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INFORMATION
TECHNOLOGY
FIT5192 Lecture 11:
Securing Enterprise Web Applications
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Last Lecture

- Understand the role that web services can have for enterprise web applications and the web as a whole.
- Review the REST approach to web services
- Review JSON processing approaches with the Java EE 7 platform.

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This Lecture

- Identify common security issues that can impact enterprise web applications and approaches to prevent common security implementations.
- Understand how we can use JAAS to implement user authentication within Java EE applications.

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Security

Importance of Security

- While security is always a priority for almost any application development, it has an even greater role for the Enterprise
- **Enterprises often deal with more confidential data as opposed to non-business applications:**
  - Employee data
  - Customer data
  - Stored payment credentials
  - And so on…
- As a result, developers need to be aware of common issues surrounding web security and how to appropriately protect against attack vectors

Web Application Security

- **Applications which are available externally to many clients via the Internet provide us with a few challenges:**
  - Without appropriate firewall rules, our application is easily accessible to outside connections.
  - Clients can *potentially* send different types of data to our application.
    - We need to validate that the data being received is of the expected message format.
  - A complex web application architecture comprised of many different web servers and endpoints create additional potential attack vectors.

Open Web Application Security Project (OWASP)

- **OWASP is an open-source project focusing on web application security and includes a wide variety of different organisations.**
- Many projects supported by OWASP help validate many different aspects of web applications and their underlying technologies.
- **The OWASP project Top 10 provides a frequently updated list that helps identify the most serious security risks for a range of different organisations.**
  – Let's take a look at the identified key issues impacting various different web applications today…

Top 10 Web Security Issues (OWASP)

1. Injection
2. Broken Authentication and Session Management
3. Cross-Site Scripting (XSS)
4. Insecure Direct Object References
5. Security Misconfiguration
6. Sensitive Data Exposure
7. Missing Function Level Access Control
8. Cross-Site Request Forgery (CSRF)
9. Using Known Vulnerable Components
10. Unvalidated Redirects and Forwards

From : https://www.owasp.org/index.php/Top_10_2013-Top_10

SQL Injection

- **Code injection technique that is the most common security issue plaguing many web applications in the past (and present!).**
  - **An attacker is able to execute their own malicious SQL statement against the web application should a vulnerability be exploited.**
- Easy to exploit when applications are reliant on user input data which is used in conjunction with an SQL database.
  - **Username/Password for Authentication**

SQL Injection: Example (1)

- Scenario: User 'forgets' their password and wants to retrieve it.
  – Application will send an email to the user with a password reset link if they provide a valid email associated with the user account.

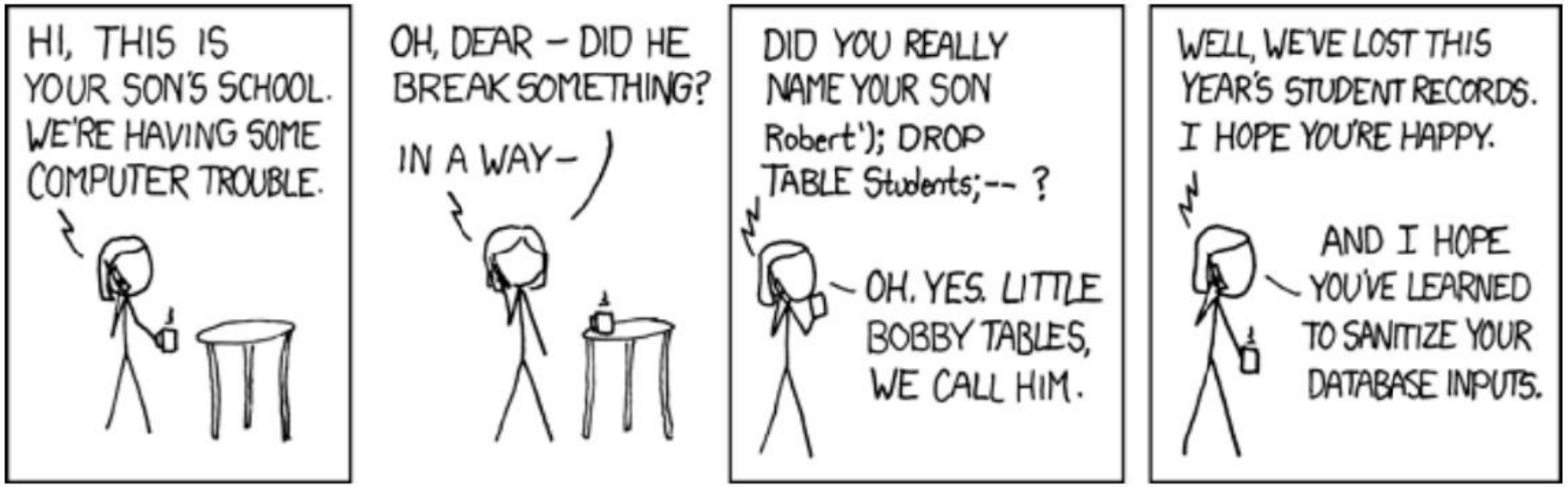
- **URL for getting email address:**
  http://localhost/app/forgotPassword?email=Matthew.Kairys@monash.edu

SQL Injection: Example (2)

- **Attempting to execute SQL Injection:**
  ```
  http://localhost/app/forgotPassword?
  email=email AND email=(SELECT COUNT(*) FROM
  USERS);--
  ```
- If the input is not filtered to prevent SQL execution, the above statement returns the number of records for any given record name.
- **If the attacker wanted to be really evil…**

  ```
  http://localhost/app/forgotPassword?
  email=email AND email=(DROP TABLE USERS);--
  ```

SQL Injection



Blocking Injection Attacks

Preventing SQL Injections with JPA

- DO NOT create queries like this:

```
String query = "SELECT * FROM USERS WHERE
email= " + emailFromUrl;
```

- **The above approach does not escape the URL GET parameter and enables malicious SQL statements to be executed.**
- Creating queries (dynamic or named) via JPA and parameterised values by default protects against this type of attack.
- **Source:** http://xkcd.com/327/

Working with Passwords

- Handling passwords in a secure manner is a critical consideration when developing a web application.
- **Storing passwords as plain Strings within a database is a massive security oversight:**
  - Should web administrators be able to view passwords?
  - What happens if the database is compromised?

