Lecture 01 – The Security Mindset

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Adapted from Michael Bailey's ECE 422

About Me

- 2012 Ph.D. from UC San Diego in CS
- 2012–2015 Assistant Research Professor at Johns Hopkins University (yes, there's an s in Johns)
- 2015– Assistant Professor at UIC

About Me

- Research area: Computer Security
- Some prior research
  - Voting machine security (change votes)
  - Automotive security (remote car hacks)
  - Back-scatter, whole-body X-ray scanner (weapons)
  - iSight camera (disable indicator LED while on)
  - Analysis of backdoored PRNG in TLS/IPSEC
- Looking for students!

About Me

Goals for this Course

- Critical thinking
  - How to think like an attacker
  - How to reason about threats and risks
  - How to balance security costs and benefits
- Learn to be a security-conscious citizen

Requirements

- 4 or 5 Security projects (difficult!)
- Two in-class exams
- No final

Policies

- Attendance: not mandatory, but you should come anyway
- Late work: 3 late days
- Collaboration: Work in groups of 2 on projects
- Communication: Don’t email me! Use Piazza
- Academic misconduct: punishment will be based on severity up to expulsion (seriously)

Examples of misconduct (nonexhaustive list)

- Claiming someone else's work as your own
- Searching for existing solutions to assignments
- Falsifying program output
- Collaborating outside your group
- Sharing code/solutions outside your group

Projects

- Work in groups of 2 (not required, *highly recommended*)
- Generally not much programming per project
- A lot of time thinking/tinkering/debugging

What is Computer Security?

- Security is a property (or more accurately a collection of properties) that hold in a given system under a given set of constraints
  - Where a system is anything from hardware, software, firmware, and information being processed, stored, and communicated.
  - and constraints define adversaries and their capabilities.
- Can also mean the measures and controls that ensure these properties
- Security is weird, as we don't *explicitly* study other properties
  - Correctness
  - Performance

Meet the Adversary

"Computer security studies how systems behave in the presence of an adversary."

- The adversary
  - a.k.a. the attacker
  - a.k.a. the bad guy

* An intelligence that actively tries to cause the system to misbehave.

