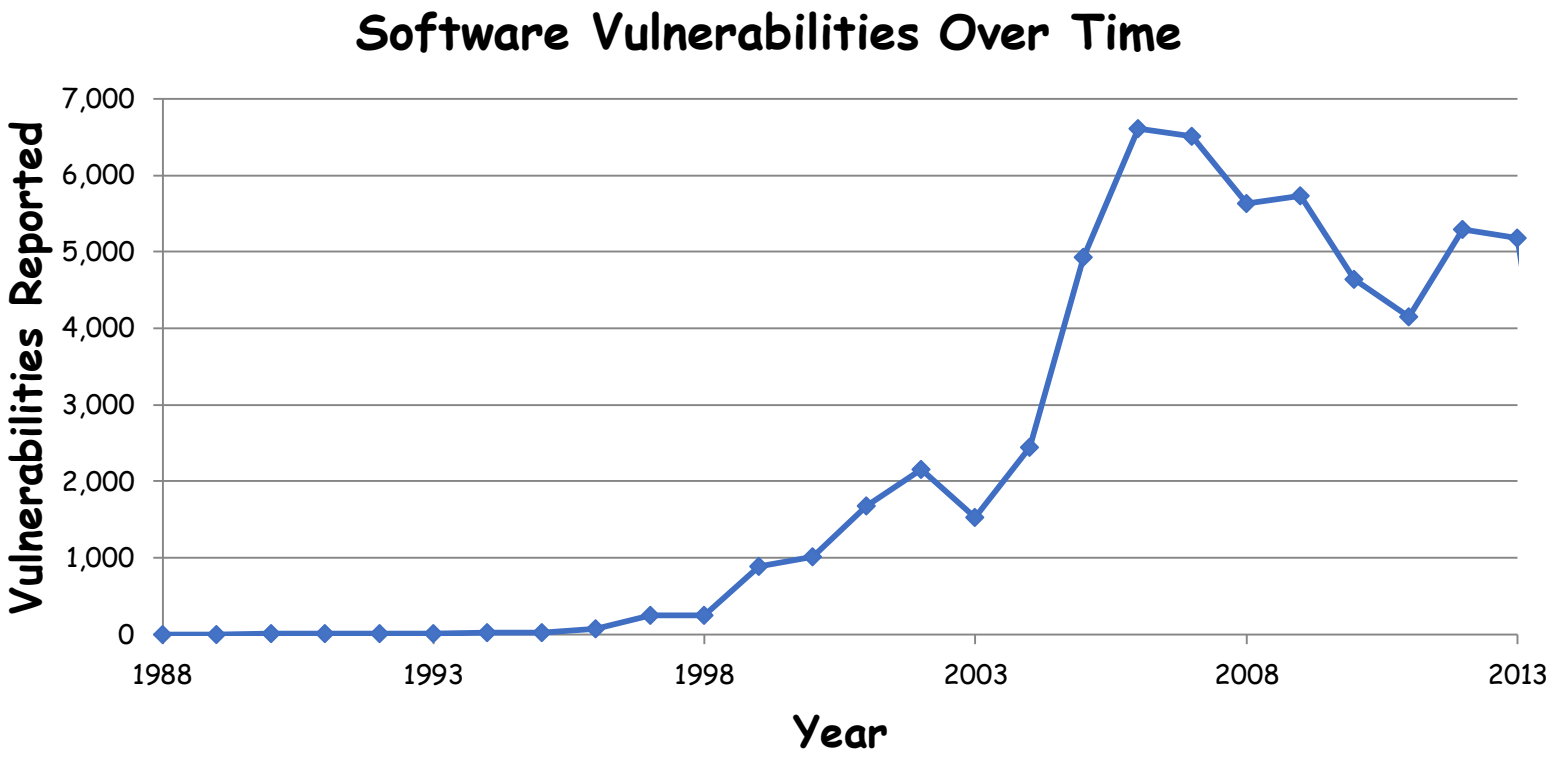
Introduction to Security

Outline

1. Single Page Application (SPA) Architecture
2. Web and HTTP
3. Web API
4. Web API using Node.js Express

Vulnerabilities Growing



Source: National Vulnerability Database
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Qatar says state news agency hacked after report cites emir criticising US

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Donald Trump urged Qatar's emir and other Arab leaders on Sunday to "isolate" Iran

Qatar has blamed hackers for a story on its state news agency website that quoted the emir as criticising US "hostility" towards Iran.

