CIS 6930 Emerging Topics in Network Security

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About Instructor

- Dr. Yao Liu, Assistant Professor of Computer Science and Engineering Department
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  - Office: ENB 336
  - Office hours:
    - MW 11:00pm – 12:30pm

Course Objectives

- Learn advanced issues, concepts, principles, and mechanisms in network security , e.g.,
  - Secret sharing
  - Broadcast authentication protocols
  - Group key management
- Learn recent research advances in network security
- Prepare for graduate research in network security

Prerequisites

- It would be helpful to you if you have a rudimentary understanding of computer networks and security.

Text

- No required textbook
- Research papers listed on the course website
- Suggested textbook
  - *Charlie Kaufman, Radia Perlman, and Mike Speciner, Network Security: Private Communication in a Public World, 2nd Edition, Prentice Hall, ISBN: 0-13-046019-2.*

Course Mechanics

- Slides will be provided
- But be prepared to
  - Take notes, and
  - Participate in class discussion
- Course website:
  - http://www.cse.usf.edu/~yliu/Emerging%20Topics/teaching.html
  - For course materials, e.g., slides, homework files, papers, etc.
  - Will be updated frequently

Grading

- Homework assignment (15%)
- Summaries of reading papers (30%)
- In-class paper presentation (20%)
- Course research project (25%)
- quiz (10%)

Grading (Cont'd)

- The final grades are computed according to the following rules:
  - A+: >= 99% A: >= 97% and < 99% A-: >= 95% and < 97%
  - B+: >= 85% and < 95% B: >= 80% and < 85% B-: >= 75% and < 80%
  - C+: >= 66% and < 75% C: >= 63% and < 66% C-: >= 60% and < 63%
  - D+: >= 56% and < 60% D: >= 53% and < 56% D-: >= 50% and < 53%
  - F: < 50%.

Policies on incomplete grades and late assignments

- Homework, paper summaries, project deadlines will be hard.
- Late submission will be accepted with a 15% reduction in grade each day they are late by.
- Once a homework solution is posted or the paper is discussed in class, submissions will no longer be accepted.

Academic Integrity

- The university policies against academic dishonesty will be strictly enforced.
- Graduate students who are caught cheating will get an FF for this course.

Course Outline

- Topic 1: Basic concepts of network security
  - Encryption, decryption, hash functions, DES, public key, authentication techniques, etc.
- Topic 2: Advanced network security primitives
  - Secret sharing
  - Group Key Management
  - Broadcast authentication

Course Outline

- Topic 3: Emerging research topics
  - Implantable Medical Device Security
  - Security and Privacy Vulnerabilities of In-Car Wireless Networks
  - Wireless Electronic Warfare: Jamming and anti-jamming techniques
  - Location Based Access Control
  - Power grid security
  - RFID security
  - Smart phone security
  - ……

Research Paper

- Small team -- at most three students per group
- Proposal, interim report, and final report
  - Proposal due: Feb/20/16
  - Interim report: March/27/16
  - Final submission due: midnight EST, April/20/16
- The instructor will be available to discuss your topic during the office hours
- You should start thinking about team and topic now

Example Topics

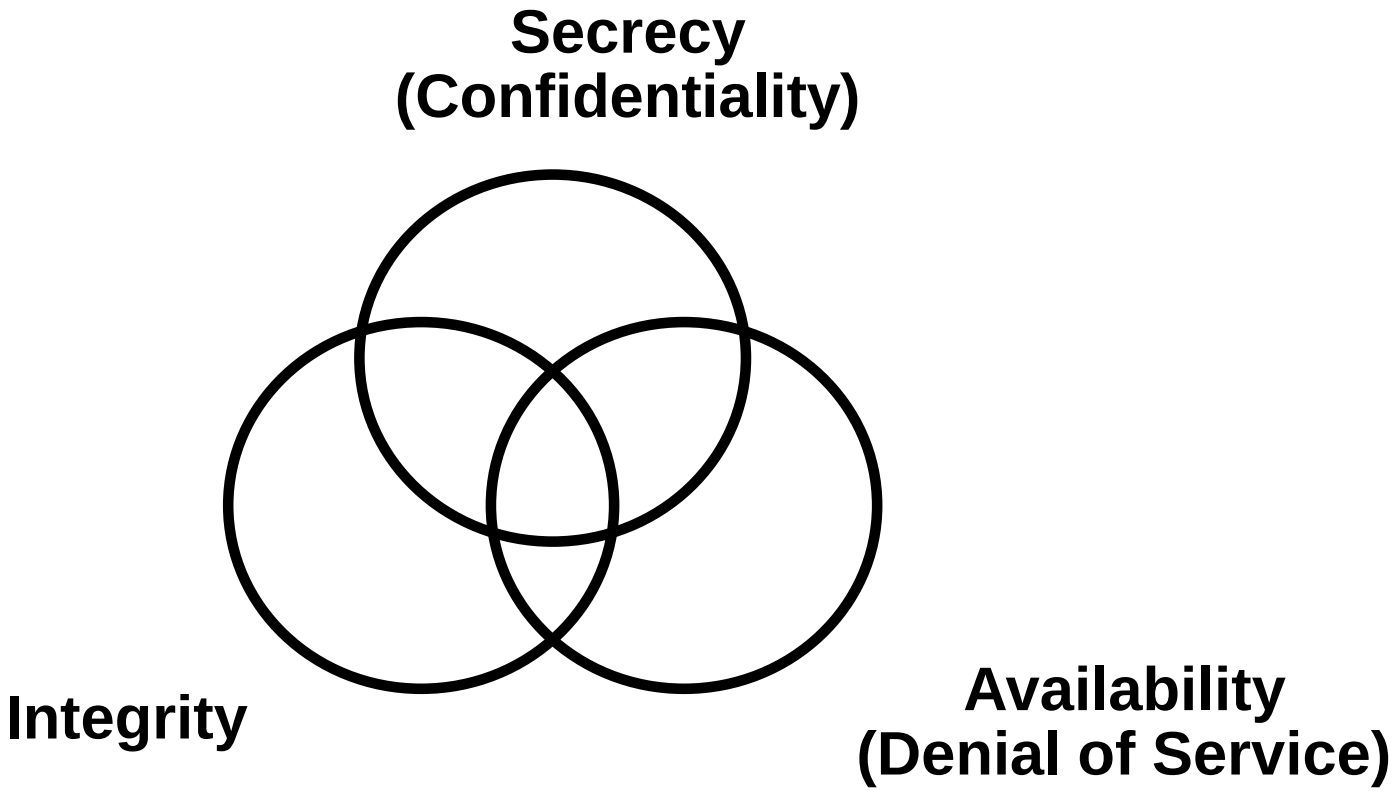
- Topics include but not limited to:
  - Security in Virtual Computing Clouds
  - Security in Mobile Ad-hoc Networks
  - Smart phone security
  - Power Grids Security
  - Vulnerability Analysis
  - Intrusion Detection
  - Authentication
  - DNS Security
  - Digital Watermarking
  - New techniques (e.g., security of Bitcoins)