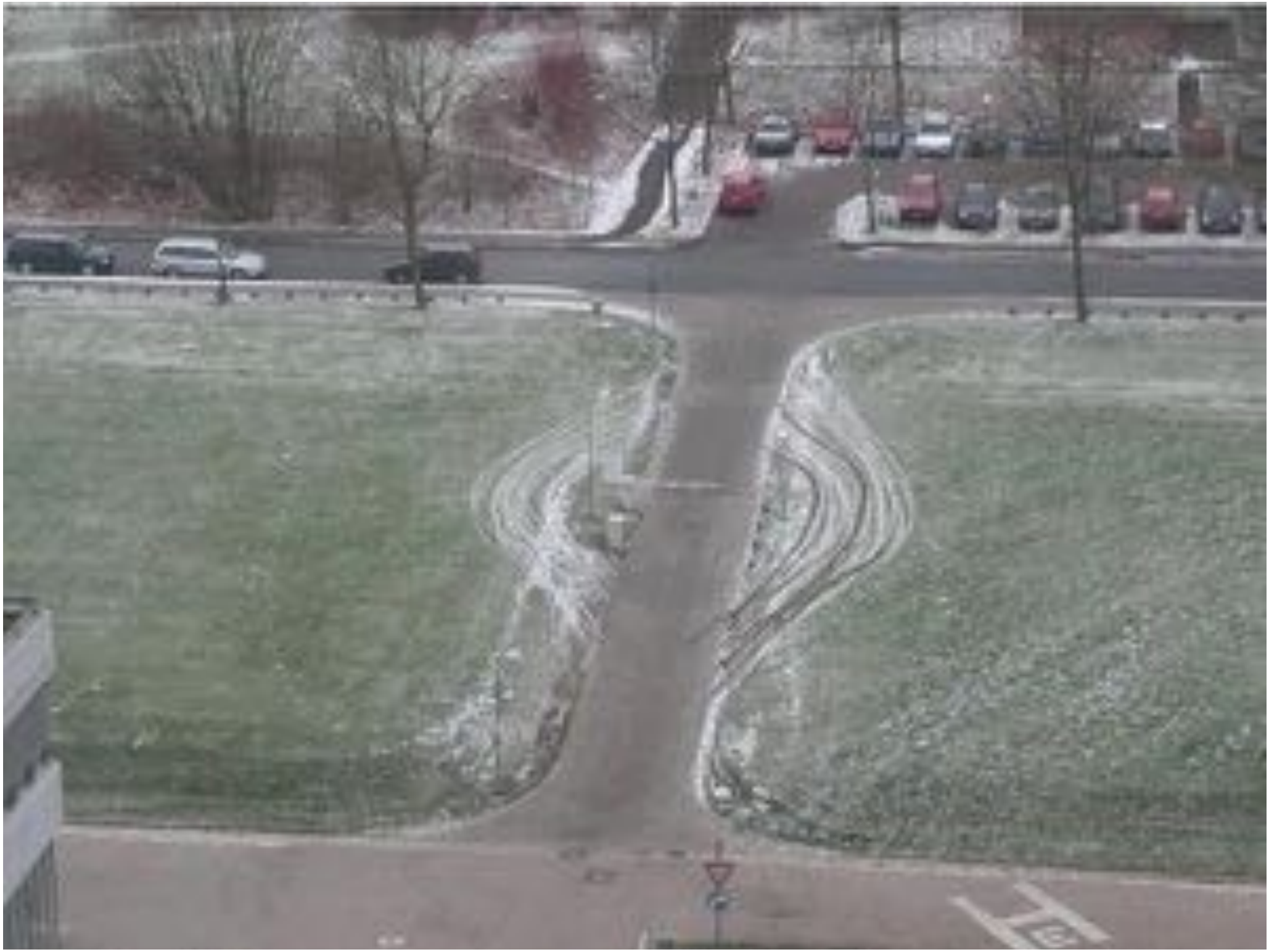
“Know your enemy.”

