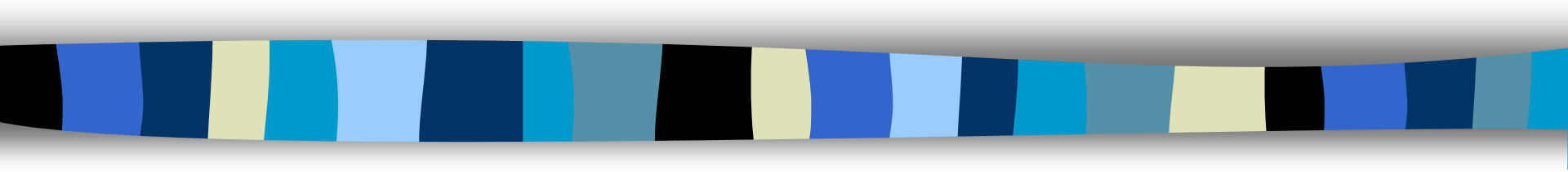
Information Security
CS 526
Topic 1



Overview of the Course

Today's Security News

- **Today: 220 million records stolen, 16 arrested in massive South Korean data breach**
  - A number of online gaming & movie ticket sites
  - Real names, account names, passwords, resident registration numbers

- Today: Cybersecurity hiring crisis: Rockstars, anger and the billion dollar problem
  - Cisco's 2014 Annual Security Report projecting a global cybersecurity jobs shortage starting at 500,000 and domestically at least 30,000

Last Week's Security News

- Aug 22: **Facebook given 4 weeks to respond to "largest privacy class action in Europe"**
  - In relation to unauthorized use of data, NSA's PRISM program, tracking users on external websites and sharing data
- Aug 22: Malicious app can steal sensitive information from other apps, e.g., Gmail

In the News (2012): Hackers Force Apple, Amazon to Change Security Policy

- What happened?
  - Hackers gained access to Mat Honan (a reporter)'s iCloud account, then (according to Honan)
    - At 5:00 PM, they remote wiped my iPhone
      At 5:01 PM, they remote wiped my iPad
      At 5:05, they remote wiped my MacBook Air.
- How did the attacker get access to iCloud account? Any guess?
- Lessons?
    - Security only as strong as the weakest link.
    - Information sharing across platforms can lead to unexpected vulnerabilities

Stuxnet (2010)

- Stuxnet: Windows-based Worm
  - Worm: self-propagating malicious software (malware)
- Attack Siemens software that control industrial control systems (ICS) and these systems
  - Used in factories, chemical plants, and nuclear power plants
- First reported in June 2010, the general public aware of it only in July 2010
- A digital weapon created by nation states
  - 60% (more than 62 thousand) of infected computers in Iran
  - Iran confirmed that nuclear program damaged by Stuxnet
  - Sophisticated design, special targets, expensive to develop

See the Course Homepage

- http://www.cs.purdue.edu/homes/ninghui/courses/526_Fall14/index.html
- Piazza
- Knowledge needed for the course
  - Probability
  - Basic knowledge of algorithms
  - Programming knowledge (for two programming projects)
    - Web (PHP)
    - Low-level (C, some knowledge of assembly)
  - Knowledge of operating systems/networking

EMERGENCY PREPAREDNESS – A MESSAGE FROM PURDUE

To report an emergency, call 911. To obtain updates regarding an ongoing emergency, sign up for Purdue Alert text messages, view www.purdue.edu/ea.

There are nearly 300 Emergency Telephones outdoors across campus and in parking garages that connect directly to the PUPD. If you feel threatened or need help, push the button and you will be connected immediately.

If we hear a fire alarm during class we will immediately suspend class, evacuate the building, and proceed outdoors. Do not use the elevator.

If we are notified during class of a Shelter in Place requirement for a tornado warning, we will suspend class and shelter in [the basement].

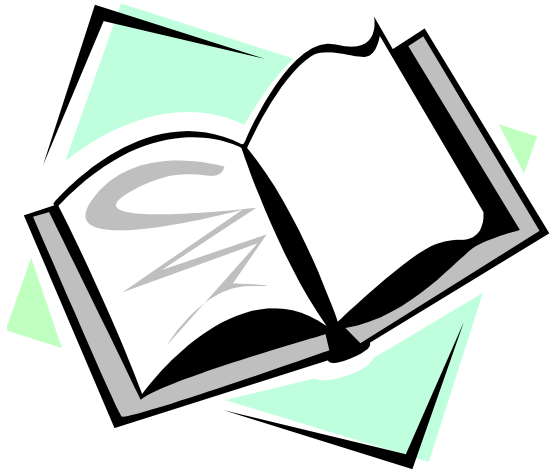
If we are notified during class of a Shelter in Place requirement for a hazardous materials release, or a civil disturbance, including a shooting or other use of weapons, we will suspend class and shelter in the classroom, shutting the door and turning off the lights.

