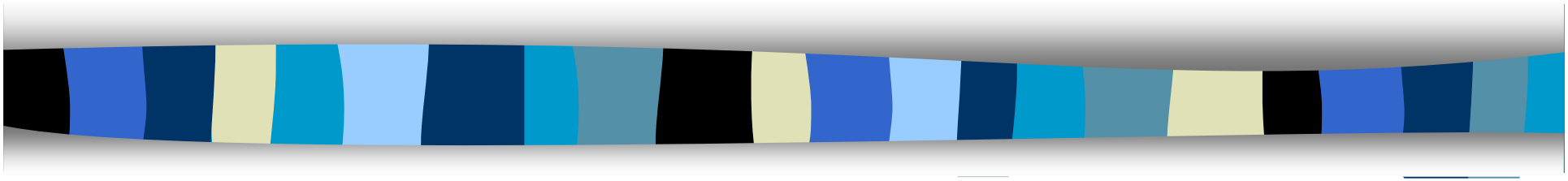
# Computer Security
# CS 426
## Lecture 16



Worms

# Announcements

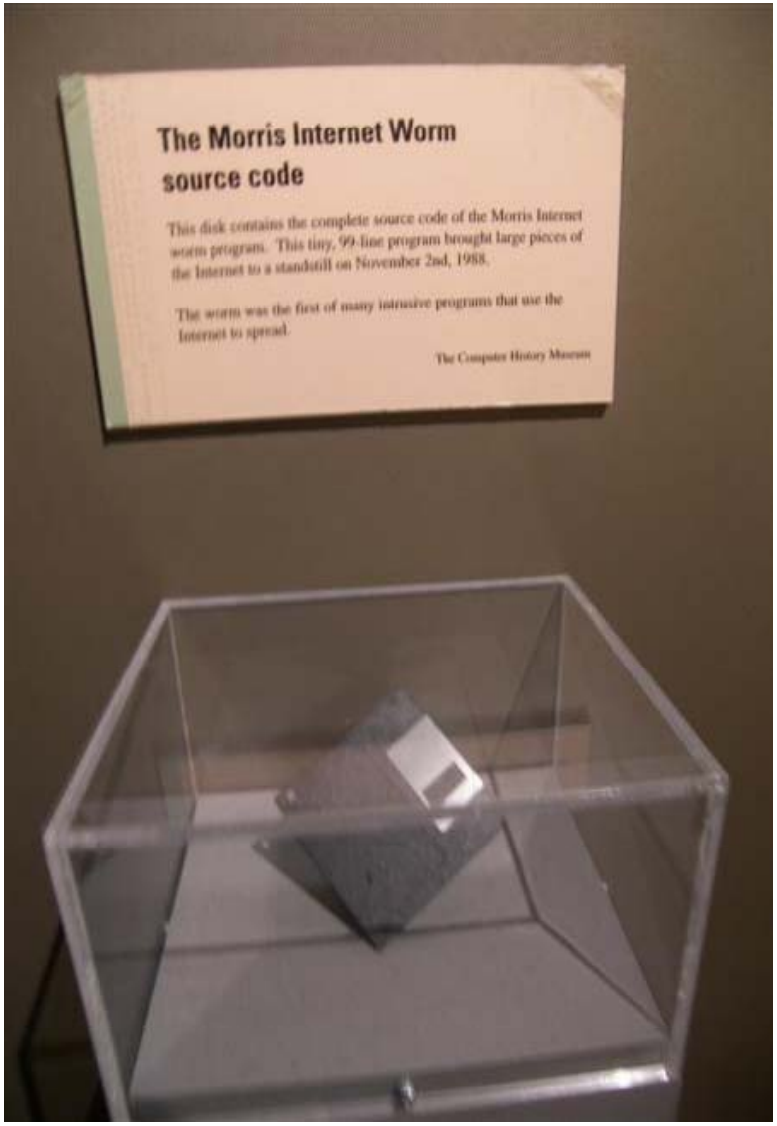
- Quiz on Friday October 1
- Guest lecture on Monday October 4
- Guest lecture on Friday October 8