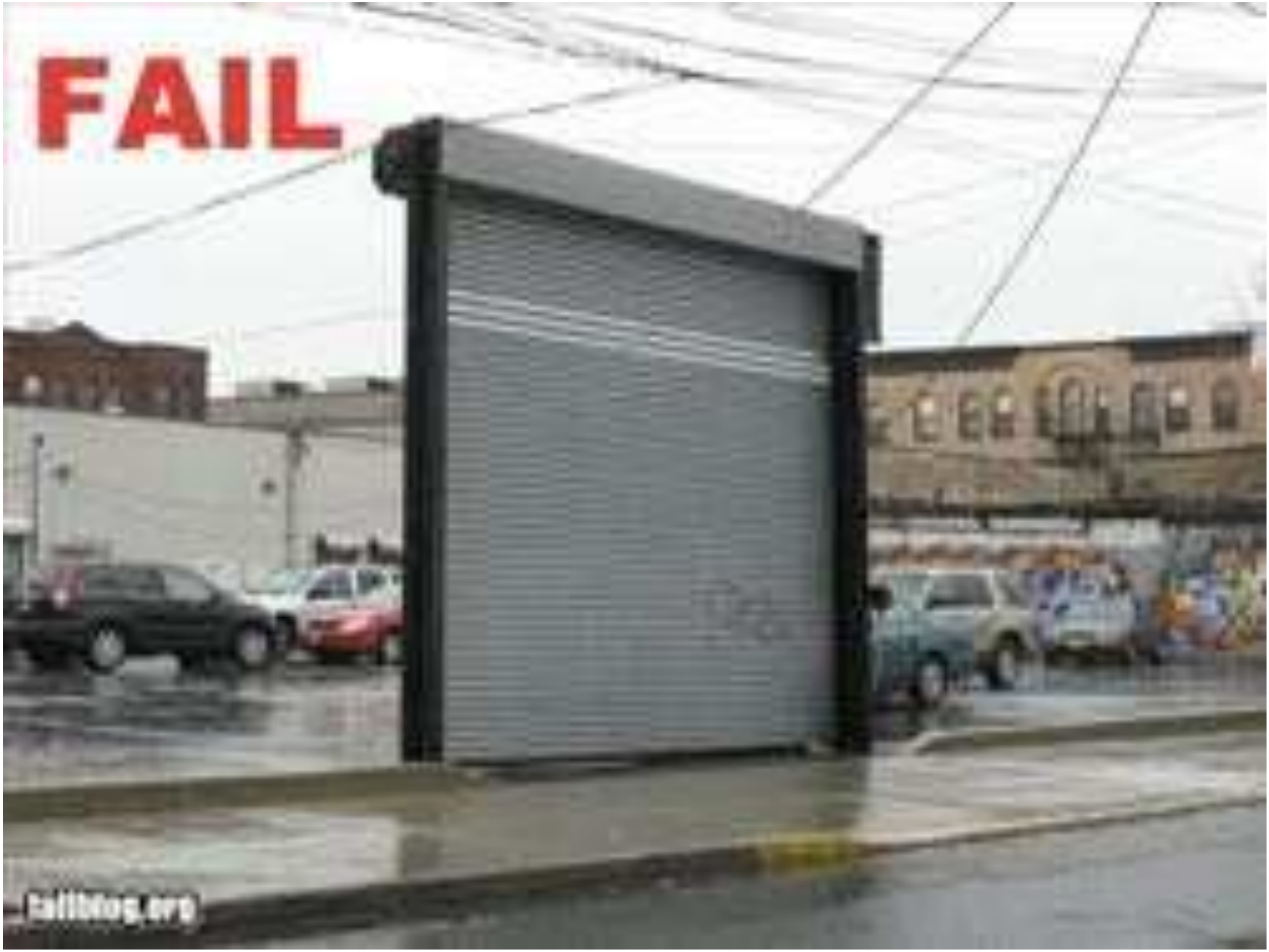
- Motives?
- Capabilities?
- Degree of access?

Thinking Like an Attacker

- Look for weakest links – easiest to attack.
- Identify assumptions that security depends on. Are they false?
- Think outside the box: Not constrained by system designer's worldview.

Practice thinking like an attacker:
For every system you interact with, think about what it means for it to be secure, and image how it could be exploited by an attacker.

