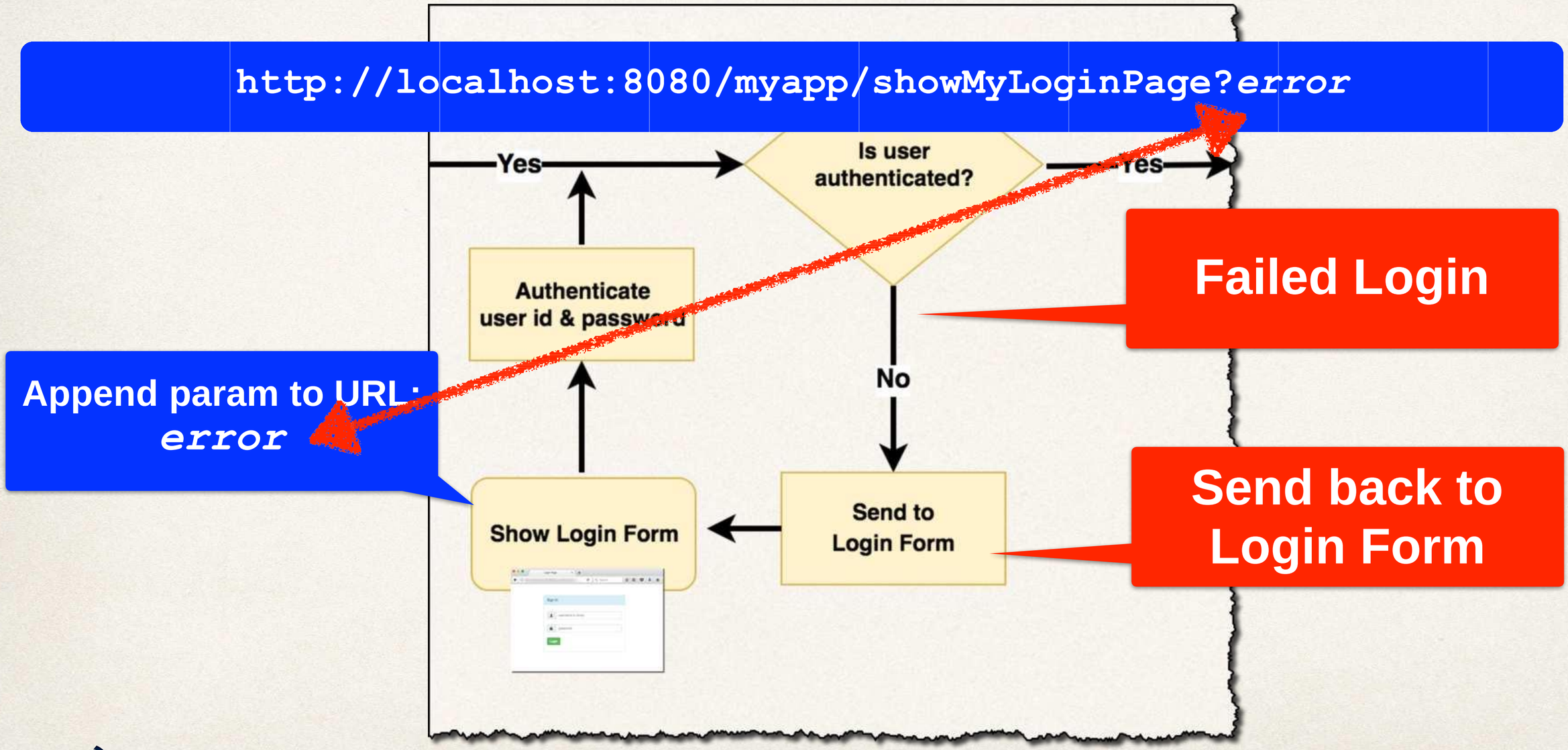


Failed Login



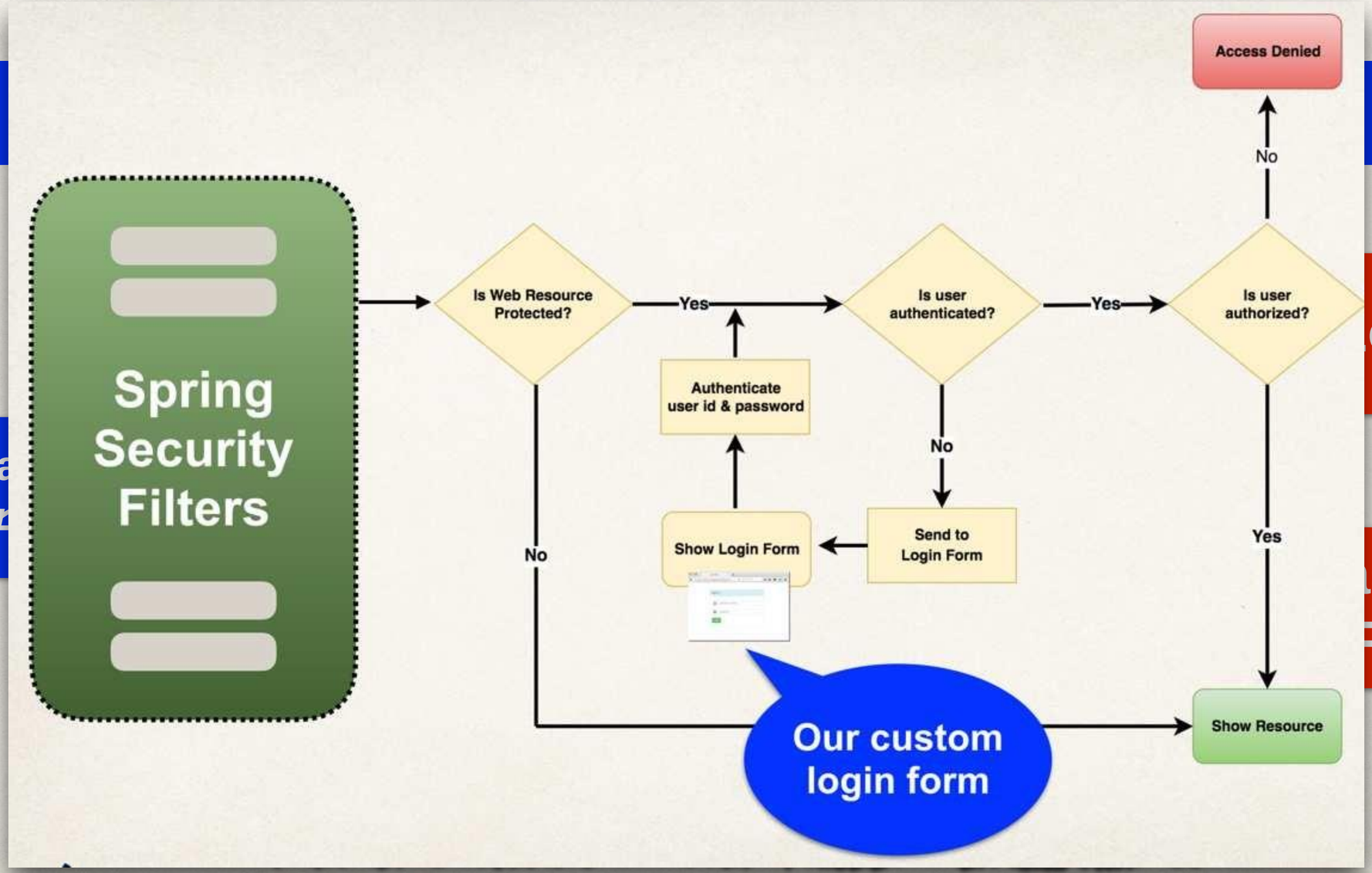
luv2code

Failed Login



luv2code

Failed Login



Append pa
er

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ck to
Form

Development Process

Step-By-Step

1. Modify custom login form

    1. Check the **error** parameter
    2. If **error** parameter exists, show an error message

Step 1: Modify form - check for error

File: src/main/resources/templates/plain-login.html

If error param then show message

```
…
<form …>

  <div th:if="${param.error}">

    <i>Sorry! You entered invalid username/password.</i>

  </div>

    User name:<input type="text"  name="username" />
    Password: <input type="password" name="password" />


</form>
…
```

Step 1: Modify form - check for error

File: src/main/resources/templates/plain-login.html

If error param
then show message

```
…
<form …>

  <div th:if="${param.error}">

    <i>Sorry! You entered invalid username/password.</i>

  </div>

    User name:<input type="text"  name="username" />
    Password: <input type="password" name="password" />

</form>
…
```

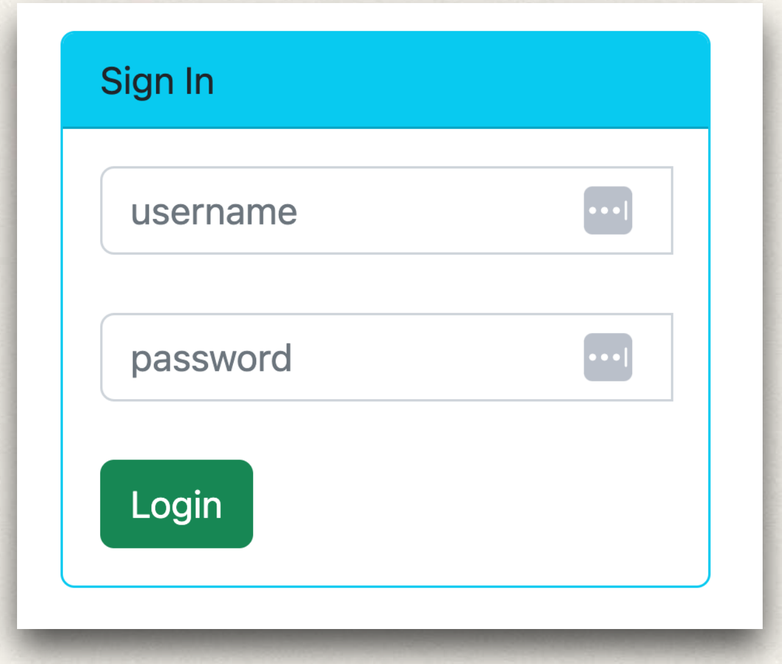
http://localhost:8080/myapp/showMyLoginPage?*error*