In-class presentation

- Each student will be assigned of one paper to present in the class
- Paper presentation will start on Feburary 10th, and follows the alphabetic order on your last name.
  - Pratik Adhav
  - Saeed Alahmari
  - Radha Aluru
  - Geol Gladson Battu

A Brief Review of Basic Security Concepts

Security Objectives



Security Objectives

- Secrecy — Prevent/detect/deter improper disclosure of information
- Integrity — Prevent/detect/deter improper modification of information
- Availability — Prevent/detect/deter improper denial of access to services provided by the system

Commercial Example

- Secrecy — An employee should not know the salary of his manager
- Integrity — An employee should not be able to modify the employee's own salary
- Availability — Paychecks should be printed on time as stipulated by law

Military Example

- Secrecy — The target coordinates of a missile should not be improperly disclosed
- Integrity — The target coordinates of a missile should not be improperly modified
- Availability — When the proper command is issued the missile should fire

A Fourth Objective

- Securing computing resources — Prevent/detect/deter improper use of computing resources including
  - Hardware Resources
  - Software resources
  - Data resources
  - Network resources

Security Mechanisms

- In general three types
  - Prevention
  - Detection
  - Tolerance

Good prevention and detection both require good authentication as a foundation

Security Services

- Security functions are typically made available to users as a set of security services through APIs or integrated interfaces
- Confidentiality: protection of any information from being exposed to unintended entities.
  - Information content.
  - Parties involved.
  - how they communicate, how often, etc.
- Authentication: assurance that an entity of concern or the origin of a communication is authentic - it's what it claims to be or from
- Integrity: assurance that the information has not been tampered with

Security Services (Cont'd)

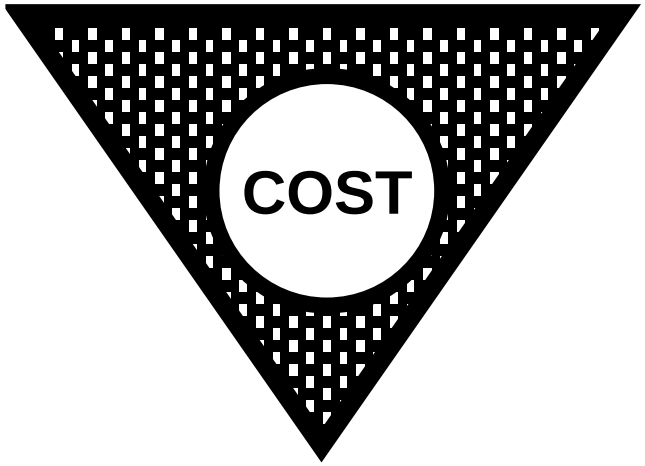
- Non-repudiation: offer of evidence that a party is indeed the sender or a receiver of certain information
- Access control: facilities to determine and enforce who is allowed access to what resources, hosts, software, network connections
- Monitor & response: facilities for monitoring security attacks, generating indications, surviving (tolerating) and recovering from attacks

Security Assurance

- How well your security mechanisms guarantee your security policy
- Everyone wants high assurance
- High assurance implies high cost
  - May not be possible
- Trade-off is needed

Security Tradeoffs

Security **Functionality**



Ease of Use

Security by Obscurity

- Security by obscurity
  - If we hide the inner workings of a system it will be secure
- More and more applications open their standards (e.g., TCP/IP, 802.11)
- Widespread computer knowledge and expertise

Security by Legislation

- Security by legislation says that if we instruct our users on how to behave we can secure our systems
- For example
  - Users should not share passwords
  - Users should not write down passwords
  - Users should not type in their password when someone is looking over their shoulder
- User awareness and cooperation is important, but cannot be the principal focus for achieving security

Threat-Vulnerability

- Threats — *Possible* attacks on the system
- Vulnerabilities — Weaknesses that may be exploited to cause loss or harm

Threat Model and Attack Model

- Threat model and attack model need to be clarified before any security mechanism is developed
- Threat model
  - Assumptions about potential attackers
  - Describes the attacker's capabilities
- Attack model
  - Assumptions about the attacks
  - Describe how attacks are launched