CSE 484 / CSE M 584:
Computer Security and Privacy

Autumn 2019

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

Announcements

- My office hours
  - 12/4 (Wed), 11:30am, CSE1 Attrium?
- Final Project checkpoint 2 looked great!
- HW3 + Lab3: both "light", but please don't wait until Friday to start
- Friday: *Optional* opportunity to learn about Space + Security

Next

- Physical Security + Connections to Computer Security
- Usability
- Social Engineering

PHYSICAL SECURITY

Physical Security and Computer Security

- Relate physical security to computer security
  - Locks, safes, etc
- Why?
  - More similar than you might think!!
  - The more places one sees "the Security Mindset" and security issues manifest, the more opportunities "the Security Mindset Muscle" can grow
  - After CSE 484, please do try to keep thinking about security everywhere – computers, locks, windows, …
    - Of course, take a balanced perspective, consider risk management, and note that "the sky is not falling" ☺

Switching Slide Decks

- We will switch to a slide deck that will not be online
- But if you’re interested in the subject of lockpicking, we recommend
  - Blaze, “Cryptology and Physical Security: Rights Amplification in Master-Keyed Mechanical Locks”
  - Blaze, “Safecracking for the Computer Scientist”
  - Tool, “Guide to Lock Picking”
  - Tobias, “Opening Locks by Bumping in Five Seconds or Less”

Returning now from the other slide deck…

Adversarial Goals

- **Confidentiality** … adversary should not be able to enter and steal information (e.g., see the spy movies, or think about bank computer screens facing windows)
- **Integrity** … adversary should not be able to enter property and remove items, or damage items, or place new items (e.g., installing spy device)
- **Availability** … adversary should no be able to deny legitimate entry (denial of service) into an environment (e.g., put superglue in a lock, or gum, or break a wrong key in lock)

Threat Modeling (Security Reviews)

- Assets: What are we trying to protect? How valuable are those assets?
- Adversaries: Who might try to attack, and why?
- Vulnerabilities: How might the system be weak?
- Threats: What actions might an adversary take to exploit vulnerabilities?
- Risk: How important are assets? How likely is exploit?
- Possible Defenses

- E.g., Different defenses and considerations might be appropriate in different situations (e.g., gym locker, bank, nuclear weapons silos)
- E.g., Different adversaries (insiders, like former tenants or ex-employees, or outsiders)

Approaches to Security

- Prevention
  - Stop an attack
  - E.g., door locks and fences and bars on windows in physical world environment
- Detection
  - Detect an ongoing or past attack
  - E.g., video camera in physical world environment
- Response
  - Respond to attacks
  - E.g.., home alarm system that calls police when entry is detected

Whole System is Critical

- Securing a system involves a whole-system view
  - Cryptography
  - Implementation
  - People
  - Physical security
  - Everything in between

- This is because "security is only as strong as the weakest link," and security can fail in many places
  - No reason to attack the strongest part of a system if you can walk right around it.

Overlapping Defensive Ideas

- Defense in Depth
  - Layers, e.g., cardkey access then physical keys
- Deterrents (which can also be layers)
  - Home alarm systems
  - Cameras
- Least Privilege
  - At UW:
    - Grad keys can open certain doors
    - Faculty keys can open all those doors and more doors
    - Custodial keys can open even more doors
    - (see previously cited document from Matt Blaze to understand how this works)