On Tuesday, the Qatar News Agency (QNA) quoted Sheikh Tamim Al Thani as

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The company said customers would have "zero liability" for any fraud losses.

Payment card data theft jumps five-fold

5:22 PM, Jan 2

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Angry South Koreans flood banks after data leak affects 20 million

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SEOUL--Tens of thousands of South Koreans flooded banks and call centers Tuesday to cancel credit cards following the unprecedented theft of the personal data of at least 20 million people.

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What is Security?

- Oxford Dictionary Definition:
  The state of being free from danger or threat

Real-World Security

- Protecting valuable things
  - Physical stuff (money, jewelry, cars, etc.)
  - People
  - Access to somewhere (parking?)

- We think of an item as secure if no one can take it, harm it, or use it without our permission.

Computer Security

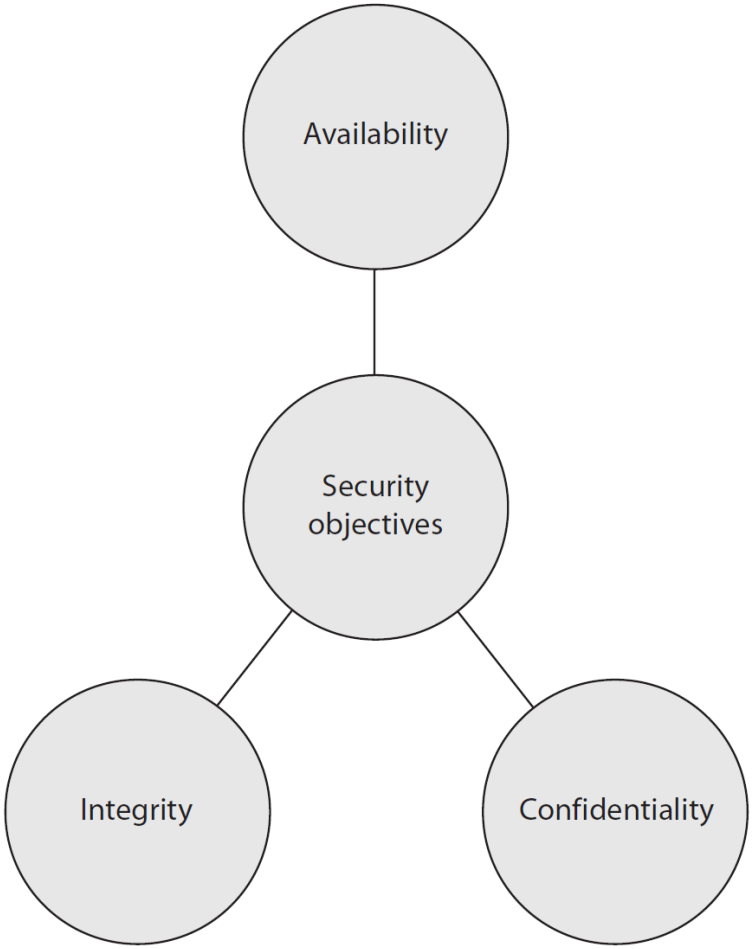
- Only one type of digital asset: *Information*

- Protecting information is hard
  - Stored on small, portable devices
  - Can be accessed electronically

