CS520 Web Programming
Declarative Security

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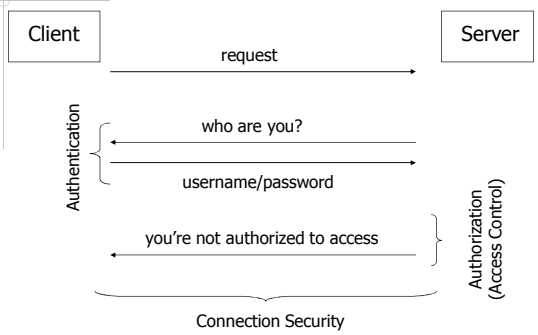
## Need for Security in Web Applications

- 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-6.0-doc/ssl-howto.html

## Programmatic Security

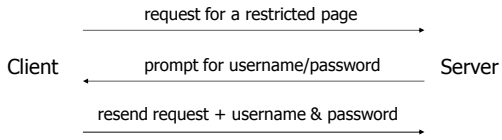
- Security is implemented in the application code
- Example:
  - `Login.jsp`
  - `Members.jsp`
- **Pros?? Cons??**

## Security by J2EE 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>
```

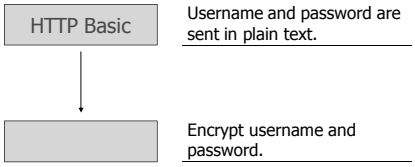
## HTTP Basic – Request Again

```
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*

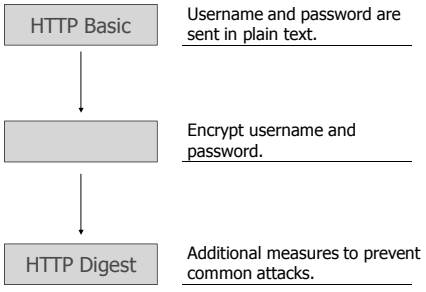
## …Cryptographic Hash Function

- 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

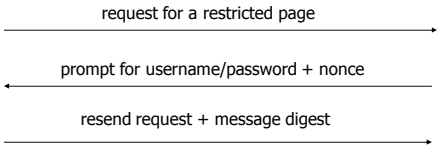
- *Why??*

## 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
- Username/password are passed as clear text
- Login page instead of login prompt

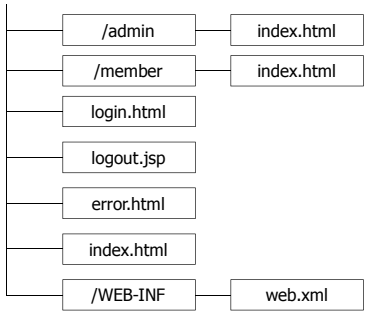
## Form-base Security using Tomcat

- `$TOMCAT/conf/tomcat-users.xml`
  - Users and roles
- `$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"/>
  <role rolename="guest"/>
  <user username="cysun" password="abcd" roles=“admin,member"/>
  <user username="test" password="test" roles=“member"/>
  <user username="guest" password="guest" roles="guest"/>
</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)

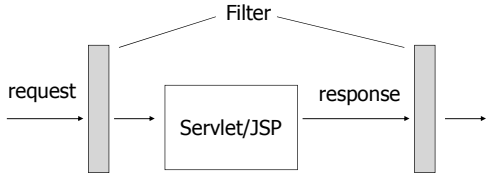
- A security framework for Spring-based applications
- Addresses all the security requirements of web applications
- Formerly known as Acegi Security
  - ABCDEFGHI

## 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

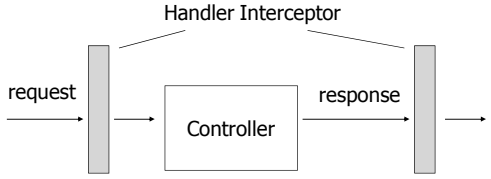



## Servlet Filter Example

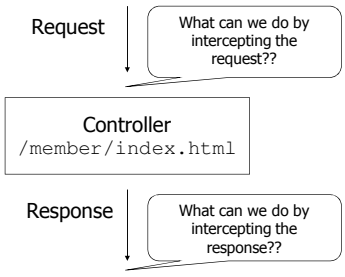
- web.xml
  - <filter> and <filter-mapping>
- Modify request
- Modify response

## Spring Handler Interceptor

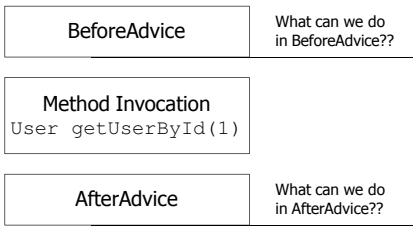
- Serve the same purpose as servlet filter
- Configured as Spring beans, i.e. support dependency injection