# Review of Malwares

- Backdoor,  logic bomb
- Trojan horse
- Virus
- Worm
- Botnets
- Rootkit: user level, kernel level, under-kernel
- Spyware
- Scareware, ransomware

# Morris Worm (November 1988)

- First major worm
- Written by Robert Morris
  - Son of former chief scientist of NSA's National Computer Security Center




What comes next: *1 11 21 1211 111221?*

# Morris Worm Description

- Two parts
  - Main program to spread worm
    - look for other machines that could be infected
    - try to find ways of infiltrating these machines
  - Vector program (99 lines of C)
    - compiled and run on the infected machines
    - transferred main program to continue attack

# Vector 1: Debug feature of sendmail

- Sendmail
  - Listens on port 25 (SMTP port)
  - Some systems back then compiled it with DEBUG option on
- Debug feature gives
  - The ability to send a shell script and execute on the host

# Vector 2: Exploiting fingerd

- Finger output

arthur.cs.purdue.edu% finger ninghui

Login name: ninghui In real life: Ninghui Li

Directory: /homes/ninghui Shell: /bin/csh

Since Sep 28 14:36:12 on pts/15 from csdhcp-120-173 (9 seconds idle)

New mail received Tue Sep 28 14:36:04 2010;

unread since Tue Sep 28 14:36:05 2010

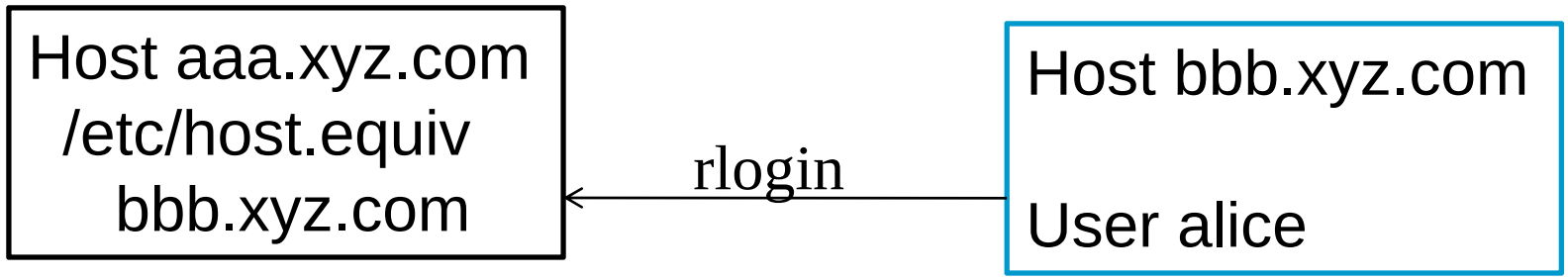
No Plan.

# Vector 2: Exploiting fingerd

- Fingerd
  - Listen on port 79
- It uses the function gets
  - Fingerd expects an input string
  - Worm writes long string to internal 512-byte buffer
- Overrides return address to jump to shell code

# Vector 3: Exploiting Trust in Remote Login

- Remote login on UNIX
  - rlogin, rsh
- Trusting mechanism
  - Trusted machines have the same user accounts
  - Users from trusted machines
  - /etc/host.equiv – system wide trusted hosts file
  - /.rhosts and ~/.rhosts – users' trusted hosts file



# Vector 3: Exploiting Trust in Remote Login

- Worm exploited trust information
  - Examining  trusted hosts files
  - Assume reciprocal trust
    - If X trusts Y, then maybe Y trusts X
- Password cracking
  - Worm coming in through fingerd was running as daemon (not root) so needed to break into accounts to use .rhosts feature
  - Read /etc/passwd, used ~400 common password strings & local dictionary to do a dictionary attack

# Other Features of The Worm

- Program is shown as 'sh' when ps
- Files didn’t show up in ls
- Find targets using several mechanisms:
  - 'netstat -r -n‘, /etc/hosts, …
- Compromise multiple hosts in parallel
  - When worm successfully connects, forks a child to continue the infection while the parent keeps trying new hosts
- Worm has no malicious payload
- Where does the damage come from?