- The internet has made this even harder

Core Goals of Security

Also known as **CIA Triad**



Three Security Properties

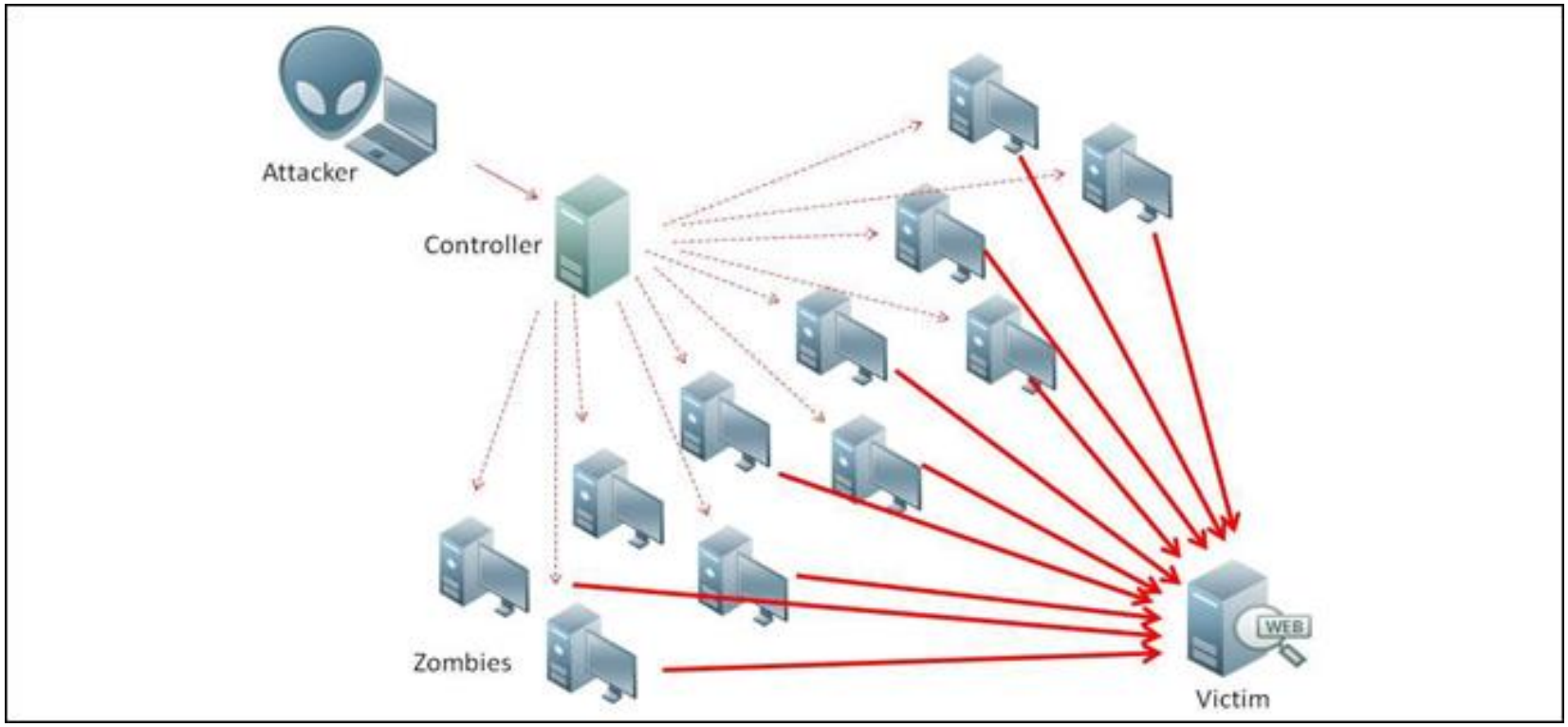
1. Confidentiality
   - Prevent unauthorized reading of data
2. Integrity
   - Prevent unauthorized modification of data
3. Availability
   - Ensure data is available to authorized people

How to achieve security goals?

- Understand the adversary.
  - what are the resources available?
  - what is the goal of the attack?
- Understand the modes of attack.
  - in what ways can the attack be launched?
  - what are the vulnerabilities?
- Understand the security/usability tradeoff.

