CS520 Web Programming
Declarative Security

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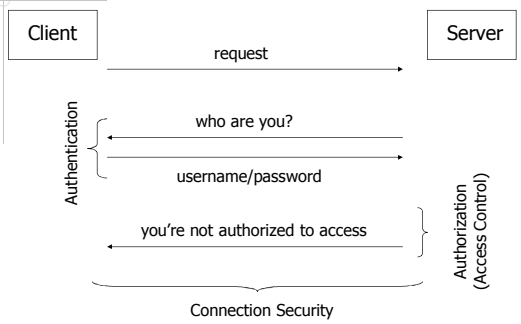
Need for Security in Web Applications

- Potentially large number of users
- Multiple user types
- No operating system to rely on

Web Application Security



Connection Security

- Secure Socket Layer (SSL)
  - Server authentication
  - Client authentication
  - Connection encryption
- Transport Layer Security (TLS)
  - TLS 1.0 is based on SSL 3.0
  - IETF standard (RFC 2246)

HTTPS

- HTTP over SSL
- Configure SSL in Tomcat - http://tomcat.apache.org/tomcat-7.0-doc/ssl-howto.html

Programmatic Security

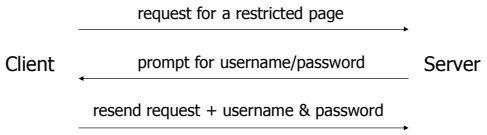
- Security is implemented in the application code
- Example:
  - `Login.jsp`
  - `Members.jsp`
- **Pros?? Cons??**

Security by Java EE Application Server

- HTTP Basic
- HTTP Digest
- HTTPS Client
- Form-based

HTTP Basic

- HTTP 1.0, Section 11.1- http://www.w3.org/Protocols/HTTP/1.0/draft-ietf-http-spec.html



HTTP Basic – Configuration

```
AuthType Basic
AuthName "Basic Authentication Example"
AuthUserFile /home/cysun/etc/htpasswords
Require user cs520
```

HTTP Basic – Request

```
GET /restricted/index.html HTTP/1.0
Host: sun.calstatela.edu
Accept: */*
```

HTTP Basic – Server Response

```
HTTP/1.1 401 Authorization Required
Date: Tue, 24 Oct 2006 14:57:50 GMT
Server: Apache/2.2.2 (Fedora)
WWW-Authenticate: Basic realm="Restricted Access Area"
Content-Length: 484
Content-Type: text/html; charset=iso-8859-1

<!DOCTYPE HTML PUBLIC "-//IETF//DTD HTML 2.0//EN">
<html>
<head><title>401 Authorization Required</title></head>
… …
</html>
```

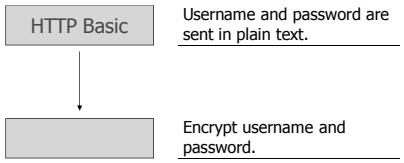
HTTP Basic – Request Again

```
GET /restricted/index.html HTTP/1.0
Host: sun.calstatela.edu
Accept: */*
Authorization: Basic Y3lzdW46YWJjZAo=
```

Base64 Encoding of "cysun:abcd"

An online Base64 decoder is at http://www.opinionatedgeek.com/dotnet/tools/Base64Decode/

Improve HTTP Basic (I)



Cryptographic Hash Function…

- String of arbitrary length → n bits *digest*
- Properties
  1. Given a hash value, it's virtually impossible to find a message that hashes to this value
  2. Given a message, it's virtually impossible to find another message that hashes to the same value
  3. It's virtually impossible to find two messages that hash to the same value
- A.K.A.
  - *One-way hashing*, *message digest*, *digital fingerprint*

