Evaluating Existing Systems

- Standards approaches aren’t always suitable
- Not helpful for evaluating the security of running systems
- Not great for custom systems
- What do you do for those problems?

Two Different Kinds of Problems

1. I need to evaluate the design and implementation of the system
2. I need to evaluate what's going on in the system as it runs

Evaluating System Design Security

- Sometimes standards aren’t the right choice
- What if you’re building your own custom system?
- Or being paid to evaluate someone else’s?
  - That’s some companies’ business
- This kind of review is about design and architecture
  - Evaluating running systems comes later

How Do You Evaluate a System's Security?

- Assuming you have high degree of access to a system
  - Because you built it or are working with those who did
- How and where do you start?
- Much of this material is from "The Art of Software Security Assessment," Dowd, McDonald, and Schuh

Stages of Review

- You can review a program’s security at different stages in its life cycle
  - During design
  - Upon completion of the coding
  - When the program is in place and operational
- Different issues arise in each case

Design Reviews

- Done perhaps before there's any code
- Just a design
- Clearly won't discover coding bugs
- Clearly could discover fundamental flaws
- Also useful for prioritizing attention during later code review

Purpose of Design Review

- To identify security weaknesses in a planned software system
- Essentially, identifying threats to the system
- Performed by a process called *threat modeling*
- Usually (but not always) performed before system is built

Attack Surfaces

- Attackers have to get into your software somehow
- The more ways they can interact with the software, the more things you must protect
- Some entry points are more dangerous than others
  - E.g., those that lead to escalated privilege
- A combination of these factors defines a system’s *attack surface*
- The smaller the attack surface, the better
  - But attack surface doesn’t indicate actual flaws, just places where they could occur

Threat Modeling

- Done in various ways
- One way uses a five step process:
  1. Information collection
  2. Application architecture modeling
  3. Threat identification
  4. Documentation of findings
  5. Prioritizing the subsequent implementation review

1. Information Collection

- Collect all available information on design
- Try to identify:
  - Assets
  - Entry points
  - External entities
  - External trust levels
  - Major components
  - Use scenarios

One Approach[1]

- Draw an end-to-end deployment scenario
- Identify roles of those involved
- Identify key usage scenario
- Identify technologies to be used
- Identify application security mechanisms

[1]From http://msdn.microsoft.com/en-us/library/ms978527.aspx

Sources of Information

- Documentation
- Interviewing developers
- Standards documentation
- Source code profiling
  - If source already exists
- System profiling
  - If a working version is available

2. Application Architecture Modeling

- Using information gathered, develop understanding of the proposed architecture
- To identify design concerns
- And to prioritize later efforts
- Useful to document findings using some type of model

Modeling Tools for Design Review

- Markup languages (e.g., UML)
  - Particularly diagramming features
  - Used to describe OO classes and their interactions
  - Also components and uses
- Data flow diagrams
  - Used to describe where data goes and what happens to it

