FIT 2093

Introduction to cyber security

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Hacking

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What is hacking?

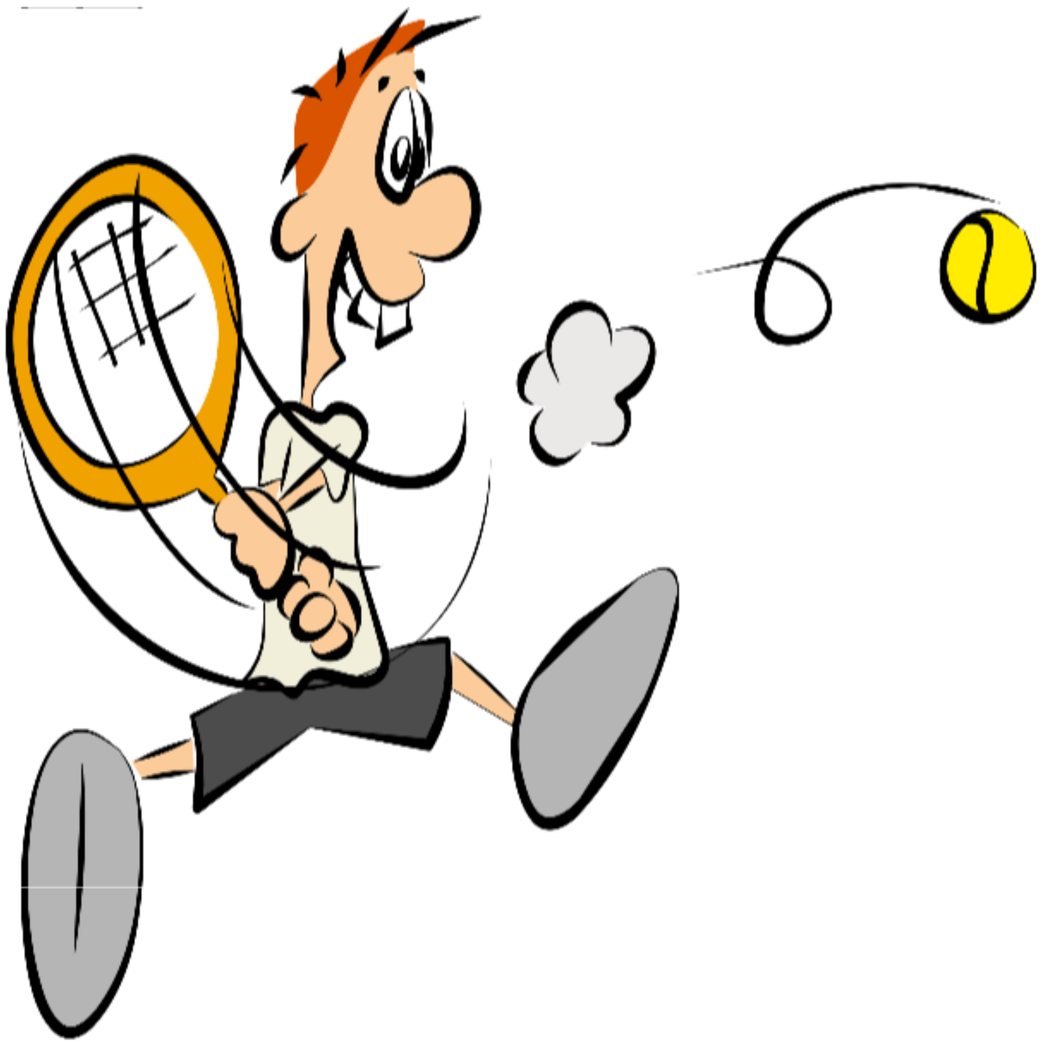
https://youtu.be/ss47ffaqA_o

Merriam Webster Dictionary:

1. One that hacks

Merriam Webster Dictionary:

2. a person who is inexperienced or unskilled at a particular activity: "a tennis hacker"



Merriam Webster Dictionary:

3. an expert at programming and solving problems with a computer

Merriam Webster Dictionary:
4. a person who illegally gains access to and sometimes tampers with information in a computer system

