# Cybersecurity

Cybersecurity Concepts

CSUSM Cybersecurity Education Hub

# Cybersecurity Fundamentals

- What is cybersecurity?
- What are we trying to protect?
- Risk – threats, vulnerabilities, likelihood
- Confidentiality, integrity, and availability (C-I-A) concepts
- What kinds of harm are we trying to avoid?
- How can we avoid that harm?

# What Is ~~Computer~~ Cyber Security?

- The protection of the assets of a ~~computer~~ system
  - Hardware
  - Software
  - Data

# Assets Are…

Hardware

- Computers but also:
  - Medical devices
  - Automobiles
  - Industrial controllers
  - Security systems
  - Household appliances
  - Scientific equipment
  - Tracking/location devices
  - …and more

Software/Network

- Operating systems, applications but also
  - Access control mechanisms
  - Physical Access
  - Location services
  - Network traffic
  - Actions
  - Device identity
  - …and more

Data

- Files, photos, music, databases but also:
  - Location
  - Actions
  - Network identity
  - Access list
  - Payment info
  - Response/Status
  - Monitored activity
  - …and more

# Basic Terms

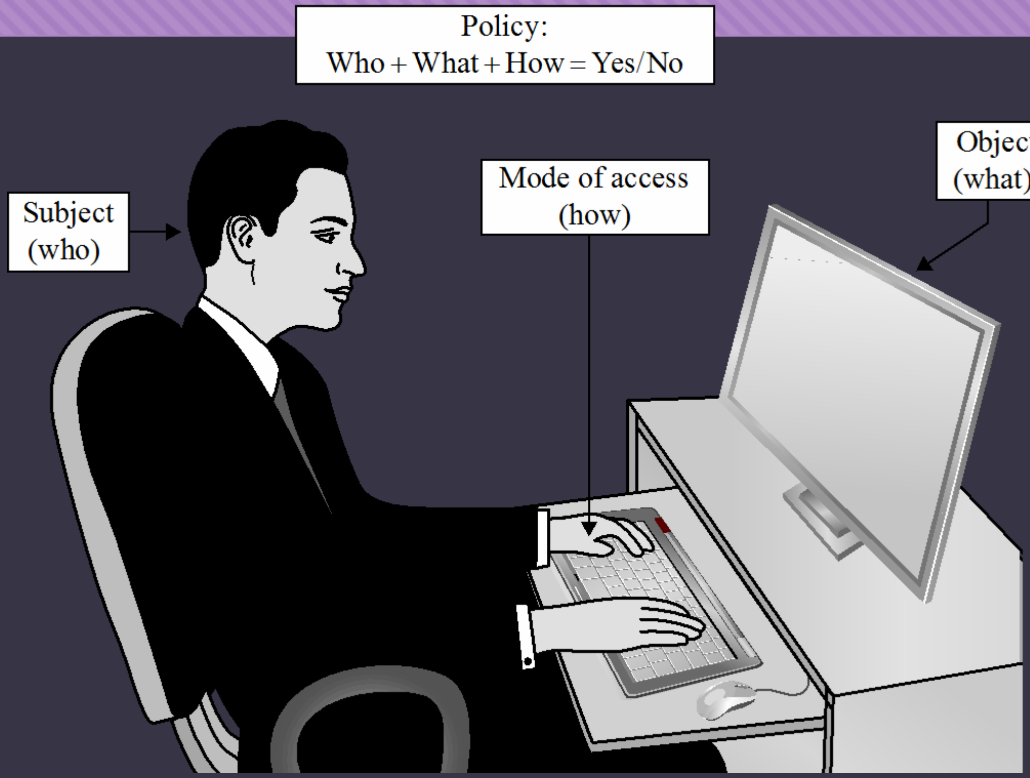
- Vulnerability – weakness in a system
- Threat – circumstance with potential to cause harm
- Attack – exploit of a vulnerability
- Countermeasure or control – action or device that removes or reduces a vulnerability

# C-I-A Triad

- Confidentiality - *Only persons authorized to access information or systems should get access to the information or system.*
- Integrity - *Only those persons or applications authorized to alter the system or information may do so, and alterations are made under controlled circumstances.*
- Availability - *The information or system, along with the applications, and other hosts used to access, store and manipulate it, is available when needed.*
- Sometimes two other desirable characteristics:
  - Authentication – *Confirm identity of a sender/signer.*
  - Nonrepudiation – *Confirm that asserted action can't be denied.*

# Confidentiality

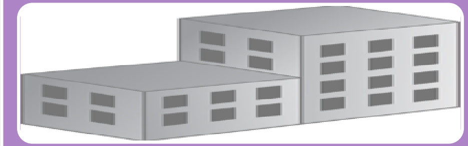
- Both actual data and information about data
- Access to all of it or part of it?
- Unauthorized – both persons and processes or systems
- Generally means viewing/obtaining but not modifying



# Confidentiality

## Personal Data and Information

- Credit card account numbers and bank account numbers
- Social security numbers and address information



## Intellectual Property

- Copyrights, patents, and secret formulas
- Source code, customer databases, and technical specifications

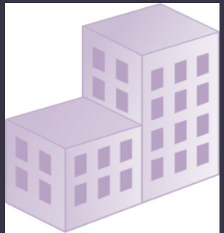
## National Security

- Military intelligence
- Homeland security and government-related information

# Integrity

- Maintain valid, precise uncorrupted, and accurate information.
  - Word “not” macro
  - Pentium math error
  - Errors
- Purposeful changes to values (accounting, salary)
- Alterations are authorized and intentional

- User names and passwords



- Patents and copyrights
- Source code

- Diplomatic information
- Financial data

# Availability

- Complex series of topics
- Moves far into operations
  - Backups and recovery?
  - Disk availability – raid, mirroring, cloud services?
  - Personnel and training?
  - Business Continuity/Disaster Recovery?
  - Uptime and “normal” failures?