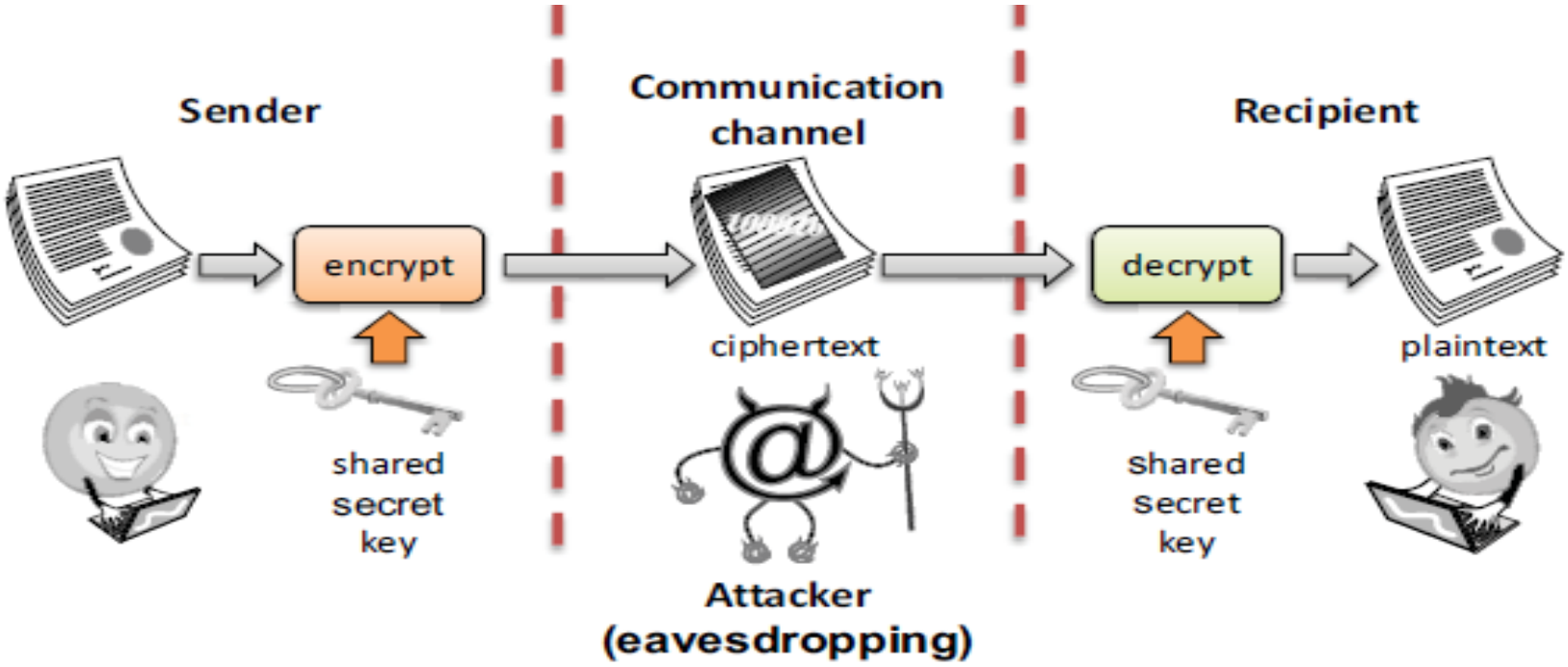
Attack Scenario of Availability

- Denial of Service: Possible to overwhelm