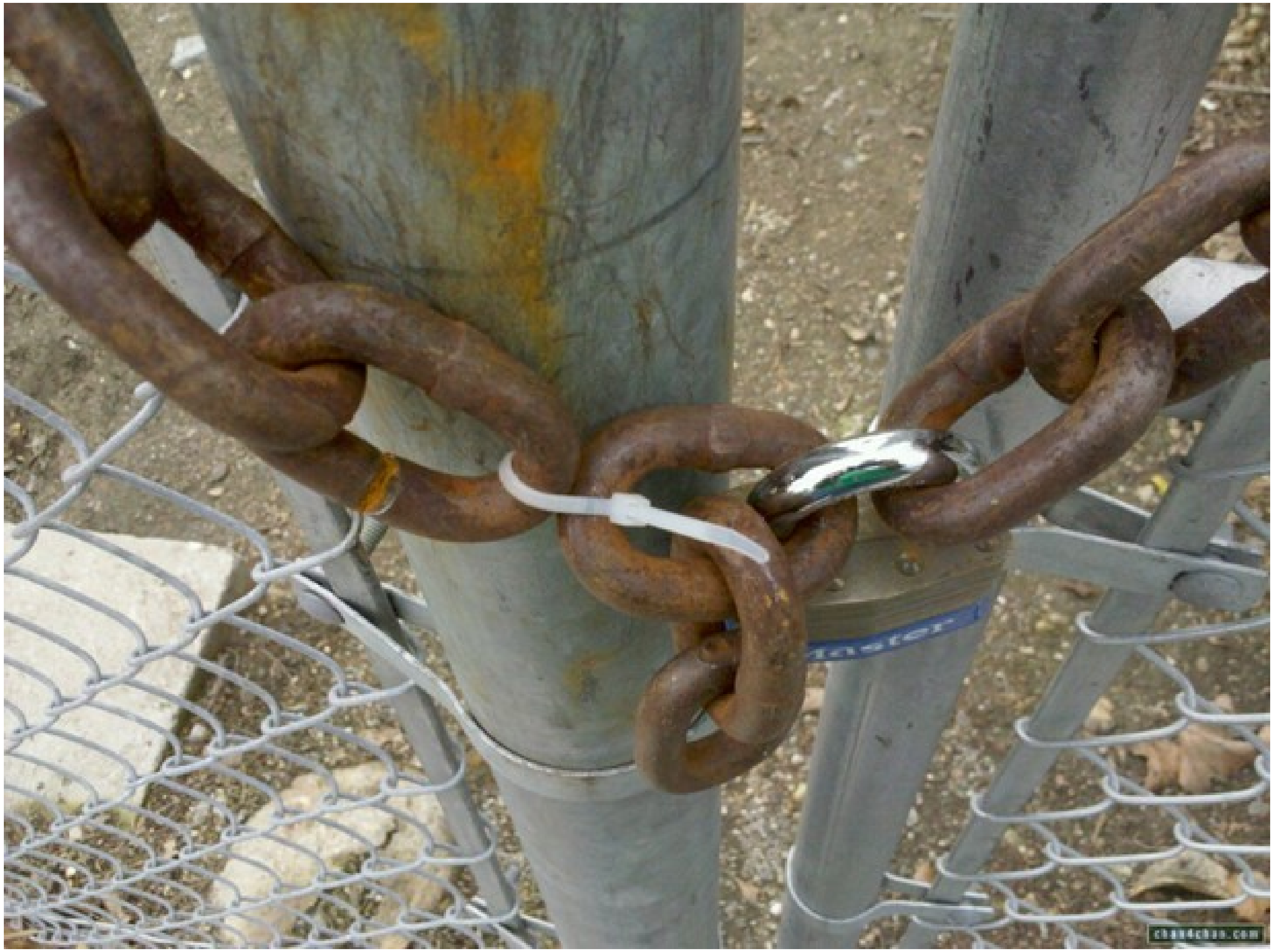
Saltzer and Schroeder (1975 paper)

- See the paper: http://web.mit.edu/Saltzer/www/publications/protection/
- Wikipedia's summary of principles on next slide (since Wikipedia summary is shorter): https://en.wikipedia.org/wiki/Saltzer_and_Schroeder%27s_design_principles
  - Connections and insights can be made by thinking about these principles in the context of physical security

Saltzer and Schroeder (1975 paper)

- **Economy of mechanism:** Keep the design as simple and small as possible.
- **Fail-safe defaults:** Base access decisions on permission rather than exclusion.
- **Complete mediation:** Every access to every object must be checked for authority.
- **Open design:** The design should not be secret.
- **Separation of privilege:** Where feasible, a protection mechanism that requires two keys to unlock it is more robust and flexible than one that allows access to the presenter of only a single key.
- **Least privilege:** Every program and every user of the system should operate using the least set of privileges necessary to complete the job.
- **Least common mechanism:** Minimize the amount of mechanism common to more than one user and depended on by all users.
- **Psychological acceptability:** It is essential that the human interface be designed for ease of use, so that users routinely and automatically apply the protection mechanisms correctly.
- **Work factor:** Compare the cost of circumventing the mechanism with the resources of a potential attacker.
- **Compromise recording:** It is sometimes suggested that mechanisms that reliably record that a compromise of information has occurred can be used in place of more elaborate mechanisms that completely prevent loss.

