Lab06

Web Security and Attacks

[This project asks you to develop attacks and test them, with our permission, against a target website that we are providing for this purpose. Attempting the same kinds of attacks against other websites without authorization is prohibited by law and university policies and may result in fines, expulsion, and jail time. You must not attack any website without authorization! Per the course ethics policy, you are required to respect the privacy and property rights of others at all times, or else you will fail the course.]

Introduction

In this project, we provide an insecure website, and your job is to attack it by exploiting three common classes of vulnerabilities: SQL injections, cross-site scripting (XSS), cross-site request forgery (CSRF). You are also asked to exploit these problems with various flawed defenses in place. Understanding how these attacks work will help you better defend your own web applications.

Objectives:

• Learn to spot common vulnerabilities in websites and to avoid them in your own projects.

• Understand the risks these problems pose and the weaknesses of naive defenses.

• Gain experience with web architecture and with HTML, JavaScript, and SQL programming.

Guidelines

• You SHOULD work in a group of 2.

• You MUST use HTML, Javascript, and SQL to complete the project. You SHOULD use jQuery to complete the project.

• Your answers may or may not be the same as your classmates'.

• All the necessary files to start the project will given under the folder called "mp2" in your

You SHOULD develop this project targeting Firefox 40, the latest version of Firefox, which you can download from https://firefox.com. Many browsers include different client-side defenses against XSS and CSRF that will interfere with your testing.

For your convenience during manual testing, we have included drop-down menus at the top of each page that let you change the CSRF and XSS defenses that are in use. The solutions you submit must override these selections by including the csrfdefense=*n* or xssdefense=*n* parameter in the target URL, as specified in each task below. You may not attempt to subvert the mechanism for changing the level of defense in your attacks. In all parts, you should implement the simplest attack you can think of that defeats the given set of defenses. In other words, do not simply attack the highest level of defense and submit that attack as your solution for all defenses. Also, you do not need to try to combine the vulnerabilities, except where explicitly stated below.

Resources

The FirefoxWeb Developer tools will be a tremendous help for this project, particular the JavaScript console and debugger, DOM inspector, and network monitor. The developer tools can be found under Tools >Web Developer in Firefox. See https://developer.mozilla.org/en-US/docs/Tools.

Although general purpose tools are permitted, you MUST not use tools that are designed to automatically test for vulnerabilities.

Your solutions will involve manipulating SQL statements and writing web code using HTML, JavaScript, and the jQuery library. Feel free to search the web for answers to basic how-to questions.

There are many fine online resources for learning these tools. Here are a few that we recommend:

SQL Tutorial http://www.w3schools.com/sql/

SQL Statement Syntax http://dev.mysql.com/doc/refman/5.5/en/sql-syntax.html

Introduction to HTML
https://developer.mozilla.org/enUS/docs/Web/Guide/HTML/Introduction

HTTP Made Really Easy
http://www.jmarshall.com/easy/http/

JavaScript 101
http://learn.jquery.com/javascript-101/

Using jQuery Core
http://learn.jquery.com/using-jquery-core/

jQuery API Reference
http://api.jquery.com

To learn more about SQL Injection, XSS, and CSRF attacks, and for tips on exploiting them, see:
https://www.owasp.org/index.php/SQL_Injection_Prevention_Cheat_Sheet
https://www.owasp.org/index.php/Cross-Site_Request_Forgery_(CSRF)_Prevention_

Cheat_Sheet
https://www.owasp.org/index.php/XSS_(Cross_Site_Scripting)_Prevention_Cheat_Shee
t
https://www.owasp.org/index.php/XSS_Filter_Evasion_Cheat_Sheet

Target Website

A startup named **BUNGLE!** is about to launch its first product—a web search engine—but their investors are nervous about security problems. Unlike the Bunglers who developed the site, you took security course, so the investors have hired you to perform a security evaluation before it goes live.

BUNGLE! is available for you to test at **http://54.159.156.104/**

The site is written in Python using the Bottle web framework. Although Bottle has built-in mechanisms that help guard against some common vulnerabilities, the Bunglers have circumvented or ignored these mechanisms in several places.