Online Services, making them unavailable



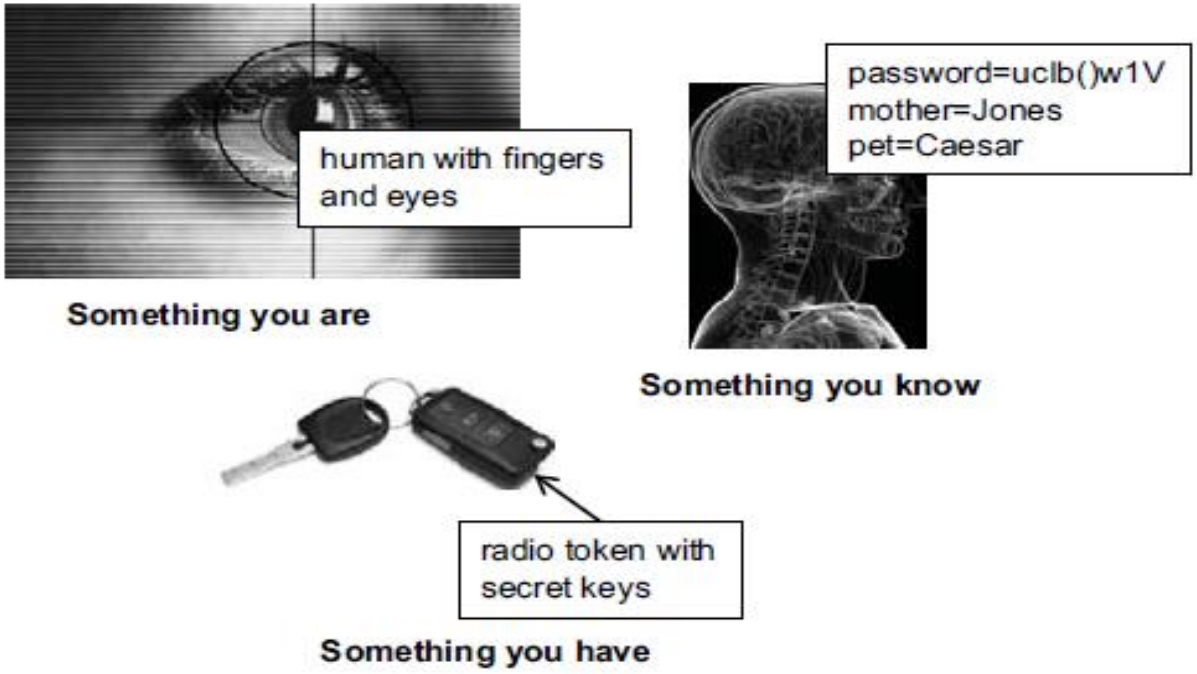
Tools for confidentiality (1/3)