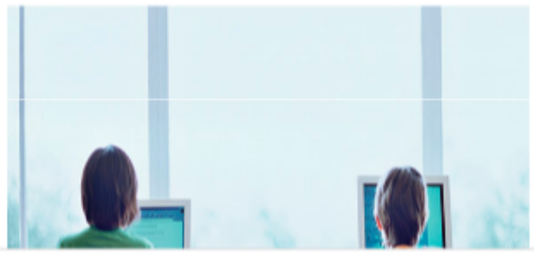

HACKED

Note that hacking is not the same as cyber-crime

future tense THE CITIZEN'S GUIDE TO THE FUTURE APRIL 10 2015 7:00 PM

Eighth-Grader Arrested, Charged With Cybercrimes for Changing Teacher's Desktop Wallpaper

By Lily Hay Newman



Are hacking skills essential for attacking IT systems?

- YES: Finding weaknesses and developing new attacks can be really diggicult.
- NO: Actually exploiting weaknesses can be really easy and just requires general computer skills.

- Penetration testing tools like Metasploit can be used to test computers and networks.
- Can also be used to lern how to attack.
- Other frameworks exist for malicious use.
- Exploits are a business model.

Look at five areas of hacking

1. Hacking single devices to get access
2. Other attacks on devices and malware
3. Get access to network traffic
4. Gaining access to services
5. Web application hacking

(just a choice…there is more)

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1. Hacking single devices to get access

- Goal for attacker: Gain full remote access
- Preferably become root (administrator)

Exploit weaknesses in Software

Examples:

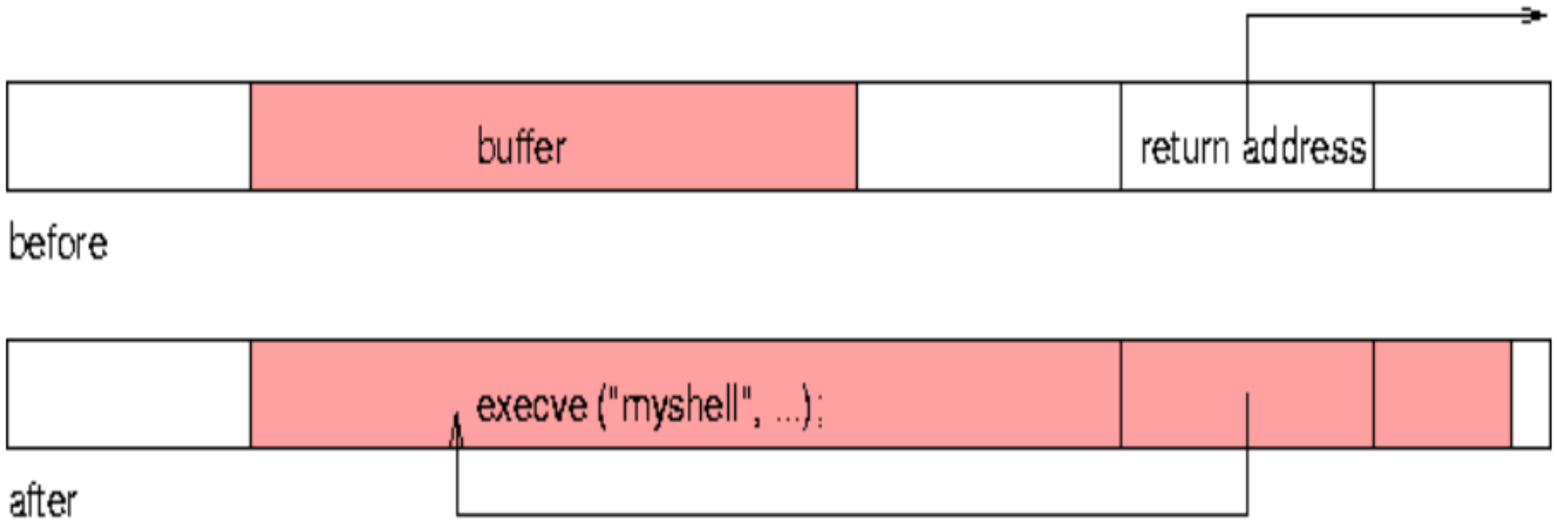
- Buffer Overflow
- Command injection

Buffer overflow

normal subprogram activation record

after buffer overflow

Example for an exploit



- Buffer overflow can be possible if input is not properly checked.
- Countermeasures do exist (canary, address randomization,...)

