Malicious Logic

COMP620

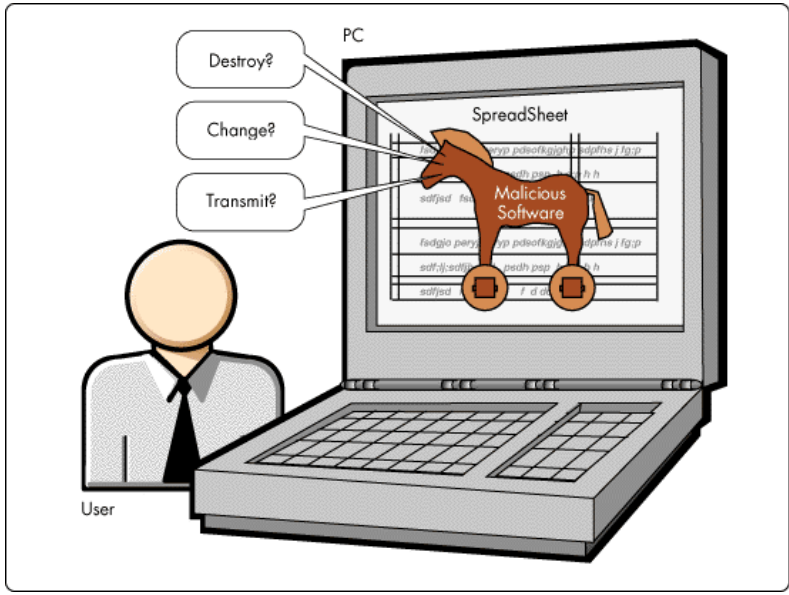
“An inefficient virus kills its host.
A clever virus stays with it.”

James Lovelock

Goals of Malware

- Steal user information
- Steal corporate information
- Ransomware
- Host files or perform calculations
- Create a botnet
- Install software
- Click fraud
- Break physical systems

Trojan Horses



- A Trojan horse is a program that does something malicious in addition to the expected function
- The author of the program intentionally adds code to do something in addition to what the user expects
- Often seen in “greeting card” programs

Animal Program

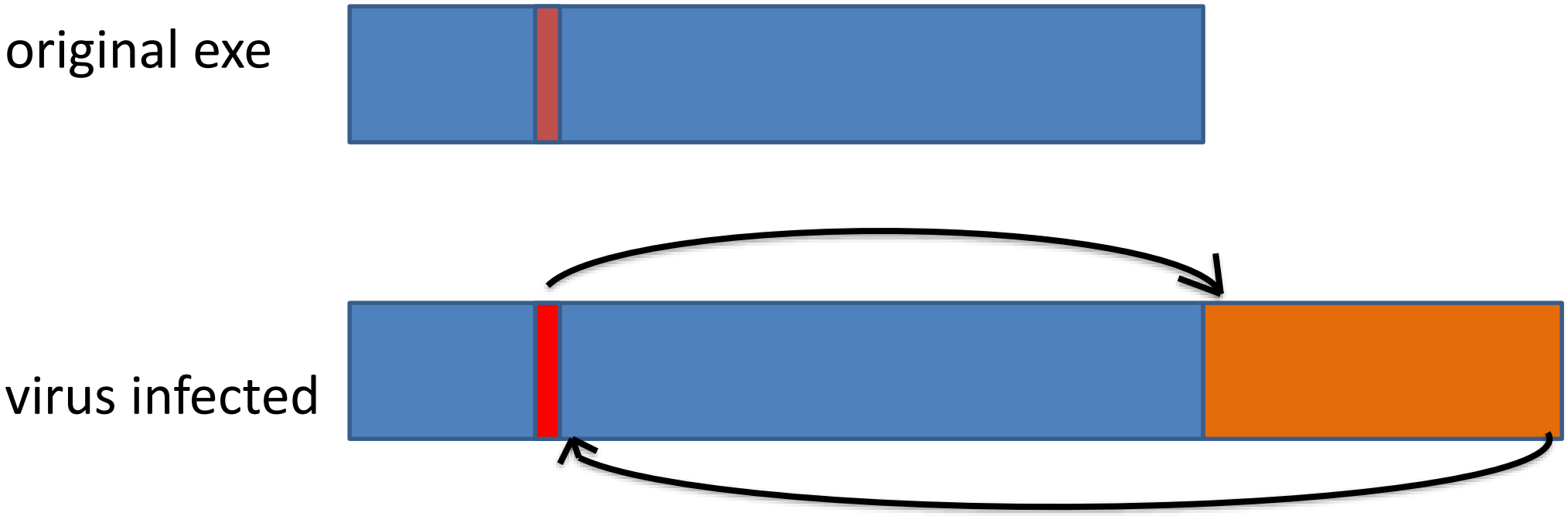
- The textbook mentions the animal program as an early Trojan horse
- When executed, the animal program copied itself into any directory that was writable
- The program was benign, but did consume disk space

Computer Viruses

- A computer virus is malicious software that propagates itself by adding its machine language to other executables
- A virus is very similar to a Trojan horse, except that the malicious code is added after the program is written