- **Encryption**: encrypt data using an encryption key



Tools for confidentiality (2/3)

- **Authentication:** determination of the identity or role that someone has.
  - Fingerprint, password, smart card / radio key,



Tools for confidentiality (3/3)

- **Access Control:** rules and policies that limit access to confidential information to those with a permission .

- **Authorization:** determination if a person or a system is allowed access to resources, based on an access control policy.

Tools for integrity

- Prevention Mechanisms
  - Access controls
  - Authentication
- Detection Mechanisms
  - Message signing: cryptographic technique to detect whether bits have been modified
  - Intrusion detection and prevention: try and understand normal behavior and detect anomalous
  - Monitors the characteristics of a single host for suspicious activity
  - Monitors network traffic and analyzes network, transport, and application protocols to identify suspicious activity
    - *Deep packet inspection:* look at packet contents (e.g., check character strings in packet against database of known virus, attack strings)

Tools for availability

- Redundancies
  - e.g., backup, multiple mail/DNS/DHCP servers, multiple network paths to ISP
- Firewall
  - isolates organization's internal net from larger Internet, allowing some packets to pass, blocking others
- Intrusion prevention

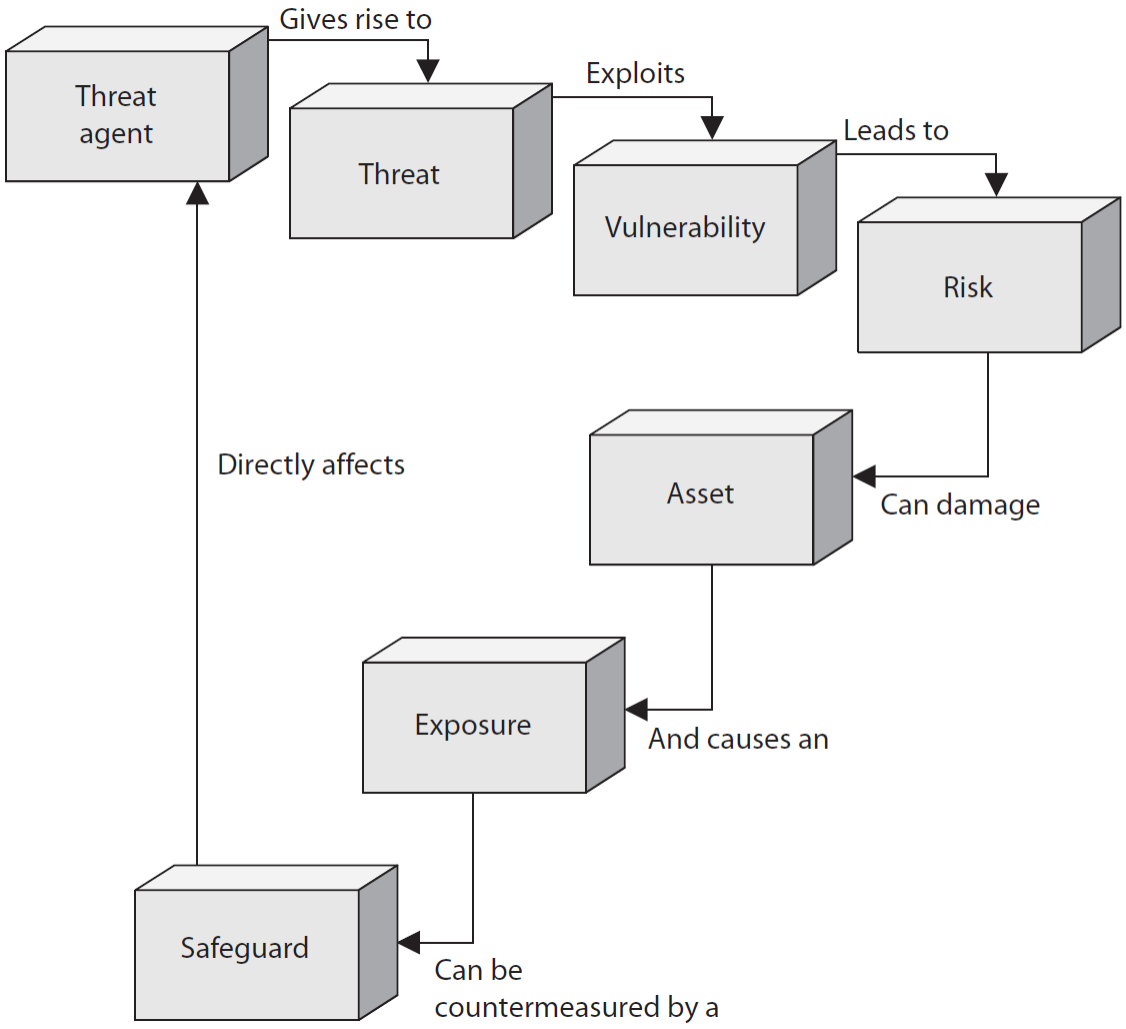
Tools to achieving CIA

- Confidentiality
  - Encryption
  - Access Control
  - Authorization
- Integrity
  - Prevention Mechanisms
  - Detection Mechanisms
- Availability
  - Redundancy
  - Intrusion Detection/Prevention

Exercise

- Classify each of the following as a violation of confidentiality, of integrity, of availability, or of some combination
  - Ali logs into Fatima's Facebook, posts a photo
  - Steve sees network traffic of Apple's earning projections and sells Apple stock
  - Jenny forges a request to Banner to change her Computer Security homework grade
  - Ali Taleh causes the power system to fail, taking the submission server offline