Command Injection

IF an application passes on user input to a shell in a bad way, in can be used to execute arbitrary shell commands with the rights of the application process.

Examples at owasp.org (Open Web Applications Security Project):
https://www.owasp.org/index.php/Command_injection

Misconfiguration

- Open telnet ports
- Other open ports with vulnerable software
- Wrong access rights
- Missing perimeter protection

Weak user credentials

- Weak or re-used passwords
- Missing/wrong certificate checks

Via malicious hardware

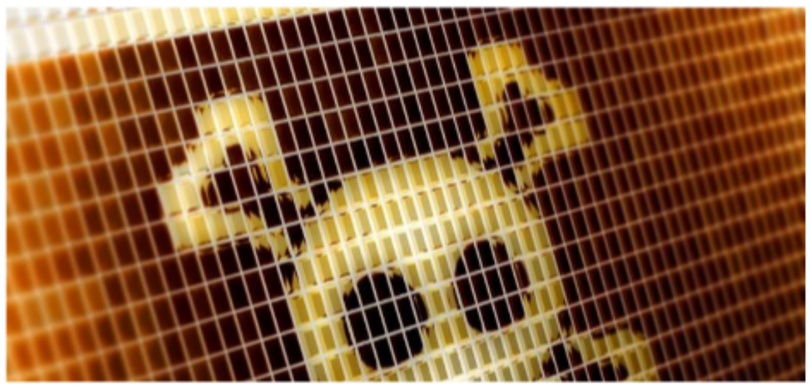
- Most prominent example: infected USB devices

SECURITY

IBM admits it sent malware-infected USB sticks to customers

In a recent support alert issued by IBM, the company noted that some USB drives that shipped with its Storwize systems contained malicious code.

By Conner Forrest | May 2, 2017, 6:05 AM PST



Social engineering

- Ask for user's credentials
- Convince user to install remote control tool themselves (e.g. "Microsoft" telephone calls)

What to use access for?

- Establish Botnet (e.g. for large-scale DDoS)
- Illegal activities
- Steal information/data
- Backdoor to a network, used to attack other devices/services in the network
- Install malware
- Sabotage
- Hacktivism

How to prevent?

- Secure software development
- Install current patches
- Reduce software/services installed/running
- Proper perimeter protection
- Monitor network traffic (also after attack)
- Educate users
- Disable ports (hardware and network)

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Often, malware does not need to give someone full control over the computer.

It can spread directly via Network, USB, e-mail, active Web content, etc.