Spring Security - Bootstrap Login Page

Let's Make our Login Form Beautiful

Before

After



Bootstrap

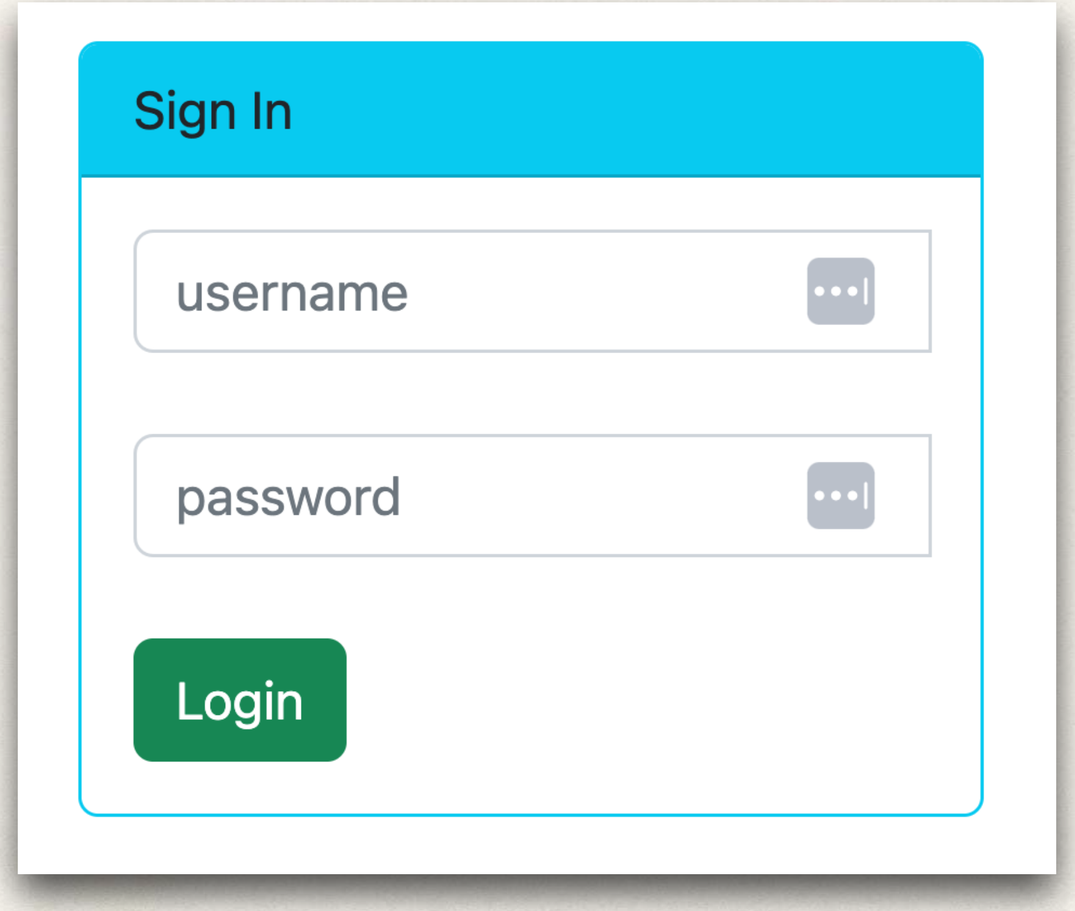
Bootstrap

- Bootstrap is a web framework that includes CSS styles and JavaScript
- Focused on front-end UI
- For our project, you do not need any experience with Bootstrap :-)

Our Game Plan

- My friend, Alan, has helped us out
  - He created an HTML login form using Bootstrap
- We'll modify the form to use Spring Security for our project

Fancy Login Form



Development Process

Step-By-Step

1. Modify form to point to our login processing URL

2. Verify form fields for username and password

3. Change our controller to use our new Bootstrap login form

Bootstrap Tutorials and Docs

- There are tons of free tutorials online: “bootstrap tutorial”

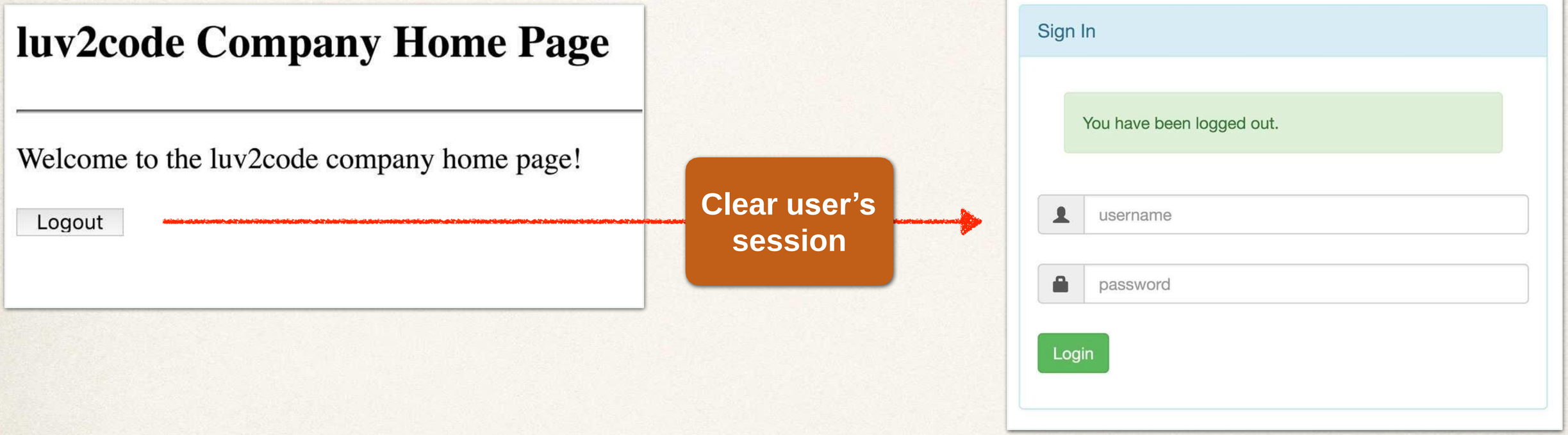
www.w3schools.com/bootstrap

- Bootstrap Official Documentation

www.getbootstrap.com/docs

Spring Security - Logout

Logging Out



Development Process

Step-By-Step

1. Add logout support to Spring Security Configuration

2. Add logout button to home page

3. Update login form to display “logged out” message

Step 1: Add Logout support to Spring Security Configuration

File: DemoSecurityConfig.java

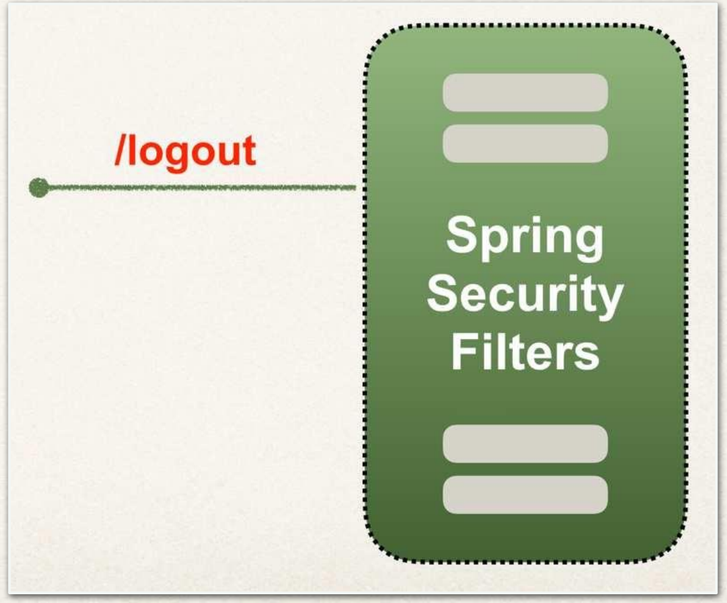
```
@Bean
public SecurityFilterChain filterChain(HttpSecurity http) throws Exception {

    http.authorizeHttpRequests(configurer ->
                    configurer
                            .anyRequest().authenticated()
            )
            .formLogin(form ->
                    form
                            .loginPage("/showMyLoginPage")
                            .loginProcessingUrl("/authenticateTheUser")
                            .permitAll()
            )
            .logout(logout -> logout.permitAll()
            );

    return http.build();
}
```

Add logout support for default URL /logout

Step 2: Add logout button

- Send data to default logout URL: `/logout`
- Logout URL will be handled by Spring Security Filters
- You get it for free … no coding required

This is
Spring Security magic …
LOL



Step 2: Add logout button

- Send data to default logout URL: **/logout**
  - By default, must use **POST** method

```
<form action="#" th:action="@{/logout}" method="POST">

        <input type="submit" value="Logout" />

</form>
```

GET method is disabled by default

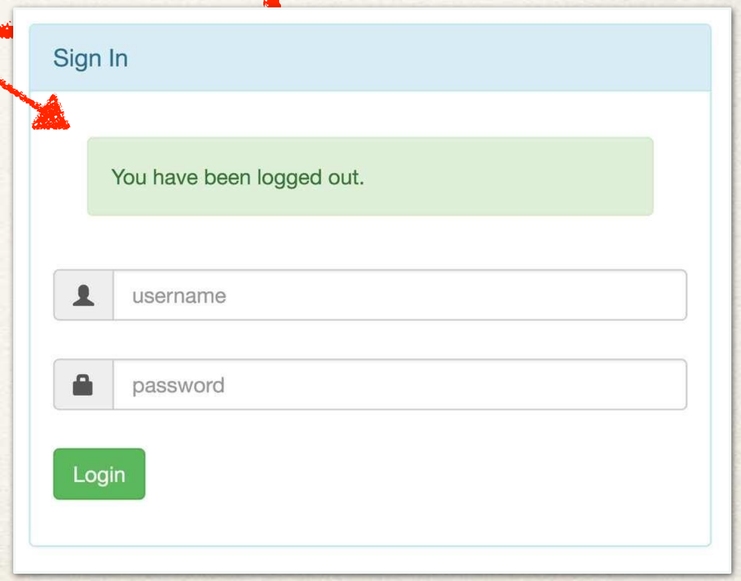
Logout process

- When a logout is processed, by default Spring Security will …
- Invalidate user's HTTP session and remove session cookies, etc
- Send user back to your login page
- Append a logout parameter: **`?logout`**

