CSE 484 (Winter 2008)

Computer Security and Privacy

Tadayoshi Kohno

Thanks to Dan Boneh, Dieter Gollmann, John Manferdelli, John Mitchell, Vitaly Shmatikov, Bennet Yee, and many others for sample slides and materials ...

High-level information

- Instructor: Tadayoshi Kohno (Yoshi)
  - Office: CSE 558
  - Office hours: Wednesdays, 10:30 to 11:20am (right after class, may change)
  - Open door policy – don't hesitate to stop by!
- TAs: Alexei Czeskis and Karl Koscher
  - Office/hours: See website (TBD)
- Course website
  - Assignments, reading materials, lecture notes
- Course email list (and blog)
  - Student discussions, announcements

Prerequisites

- Required: Data Structures (CSE 326)
- Required: Machine Org and Assembly (CSE 378)
- Assume: Working knowledge of C and assembly
  - One of the projects involves writing buffer overflow attacks in C
  - You must have detailed understanding of x86 architecture, stack layout, calling conventions, etc.
- Assume: Working knowledge of software engineering tools for Unix environments (gdb, etc)
- Assume: Working knowledge of Java and JavaScript

Prerequisites

- Recommended: Computer Networks; Operating Systems
  - Will help provide deeper understanding of security mechanisms and where they fit in the big picture
- Recommended: Complexity Theory; Discrete Math; Algorithms
  - Will help with the more theoretical aspects of this course.

Prerequisites

- Most of all: Eagerness to learn!
  - This is a 400 level course.
  - I expect you to push yourself to learn as much as possible.
  - I expect you to be a strong, independent learner capable of learning new concepts from the lectures, the readings, and on your own.

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Course Logistics

- Lectures: Mon, Wed, Fri: 9:30 to 10:20am ; Recitations: Thurs: 8:30 to 9:20am
- Security is a contact sport!
- Projects (40% of the grade)
  - Projects involve a lot of programming
  - Can be done in teams of 2-3 students
- Homeworks (20% of grade)
  - Textbook-style questions (10%)
  - Blog entries (10%)
- Midterm (15% of the grade)
- Final (25% of the grade)

Exceptional work may be rewarded with extra credit

No make-up or substitute exams! If you are not sure you will be able to take the exams in class on the assigned dates, **do not take this course!**

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Late Submission Policy

- Homeworks should be turned in at the start of class on the due date
- Blog posts and projects should also be turned in on time
- Late assignments will be dropped 20% per day.
  - Late days will be rounded up
  - So an assignment turned in 1.25 days late will be downgraded 40%.
- Homeworks generally due on Fridays, some exceptions.

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Course Materials

- Textbooks:

  Pfleeger and Pfleeger, "Security in Computing" (Main textbook)

  Kaufman, Perlman, and Speciner, "Network Security" (Secondary textbook)
  - Lectures will not follow the textbooks
  - Lectures will focus on "big-picture" principles and ideas
  - Attend lectures. Lectures will cover some material that is not in the textbook – and you will be tested on it! (Also make sure to read the blog)
- Plus assigned readings from other sources

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Other Helpful Books (all online)

- Ross Anderson, "Security Engineering"
  - Focuses on design principles for secure systems
  - Wide range of entertaining examples: banking, nuclear command and control, burglar alarms
  - You should all at least look at the Table of Contents for this book.
- Kaashoek and Saltzer, "Principles of Computer System Design"
- Menezes, van Oorschot, and Vanstone, "Handbook of Applied Cryptography"

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What does "security" mean to you?