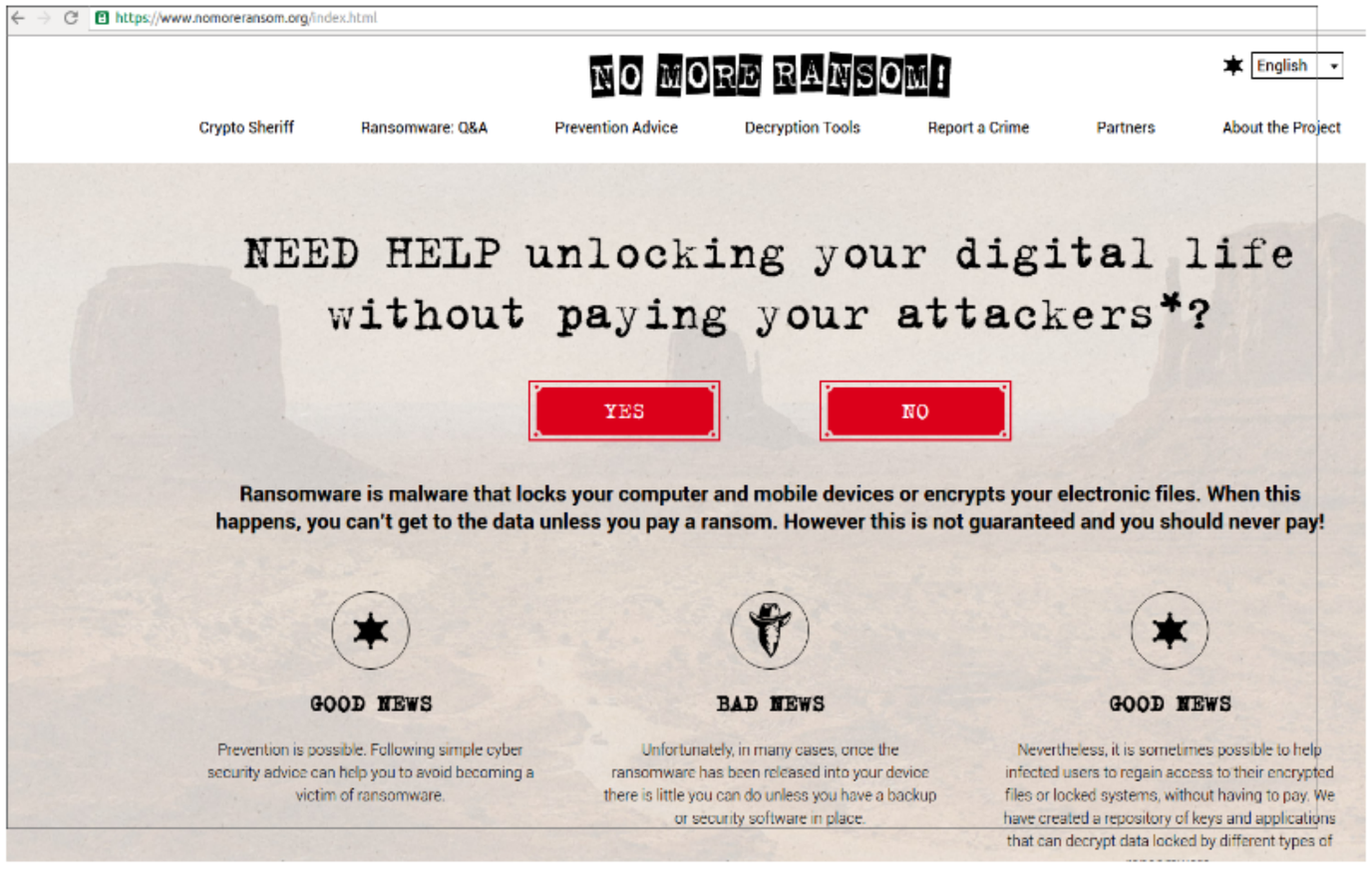
or attacker find alternative ways of distribution, e.g. links in e-mail

Examples for malware

- Banking malware
- Ransomware
- Spyware
- Botnets
- Adware

Note that these do not need full access to the computer.

www.nomoreransom.org



Other attacks
Example 1/3

- Pod slurping

Attach a storage device (e.g IPod) to a computer and slurp large amounts of data.

Prevention: Don't let anyone just attache devices.

Other attacks
Example 2/3

- Attacks via DMA

Direct memory access DMA can be used to read arbitrary parts of memory

Prevention: Don't let anyone just attache devices.

Other attacks
Example 3/3

- Physical (hard-disk access)

With physical (temporary) access, one can directly read from the hard-disk (or write to it) without being logged in.

Prevention: Disk encryption. Self-encrypted disks.

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All unencrypted network traffic can be extracted through:

- access to the Ethernet cable
- sniffing wireless traffic
- at each switch/router on the route

Encryption can still leave access to full data on other layers or to meta-data (depending on the layer):

- Wifi encryption is only between client and access point
- TLS only encrypts above transport layer. IP addresses etc. are still visible
- TLS for mail leaves content on mail-server unencrypted
- S/Mime and PGP encrypt mail content, but not headers

Unprotected traffic can also be manipulated/changed!

