Web security: server-side attacks

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Injection attack

OWASP definition

Injection flaws, such as SQL, OS, and LDAP injection occur when untrusted data is sent to an interpreter as part of a command or query. The attacker's hostile data can trick the interpreter into executing unintended commands or accessing data without proper authorization.

We are going to look at:

- command injection attacks
- SQL injection attacks

Command injection: a simple example

- Service that prints the result back from the linux program whois
- Invoked via URL like (a form or Javascript constructs this URL):

  `http://www.example.com/content.php?domain=google.com`

- Possible implementation of `content.php`

```
<?php
  if ($_GET['domain']) {
    <?  echo system('whois '.$_GET['domain']); ?>
  }
?>
```

Command injection: a simple example cont'd

- This script is subject to a **command injection attack**! We could invoke it with the argument `www.example.com; rm *`

  `http://www.example.com/content.php?`
  `domain=www.google.com; rm *`

- Resulting in the following PHP

  ```
  <?  echo system('whois www.google.com; rm *'); ?>
  ```

Defense: input escaping

```
<?  echo system('whois'.escapeshellarg($_GET['domain'])); ?>
```

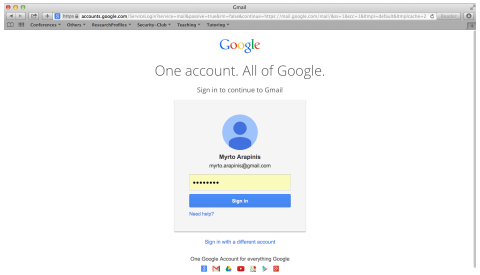
escapeshellarg() adds single quotes around a string and quotes/escapes any existing single quotes allowing you to pass a string directly to a shell function and having it be treated as a single safe argument

GET INPUT	Command executed
`www.google.com`	`whois 'www.google.com'`
`www.google.com; rm *`	`whois 'www.google.com rm *'`

Command injection recap

- Injection is generally caused when data and code share the same channel:
  - `"whois"` is the code and the filename the data
  - **But** `';'` allows attacker to include new command
- **Defenses** include input validation, input escaping and use of a less powerful API

Web applications



Client
(HTML, JavaScript)

Google

Server
(PHP)

Database
(SQL)

Databases

username	password
alice	01234
bob	56789
charlie	43210

user_accounts

- Web server connects to DB server:
  - Web server sends **queries** or **commands** according to incoming HTTP requests
  - DB server returns associated values
  - DB server can **modify/update** records
- SQL: commonly used database query language

SQL SELECT

Retrieve a set of records from DB:

```
SELECT field FROM table WHERE condition # SQL comment
```

returns the value(s) of the given field in the specified table, for all records where condition is true

Example:

username	password
alice	01234
bob	56789
charlie	43210

user_accounts

`SELECT password FROM user_accounts WHERE username='alice'` returns the value `01234`

SQL INSERT

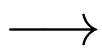
Retrieve a set of records from DB:

```
INSERT INTO table VALUES record # SQL comment
```

adds the value(s) a new record in the specified table
Example:

username	password
alice	01234
bob	56789
charlie	43210

user_accounts



username	password
alice	01234
bob	56789
charlie	43210
eve	98765

user_accounts

```
INSERT INTO user_accounts VALUES ('eve', 98765)
```

Other SQL commands

- `DROP TABLE table`: deletes entire specified table
- Semicolons separate commands:
  Example:

```
INSERT INTO user_accounts VALUES ('eve', 98765);
SELECT password  FROM user_accounts
                 WHERE username='eve'
```

returns `98765`

SQL injection: a simple example

The web server logs in a user if the user exists with the given username and password.

```
login.php:
$conn = pg_pconnect("dbname=user_accounts");
$result = pg_query(conn,
                   "SELECT * from user_accounts
                   WHERE username = " '.$_GET['user'].'"
                   AND password = '".$_GET['pwd']."';");
if(pg_query_num($result) > 0) {
   echo "Success";
   user_control_panel_redirect();
}
```

It sees if results exist and if so logs the user in and redirects them to their user control panel

SQL injection: a simple example

Login as admin:

SQL injection: a simple example

Login as admin:

http://www.example.com/login.php?user=admin'#&pwd=f

```
pg_query(conn,
         "SELECT * from user_accounts
         WHERE username = 'admin' # ' AND password = 'f';");
```

SQL injection: a simple example

Login as admin:

http://www.example.com/login.php?user=admin'#&pwd=f

```
pg_query(conn,
         "SELECT * from user_accounts
         WHERE username = 'admin' # ' AND password = 'f';");
```

Drop `user_accounts` **table:**

SQL injection: a simple example

Login as admin:

http://www.example.com/login.php?user=admin'#&pwd=f

```
pg_query(conn,
         "SELECT * from user_accounts
         WHERE username = 'admin' # ' AND password = 'f';");
```

Drop `user_accounts` **table:**

http://www.example.com/login.php?user=admin';
DROP TABLE user_accounts #&pwd=f

```
pg_query(conn,
         "SELECT * from user_accounts;
         WHERE user = 'admin'; DROP TABLE user_accounts;
         # ' AND password = 'f';");
```

Defense: prepared statements

- Creates a template of the SQL query, in which data values are substituted
- Ensures that the untrusted value is not interpreted as a command

```
$result = pg_query_params(
            conn,
            SELECT * from user_accounts  WHERE username = $1
                                         AND password = $2,
            array($_GET['user'], $_GET['pwd']));
```