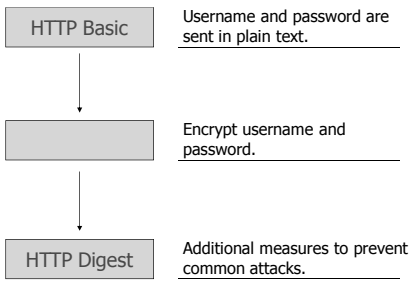
…Cryptographic Hash Function

- Common usage
  - Store passwords, software checksum …
- Popular algorithms
  - MD5 (broken, partially)
  - SHA-1 (broken, sort of)
  - SHA-256 and SHA-512 (recommended)

Encrypting Password is Not Enough

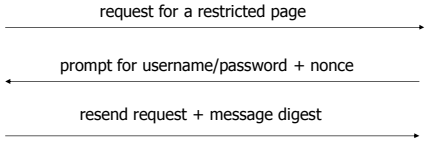
- *Why??*

Improve HTTP Basic (II)



HTTP Digest

- RFC 2617 (Part of HTTP 1.1) - http://www.ietf.org/rfc/rfc2617.txt



HTTP Digest – Server Response

```
HTTP/1.1 401 Authorization Required
Date: Tue, 24 Oct 2006 14:57:50 GMT
Server: Apache/2.2.2 (Fedora)
WWW-Authenticate: Digest realm="Restricted Access Area",
                  qop="auth,auth-int",
                  nonce="dcd98b7102dd2f0e8b11d0f600bfb0c093",
                  algorithm="MD5",
                  opaque="5ccc069c403ebaf9f0171e9517f40e41"
Content-Length: 484
Content-Type: text/html; charset=iso-8859-1

<!DOCTYPE HTML PUBLIC "-//IETF//DTD HTML 2.0//EN">
<html>
<head><title>401 Authorization Required</title></head>
… …
</html>
```

HTTP Digest – Request Again

```
GET /restricted/index.html HTTP/1.0
Host: sun.calstatela.edu
Accept: */*
Authorization: Digest username="cysun",
       realm="Restricted Access Area",
       nonce="dcd98b7102dd2f0e8b11d0f600bfb0c093",
       uri="/restricted/index.html", qop=auth,
       nc=00000001, cnonce="0a4f113b",
       opaque="5ccc069c403ebaf9f0171e9517f40e41",
       algorithm="MD5"
       response="6629fae49393a05397450978507c4ef1"
```

Hash value of the combination of of *username*, *password*, *realm*, *uri*, *nonce*, *cnonce*, *nc*, *qop*

Form-based Security

- Unique to J2EE application servers
- Include authentication and authorization, but not connection security

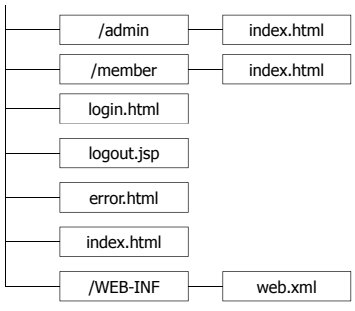
Form-base Security using Tomcat

- `$TOMCAT/conf/tomcat-users.xml`
  - Users and roles
- `$APPLICATION/WEB-INF/web.xml`
  - Authentication type (`FORM`)
  - Login and login failure page
  - URLs to be protected

Example – Users and Roles

```
<?xml version='1.0' encoding='utf-8'?>
<tomcat-users>
   <role rolename="admin"/>
   <role rolename="member"/>
   <user username="admin" password="1234"
         roles="admin,member"/>
   <user username="cysun" password="abcd"
         roles="member"/>
</tomcat-users>
```

Example – Directory Layout



Example – Login Page

```
<form action="j_security_check" method="post">
    <input type="text" name="j_username">
    <input type="password" name="j_password">
    <input type="submit" name="login" value="Login">
</form>
```

Example – web.xml …

```
<login-config>
    <auth-method>FORM</auth-method>
    <form-login-config>
        <form-login-page>/login.html</form-login-page>
        <form-error-page>/error.html</form-error-page>
    </form-login-config>
</login-config>
```

