Lecture 2
September 26, 2025

ECS 235A, Computer and Information Security

Administrative Stuff

- Some minor corrections to Homework 1:
  - I deleted the spurious "10 minutes" at the end of question 3; it was there by error
  - I added "In the Bell-LaPadula Model" to question 9 to clarify the specific model and context for the question
- There was no audio on the video for the last class; the slides are clear, though
  - No, it isn't your computer . . .

Security and Workplace Politics

- Politics in the workplace introduces risks, which makes politics in the workplace a security issue.
  - Decision making
  - Divisiveness
  - Exclusion
  - Groupthink
  - Limited resources

By Joshua Goldfarb, in https://www.securityweek.com/perspective-why-politics-in-the-workplace-is-a-cybersecurity-risk/

Design Principles

- Underlying concepts: simplicity, restriction
- Principles
  - Least Privilege
  - Fail-Safe Defaults
  - Economy of Mechanism
  - Complete Mediation
  - Open Design
  - Separation of Privilege
  - Least Common Mechanism
  - Least Astonishment

Overview

- Simplicity
  - Less to go wrong
  - Fewer possible inconsistencies
  - Easy to understand
- Restriction
  - Minimize access
  - Inhibit communication

Least Privilege

- A subject should be given only those privileges necessary to complete its task
  - Function, not identity, controls
  - Rights added as needed, discarded after use
  - Minimal protection domain

Related: Least Authority

- Principle of Least Authority (POLA)
  - Often considered the same as Principle of Least Privilege
  - Some distinguish them:
    - *Permissions* control what subject can do to an object directly
    - *Authority* controls what influence a subject has over an object (directly or indirectly, through other subjects)

Fail-Safe Defaults

- Default action is to deny access
- If action fails, system as secure as when action began

Economy of Mechanism

- Keep it as simple as possible
  - KISS Principle
- Simpler means less can go wrong
  - And when errors occur, they are easier to understand and fix
- Interfaces and interactions

Complete Mediation

- Check every access
- Usually done once, on first action
  - UNIX: access checked on open, not checked thereafter
- If permissions change after, may get unauthorized access

Open Design

- Security should not depend on secrecy of design or implementation
  - Popularly misunderstood to mean that source code should be public
  - “Security through obscurity”
  - Does not apply to information such as passwords or cryptographic keys

Separation of Privilege

- Require multiple conditions to grant privilege
  - Separation of duty
  - Defense in depth

Least Common Mechanism

- Mechanisms should not be shared
  - Information can flow along shared channels
  - Covert channels
- Isolation
  - Virtual machines
  - Sandboxes

Least Astonishment

- Security mechanisms should be designed so users understand why the mechanism works the way it does, and using mechanism is simple
  - Hide complexity introduced by security mechanisms
  - Ease of installation, configuration, use
  - Human factors critical here

Related: Psychological Acceptability

- Security mechanisms should not add to difficulty of accessing resource
  - Idealistic, as most mechanisms add *some* difficulty
    - Even if only remembering a password
  - Principle of Least Astonishment accepts this
    - Asks whether the difficulty is unexpected or too much for relevant population of users

Reference Monitor

- *Reference monitor* is access control concept of an abstract machine that mediates all accesses to objects by subjects
- *Reference validation mechanism* (RVM) is an implementation of the reference monitor concept.
  - Tamperproof
  - Complete (always invoked and can never be bypassed)
  - Simple (small enough to be subject to analysis and testing, the completeness of which can be assured)
    - Last engenders trust by providing evidence of correctness
- Note: RVM is almost always called a reference monitor too

Examples

- *Security kernel* combines hardware and software to implement reference monitor
- *Trusted computing base* (*TCB*) consists of all protection mechanisms within a system responsible for enforcing security policy
  - Includes hardware and software
  - Generalizes notion of security kernel

Policy and Reference Monitor

- Reference monitor implements a given policy
  - It has a tamperproof authorization database
  - Also maintains an audit trail (record of security-related events) for review

- More on this later; we need some background first

Security Policy

- Policy partitions system states into:
  - Authorized (secure)
    - These are states the system can enter
  - Unauthorized (nonsecure)
    - If the system enters any of these states, it's a security violation
- Secure system
  - Starts in authorized state
  - Never enters unauthorized state