Step 3: Update login form to display “logged out” message

1. Update login form

1. Check the **logout** parameter
2. If **logout** parameter exists, show “logged out” message



Modify Login form - check for "logout"

File: src/main/resources/templates/plain-login.html

```
…
<form … th:action="…" method="…">

  <div th:if="${param.logout}">

    <i>You have been logged out.</i>

  </div>

    User name:<input type="text"  name="username" />
    Password: <input type="password" name="password" />

</form>
…
```

If logout param then show message

Modify Login form - check for "logout"

File: src/main/resources/templates/plain-login.html

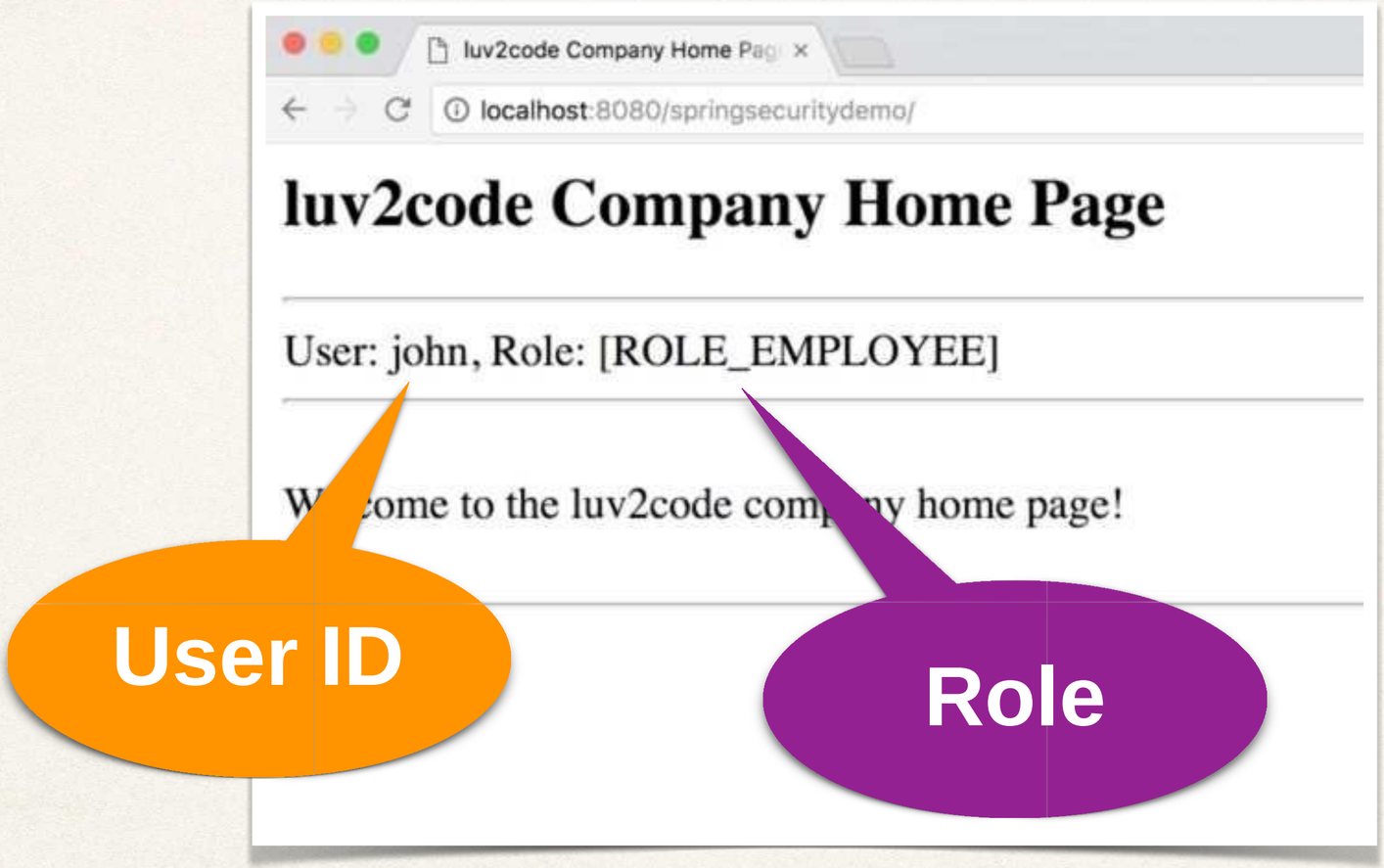
```
…
<form … th:action="…" method="…">

  <div th:if="${param.logout}">

    <i>You have been logged out </i>

  </div>

    User name:<input type="text"  name="username" />
    Password: <input type="password" name="password" />
```

If logout param then show message

http://localhost:8080/showMyLoginPage?logout

Display User ID and Roles

Display User ID and Roles



Spring Security

- Spring Security provides support for accessing user id and roles

Development Process

Step-By-Step

1. Display User ID

2. Display User Roles

Step 1: Display User ID

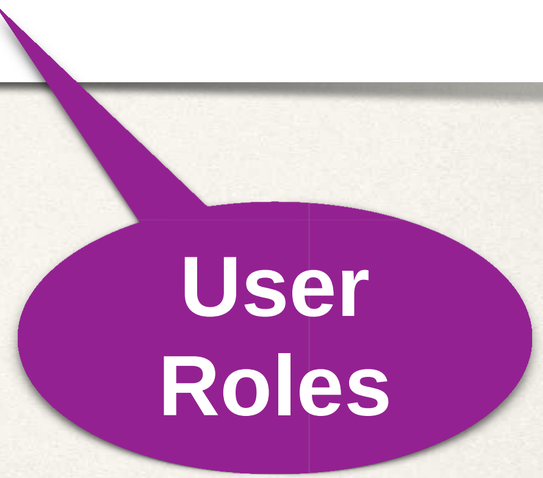
File: home.html

```
...

User: <span
sec:authentication="principal.username"></span>
```

Step 2: Display User Roles

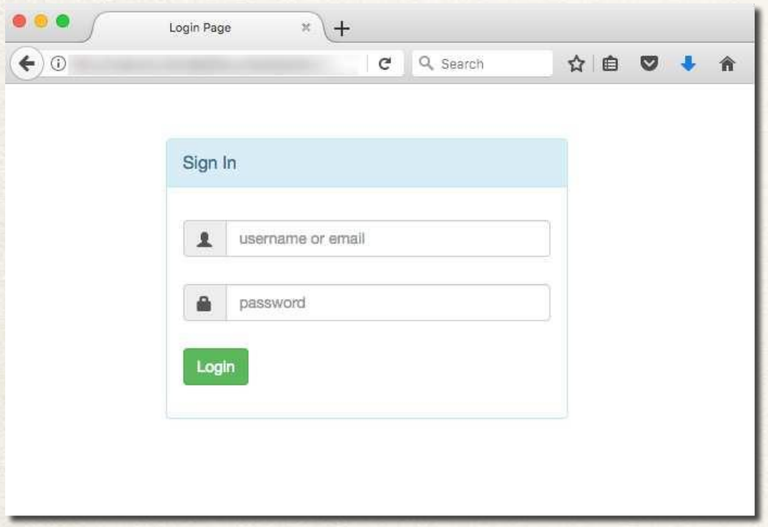
File: home.html

```
...

Role(s): <span
sec:authentication="principal.authorities"></span>
```