… Example – web.xml

```
<security-constraint>
  <web-resource-collection>
    <web-resource-name>AdminArea</web-resource-name>
    <url-pattern>/admin/*</url-pattern>
  </web-resource-collection>
  <auth-constraint>
    <role-name>admin</role-name>
  </auth-constraint>
</security-constraint>
```

Declarative Security

- Security constraints are defined *outside application code* in some metadata file(s)
- Advantages
  - Application server provides the security implementation
  - Separate security code from normal code
  - Easy to use and maintain

Limitations of Declarative Security by App Servers

- Application server dependent
- Not flexible enough
- Servlet Specification only requires *URL access control*

Security Requirements of Web Applications

- Authentication
- Authorization (Access Control)
  - URL
  - Domain object
  - Method invocation
    - Access to service layer, e.g. DAO
    - Access to web services

Spring Security (SS)

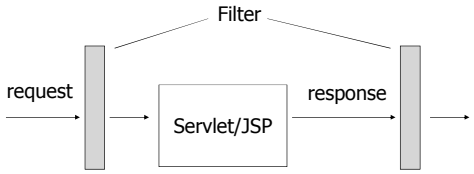
- A security framework for Spring-based applications
- Addresses all the security requirements of web applications
- Formerly known as Acegi Security
  - ABCDEFGHI

How Does Spring Security Work

- Intercept request and/or response
  - Servlet filters
  - Spring *handler interceptors*
- Intercept method calls
  - Spring *method interceptors*

Servlet Filter

- Intercept, examine, and/or modify request and response

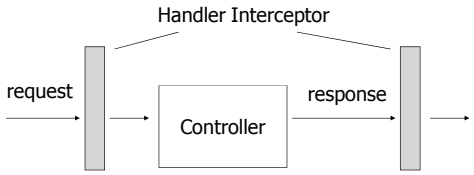


Servlet Filter Example

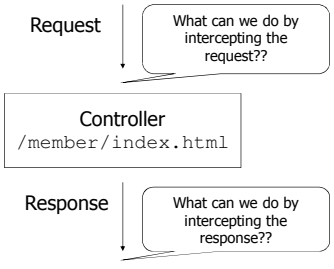
- web.xml
  - <filter> and <filter-mapping>
- Modify request
- Modify response

Spring Handler Interceptor

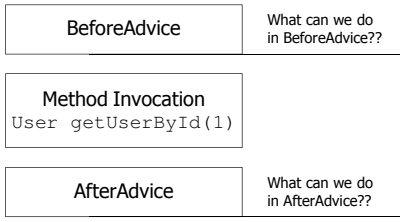
- Serve the same purpose as servlet filter
- Configured as Spring beans, i.e. support dependency injection



Intercept Request/Response



Intercept Method Call



Add Spring Security to a Web Application

web.xml

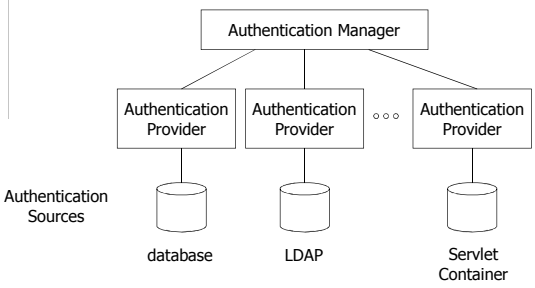
```
<filter>
   <filter-name>springSecurityFilterChain</filter-name>
   <filter-class>
      org.springframework.web.filter.DelegatingFilterProxy
   </filter-class>
</filter>

<filter-mapping>
   <filter-name>springSecurityFilterChain</filter-name>
   <url-pattern>/*</url-pattern>
</filter-mapping>
```

Main Components of Spring Security

- Authentication
- URL Security
- Method invocation security
- Object access security
- Security tag libarary

Authentication Manager



Authentication Sources Supported

- Database
- LDAP
- JAAS
- CAS
- OpenID
- SiteMinder
- X.509
- Windows NTLM
- Container-based
  - JBoss
  - Jetty
  - Resin
  - Tomcat