What’s Wrong With This Picture?



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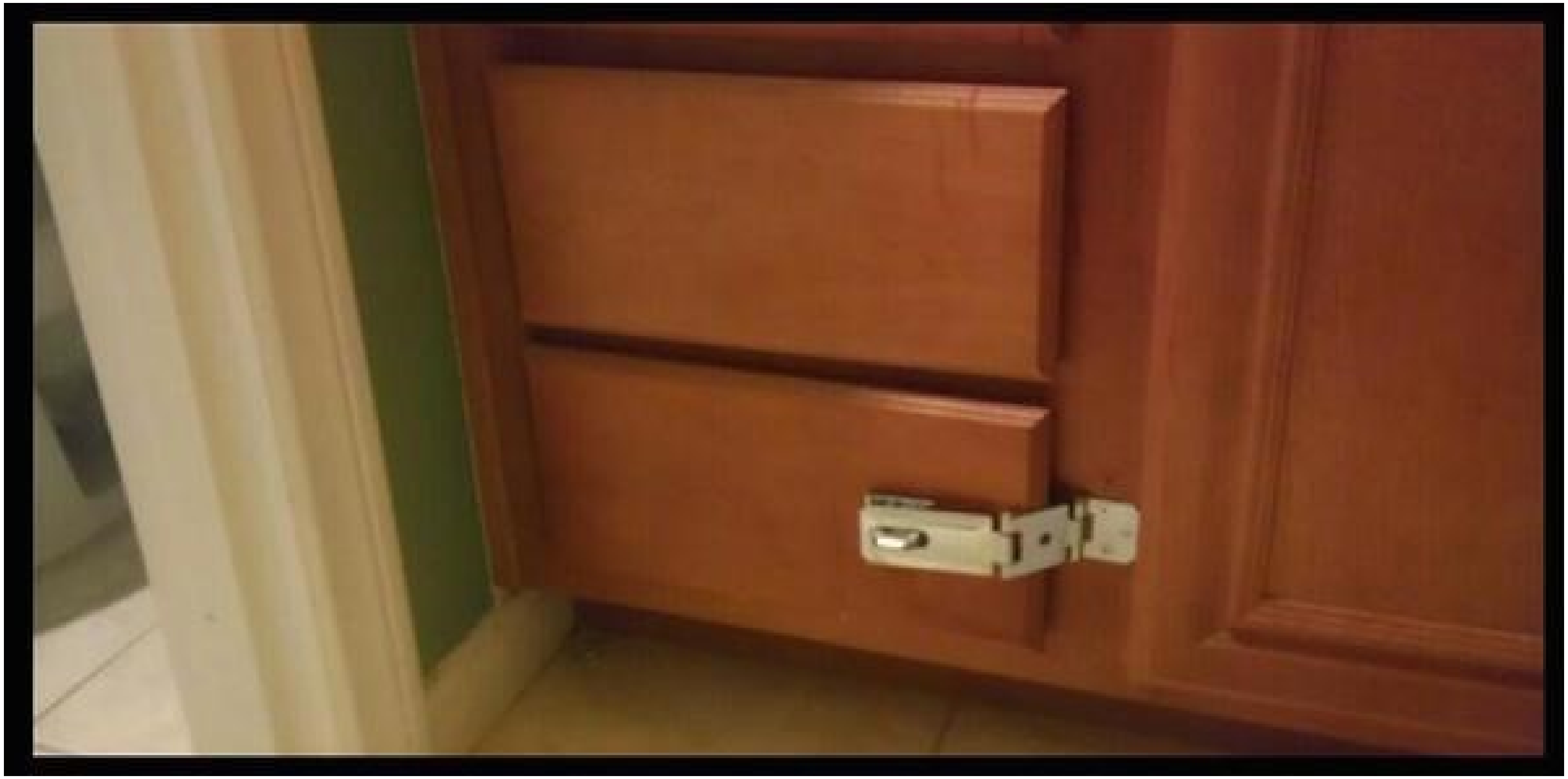
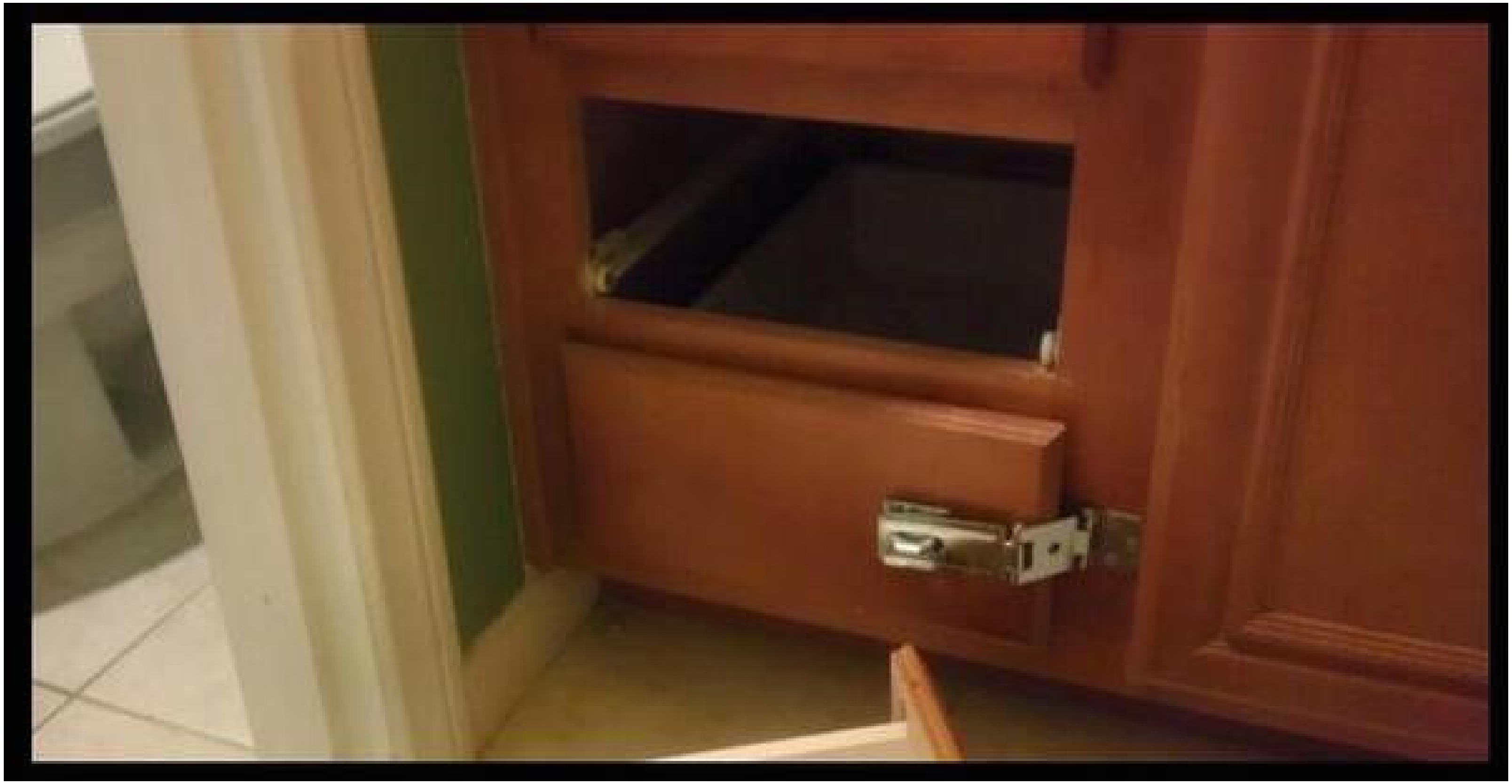