Restrict Access Based on Roles

Our Example



/

Home Page

role: EMPLOYEE

/leaders

Leadership Retreat Page

role: MANAGER

/systems

Admin Holiday Cruise

role: ADMIN

luv2code

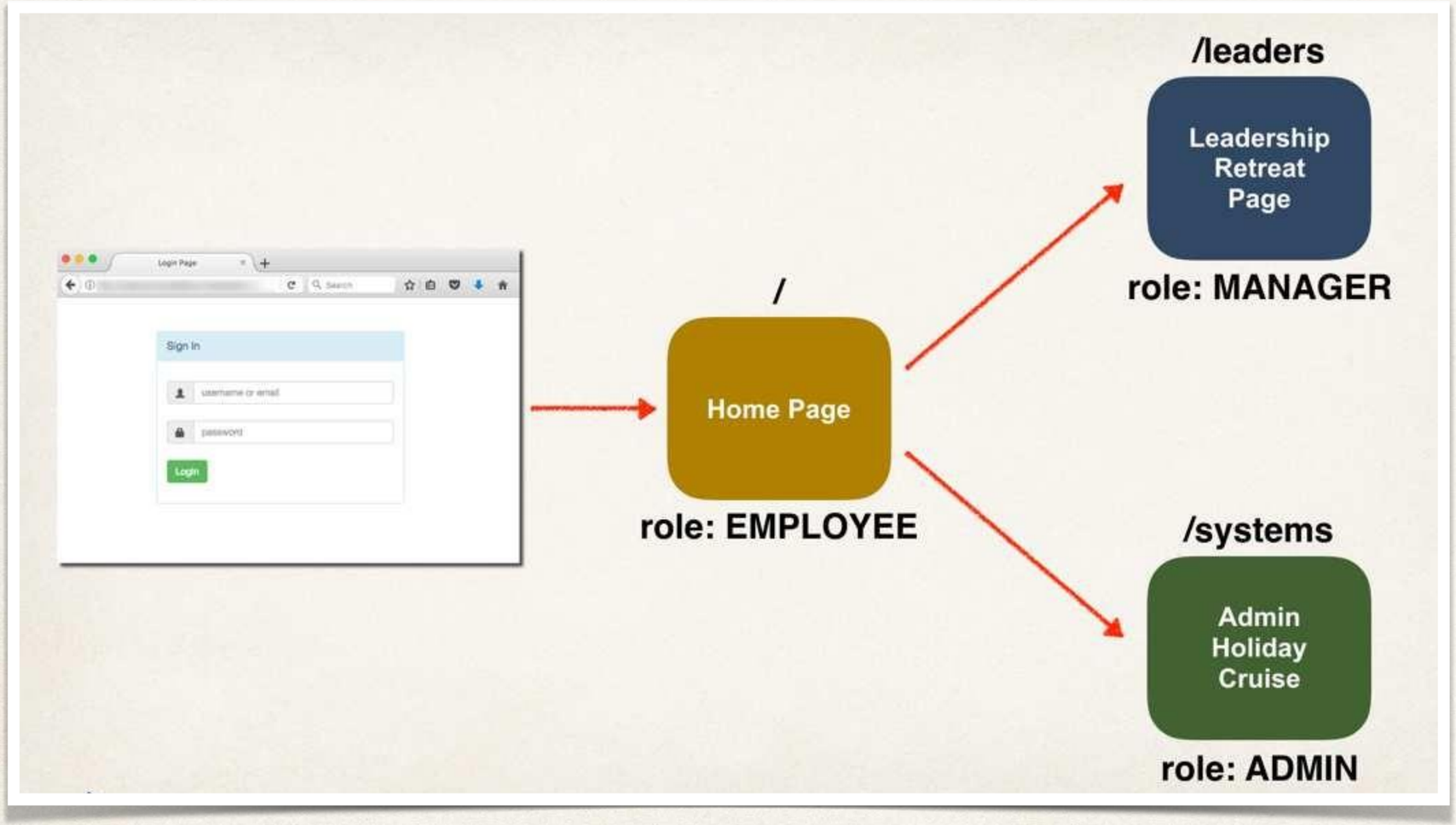
Development Process

Step-By-Step

1. Create supporting controller code and view pages

2. Restrict Access based on Roles

Step 1: Create Supporting Controller code and View Pages



Cover these steps in the video

Step 2: Restricting Access to Roles

- Update your Spring Security Java configuration file (.java)
- General Syntax

```
requestMatchers(<< add path to match on >>).hasRole(<< authorized role
>>)
```

Single role

Restrict access to a given path "/systems/"**

"ADMIN"

Step 3: Restricting Access to Roles

Any role in the list, comma-delimited list

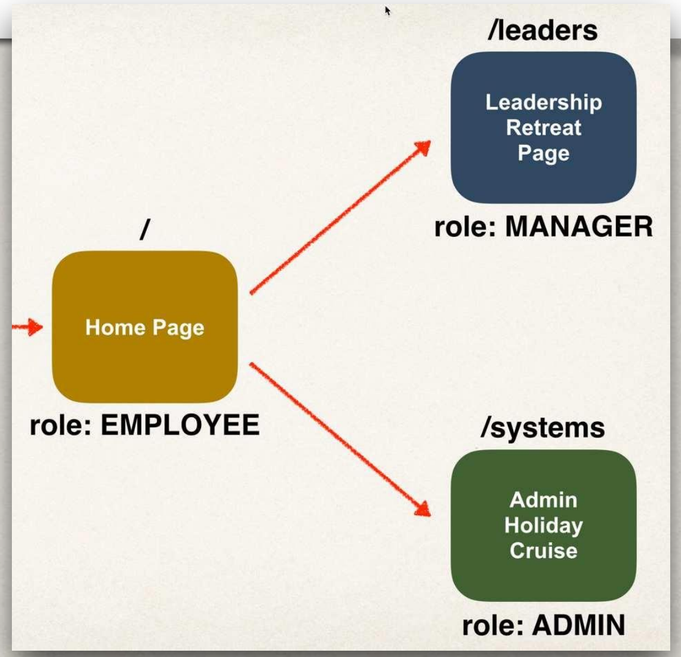
```
requestMatchers(<< add path to match on >>).hasAnyRole(<< list of authorized roles >>)
```

“ADMIN”, “DEVELOPER”, “VIP”, “PLATINUM”

Restrict Path to EMPLOYEE

```
requestMatchers("/").hasRole("EMPLOYEE")
```

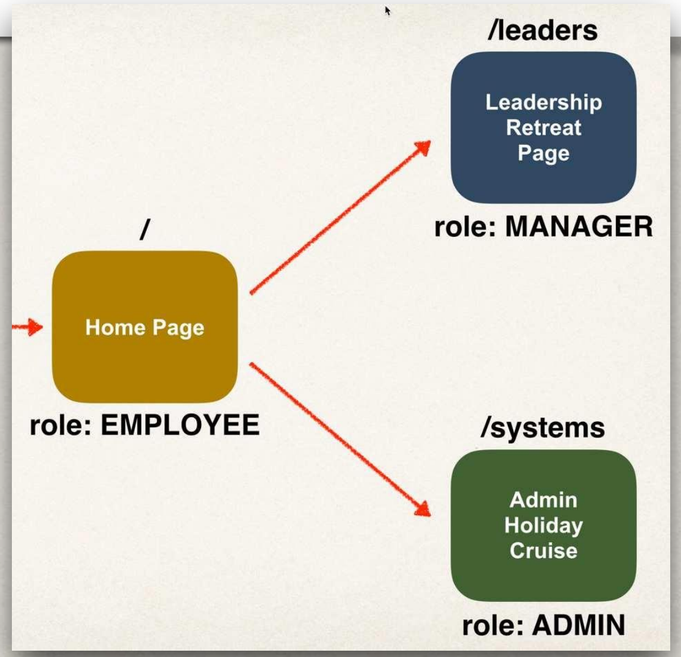
Match on root path: /



Restrict Path /leaders to MANAGER

```
requestMatchers("/leaders/**").hasRole("MANAGER")
```

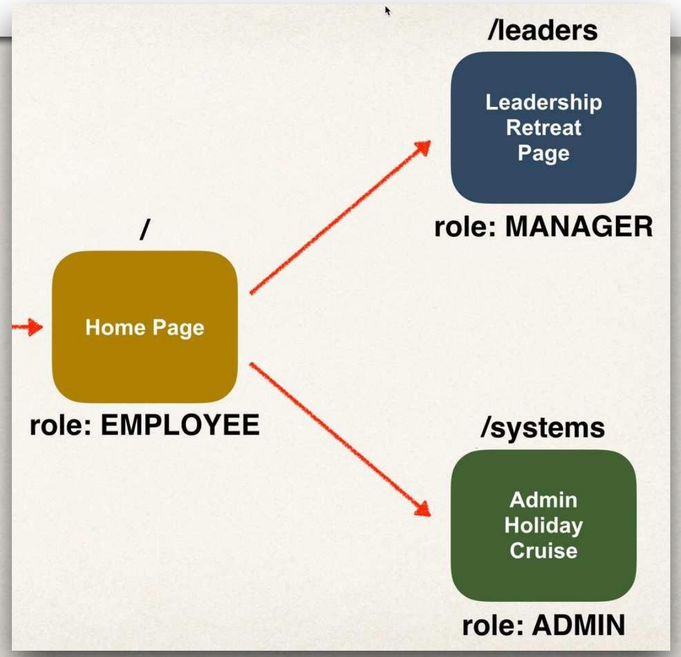
Match on path: /leaders
And all sub-directories (**)



Restrict Path /systems to ADMIN

```
requestMatchers("/systems/**").hasRole("ADMIN")
```

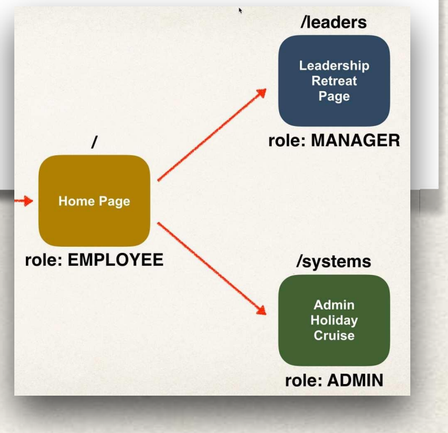
Match on path: /systems
And all sub-directories (**)



Pull It Together

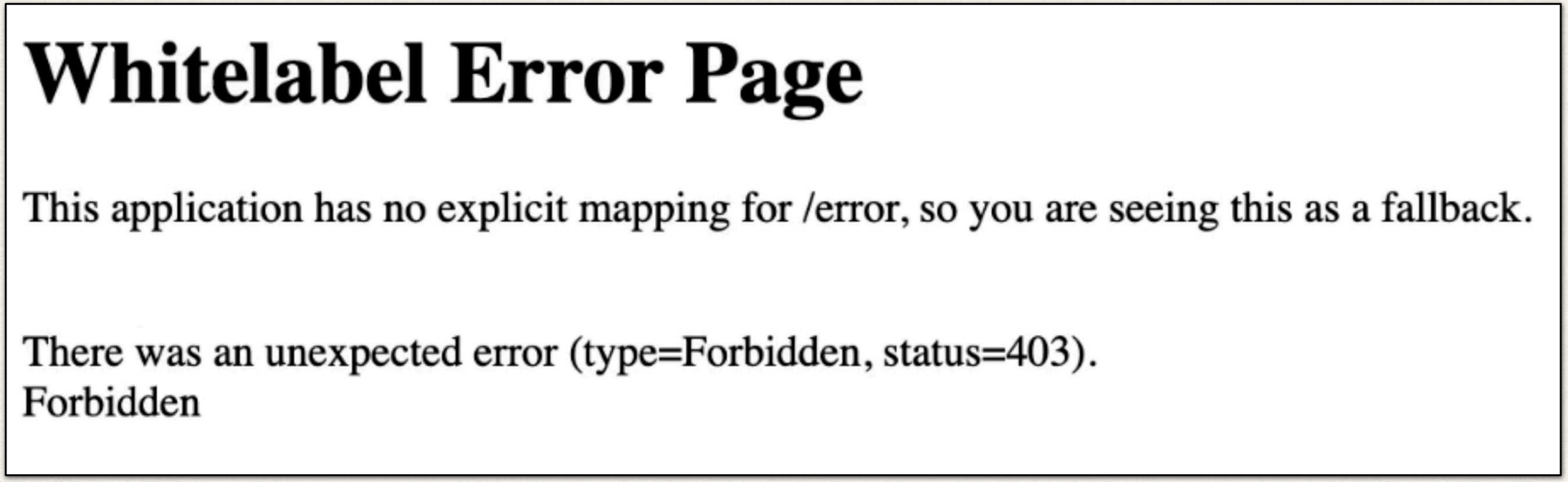
```
@Bean
public SecurityFilterChain filterChain(HttpSecurity http) throws Exception {

    http.authorizeHttpRequests(configurer ->
                    configurer
                            .requestMatchers("/").hasRole("EMPLOYEE")
                            .requestMatchers("/leaders/**").hasRole("MANAGER")
                            .requestMatchers("/systems/**").hasRole("ADMIN")
                            .anyRequest().authenticated()
            )

    ...
}
```