Password Hashing

- To store passwords in a more secure manner, we can use one-way hashing algorithms to obtain a completely different encrypted value.

  Example using MD5:

  - 'password‘ => '5f4dcc3b5aa765d61d8327deb882cf99'

- **By storing passwords in this manner, we can hash user password inputs and compare them with the stored value in the database.**

  – We cannot obtain the value of the password otherwise unless we attempt to brute-force the password by generating hashes for each potential password combination

Password Hashing: DB Example

- User Table Example:

USER		
ID	USERNAME	PASSWORD
1	**Admin**	**5f4dcc3b5aa765d61d8327deb882cf99**
2	Chris	2ab96390c7dbe3439de74d0c9b0b1767

Rainbow Table Attacks

- Unfortunately storing passwords using the previous hash approach is still not very secure!
- Majority of hash algorithms are designed for high performance.
  - With the computational hardware available today common passwords are easy to be computed via brute-force method.
- Rainbow tables are precomputed key-value pair tables which enable the reverse lookup of hash algorithms against common phrases.
  - These are easily available online and for purchase.

Example: Rainbow Table

- Let's check what the password was for 'admin':

MD5 HASH	PASSWORD
C75fd00c9126c6940629d96357587aa3	passworda
4de98e9fc935c2d872482c23cccc70a2	passwordb
1b01dab91d4a847cd9c0838537b3bb44	passwordc
5f4dcc3b5aa765d61d8327deb882cf99	passwordd
a826176c6495c5116189db91770e20ce	passworde

- **We can prevent these type of attacks through the use of *password salting.***

Password Salting

- We can strengthen stored passwords by adding random data that is associated with the hashed password.
  - Salted value can be simply added with the password (password + passwordSalt).
  - Random data must be generated for each user for optimum security.
- **Example using MD5:**

```
Password = 'password';
passwordSalt = 'RN5_43<m84@|]5&66[33';
password = password + passwordSalt;
Hashed password
'password' => '4a935057ff675ffc83a4e46ca4f873dd'
```

Password Salting: DB Example

- **User Table Example:**

USER			
ID	USERNAME	PASSWORD	PASSWORD_SALT
1	admin	4a935057ff675ffc83a4e46ca4f873dd	RN5_43<m84@|]5&66[33
2	mkairys	939358daeb4229850179d1075d6086ed	[2![$0644D<Z7s1

Password Salting: Benefits

- By each user having their own salt attached with the password they input, we prevent the effectiveness of rainbow table attacks.
  - Long random data segments will significantly increase computational requirements to brute-force hashed passwords.
- If your database is compromised, the attacker would need to brute-force each individual user password with their assigned salt to obtain the true value.
  - Other algorithms can be used which are designed to take time to compute (E.g. bcrypt, scrypt) to also prevent the effectiveness of this approach.

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JAAS

Java Authentication and Authorization Service (JAAS)

- JAAS provides a set of APIs that enable various services within the Java EE platform to support authentication and enforce access control lists (ACL) upon user roles.
- In particular, we will be using this service to integrate user authentication into our web applications.

JAAS: Supported Authentication Methods

- The Java EE platform supports the following authentication mechanisms:
  - Basic authentication
  - Form-based authentication
  - Digest authentication
  - Client authentication
  - Mutual authentication
- **We will focus on Basic and Form-based authentication methods for this unit.**

Form-based Authentication via JAAS (1)

- We can setup rules in our web application configuration defining how we are going to validate users via JAAS and which sections of the application are restricted.
- The server will supply us with a cookie with an assigned session identifier (JSESSIONID) upon attempting to access a restricted area of the application.
- Must be submitted via post to a URL containing the String j_security_check.

  E.g. http://localhost/app/j_security_check

Form-based Authentication via JAAS (2)

- **We submit the username (j_username) and password (j_password) with the cookie to the server.**
  - If successful, we will be authenticated with the server and redirected back to the original protected resource.
  - If successful but we lack the required permissions to access the resource, we will receive a permissions error and redirected to an error page.
  - If unsuccessful due to incorrect user credentials, we will be redirected to an error page.
    - This error page will most likely have the login form again to enable the user to retry authentication.

Demo

- **Let's do a walkthrough of the process required to setup a web/enterprise application with user authentication functionality.**
  - Breakdown of the Lab exercise.
  - Highlighting the process in NetBeans to setup user authentication.

Summary

- Identify common security issues that can impact enterprise web applications and approaches to prevent common security implementations.
  - SQL Injections are easy to execute, easy to prevent!
  - Passwords should always be salted for added security.
- Understand how we can use JAAS to implement user authentication within Java EE applications.
  - **Make sure you do your readings as they explain more complex user authentication approaches in Java EE:**
  - In particular, additional configuration options and annotation methods for specifying access permissions based on roles

Next Lecture

- **Start the Module 2 on ASP.NET!**

- **Organise Assignment Demo/Interviews**
- **Interviews from Wednesday next week during your normal tutorial time**
  - All interviews will hopefully be completed by *Friday this week.*

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See you in the Studio !

Readings

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- **Part X *Security* in The Java EE 7 Tutorial**

Chapter 47 to 50 cover the various JEE security technologies