Think About the Whole System



Usability

- Usability is so important, that the importance of usability has permeated much of this course
- But let's now take a few moments to consider usability specifically

- And I encourage everyone to consider taking an HCI course!
- And to always think about *all* the stakeholders that might be impacted by a system
  - Direct stakeholders
  - Indirect stakeholders
- Developers are users too ☺ (i.e., consider making it easy/usable to develop secure solutions)

On Usability

- Why is usability important?
  - People are the critical element of any computer system
    - People are the real reason computers exist in the first place
  - Even if it is **possible** for a system to protect against an adversary, people may use the system in other, **less secure** ways
  - Usability errors can lead people to think that they are using a secure setting when in fact they are not (e.g., certain password managers)

Question

- What does usable security mean?
- What does it mean for a system to have usable security?

How to Improve?

- These are all **concepts** that people have discussed (not that everyone agrees):
  - Security education and training
  - Help users build accurate mental models
  - Find ways to make systems better match people's natural mental models
  - Make security invisible
  - Make security the least-resistance path
- **On your own:** Think about usability challenges that you have encoutered, with respect to security, and what would have made those systems more usable
- **Big recommendation:** Think proactively about all stakeholders (not just people similar to the system designers)

Social Engineering

- Art or science of skillfully maneuvering human beings to take action in some aspect of their lives
  - From Social Engineering: The Art of Human Hacking by Christopher Hadnagy
  - (Also see: The Art of Deception: Controlling the Human Element of Security by Kevin Mitnick and William Simon)
- Used by
  - Hackers
  - Penetration testers
  - Spies
  - Identity thieves
  - Disgruntled employees
  - Scam artists
  - Executive recruiters
  - Salespeople
  - Governments

Example

- Hello?
- Hello?
- Hello?
- You called me?
- You called me?
- There’s something wrong with this phone – what kind of phone do you have?
- (From DEFCON social engineering competition winner)

Example

- Take this survey, win and iPhone
- Call “victims”, to explain that they were victims of a phishing training, which they failed, and now need to clear up their computer
- Have them download and install clean up software
- Yes, okay to bypass “unknown source” warning for the software install
- Okay, great, now next, I need you to now change your password on this main system…
- Good, good, you are clearly a responsible employee. Thank you for taking this so seriously. Now I need you to download a new certificate for your directory server, let me tell you how…
- (Inspired by a talk by Chris Hadnagy, though I might have exact words wrong)

Example from Mark Seiden

- Every time he pen tests a company, he carries with him a printed document that says
  - "This person is doing a pen test of security, authorized by the CEO"
  - "If you have any questions, call this number <number>"
  - Signed by the CEO
- 50% of times that he is stopped by a security guard, he shows them the paper and they say "oh, okay, that makes sense", and then lets him proceed
- 50% of the remaining 50% of the times: the security guard calls the phone number *on the paper…*

Information Gathering

- “No information is irrelevant”

- Example:
  - Know that target collects bumper stickers (see forum post related to bumper sticker collecting)
  - Call target, mention recently inherited a bumper sticker collection
  - Send follow-up email, with a link (behind which is malware)
  - Information used: email address, phone number, information about interest in bumper stickers

Information to Collect

- About a company
  - The company itself
  - Procedures within the company (e.g., procedures for breaks)
- About individuals

Elicitation

- To bring or draw out. Alternately, it is defined as a stimulation that calls up a particular class of behaviors
  - Being able to use elicitation means you can fashion questions that draw people out and stimulate them to take a path of behavior you want.
  - (From Social Engineering: The Art of Human Hacking by Christopher Hadnagy)
- NSA definition: "the subtle extraction of information during an apparently normal and innocent conversation."

Why Elicitation Works

- Most people have the desire to be polite, especially to strangers
- Professionals want to appear well informed and intelligent
- If people are praised, they will often talk more and divulge more
- Most people would not lie for the sake of lying
- Most people respond kindly to people who appear concerned about them

Strategies Social Engineering Experts Mention

- Appeal to Someone’s Ego
- Express a Mutual Interest
- Make a Deliberately False Statement
- Volunteer Information
- Assume Knowledge
- Use the Effect of Alcohol

Pretexting

- The background story, dress, grooming, personality, and attitude that make up the character you will be. Everything you would imagine that person to be.
  - Another definition: creating an invented scenario to persuade a targeted victim to release information or perform some action.
  - (From Social Engineering: The Art of Human Hacking by Christopher Hadnagy)

Principles and Planning

- The more research you do, the better chance of success
- Involving your own personal interests will increase success
- Practice dialects or expressions
- Phone can be easier than in person
- The simpler the pretext, the better the chance of success
- The pretext should appear spontaneous
- Provide a logical conclusion or follow-through for the target

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