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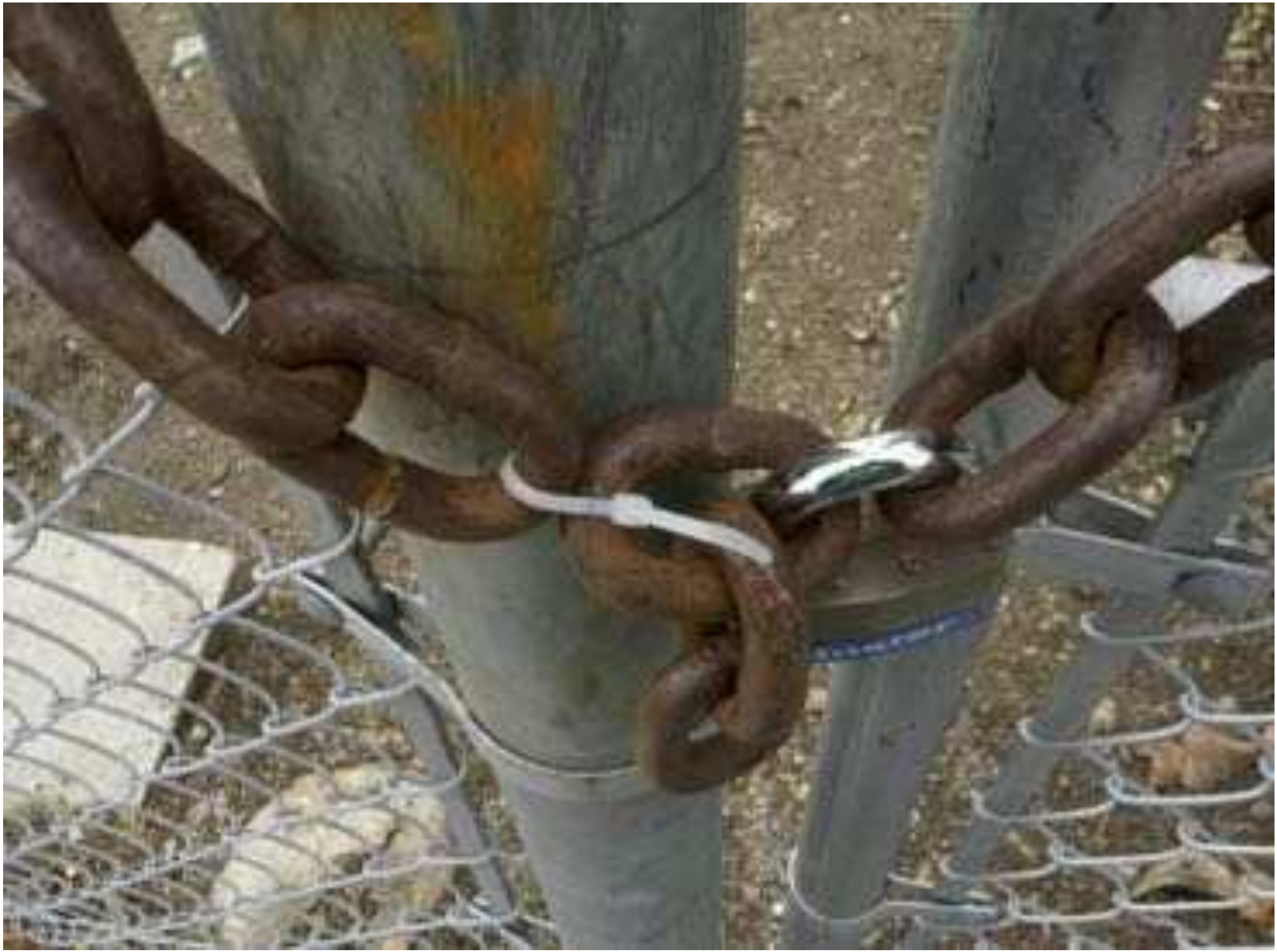
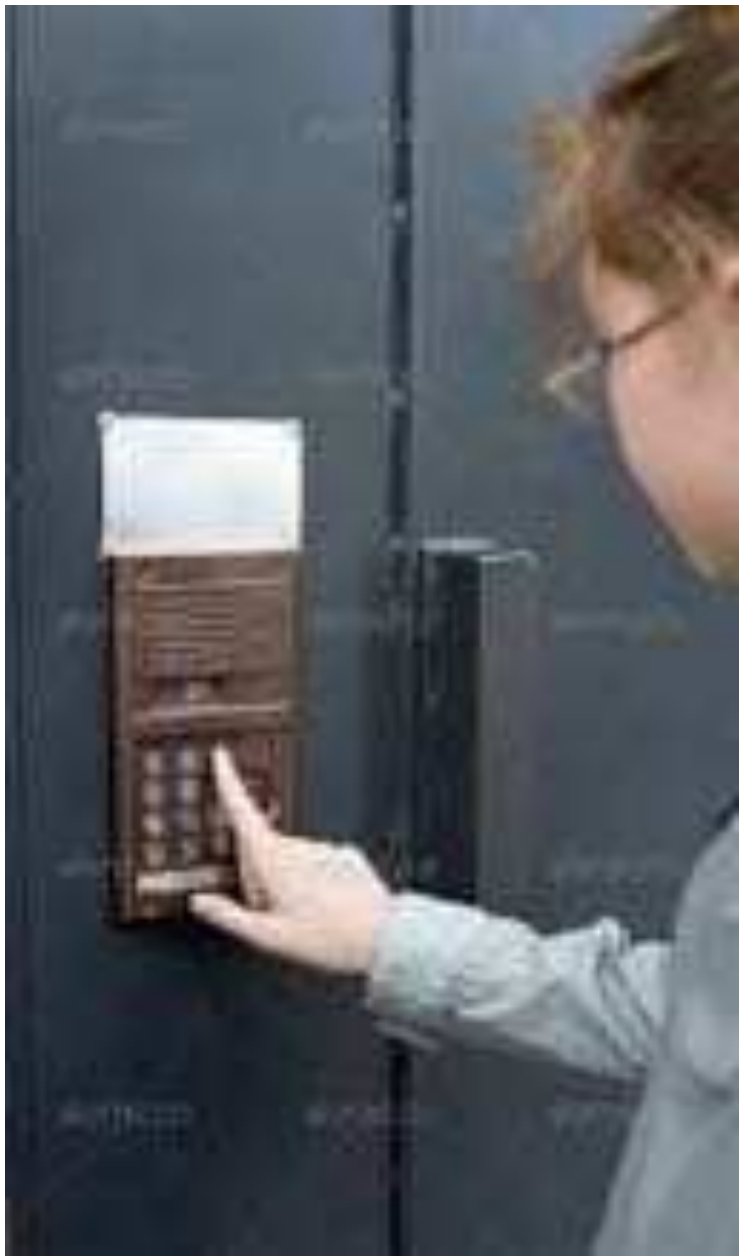