Please review the Emergency Preparedness website for additional information.
http://www.purdue.edu/ehps/emergency_preparedness/index.html

Readings for This Lecture

Required readings:

- Information Security on Wikipedia (Basic principles & Risk management)



Optional Readings:

- Counter Hack Reloaded
  - Chapter 1: Introduction
- Security in Computing: Chapter 1

What is Information (Computer) Security?

- Security = Sustain desirable properties under intelligent adversaries

- Desirable properties
  - Understand what properties are needed.

- Intelligent adversaries
  - Needs to understand/model adversaries
  - Always think about adversaries.

Security Goals/Properties (C, I, A)

- Confidentiality (secrecy, privacy)
  - only those who are authorized to know can know
- Integrity (also authenticity in communication)
  - only modified by authorized parties and in permitted ways
  - do things that are expected
- Availability
  - those authorized to access can get access

Which of C, I, A are violated in ..

- The Stuxnet attack compromises
  - integrity of software systems,
  - availability of some control functionalities,
  - confidentiality of some keys in order to sign malware to be loaded by Windows
- The Apple/Amazon attack
  - Confidentiality of credit card digits
  - Integrity of password
  - Availability of data and devices
- The Android App attack
  - Confidentiality
  - Potential integrity/availability concern

Computer Security Issues

- Malware (Malicious Software)
  - Computer viruses
  - Trojan horses
  - Computer worms
    - E.g., Morris worm (1988), Melissa worm (1999), Stuxnet (2010), etc.
  - Spywares
  - Malwares on mobile devices
- Computer break-ins
- Email spams
  - E.g., Nigerian scam (419 scam, advanced fee fraud), stock recommendations

More Computer Security Issues

- Identity theft
- Driveby downloads
- Botnets
- Distributed denial of service attacks
- Serious security flaws in many important systems
  - electronic voting machines, ATM systems

Why Do Computer Attacks Occur?

- Who are the attackers?
  - bored teenagers, criminals, organized crime organizations, rogue (or other) states, industrial espionage, angry employees, …
- Why they do it?
  - fun,
  - fame,
  - profit, …
    - computer systems are where the moneys are
  - Political/military objectives

Why These Attacks Can Succeed?

- Software/computer/information systems/designs are buggy
  - They are complex, dynamic, and increasingly so
- Users make mistakes
- Some Technological factors
  - Von Neumann architecture: stored programs mixing code and data
  - Unsafe program languages

Why Do These Factors Exist?

- Economical factors
  - Lack of incentives for secure software
  - Security is difficult, expensive and takes time
- Human factors
  - Lack of security training for software engineers
  - Largely uneducated population

Security is Secondary

- What protection/security mechanisms one has in the physical world?
- Why the need for security mechanisms arises?
- Security is secondary to the interactions that make security necessary.

> Robert H. Morris : The three golden rules to ensure computer security are: do not own a computer; do not power it on; and do not use it.

Information Security is Interesting

- The most interesting/challenging threats to security are posed by human adversaries
  - Security is harder than reliability
- Information security is a self-sustaining field
  - Can work both from attack perspective and from defense perspective
- Security is about benefit/cost tradeoff
  - Thought often the tradeoff analysis is not explicit
- Security is not all technological
  - Humans are often the weakest link

Information Security is Challenging

- Defense is almost always harder than attack.
- In which ways information security is more difficult than physical security?
  - adversaries can come from anywhere
  - computers enable large-scale automation
  - adversaries can be difficult to identify
  - adversaries can be difficult to punish
  - potential payoff can be much higher
- In which ways information security is easier than physical security?

Tools for Information Security

- Cryptography
- Authentication and Access control
- Hardware/software architecture for separation
- Processes and tools for developing more secure software
- Monitoring and analysis
- Recovery and response

What is This Course About?

- Learn to think about security when doing things
- Learn how computers can be attacked, how to prevent attacks and/or limit their consequences.
  - No silver bullet; man-made complex systems will have errors; errors may be exploited
  - Large number of ways to attack
  - Large collection of specific methods for specific purposes
- Learn to understand and apply security principles when designing/building/analyzing systems

Ethical Use of Security Information

- We discuss vulnerabilities and attacks
  - Most vulnerabilities have been fixed
  - Some attacks may still cause harm
  - Do *not* try these outside the context of this course

Policies for Homework Cheating

- It is allowed/encouraged to discuss homework problems
- However, if you looks at another student's written or typed answers, or let another student look at your written or typed answers, that is considered cheating.
- If caught for the first time, receive 0 in the assignment. For the second time, receive a failing grade in class.

Coming Attractions …

- Cryptography: terminology and classic ciphers.
- Readings
  - Cryptography on Wikipedia