IP Address spoofing:

- hide the identity of a sender
- pretend to be another computer (network) for impersonation
- bi-directional traffic difficult, can mainly disrupt

MAC Address spoofing:

- Circumvent MAC-based network access control
- Bring foreign devices in a network and then

start attacks, sniff traffic

In some countries, laws require full (sometime real-time) network access for police and secret services!

What can possibly go wrong?


1984
WAS NOT
SUPPOSED
TO BE AN
INSTRUCTION
MANUAL.

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Goals for attacking service access

- Criminal activities / Money (banking)
- Identity theft (various services)
- Damage reputation (social networks, personal homepages, e-mail)
- Part of a larger (targeted) attack

Phishing

- Most successful and frequent.
- Usually via e-mail. Lure users into clicking on a link to a fake website.
    - Users provide their credentials on the fake website.
    - Attackers can gain full access to service.

Prevention: Two-factor authentication

Phishing has many variants

- Smishing (via SMS)
- Spear phishing (targeted phishing)
- Combinations with social engineering
- For virtually all types of services

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Web applications

- Interface between users and web-servers
- Dynamic web-pages generated at the server side
- Plus script code executed in the client's Web browser
- Support key business processes
- Often data-base driven

Vulnerable to various attacks

There are enforcement mechanisms for security policies.

But, there is:

- Cross-site scripting
- SQL injection
- Session hijacking
- Browser/server vulnerabilities
- Third-party content (JavaScript, Flash, ActiveX,...)

What is HTTP?

- Hypertext Transfer Protocol
- Client requests data from a resource (server)
- Two HTTP request methods: GET (request data) and POST (submit data)
- In principle stateless

State can be created (for sessions)

- Cookies
- TLS session
- Numbers in URLs

Server-side technologies

- Scripting languages (PHP, VBScript, Perl)
- Web application platforms ASP.Net, Node.js

(for server-side Java-script), Ruby on Rails, Java

- Various web servers (Apache, IIS, etc.)
- Databases (Oracle, SAP, MS-SQL, MySQL,

various NoSQL databases)

- Soap-based web-services / XML messages
- others

Client-side technologies

- Different browsers
- HTML -> HTML5, CSS, JavaScript
- Extensions (Flash :-(, Java, ActiveX, etc.)
- Others

How to attack?

1. Analyze the application
2. Change client-side behaviour, bypass client-side controls (scripts, change URLs, cookies, etc.)
3. Attack authentication (if necessary) / Attack session management
4. Attack data stores
5. Analyse and attack back-end components and APIs
6. Attacking users

1. Analyze the application

- Spider the application. Can we find the directory structure, files, etc. Create a map
- Find hidden content
- Find hidden parameters (e.g. debug=true)
- Identify entry points for user input (URL, forms, uploads, headers, via cookies, out-of-band)
- Analyse server-side technologies (versions, file extensions, session tokens, look at requests, etc.)
- Analyse sessions (cookies, etc.)
- Map attack surface

2. Client side behaviour

- The attacker controls the client side
- Change URLs
- Manipulate Cookies
- Change Scripts
- Circumvent client-side controls

3. Attack authentication / session management

- Crack passwords, steal credentials (phishing)
- Create/steal session cookies
- Circumvent authentication
- Steal active sessions

4. Attack data-bases

- E.g. by SQL Injection (a bit outdated, but still possible here and there)
- Attacks on MongoDB
- more about this topic next week

5. Analyse and attack back-end components and APIs

- Simple things like path traversal vulnerabilities can potentially use with big effect
- NODE.js is a great candidate for building insecure APIs...
- NODE.JS applications can interact freely with the operating system without the benefits of a security sandbox!
- Injection vulnerabilities!

OWASP is a great resource

https://www.owasp.org/index.php/Path_Traversal

6. Attacking users

One example of an attack type:

- Cross-site scripting (XSS) attacks

What is Cross-site scripting?