User ID	Password	Roles
john	test123	EMPLOYEE
mary	test123	EMPLOYEE, MANAGER
susan	test123	EMPLOYEE, MANAGER, ADMIN



Custom Access Denied Page

Default Access Denied Page



Custom Access Denied Page

Development Process

Step-By-Step

1. Configure custom page for access denied

2. Create supporting controller code and view page

Step 1: Configure custom page access denied

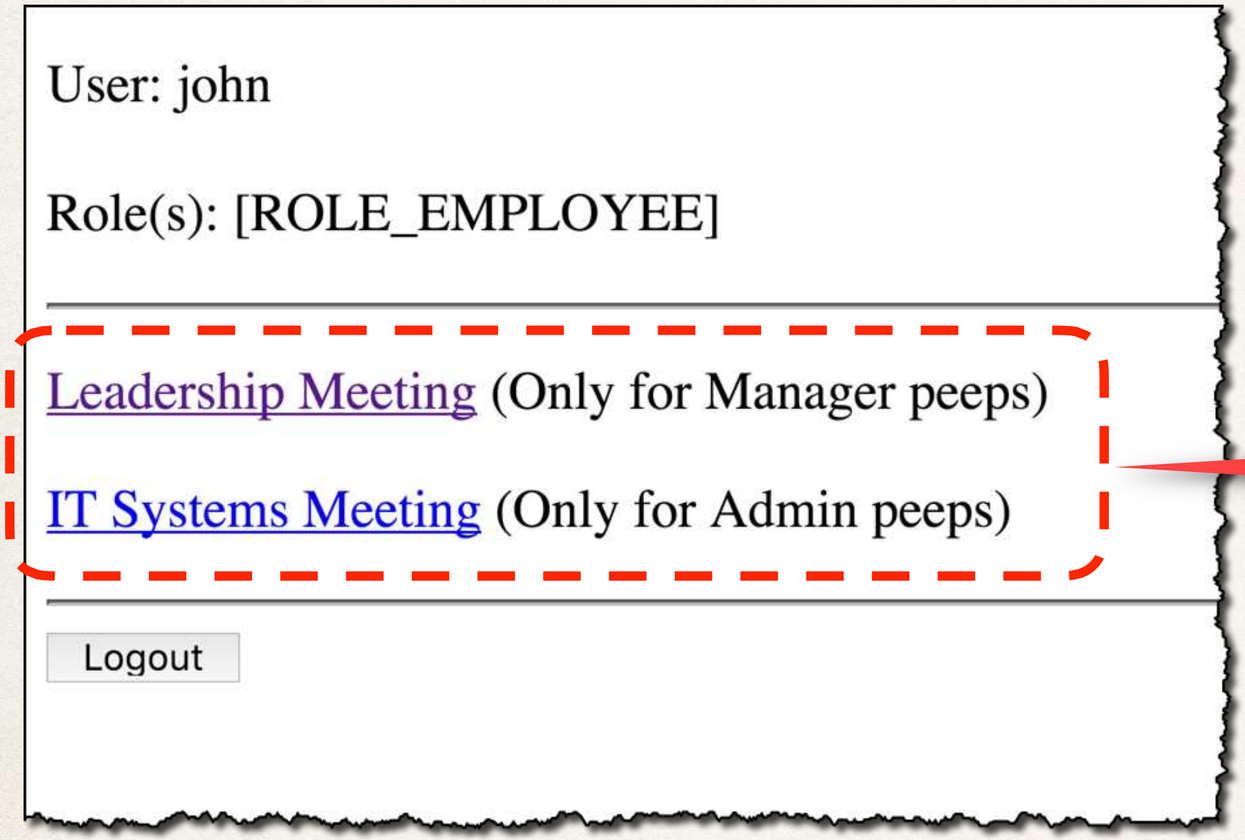
```
@Bean
public SecurityFilterChain filterChain(HttpSecurity http) throws Exception {

    http.authorizeHttpRequests(configurer ->
                    configurer
                            .requestMatchers("/").hasRole("EMPLOYEE")
                            …
            )
            .exceptionHandling(configurer ->
                    configurer
                            .accessDeniedPage("/access-denied")
            );
    …
}
```

Our request mapping path

Step 2: Create Supporting Controller code and View Page

Display Content Based on Roles

Why Show These Links?



Since John is an employee,

he shouldn't be able to see this content / links

Display Content Based on Roles

Mary can see MANAGER content

Spring Security

Only show this section for users with MANAGER role

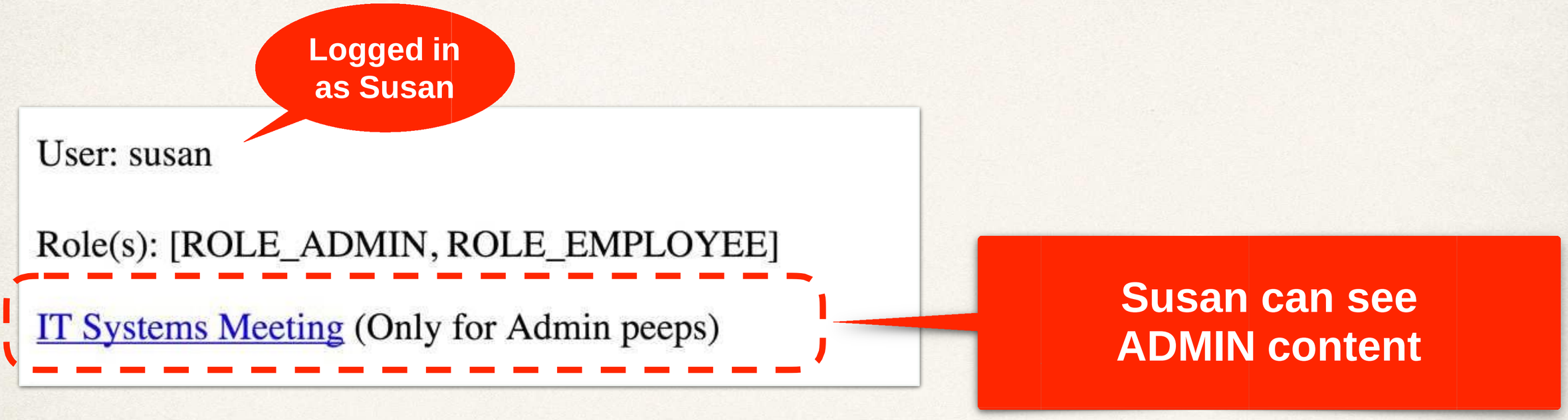
```
...
<div sec:authorize="hasRole('MANAGER')">

    <p>
        <a th:href="@{/leaders}">
          Leadership Meeting
        </a>
        (Only for Manager peeps)
    </p>

</div>
```

User: mary

Role(s): [ROLE_EMPLOYEE, ROLE_MANAGER]

Leadership Meeting (Only for Manager peeps)

Display Content Based on Roles



Spring Security

Only show this section for users with ADMIN role

```
...
<div sec:authorize="hasRole('ADMIN')">

    <p>
        <a th:href="@{/systems}">
            IT Systems Meeting
        </a>
        (Only for Admin peeps)
    </p>

</div>
```

User: susan

Role(s): [ROLE_ADMIN, ROLE_EMPLOYEE]

IT Systems Meeting (Only for Admin peeps)

Spring Security
User Accounts Stored in Database

Database Access

- So far, our user accounts were hard coded in Java source code

- We want to add database access

Recall Our User Roles

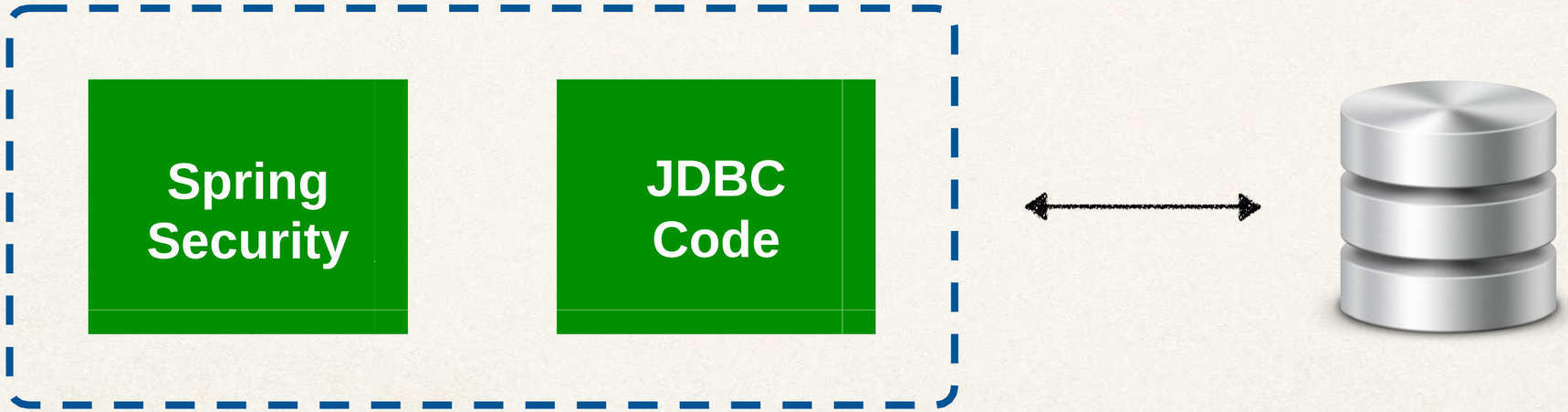
User ID	Password	Roles
john	test123	EMPLOYEE
mary	test123	EMPLOYEE, MANAGER
susan	test123	EMPLOYEE, MANAGER, ADMIN

