Computer Security Seminar — Lecture 1

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Computer Science Department

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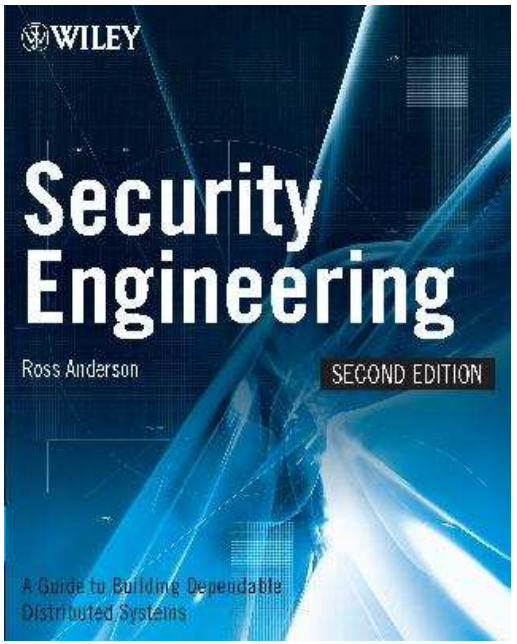
Outline

What?

- This is a seminar about computer security.
- Seminar:
  - I shall give a few introductory lectures,
  - Each one will present a chapter from the "Security Engineering" book by Ross Andreson.
- You shall present the chapters to the class.
- Which means: you need to know the material, and you need to pass it on to your peers.



Why?

- Computer security is a really hot topic.
- Computer security is becoming increasingly important in an interconnected world (especially in the critical network infrastructure sector).
- We meet computer security on a daily base, but usually it is not satisfactory.

Where, When, and Who?

- Location: Jacobs' 205.
- Sun., 16:15–17:45.
- Lecturer:
  - Orr Dunkelman
  - Email: orrd (at-sign) cs (dot) haifa (dot) ac (dot) il
  - Office: Jacobs 408.
  - Phone: 8447
  - Office Hour: Sun., 10:30–11:30.
- Website:
  `http://www.cs.haifa.ac.il/~orrd/CompSecSeminar/`

Grades

- 60% — Lecturer's evaluation,
- 20% — Participation in classes (it is mandatory to attend at least 10 meetings),
- 20% — Peers' evaluation.

Perquisites

- Operating Systems (203.2110),
- Computational Models (203.3510)

Knowledge of computer networks is recommended (but not mandatory).

Computer Security

- Most engineering fields try to optimize:
  - Minimal costs (production, deployment, maintenance),
  - Maximal reuse (chemicals, designs, code snippets),
  - Safety margins,
- Safety margins are the outcome of experience and risk assessment processes:
  - Ground type (the more solid — lower safety margins),
  - Risk of earth-quacks (the safer — lower safety margins),
  - Failure "cost" (less users — lower safety margins),
  - Identification of "wear and tear" (easier identification — lower safety margins)

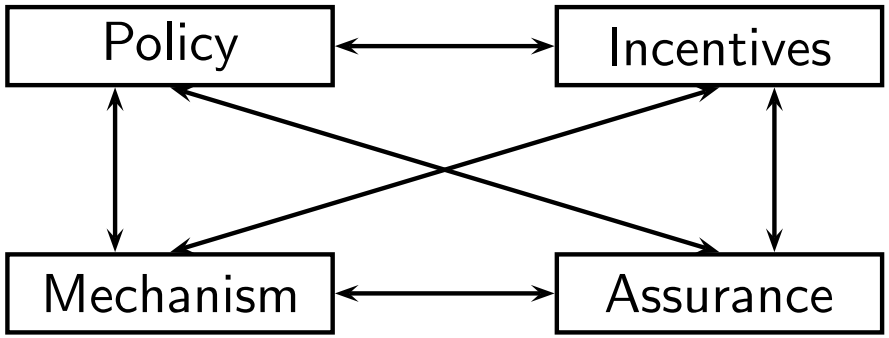
Computer Security (cont.)

- Security engineering is very different from typical engineering:
  - The damage is not caused randomly, but is targeted.
  - The adversary is malicious, rather than "randomly distributed" (e.g., in communication systems).
  - The adversary looks for the weakest link.
  - The adversary may have a great deal of resources at his disposal.
- In addition, the risk assessment process is biased.
  - We have very little experience with the effects of failed security mechanisms,
  - The economic incentives are not always aligned correctly.
  - The working environments of running code changes, leaving "internal" systems open to the "world".
  - Security engineering — not a very common practice.