# Damage

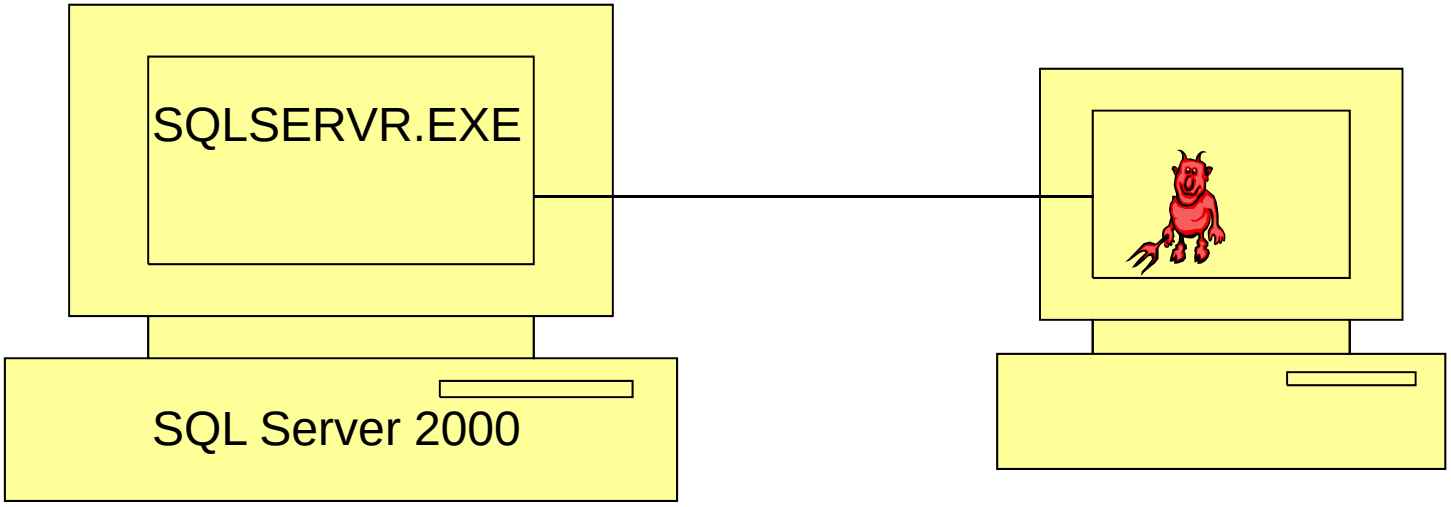
- One host may be repeatedly compromised
- Supposedly designed to gauge the size of the Internet
- The following bug made it more damaging.
- Asks a host whether it is compromised; however, even if it answers yes, still compromise it with probability 1/8.