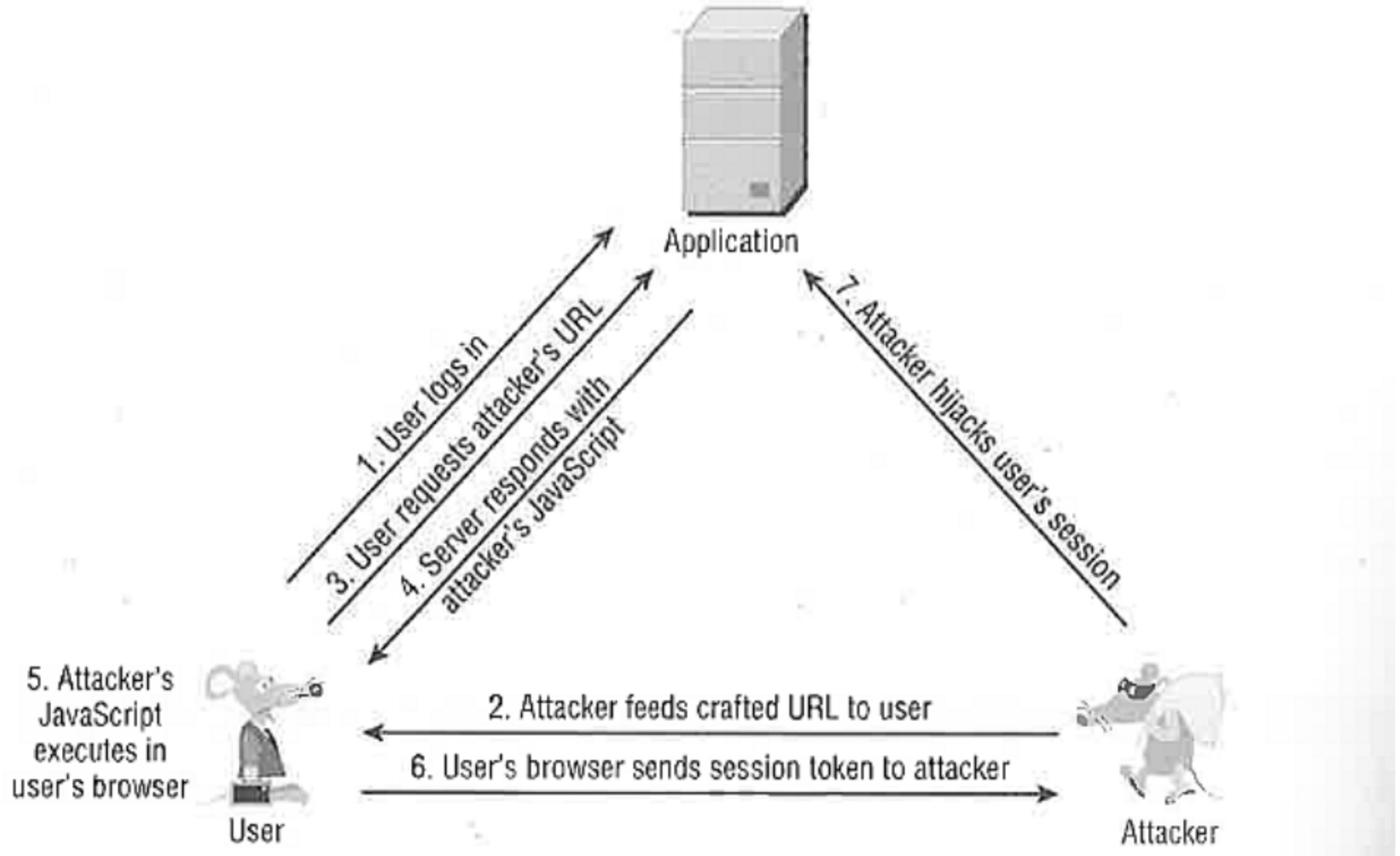
- Usually, browsers don't execute scripts not loaded (directly or indirectly) from the domain of the visited page.
- If attacker can insert own code to be executed is this cross-site.

How can attacker get script included in the page send from the server?