Database Support in Spring Security

Out-of-the-box

- Spring Security can read user account info from database

- By default, you have to follow Spring Security's predefined table schemas



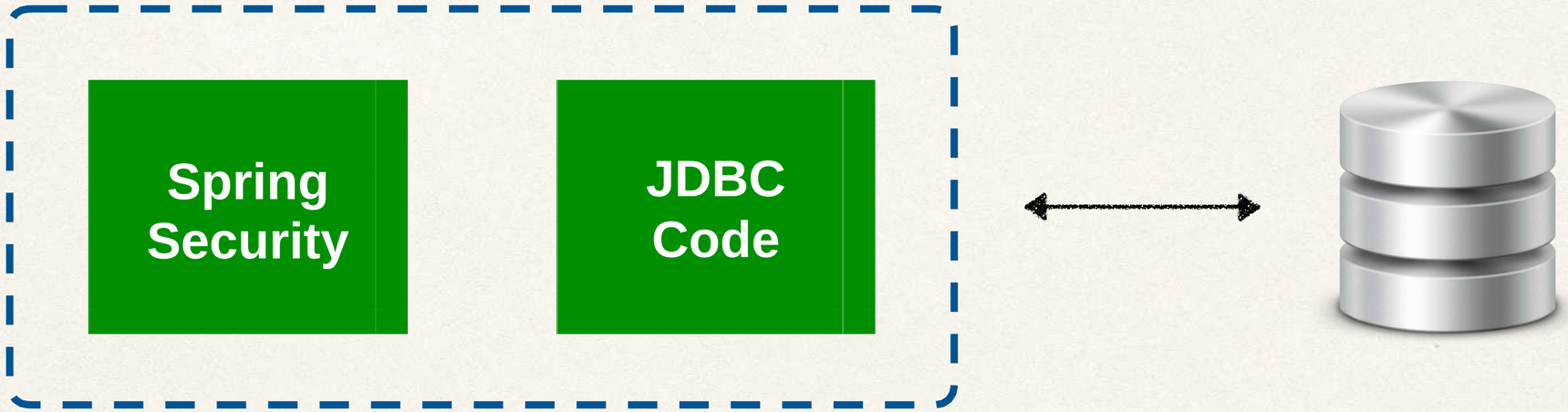
Customize Database Access with Spring Security

- Can also customize the table schemas
- Useful if you have custom tables specific to your project / custom
- You will be responsible for developing the code to access the data
  - JDBC, JPA/Hibernate etc …

Database Support in Spring Security

Out-of-the-box

- Follow Spring Security's predefined table schemas



Development Process

Step-By-Step

1. Develop SQL Script to set up database tables

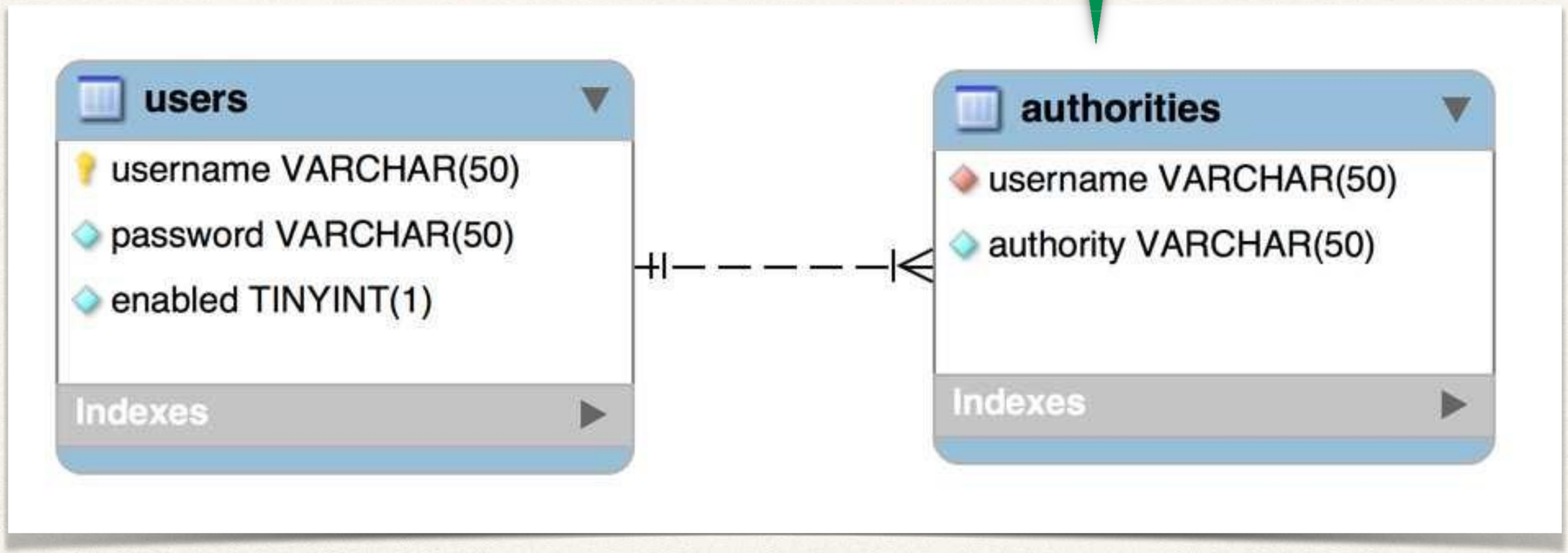
2. Add database support to Maven POM file

3. Create JDBC properties file

4. Update Spring Security Configuration to use JDBC

Default Spring Security Database Schema

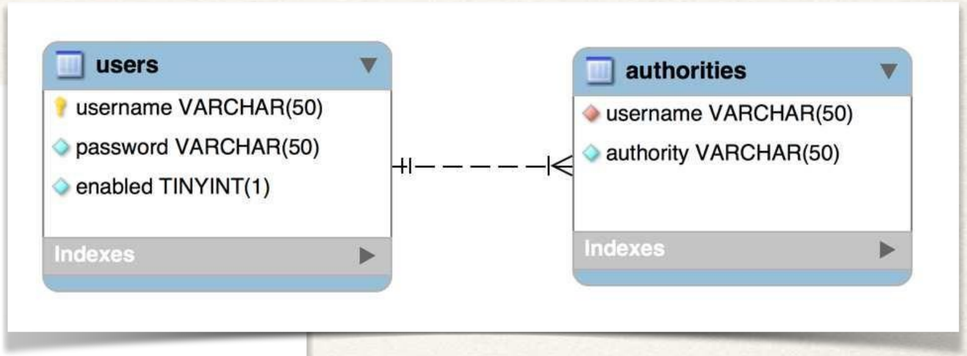
"authorities" same as "roles"



luv2code

Step 1: Develop SQL Script to setup database tables

```
CREATE TABLE `users` (
  `username` varchar(50) NOT NULL,
  `password` varchar(50) NOT NULL,
  `enabled` tinyint NOT NULL,

  PRIMARY KEY (`username`)

) ENGINE=InnoDB DEFAULT CHARSET=latin1;
```



Step 1: Develop SQL Script to setup database tables

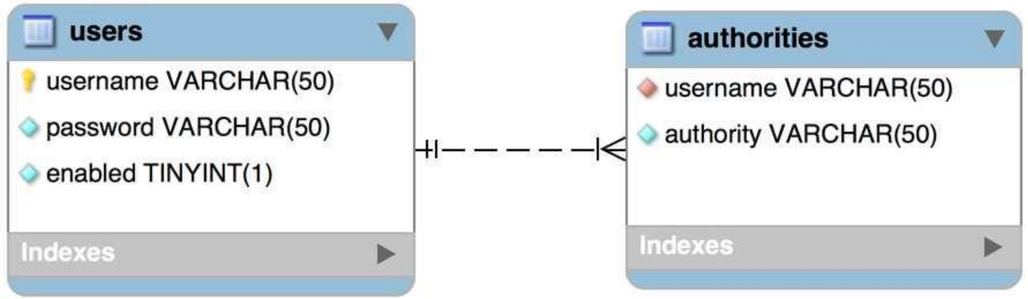
The encoding algorithm id

The password

```
INSERT INTO `users`
VALUES
('john','{noop}test123',1),
('mary','{noop}test123',1),
('susan','{noop}test123',1);
```

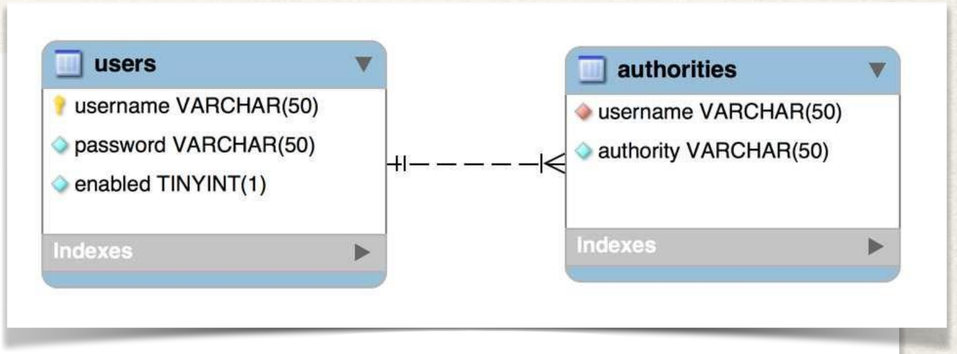
Let's Spring Security know the passwords are stored as plain text (noop)

User ID	Password	Roles
john	test123	EMPLOYEE
mary	test123	EMPLOYEE, MANAGER
susan	test123	EMPLOYEE, MANAGER, ADMIN



luv2code

Step 1: Develop SQL Script to setup database tables




```
CREATE TABLE `authorities` (
  `username` varchar(50) NOT NULL,
  `authority` varchar(50) NOT NULL,

  UNIQUE KEY `authorities_idx_1` (`username`,`authority`),

  CONSTRAINT `authorities_ibfk_1`
  FOREIGN KEY (`username`)
  REFERENCES `users` (`username`)
) ENGINE=InnoDB DEFAULT CHARSET=latin1;
```