Exercise

- Door lock/intercom
  - Occupant presses key which makes a tone over the intercom
  - Lock is unlocked when tone is detected over the intercom
- How can an attacker subvert this to gain access?



Thinking as a Defender

- Security policy
  - What are we trying to protect?
  - What properties are we trying to enforce?
- Threat model
  - Who are the attackers?
  - What are their Capabilities? Motivations? Access?
- Risk assessment
  - What are the weaknesses of the system?
  - How likely?
- Countermeasures
  - Technical vs. nontechnical?
  - How much do they cost?

Challenge is to think rationally and rigorously about risk. *Rational paranoia.*

Security Policies

- What assets are we trying to protect?

- What properties are we trying to enforce?
  - Confidentiality
  - Integrity
  - Availability
  - Privacy
  - Authenticity

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Threat Models

- Who are our adversaries?
  - Motives?
  - Capabilities?
  - Access?

- What kinds of attacks do we need to prevent?
  (Think like the attacker!)

- Limits: Kinds of attacks we should ignore?

Assessing Risk

- What would security breaches cost us?
  - Direct costs: Money, property, safety, ...
  - Indirect costs: Reputation, future business, well being, …
- How likely are these costs?
  - Probability of attacks?
  - Probability of success?
- Remember: rational paranoia

Countermeasures

- Technical countermeasures
- Nontechnical countermeasures
  - Law, policy (government, institutional), procedures, training, auditing, incentives, etc.

Security Costs

- No security mechanism is free
  - Direct costs: Design, implementation, enforcement, false positives
  - Indirect costs: Lost productivity, added complexity
- Challenge is rationally weigh costs vs. risk
  - Human psychology makes reasoning about high cost/low probability events hard

Exercise

- Should you lock your bike?
  - Assets?
  - Adversaries?
  - Risk assessment?
  - Countermeasures?
  - Costs/benefits?

The Security Mindset

- Thinking like an attacker
  - Understand techniques for circumventing security.
  - Look for ways security can break, not reasons why it won't.
- Thinking like a defender
  - Know what you're defending, and against whom.
  - Weigh benefits vs. costs: No system is ever completely secure.
  - "Rational paranoia!"

Schneier’s law

- “Anyone, from the most clueless amateur to the best cryptographer, can create an algorithm that he himself can't break.”
- Replace “cryptographer” with “engineer” and “algorithm” with “system” and it still holds true

To Learn More …

- The Security Mindset. https://www.schneier.com/blog/archives/2008/03/the_security_mi_1.html
- https://freedom-to-tinker.com/blog/felten/security-mindset-and-harmless-failures/
- https://cubist.cs.washington.edu/Security/2007/11/22/why-a-computer-security-course-blog/

Questions?