CISC 327 - Software Quality Assurance

Lecture 19–3 (29b in 2017)

Web Application Security

Outline

- Web Application Security
  - SQL Injection
  - Parameter Manipulation

Security on the Web

- In an ideal world...
  - You develop a simple and robust web application
  - Users discover your web application and use it as you anticipate they would
  - The interface is clear enough to communicate proper usage of your application
  - There is no need to defend against malicious attacks against your application

Security on the Web

- In the real world...
  - Most users are wonderful
    - Even inexperienced users don't get too far out of line
  - Users often use applications in ways that you never could have anticipated
    - "That's how you use it?"
    - A significant amount of Google queries should have been entered in the Location bar
  - Malicious users like to hack

Security on the Web

- Don't trust user input
  - Users will not always submit data that your application will expect
  - As a general principle, do not trust user input by default
    - URL parameters, form data, cookies, etc.
  - Problems will often be unintentional
    - Non-sanitized quotes, hyphens, or non-ASCII characters (see the “Piece of Crap” lecture)

SQL Injection

- Parameter injection to exploit vulnerabilities
  - SQL statements (or parts of one) are injected into a web form or URL string
  - Attacks software that does not properly filter user input
  - Arbitrary SQL commands can be authored by an attacker to dump database information or change database content

SQL Injection

- PHP Example

```
$query = "SELECT * FROM `users` WHERE name = '" +
    $user_name + "';";
```

- Good case: $user_name == "Scott Grant"

```
SELECT * FROM `users` WHERE name = 'Scott Grant';
```

- Malicious case: $user_name == "' OR '1'='1"

```
SELECT * FROM `users` WHERE name = '' OR '1'='1';
```

SQL Injection

- Valid SQL statements can be constructed

```
$query = "SELECT * FROM `users` WHERE name = '" +
    $user_name + "';";
```

- $user_name == "'; DROP TABLE `users`; --"

```
SELECT * FROM `users` WHERE name = '';
DROP TABLE `users`; --';
```

Preventing SQL Injection

- Ensure characters are escaped
  - The problem in the earlier query was caused by non-escaped quotes

```
SELECT * FROM `users` WHERE name = '' OR '1'='1';
```

  - If the input string contains characters that need to be quoted in SQL strings, we must ensure that those characters are actually quoted

```
SELECT * FROM `users` WHERE name = '\' OR \'1\'=\'1';
```

Preventing SQL Injection

- Proper type checking
  - If a parameter is supposed to be a number, we must ensure that a number is used

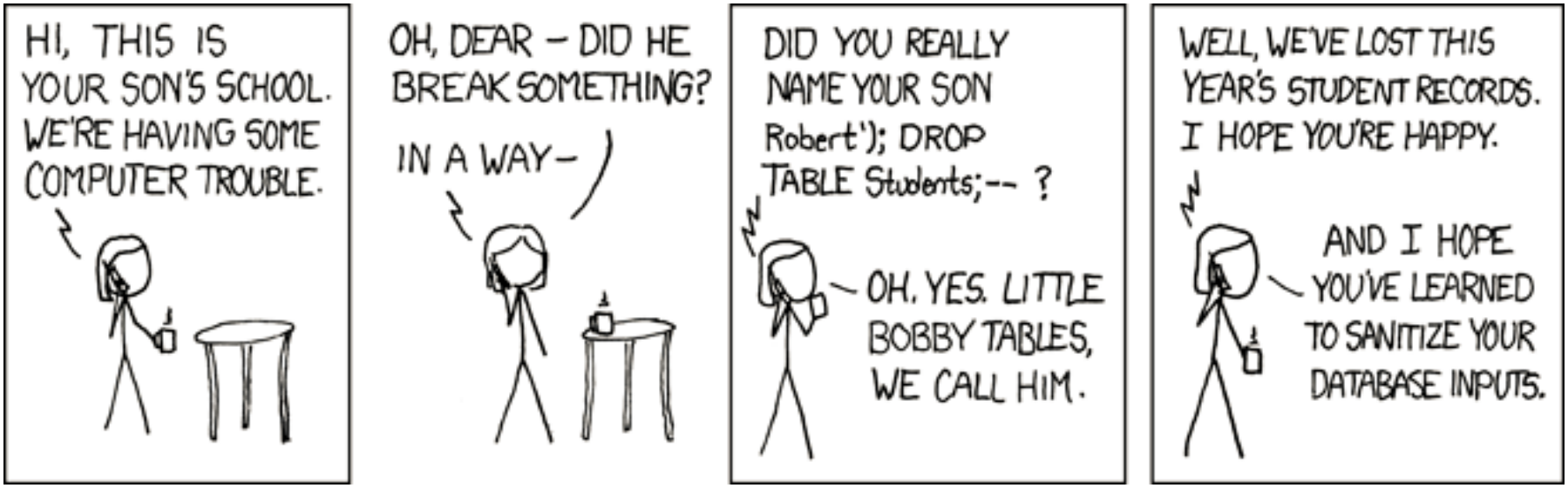
```
$query = "SELECT * FROM `users` WHERE id = " +
    $user_id + ";";
```

  - Malicious: $user_id = "1; DROP TABLE `users`"

```
SELECT * FROM `users` WHERE id = 1;
DROP TABLE `users`;
```

SQL Injection

- https://xkcd.com/327/



Parameter Manipulation

- Manual modification of parameters
  - Information is usually stored in cookies, hidden form fields, or URL query strings
    - http://www.bookstore.com/addcart.php?id=142857&quantity=1&cost=49.99
  - If cost is a part of the parameters, it can be changed by a malicious user
    - http://www.bookstore.com/addcart.php?id=142857&quantity=1&cost=2.99

…walks into a bar…

- https://www.sempf.net/post/On-Testing1

- http://www.businessinsider.com/when-amazon-launched-a-bug-allowed-users-to-get-paid-by-the-company-2011-10
  “You Used To Be Able To Order A Negative Quantity Of Books On Amazon And Get Paid Real Money”

Parameter Manipulation

- Manual modification of parameters

Hackers breached Citibank security using simple URL manipulation (June 15, 2011)

The theft of approximately 200,000 Citibank customer accounts may have achieved by means of a simple manipulation of the Citibank URL. Security experts told the New York Times that the hackers were able to impersonate actual account holders by using a simple trick.

After logging into a valid account, the URL to the Citi Account Online system contains a string of numbers which represents the customer's account. By changing this string, the criminals were able to easily switch between multiple accounts and obtain private customer information. Using a script to automate this process allowed them to do so hundreds of thousands of times.

Parameter Manipulation

- Don't trust the user!
  - If you have the cost of a book in a database, query the database instead of the parameter string
  - If you have a user logging in, track their account number using almost anything other than the parameters
  - In general, assume that a request is malicious, even if the majority of users are friendly

Parameter Manipulation

- Consider the effect of each parameter
  - If every parameter can be modified on the fly, what does this mean for your program?
  - Spending the time early in development to prevent unauthorized access will save time repairing issues later
  - Remember, form data and cookies are just other forms of user input, and they must be treated with caution

Summary

- SQL Injection attacks are a real threat
  - Compromise sensitive user data
  - Alter or damage critical data
  - Provide unwanted access to the database
- Validate and sanitize data early
  - Best to sanitize input at entry point into the code
- But respect your users!
  - Please don't "sanitize" François into Francois or Franois, O'Brien into OBrien, or Håkan into Hkan