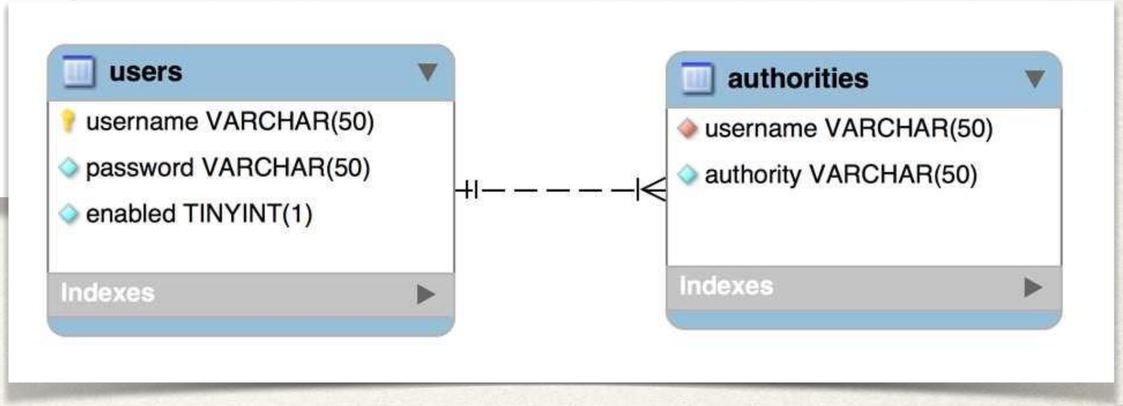
Step 1: Develop SQL Script to setup database tables

"authorities" same as "roles"

```
INSERT INTO `authorities`
VALUES
('john','ROLE_EMPLOYEE'),
('mary','ROLE_EMPLOYEE'),
('mary','ROLE_MANAGER'),
('susan','ROLE_EMPLOYEE'),
('susan','ROLE_MANAGER'),
('susan','ROLE_ADMIN');
```

Internally Spring Security uses "ROLE_" prefix

User ID	Password	Roles
john	test123	EMPLOYEE
mary	test123	EMPLOYEE, MANAGER
susan	test123	EMPLOYEE, MANAGER, ADMIN



Step 2: Add Database Support to Maven POM file

```
<!-- MySQL -->
<dependency>
   <groupId>com.mysql</groupId>
   <artifactId>mysql-connector-j</artifactId>
   <scope>runtime</scope>
</dependency>
```

JDBC Driver

Step 3: Create JDBC Properties File

File: application.properties

```
#
# JDBC connection properties
#
spring.datasource.url=jdbc:mysql://localhost:3306/employee_directory
spring.datasource.username=springstudent
spring.datasource.password=springstudent
```

Step 4: Update Spring Security to use JDBC

```
@Configuration
public class DemoSecurityConfig {

    @Bean
    public UserDetailsManager userDetailsManager(DataSource dataSource) {

        return new JdbcUserDetailsManager(dataSource);
    }

    ...
}
```

Inject data source
Auto-configured by Spring Boot

No longer
hard-coding users :-)

Tell Spring Security to use
JDBC authentication
with our data source

Spring Security
Password Encryption

Password Storage

- So far, our user passwords are stored in plaintext … yikes!

username	password	enabled
john	{noop}test123	1
mary	{noop}test123	1
susan	{noop}test123	1

- Ok for getting started … but not for production / real-time project :-(

Password Storage - Best Practice

Best Practice

- The best practice is store passwords in an encrypted format

username	password	enabled
john	{bcrypt}$2a$10$qeS0HEh7urweMojsnwNAR.vcXJeXR1UcMRZ2WcGQl9YeuspUdgF.q	1
mary	{bcrypt}$2a$10$qeS0HEh7urweMojsnwNAR.vcXJeXR1UcMRZ2WcGQl9YeuspUdgF.q	1
susan	{bcrypt}$2a$10$qeS0HEh7urweMojsnwNAR.vcXJeXR1UcMRZ2WcGQl9YeuspUdgF.q	1

Encrypted version of password

Spring Security Team Recommendation

- Spring Security recommends using the popular **bcrypt** algorithm

- bcrypt
  - Performs one-way encrypted hashing
  - Adds a random salt to the password for additional protection
  - Includes support to defeat brute force attacks

Bcrypt Additional Information

- Why you should use bcrypt to hash passwords

  /why-bcrypt

- Detailed bcrypt algorithm analysis

  /bcrypt-wiki-page

- Password hashing - Best Practices

  /password-hashing-best-practices

How to Get a Bcrypt password

You have a plaintext password and you want to encrypt using bcrypt

- Option 1: Use a website utility to perform the encryption
- Option 2: Write Java code to perform the encryption

How to Get a Bcrypt password - Website

- Visit: `/generate-bcrypt-password`
- Enter your plaintext password
- The website will generate a bcrypt password for you

DEMO

Development Process

1. Run SQL Script that contains encrypted passwords

- Modify DDL for password field, length should be 68

THAT'S IT … no need to change Java source code :-)

Spring Security Password Storage

- In Spring Security, passwords are stored using a specific format

```
{bcrypt}encodedPassword
```

Password column must be at least 68 chars wide

{bcrypt} - 8 chars
***encodedPassword* - 60 chars**

username	password	enabled
john	{bcrypt}$2a$10$qeS0HEh7urweMojsnwNAR.vcXJeXR1UcMRZ2WcGQl9YeuspUdgF.q	1
mary	{bcrypt}$2a$10$qeS0HEh7urweMojsnwNAR.vcXJeXR1UcMRZ2WcGQl9YeuspUdgF.q	1
susan	{bcrypt}$2a$10$qeS0HEh7urweMojsnwNAR.vcXJeXR1UcMRZ2WcGQl9YeuspUdgF.q	1

Modify D D L for Password Field

```
CREATE TABLE `users` (
   `username` varchar(50) NOT NULL,
   `password`     char(68) NOT NULL,
   `enabled` tinyint NOT NULL,

   PRIMARY KEY (`username`)

) ENGINE=InnoDB DEFAULT CHARSET=latin1;
```

Password column must be at least 68 chars wide

{bcrypt} - 8 chars
***encodedPassword* - 60 chars**

Step 1: Develop SQL Script to setup database tables

The encoding algorithm id

The encrypted password: fun123

```
INSERT INTO `users`
VALUES
('john','{bcrypt}$2a$10$qeS0HEh7urweMojsnwNAR.vcXJeXR1UcMRZ2WcGQl9YeuspUdgF.q',1)
,
...
```

Let's Spring Security know the passwords are stored as encrypted passwords: bcrypt

Step 1: Develop SQL Script to setup database tables

The encoding algorithm id

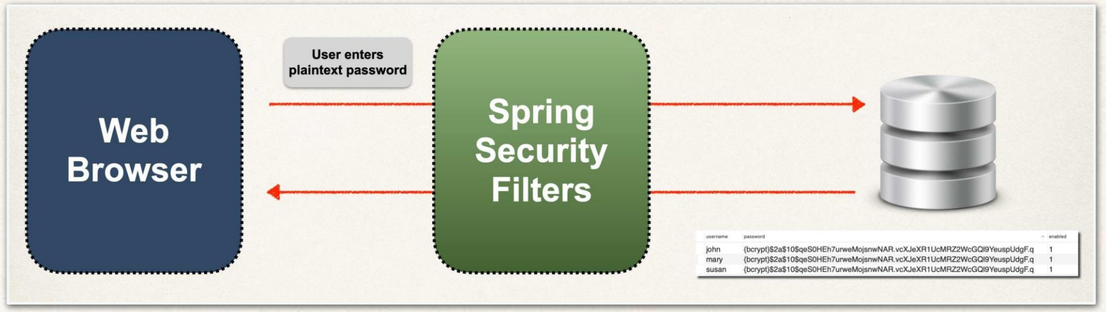
The encrypted password: fun123

```
INSERT INTO `users`
VALUES
('john','{bcrypt}$2a$10$qeS0HEh7urweMojsnwNAR.vcXJeXR1UcMRZ2WcGQ19YeuspUdgF.q',1)
,
('mary','{bcrypt}$2a$04$eFytJDGtjbThXa80FyOOBuFdK2IwjyWefYkMpiBEFlpBwDH.5PM0K',1),

('susan','{bcrypt}$2a$04$eFytJDGtjbThXa80FyOOBuFdK2IwjyWefYkMpiBEFlpBwDH.5PM0K',1)
;
```

Spring Security Login Process

username	password	enabled
john	{bcrypt}$2a$10$qeS0HEh7urweMojsnwNAR.vcXJeXR1UcMRZ2WcGQl9YeuspUdgF.q	1
mary	{bcrypt}$2a$10$qeS0HEh7urweMojsnwNAR.vcXJeXR1UcMRZ2WcGQl9YeuspUdgF.q	1
susan	{bcrypt}$2a$10$qeS0HEh7urweMojsnwNAR.vcXJeXR1UcMRZ2WcGQl9YeuspUdgF.q	1