In addition to providing search results, the site accepts logins and tracks users' search histories. It stores usernames, passwords, and search history in a MySQL database. Before being granted access to the source code, you reverse engineered the site and determined that it replies to five main URLs: /, /search, /login, /logout, and /create. The function of these URLs is explained below, but if you want an additional challenge, you can skip the rest of this section and do the reverse engineering yourself.

Main page (***/***) The main page accepts GET requests and displays a search form. When submitted, this form issues a GET request to /search, sending the search string as the parameter "q". If no user is logged in, the main page also displays a form that gives the user the option of logging in or creating an account. The form issues POST requests to /login and /create.

Search results (**/search**) The search results page accepts GET requests and prints the search string, supplied in the "q" query parameter, along with the search results. If the user is logged in, the page also displays the user's recent search history in a sidebar. Note: Since actual search is not relevant to this project, you might not receive any results.

Login handler (**/login**) The login handler accepts POST requests and takes plaintext “username” and “password” query parameters. It checks the user database to see if a user with those credentials exists. If so, it sets a login cookie and redirects the browser to the main page. The cookie tracks which user is logged in; manipulating or forging it is not part of this project.

Logout handler (**/logout**) The logout handler accepts POST requests. It deletes the login cookie, if set, and redirects the browser to the main page.

Create account handler (**/create**) The create account handler accepts POST requests and receives plaintext “username” and “password” query parameters. It inserts the username and password into the database of users, unless a user with that username already exists. It then logs the user in and redirects the browser to the main page.

6.1 SQL Injection (60 points)

In this section, your goal is to demonstrate SQL injection attacks that log you in as an arbitrary user without knowing the password. Your job is to find SQL injection vulnerability for two targets.

For each of the following defenses, provide inputs
to the target login form that successfully log you in as the user “victim”.

6.1.1 No defenses (10)

This target does not have any protection against SQL injection.
Target: http://54.159.156.104/sqlinject0/

6.1.2 Simple escaping (10)

The server escapes single quotes (’) in the inputs by replacing them with two single quotes.

Target: http://54.159.156.104/sqlinject1/

6.1.3 Escaping and Hashing (20)

The server uses the following PHP code, which escapes the username and applies the MD5 hash function to the password.

```
if (isset($_POST[’username’]) and isset($_POST[’password’])) {
$username = mysql_real_escape_string($_POST[’username’]);
$password = md5($_POST[’password’], true);
$sql_s = "SELECT * FROM users WHERE username=’$username’ and pw=’$password’";
$rs = mysql_query($sql_s);
if (mysql_num_rows($rs) > 0) {
echo "Login successful!";
} else {
echo "Incorrect username or password";
}
}
```

This is more difficult than the previous two defenses. You will need to write a program to produce a working exploit. You can use any language you like, but we recommend C. You need to submit source code of this program and the .txt file which has a solution displayed on the webpage.

Target: http://54.159.156.104/sqlinject2/

6.1.4 The SQL (20)

This target uses a different database. Your job is to use SQL injection to retrieve:

1. The name of the database
2. The version of the SQL server
3. All of the names of the tables in the database
4. A secret string hidden in the database

Target: http://54.159.156.104/sqlinject3/

The text file you submit should starts with a list of the URLs for all the queries you made to learn the answers. Follow this with the values specified above, using this format:
URL
URL
URL
...
Name: *DB name*
Version: *DB version string*
Tables: *comma separated names*
Secret: *secret string*

What to submit

1. After you successfully logged in to http://54.159.156.104/sqlinject0/, copy the value you obtained from the website to 6.1.1.txt.

2. After you successfully logged in to http://54.159.156.104/sqlinject1/, copy the value you obtained from the website to 6.1.2.txt.

3. 6.1.3.tar.gz: Submission for 6.1.3 which consists of a source code and a .txt file which has the value obtained from the website.

4. 6.1.4.txt: Submission for 6.1.4.