3. Threat Identification

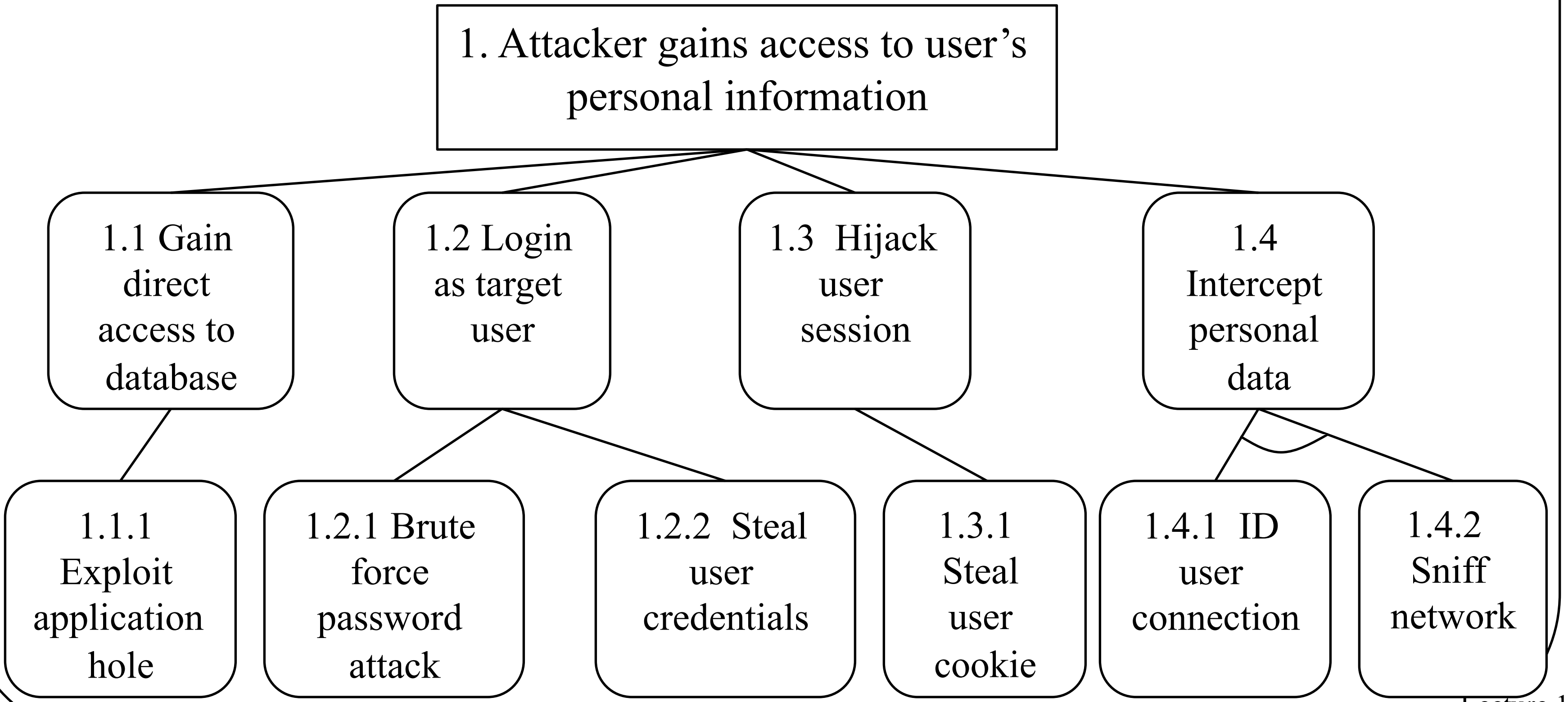
- Based on models and other information gathered
- Identify major security threats to the system's assets
- Sometimes done with *attack trees*

Attack Trees

- A way to codify and formalize possible attacks on a system
- Makes it easier to understand relative levels of threats
  - In terms of possible harm
  - And probability of occurring

A Sample Attack Tree

- For a web application involving a database
- Only one piece of the attack tree


1. Attacker gains access to user's personal information
1.1 Gain direct access to database
1.2 Login as target user
1.3 Hijack user session
1.4 Intercept personal data
1.1.1 Exploit application hole
1.2.1 Brute force password attack
1.2.2 Steal user credentials
1.3.1 Steal user cookie
1.4.1 ID user connection
1.4.2 Sniff network

The STRIDE Approach

- Developed and used by Microsoft
  - Part of their SDL threat modeling process[1]
- Depends on having built a good system model diagram
  - Showing components, data flows, interactions
  - Specifying where data and control cross trust boundaries
- Then, for each element, consider the STRIDE threats

[1]http://blogs.technet.com/b/security/archive/2012/08/23/microsoft-s-free-security-tools-threat-modeling.aspx

STRIDE Threats

- **S**poofing
- **T**ampering
- **R**epudiation
- **I**nformation Disclosure
- **D**enial of Service
- **E**scalation of Privilege

How To Apply STRIDE

- For each element in diagram, consider each possible STRIDE threat
- Some types of threats not applicable to some types of elements
- Pay particular attention to things happening across trust boundaries

4. Documentation of Findings

- Summarize threats found
  - Give recommendations on addressing each
- Generally best to prioritize threats
  - How do you determine priorities?
  - DREAD methodology is one way

DREAD Risk Ratings

- Assign number from 1-10 on these categories:
- **D**amage potential
- **R**eproducibility
- **E**xploitability
- **A**ffected users
- **D**iscoverability
- Then add the numbers up for an overall rating
- Gives better picture of important issues for each threat

5. Prioritizing Implementation Review

- Review of actual implementation once it’s available
- Requires a lot of resources
- You probably can’t look very closely at everything
- Need to decide where to focus limited amount of attention

One Prioritization Approach

- Make a list of the major components
- Identify which component each risk (identified earlier) belongs to
- Total the risk scores for categories
- Use the resulting numbers to prioritize