# Increasing propagation speed

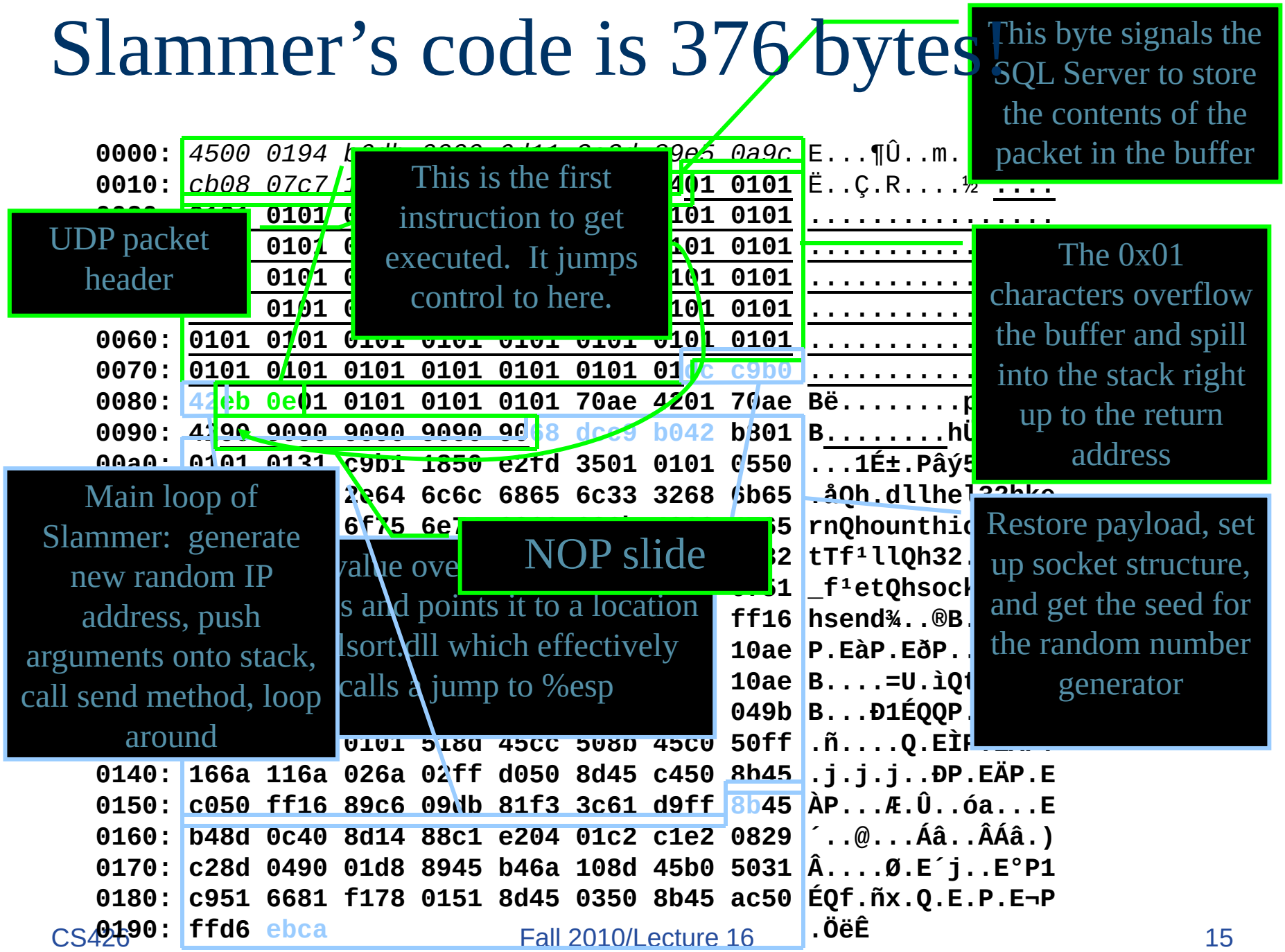
- Code Red, July 2001
  - Affects Microsoft Index Server 2.0,
    - Windows 2000 Indexing service on Windows NT 4.0.
    - Windows 2000 that run IIS 4.0 and 5.0 Web servers
  - Exploits known buffer overflow in Idq.dll
  - Vulnerable population (360,000 servers) infected in 14 hours
- SQL Slammer, January 2003
  - Affects in Microsoft SQL 2000
  - Exploits known buffer overflow vulnerability
    - Server Resolution service vulnerability reported June 2002
    - Patched released in July 2002 Bulletin MS02-39
  - Vulnerable population infected in less than 10 minutes

# Slammer Worms (Jan., 2003)

- MS SQL Server 2000 receives a request of the worm
  - SQLSERVR.EXE process listens on UDP Port 1434



# Slammer's code is 376 bytes!



# Nimda worm (September 18, 2001)

- Key Vulnerability to Exploit
  - **Microsoft Security Bulletin (MS01-020):** March 29, 2001
  - A logic bug in IE's rendering of HTML
  - Specially crafted HTML email can cause the launching of an embedded email
- Vector 1: e-mails itself as an attachment (every 10 days)
    - runs once viewed in preview plane
- Vector 2: copies itself to shared disk drives on networked PCs
  - Why this may lead to propagating to other hosts?