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Two key themes of this course

- How to **think** about security
  - The Security Mindset - "new" way to think about systems
  - Threat models, security goals, assets, risks, adversaries
  - Connection between security, technology, politics, ethics, ...
  - The first few lectures, and the blog
    - http://cubist.cs.washington.edu/Security/
    - http://slashdot.org/
- **Technical aspects** of security
  - Attack techniques
  - Defenses

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Technical Themes

- Vulnerabilities of computer systems
  - Software problems (buffer overflows); crypto problems; network problems (DoS, worms); people problems (usability, phishing)
- Defensive technologies
  - Protection of information in transit: cryptography, security protocols
  - Protection of networked applications: firewalls and intrusion detection
  - "Defense in depth"

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What This Course is Not About

- Not a comprehensive course on computer security
  - Computer security is a broad discipline!
  - Impossible to cover everything in one quarter
    - Not much language-based security
    - Moderate discussion of crypto (crypto could take a whole year of courses!)
  - So be careful in industry or wherever you go!
- Not about all of the latest and greatest attacks
  - Read bugtraq or other online sources instead
- Not a course on ethical, legal or economic issues
  - We will touch on ethical issues, but not focus on them
- Not a course on how to "hack" or "crack" systems

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What is Computer Security?

- Systems may fail for many reasons
- Reliability deals with accidental failures
- Usability deals with problems arising from operating mistakes made by users
- Security deals with intentional failures created by intelligent parties
  - Security is about computing in the presence of an adversary
  - But security, reliability, and usability are all related

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What Drives the Attackers?

- Adversarial motivations:
  - Money, fame, malice, curiosity, politics....
- Fake websites, identity theft, steal money and more
- Control victim's machine, send spam, capture passwords
- Industrial espionage and international politics
- Access copy-protected movies and videos
- Attack on website, extort money
- Wreak havoc, achieve fame and glory

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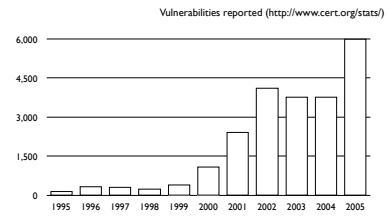
Growing Problem



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Challenges: What is "Security?"

- What does security mean?
  - Often the hardest part of building a secure system is figuring out what security means
  - What are the assets to protect?
  - What are the threats to those assets?
  - Who are the adversaries, and what are their resources?
  - What is the security policy?
- Perfect security does not exist!
  - Security is not a binary property
  - Security is about risk management

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From Policy to Implementation

- After you've figured out what security means to your application, there are still challenges
  - How is the security policy enforced?
  - Design bugs
    - Poor use of cryptography
    - Poor sources of randomness
    - …
  - Implementation bugs
    - Buffer overflow attacks
    - …
  - Is the system usable?

Don't forget the users! They are a critical component!

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Many Participants

- Many parties involved
  - System developers
  - Companies deploying the system
  - The end users
  - The adversaries (possibly one of the above)
- Different parties have different goals
  - System developers and companies may wish to optimize cost
  - End users may desire security, privacy, and usability
  - But the relationship between these goals is quite complex (will customers choose not to buy the product if it is not secure?)

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Other (Mutually-Related) Issues

- Do consumers actually care about security?
- Security is expensive to implement
- Plenty of legacy software
- Easier to write "insecure" code
- Some languages (like C) are unsafe

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Approaches to Security

- Prevention
  - Stop an attack
- Detection
  - Detect an ongoing or past attack
- Response
  - Respond to attacks
- The threat of a response may be enough to deter some attackers

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Blog and Security Reviews

- Previous courses looked at
  - Nike+iPod Sport Kit
  - Wireless keyboards
  - iPhone
  - Zune
  - SlingBox
  - Nintendo Wii
  - Dodgeball
  - Netflix
  - …
- Blog URL: http://cubist.cs.washington.edu/Security/

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Homework 1

- http://www.cs.washington.edu/education/courses/484/08wi/homework/hw1.html

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Ethics

- In this class you will learn about how to attack the security and privacy of (computer) systems.
- Knowing how to attack systems is a critical step toward knowing how to protect systems.
- But one must use this knowledge in an ethical manner.
- In order to get a non-zero grade in this course, you must sign the "Security and Privacy Code of Ethics" form by the start of class on Jan 14 (next Monday). http://www.cs.washington.edu/education/courses/484/08wi/administrivia/ethics.pdf

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