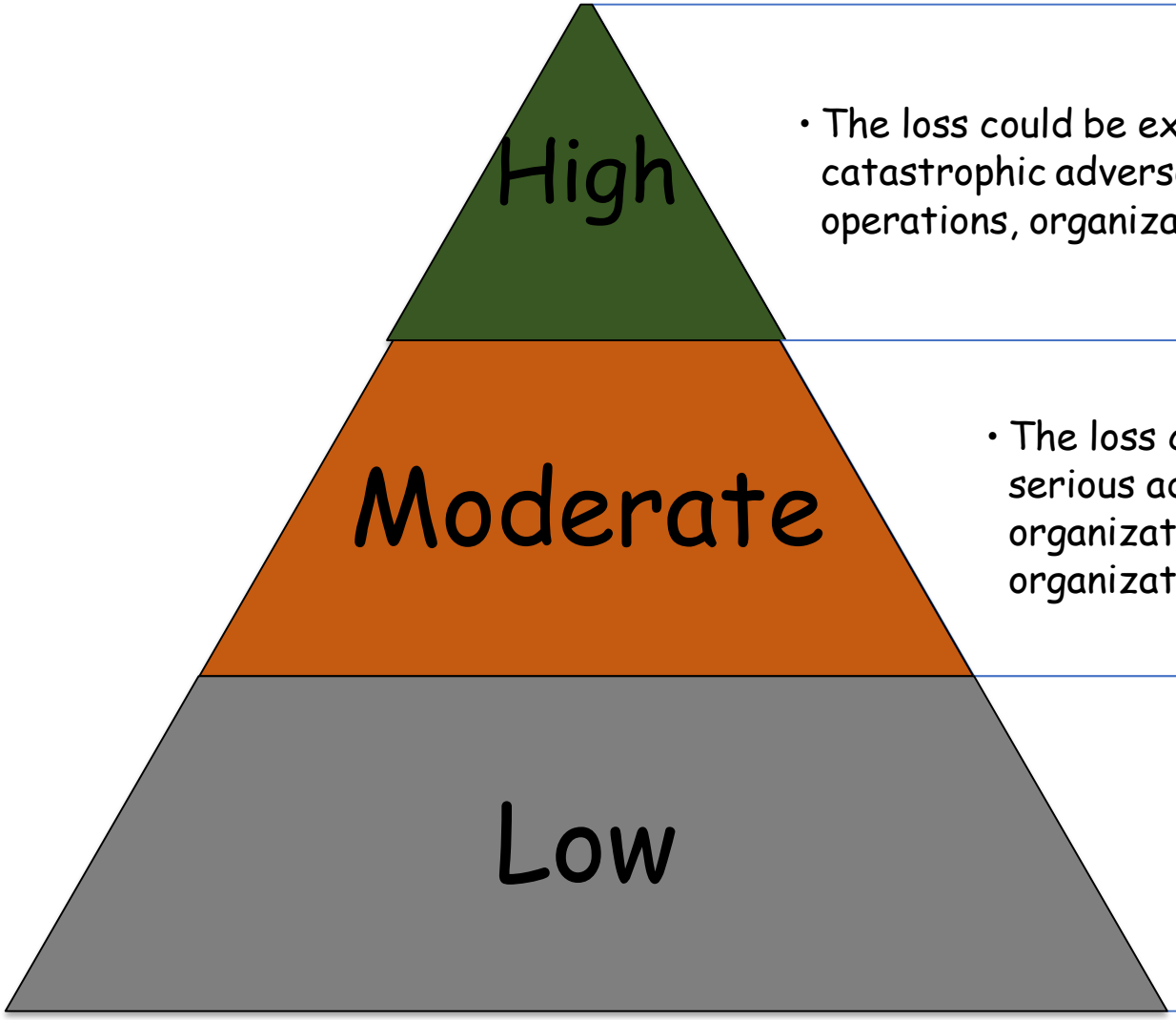
The relationships among the different security concepts



Security Concepts

- A **vulnerability** is a weakness in a system that allows a threat source to compromise its security.
  - e.g., unpatched applications or OS, an unrestricted wireless access point
- A ***threat*** is any potential danger that is associated with the exploitation of a vulnerability.
- A ***risk*** is the likelihood of a threat source exploiting a vulnerability.
  - e.g., if a firewall has several ports open, there is a higher likelihood that an intruder will use one to access the network in an unauthorized method.
- An ***exposure*** is an instance of being exposed to losses. A vulnerability exposes an organization to possible damages.
  - e.g., if strong password rules are not enforced, the company is exposed to the possibility of having users' passwords compromised and used in an unauthorized manner
- A ***control***, countermeasure or safeguard, is put into place to mitigate (reduce) the potential risk.
  - e.g., strong password management, firewalls, Intrusion Detection System, access control mechanisms, encryption, and security-awareness training.

Breach of Security - Levels of Impact



- The loss could be expected to have a severe or catastrophic adverse effect on organizational operations, organizational assets, or individuals

- The loss could be expected to have a serious adverse effect on organizational operations, organizational assets, or individuals

- The loss could be expected to have a limited adverse effect on organizational operations, organizational assets, or individuals

Summing Up

- Attacks are growing
- They affect real people
- Three main properties in computer security:
  - Confidentiality
  - Integrity
  - Availability
- A system is as secure as its weakest component
  - Partly why security so hard: attacker just needs to find the weakest link

Resources

- SecTools.Org: Top 125 Network Security Tools

http://sectools.org/

- A collection of awesome penetration testing resources and tools
  - https://github.com/enaqx/awesome-pentest

- SANS Penetration Testing Blog

https://pen-testing.sans.org/blog