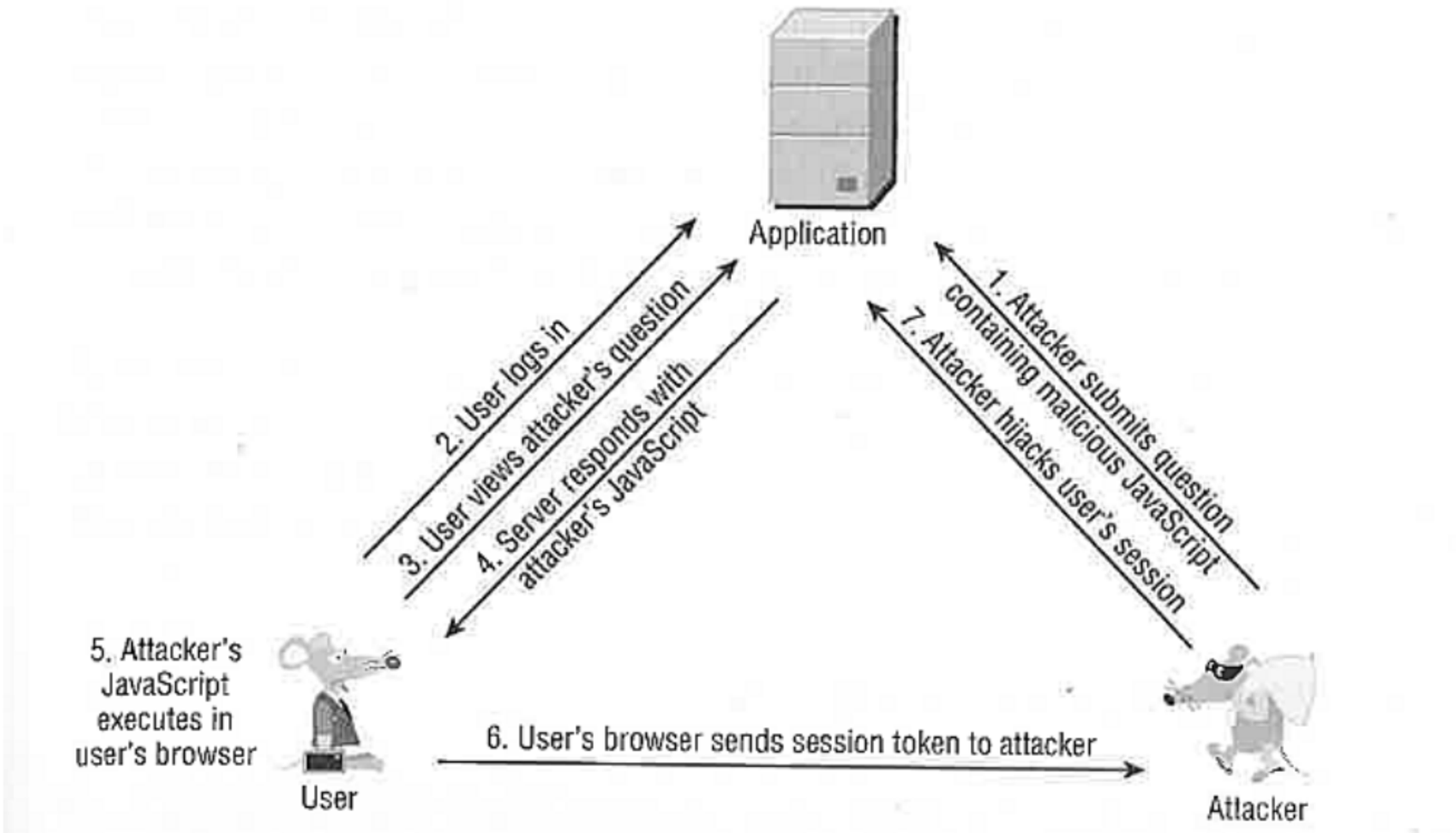
Let's look at two examples:

- Reflected XSS attack
- Stored XSS attack

Reflected XSS attack



Stored XSS attack



How to prevent XSS?

https://www.owasp.org/index.php/XSS_(Cross_Site_Scripting)_Prevention_