Authenticate Against a Database – Configuration

In the `security` namespace:

```
<authentication-manager>
   <authentication-provider>
      <jdbc-user-service
         data-source-ref="dataSource" />
   <authentication-provider>
</authentication-manager>
```

Authenticate Against a Database – Default Schema

```
create table users (
    username string primary key,
    password string,
    enabled boolean
);

create table authorities (
    username string references users(username),
    authority string -- role name
);
```

Authenticate Against a Database – Customization

- <jdbc-user-service>
  - users-by-username-query
  - authorities-by-username-query
- <authentication-provider>
  - <password-encoder>
  - user-service-ref

URL Security – Configuration

In the `security` namespace:

```
<http auto-config="true" use-expressions="true">
    <intercept-url pattern="/admin/**"
        access="hasRole('ROLE_ADMIN')" />
    <intercept-url pattern="/member/**"
        access="hasRole('ROLE_MEMBER')" />
</http>
```

<http>

- Create and control a chain of security filters, e.g.
  - FilterSecurityInterceptor
  - ExceptionTranslationFilter
  - SecurityContextPersistenceFilter
  - UsernamePasswordAuthenticationFilter

Pattern for <intercept-url>

- Default to Ant path pattern, e.g.
  - `/admin/*`
  - `/admin/**`
  - `/*.html`
  - `/**/*.html`

Security-Related SpEL Methods and Properties

- hasIpAddress()
- hasRole()
- hasAnyRole()
- permitAll
- denyAll
- anonymous
- authenticated
- rememberMe
- fullyAuthenticated

Some <http> Customizations

- <form-login>
  - login-page
  - authentication-failure-url
  - default-target-url
- <remember-me>

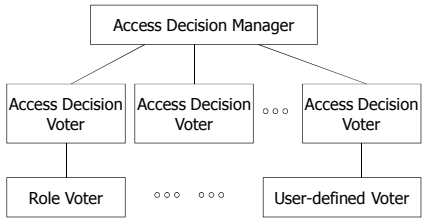
Enable Method and Object Security

In the `security` namespace:

<global-method-security secured-annotations="enabled">

- Use an *Access Decision Manager* for method security
- Use one or more *After Invocation Providers* for object security

Access Decision Manager



Each voter returns `ACCESS_GRANTED`, or `ACCESS_DENIED`, or `ACCESS_ABSTAIN`

Types of Decision Managers

- Affirmative based
- Consensus based
- Unanimous based

How Access Decision Voter Work

- `supports()` – determines whether the voter should participate a vote based on
  - The class type of the object to be authorized
  - Some configuration attributes, e.g. `ROLE_ADMIN`, `PERM_COURSE_WRITE`
- `vote()` – casts a vote based on
  - Authentication information of the current user
  - The object to be authorized
  - Configuration attributes

Method Security Example in CSNS2

- Secure `CourseDao.saveCourse()` so that administrators can create and edit courses, while course coordinators can edit their own courses
  - `MethodAccessVoter.java`
  - `CourseWriteVoter.java`
  - `CourseDao.java`
  - `security.xml`

Object Security Using After Invocation Provider

- Very similar to Access Decision Voter
  - `supports()`
  - `decide()`

Object Security Example in CSNS2

- Secure `AssignmentDao.getAssignmentById()` to allow only the instructors and the students in a section to access an assignment
  - `ObjectAccessVoter.java`
  - `AssignmentReadVoter.java`
  - `AssignmentDao.java`
  - `security.xml`

Security Tag Library

- http://static.springsource.org/spring-security/site/docs/3.1.x/reference/taglibs.html
- <authorize>
  - access
- <authentication>
  - property

Security Taglib Examples in CSNS2

- Hide menus from the users who are not authorized to access them
  - `menu.jsp`

Conclusion

- Declarative security vs. Programmatic security
- Spring Security provides the best of both worlds
  - Declarative security framework
  - Portability and flexibility
  - Separate security code from regular code