Virus Propagation

- A virus adds its machine language to the end of an executable



Antivirus Software

- Antivirus software helps to detect malware
  - Pattern matchers that scan files for known viruses
  - Watch for suspicious activity, such as writing to an executable file
- Virus scanners can only look for known viruses
- Virus scanners are big string match programs looking for machine language known to be in a virus
- New virus signatures are created frequently and distributed by vendors

Hiding Viruses

- Viruses can hide through encrypting themselves
- The initial code of the virus decrypts the instructions and then executes the main portion of the virus
  - Encryption with different keys makes the encrypted instructions different and difficult to detect
- A polymorphic virus change the code in a random like manner to avoid scanners

Macro Viruses

- Some file types support macros, such as Microsoft office
- Macros allow programmers to add functionality to the documents
- The functionality can be malicious
- When an Office document is downloaded, Microsoft flags it as potentially dangerous

How can you defend against viruses?

- Antivirus software is on defense
- Works with the people around you to come up with another

Defense Against Virus Propagation

- Adding a digital signature to an executable file allows detection of any modification by a virus
- Disable writing to an existing executable file
  - A virus might create a new file and then change the name
  - Developers create new executables
- Software installation should make the entire directory read-only

Virus History

- Programmers for Apple II wrote some
  - Not called viruses; very experimental
- Fred Cohen
  - Graduate student who described them
  - Teacher (Adleman) named it “computer virus”
  - Tested idea on UNIX systems and UNIVAC 1108 system

Cohen's Experiments

- UNIX systems: goal was to get superuser privileges
  - Max time 60m, min time 5m, average 30m
  - Virus small, so no degrading of response time
  - Virus tagged, so it could be removed quickly
- UNIVAC 1108 system: goal was to spread
  - As writing not inhibited, viruses spread easily

First Reports

- Brain (Pakistani) virus (1986)
  - Written for IBM PCs
  - Alters boot sectors of floppies, spreads to other floppies
- MacMag Peace virus (1987)
  - Written for Macintosh
  - Prints “universal message of peace” on March 2, 1988 and deletes itself

More Reports

- Duff's experiments (1987)
  - Small virus placed on UNIX system, spread to 46 systems in 8 days
  - Wrote a Bourne shell script virus
- Highland's Lotus 1-2-3 virus (1989)
  - Stored as a set of commands in a spreadsheet and loaded when spreadsheet opened
  - Changed a value in a specific row, column and spread to other files

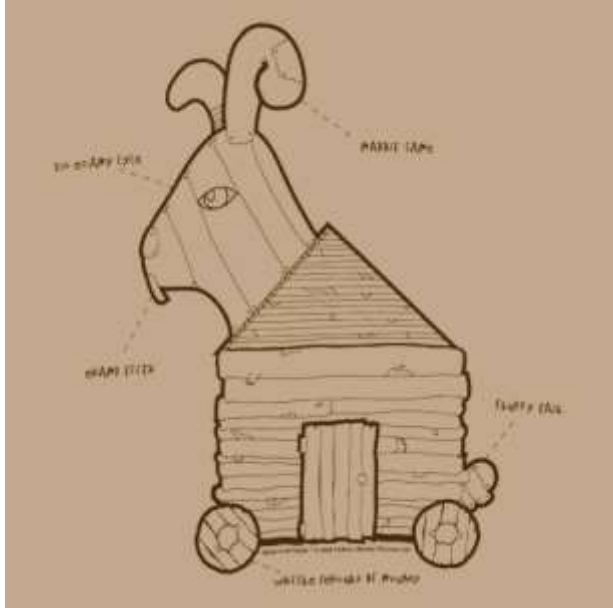
Computer Worms

- A computer worm is a program that propagates itself without modifying other programs
- Some worms are transported by email and will automatically send themselves to everyone on the victims address book

Example: The Great Internet Worm

- The 99 line program was created by Robert Morris on November 2, 1988
- Targeted Berkeley, Sun UNIX systems
  - Used virus-like attack to inject instructions into running program and run them
  - To recover, had to disconnect system from Internet and reboot
  - To prevent re-infection, several critical programs had to be patched, recompiled, and reinstalled
- Analysts had to disassemble it to uncover function
- Disabled several thousand systems in 6 or so hours
- According to its creator, the Morris worm was not written to cause damage, but to gauge the size of the Internet
- Robert Morris was sentenced to three years probation, 400 hours of community service, and a fine of $10,050 plus costs

Rabbits



- Rabbits are programs that wastefully consume resources
- These create denial of service attacks

- The following will create an endless number of processes preventing needed processes from starting

```
while (true) fork();
```

Create a Rabbit

- With the students around you, write a rabbit program that will stop a system

Logic Bombs

- A logic bomb is like a Trojan horse. It is created intentionally by the programmer
- Usually a logic bomb waits for a particular situation and then does something malicious
- A classical logic bomb was written by a programmer in the payroll department. If his ID number did not appear when printing paychecks *(indicating he was fired)*, the program erased the payroll database

Trusting Trust

- Please read “Reflections on Trusting Trust” by Ken Thompson, Communications of the ACM, vol. 27, no. 8, August 1984
- Available on Blackboard under Course Materials
- It is a classic paper in Computer Science
- There are important concepts about source code inspection

- It is only 3 pages long