# Nimda Worm

- Vector 3: Exploits various IIS directory traversal vulnerabilities
  - Use crafted URL to cause a command executing at
  - Example of a directory traversal attack:
    - http://address.of.iis5.system/scripts/..%c1%1c../winnt/system32/cmd.exe?/c+dir+c:\
- Vector 4: Exploit backdoors left by earlier worms
- Vector 5: Appends JavaScript code to Web pages

```
<script language="JavaScript">
window.open("readme.eml", null, "resizable=no,top=6000,left=6000")
</script>
```

# Nimda worm

- Nimda worm also
  - enables the sharing of the c: drive as C$
  - creates a "Guest" account on Windows NT and 2000 systems
  - adds this account to the "Administrator" group.
- 'Nimda fix' Trojan disguised as security bulletin
  - claims to be from SecurityFocus and TrendMicro
  - comes in file named FIX_NIMDA.exe
    - TrendMicro calls their free Nimda removal tool FIX_NIMDA.com

# Research Worms

- Warhol Worms
  - infect all vulnerable hosts in 15 minutes – 1 hour
  - optimized scanning
    - initial hit list of potentially vulnerable hosts
    - local subnet scanning
    - permutation scanning for complete, self-coordinated coverage
  - see paper by Nicholas Weaver
- Flash Worms
  - infect all vulnerable hosts in 30 seconds
  - determine complete hit list of servers with relevant service open and include it with the worm
  - see paper by Stuart Staniford, Gary Grim, Roelof Jonkman, Silicon Defense

# Storm botnet

- First detected in Jan 2007
- Vectors (primarily social engineering):
  - Email attachments
  - Download program to show a video
  - Drive-by exploits
- DDoS spam fighting sites, and whichever host discovered to investigate the botnet
- Peer-to-peer communications among bots
  - for asking for C&C server

# Conficker (November 2008)

- Also known as **Downup**, **Downadup** and **Kido**.
- Five variants
  - A (2008-11-21);  B (2008-12-29); C (2009-02-20)
  - D (2009-03-04);  E(2009-04-07)
- Estimated between 9 and 15 millions computers are compromised
- Microsoft offers $250,000 reward to catch creater
- Highly secure mechanism for updating itself.
- Several self-defense mechanism
  - Disable several security critical programs
  - Disable DNS lookup related to anti-virus vedors, and windows update

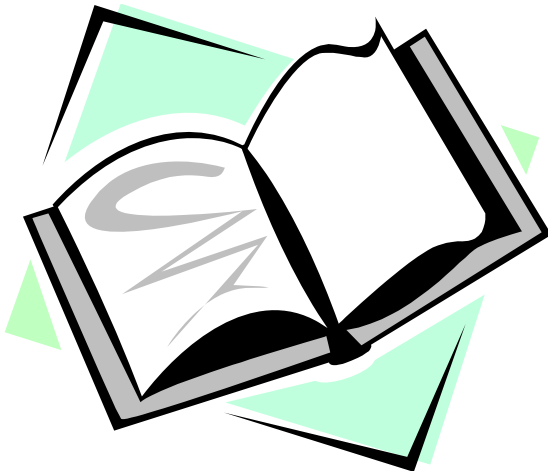
# Conficker

- Vector 1: Vulnerability in (**MS08-067)**
  - Bulletin October 23, 2008
  - Vulnerability in MS Server service
  - Exploited by remote RPC request
  - Lead to code execution without authentication
- Vector 2: Dictionary attack on ADMIN$ share
  Vector 3: Creates DLL-based AutoRun trojan on attached removable drive

Why is it able to compromise more hosts than SQL slammer & code red?

# Readings for This Lecture

- Wikipedia
  - Morris Worm
  - Conficker



# Coming Attractions …

- Dealing with Malwares