Security Engineering

- Building dependable systems in face of malice, error, or mischance.
- Composed of tools, processes, and methods for:
  - Design,
  - Implementation,
  - Testing,
  - Auditing,
  - Adaptation,
- to target a varying set of attacks and adversaries.

The Security Engineering Framework



- Policy — the intended outcome (security level).
- Mechanism — how to achieve the security level.
- Assurance — the trust needed from each mechanism.
- Incentives — motivating the entities in the "world".

Example — Airport Security

- The 9/11 success was due to policy failure (small knives were allowed through security at that time).
- The policy has changed to ban knives.
- Now, the policy has changed to ban many "possible" weapons (e.g., umbrellas, liquids).
- Of course, even a good policy does not cover all cases.
- Moreover, airport security prefers to "err" to the safe side.
- Obviously, this approach is wrong.
- As noted by Freakonimcs writers, the total time wasted in these security checks is equivalent to the lives of several tens of people a year...
- Which makes the 6–8 billion US$/year spent by the TSA a huge waste.

Example — Airport Security (cont.)

- Other good policies/mechanisms would be:
  1. Fortify the cockpits (one time investment).
  2. Guarding airports at night.
  3. True identification of flyers (and maintaining a database of true suspects).
  4. Profiling — identifying which person is more of a threat.
- However, political, psychological, and moral issues, tend to interfere with these policies.

The Security Evaluation Process

- To define the policies, we first need to identify the threat model:
  - What are the assets to protect,
  - What are the possible threats (and their probabilities),
  - What are the risks which arise from these threats,
  - Who is the adversary, and what resources he has at his disposal,
  - What is the "security budget" (purchase, training, maintenance, interference with usability, etc.)
  - What are the impacts of applying the policies.
- Usually the threats are organized in *attack vectors*, which identify the weakness source, and the adversarial plan.

The Security Evaluation Process — Threats

- Confidentiality, secrecy, and privacy — obtaining access to restricted information.
- Integrity — changing values or system behavior by unauthorized entities.
- Availability — preventing access from authorized entities.
- Destruction — disabling resources.
- Money stealing/laundering/hiding — performing illegal/illegitimate actions with money (or equivalent tokens).

Security Analysis of a Typical Bank

- Identify the systems in use:
  - Bookkeeping system (teller, branch, county, bank).
  - Automatic teller machine systems.
  - Website (information, promotional, users' accounts).
  - Messaging systems (between branches, banks, stock exchange, etc.)
  - Alarms in branches.
  - Identification (account holders, personal, safes).

Threats on the Bookkeeping System

- Tellers:
  - "Creative" transaction registration,
  - Report faulty loses in case of a bank robbery,
  - "Manipulating" account holders,
- Accountants:
  - "Creative" transaction registration,
  - Embezzlement,
- Loan agents: Abusing credit supplied by bank,
- Bookkeeping software developer/system personal:
  - Installation of backdoors in software/system,
  - Collaboration with other fraudulent individuals,
  - Obtaining access codes of other users in the system,

Threats on the Automated Teller Machines

- "Insiders":
  - Developer/system personal,
  - Bank agents (abusing new bank cards),
- Account holders: Reporting "unsuccessful" withdrawals.
- Crooks:
  - Stealing bank cards and PINs,
  - Mugging,
  - Rouge ATM machines deployment,
  - Stealing an ATM machine.

Who are the Adversaries?

Everyone!

- Users and insiders.
- "Old school" hackers.
- Script Kiddies.
- Criminals.
- Terrorists.
- Countries and superpowers.

Why to Hack/Attack?

- Fun.
- Money.
- Espionage (business/intelligence).
- Causing damage.
- Reputation (as an attacker).
- Hurting reputation (as a defender).
- Instantiating fear.
- Cyber warfare.

How to Attack?

- Social engineering.
- Wiretapping.
- Manipulating communications.
- Manipulating data (at transit or at rest).
- Physical entry/Inside access.
- The use of malware (viruses, Trojan horses, worms, ...).
- (Distributed) Denial of Service.
- Spam.
- Targeted attacks.

How to Protect?

- Physical security.
- Authentication and identification.
- Security protocols.
- Cryptographic tools.
- Security products (firewalls, proxies, ...).
- Audit trials.
- Redundancy.
- Virtualization.
- Access control.
- Failsafe design methodologies.
- Awareness.
- Penetration testing.