Spring Security Login Process



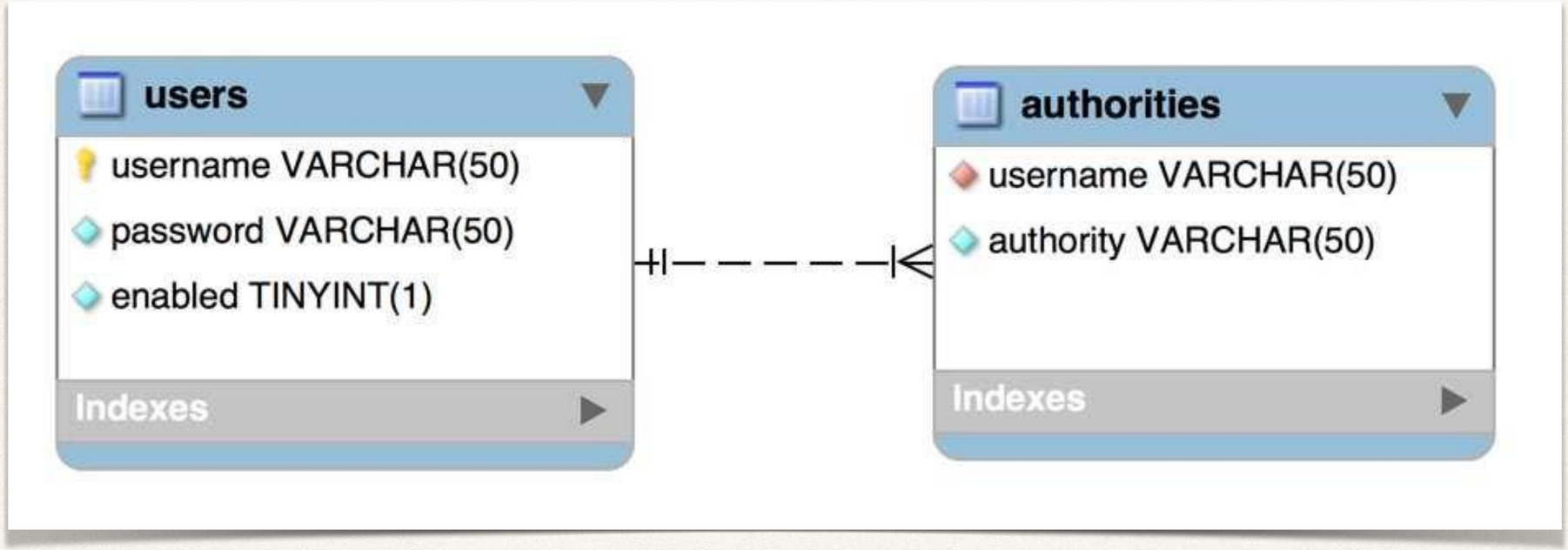
1. Retrieve password from db for the user
2. Read the encoding algorithm id (bcrypt etc)
3. For case of bcrypt, encrypt plaintext password from login form (using salt from db password)
4. Compare encrypted password from login form WITH encrypted password from db
5. If there is a match, login successful
6. If no match, login NOT successful

Note:
The password from db is NEVER decrypted

Because bcrypt is a one-way encryption algorithm

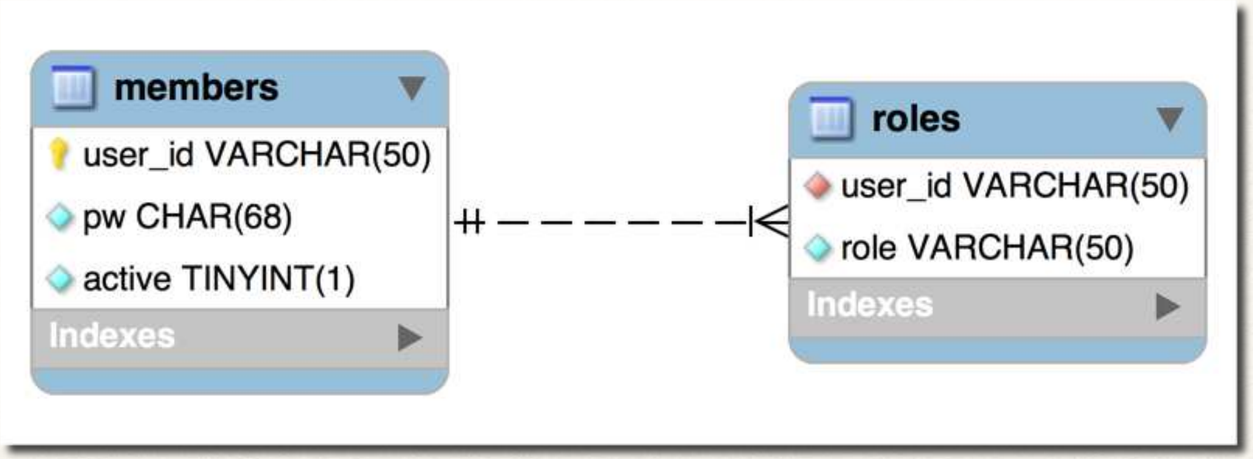
Spring Security
Custom Tables

Default Spring Security Database Schema



Custom Tables

- What if we have our own custom tables?
- Our own custom column names?



This is all custom
Nothing matches with default Spring Security table schema

For Security Schema Customization

- Tell Spring how to query your custom tables
- Provide query to find user by user name
- Provide query to find authorities / roles by user name

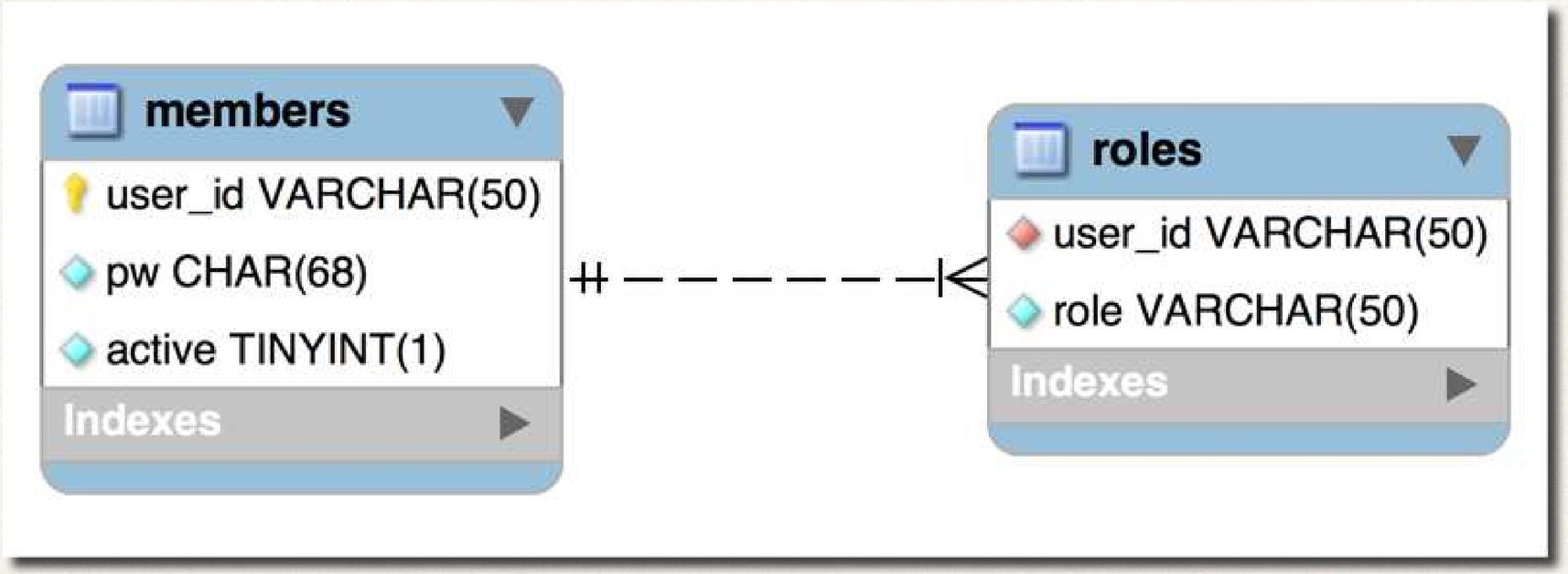
Development Process

Step-By-Step

1. Create our custom tables with SQL

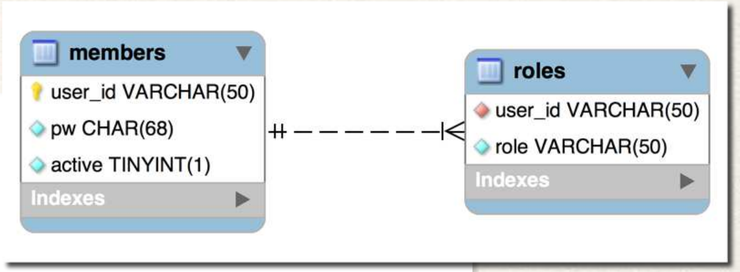
2. Update Spring Security Configuration
    - Provide query to find user by user name
    - Provide query to find authorities / roles by user name

Step 1: Create our custom tables with SQL



This is all custom
Nothing matches with default Spring Security table schema

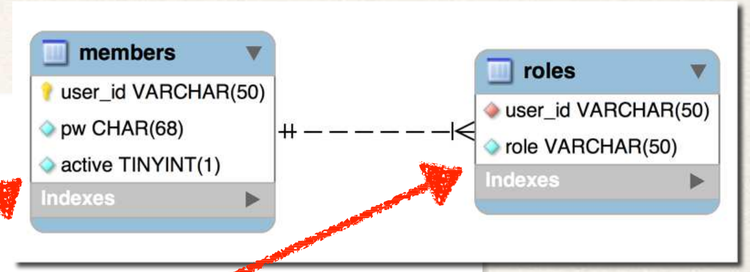
Step 2: Update Spring Security Configuration




```
@Configuration
public class DemoSecurityConfig {

    @Bean
    public UserDetailsManager userDetailsManager(DataSource dataSource) {
        JdbcUserDetailsManager theUserDetailsManager = new JdbcUserDetailsManager(dataSource);

        theUserDetailsManager
           .setUsersByUsernameQuery("select user_id, pw, active from members where user_id=?");

        theUserDetailsManager
           .setAuthoritiesByUsernameQuery("select user_id, role from roles where user_id=?");

        return theUserDetailsManager;
    }

    ...

}
```

Step 2: Update Spring Security Configuration

```
@Configuration
public class DemoSecurityConfig {

    @Bean
    public UserDetailsManager userDetailsManager(DataSource dataSource) {
        JdbcUserDetailsManager theUserDetailsManager = new JdbcUserDetailsManager(dataSource);

        theUserDetailsManager
           .setUsersByUsernameQuery("select user_id, pw, active from members where user_id=?");

        theUserDetailsManager
           .setAuthoritiesByUsernameQuery("select user_id, role from roles where user_id=?");

        return theUserDetailsManager;
    }

    ...

}
```



How to find users

How to find roles

Question mark "?"
Parameter value will be the user name from login