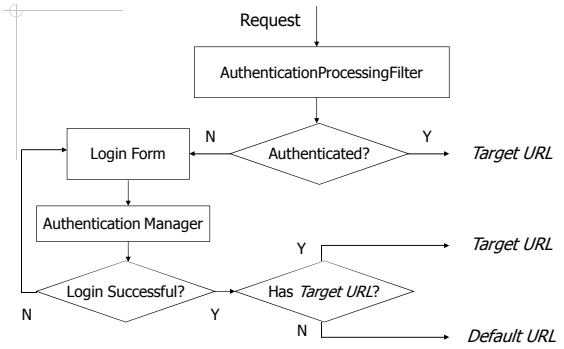

## Intercept Request/Response



## Intercept Method Call




## Authentication Processing Filter



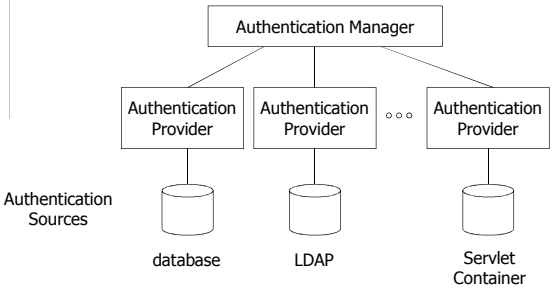

## Login Form

- Action: `j_spring_security_check`
- Username: `j_username`
- Password: `j_password`

## Configure Authentication Filter Beans

- `DelegatingFilterProxy` in web.xml
- In spring-security.xml
  - `springSecurityFilterChain`
  - `authenticationProcessingFilter`

## 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 …

- What SS expects your tables look like:

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

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

## … Authenticate Against a Database …

**users**

| username | password | enabled |
|---|---|---|
| 'cysun' | md5('abcd') | 't' |
| 'jdoe' | md5('xyz') | 'f' |

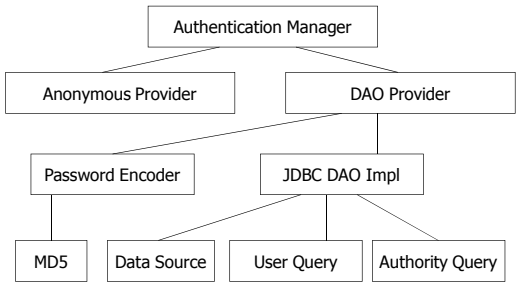
**authorities**

| username | authority |
|---|---|
| 'cysun' | 'ROLE_ADMIN' |
| 'cysun' | 'ROLE_MEMBER' |
| 'jdoe' | 'ROLE_MEMBER' |

## … Authenticate Against a Database

- Define your owner queries if your tables are different
  - `usersByUsernameQuery`
  - `authoritiesByUsernameQuery`

## CSNS Example: Configure an Authentication Manager




## Anonymous Authentication

- An anonymous user has their own credentials
  - `AnonymousProcessingFilter`
  - `AnonymousAuthenticationProvider`

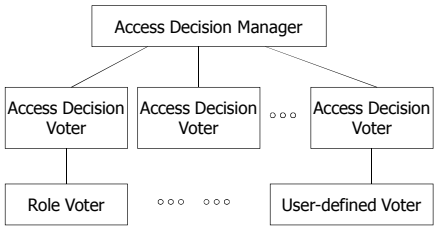
## Access User Details in Application Code

- User details – http://static.springsource.org/spring-security/site/docs/2.0.x/apidocs/org/springframework/security/userdetails/UserDetails.html
  - Username
  - Password
  - Authorities (Roles)
- Example: `SecurityUtils` in CSNS

## Authorization (Access Control)

- Secure URL access
- Secure method invocation
- Secure object access

## Access Decision Manager




*E.g. if a user is of Admin role, then grant access.*

## Types of Decision Managers

- Affirmative based
- Consensus based
- Unanimous based

## How Decision Voter Works

- `AccessDecisonVoter` Interface
- Given
  - Object to be accessed
  - User information: username, roles
  - *Configuration attributes*, typically are roles names and/or access types like READ, WRITE etc.
- Return
  - `ACCESS_GRANTED`, or `ACCESS_DENIED`, or `ACCESS_ABSTAIN`

## Secure URL Access

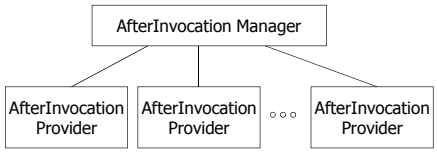
- `FilterSecurityInterceptor`
- CSNS Example:
  - Mapping from URL patterns to roles
  - `RoleVoter`

## Secure Method Invocation

- `MethodSecurityInterceptor`
- CSNS Example
  - Mapping from method name patterns to roles
  - `RoleVoter`

## Secure Object Access

- Implemented by checking the returned object of a method call
- Access decision is manage by `AfterInvocationManager`




## Secure Object Access Example

- CSNS
  - `MethodSecurityInterceptor`
    - `AfterInvocationManager`
  - Customized AfterInvocation providers to provide application-specific access control
    - SectionAccessVoter
    - AssignmentAccessVoter
    - SubmissionAccessVoter
    - FileAccessVoter

## Security Tag Library

- URI - http://www.springframework.org/security/tags
- <authorize>
  - ifNotGranted, ifAllGranted, ifAnyGranted
- <authentication>
  - property

## Usage of the Security Tag Library

- CSNS Examples
  - WEB-INF/jsp/surveys.jsp
  - WEB-INF/jsp/include/header.jspf

## Other Interesting Features of Spring Security

- Simplified namespace-based configuration syntax
- ACL based authorization
- Groups and hierarchical roles

## 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