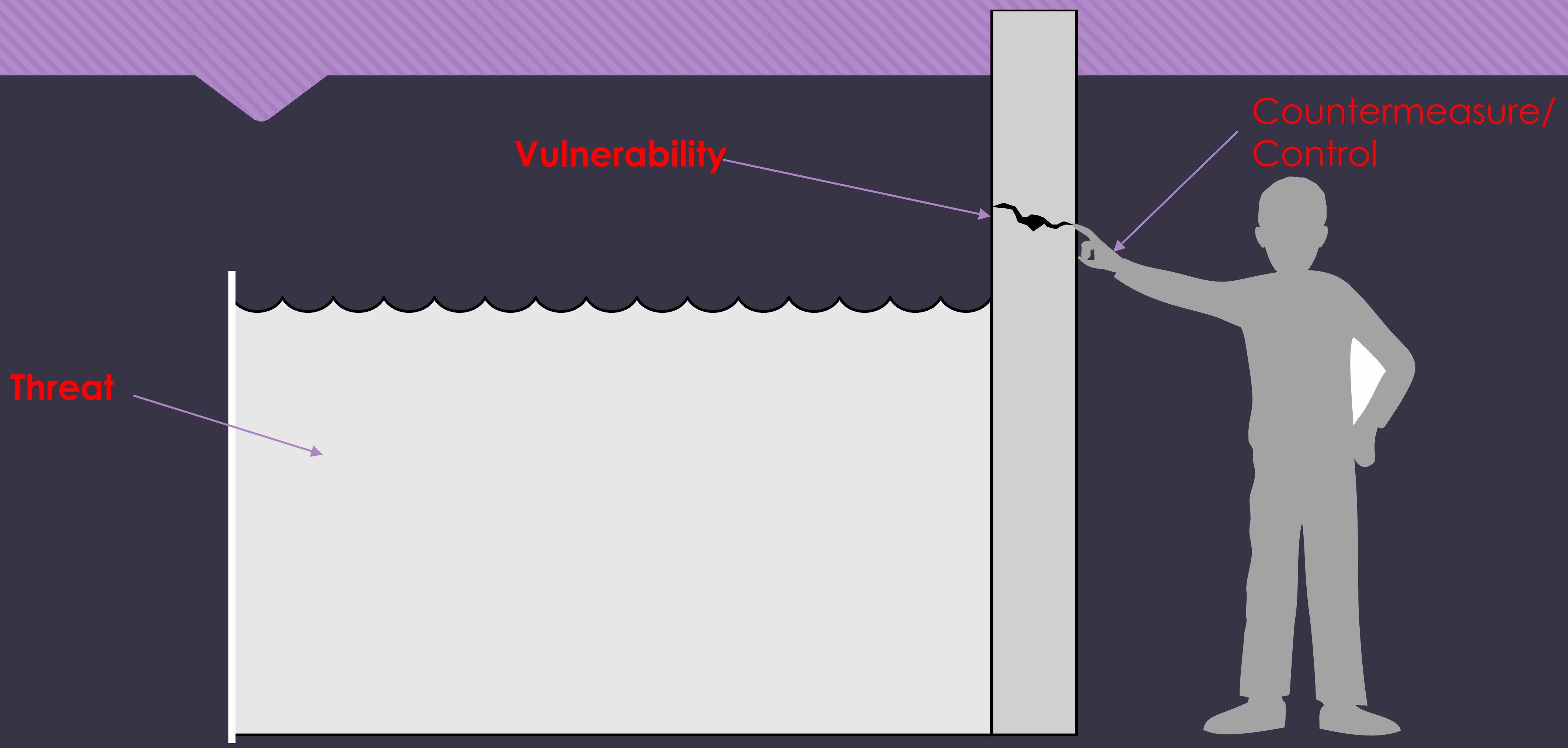
# Harm

- Negative consequence of the attack
- Dependency on value of asset
  - Theft (identity/financial/intellectual property)
  - Loss of privacy
  - Loss (destruction) of asset
  - Organizational operations impact
  - Reputational harm

# Risk

- Potential of harm (loss) …. From failure/attack of an information system
- Likely threats - Fire? Earthquake? Theft? Social engineering? Malware?
- Countermeasures
- Risk transfer
- Value of asset, amount of harm, cost of countermeasure(s)
- Problem:
  - Difficult to assess value
  - Difficult to assess impact (amount of harm)
  - Difficult to identify threats
  - Difficult to assess “likelihood” of threat

# Threat and Vulnerability



# Vulnerability

- Vulnerability - Weakness that can allow harm to occur
- Jargon: “Attack surface” – the full set of a system’s vulnerabilities
- Common vulnerabilities
  - Untrained users
  - Employee sabotage
  - Poor authentication implementation
  - Poor configuration
  - Lack of physical security
  - Failure to adequately isolate network traffic
  - … etc

# Threats

- There are many ways to classify threats
  - Nonhuman threats: natural disasters, hardware failures, etc.
  - Human threats: spilling a soft drink, entering the wrong data by mistake, intentionally hacking a system
  - Malicious vs. non-malicious
  - Random vs. directed

# Harm From Human Threats

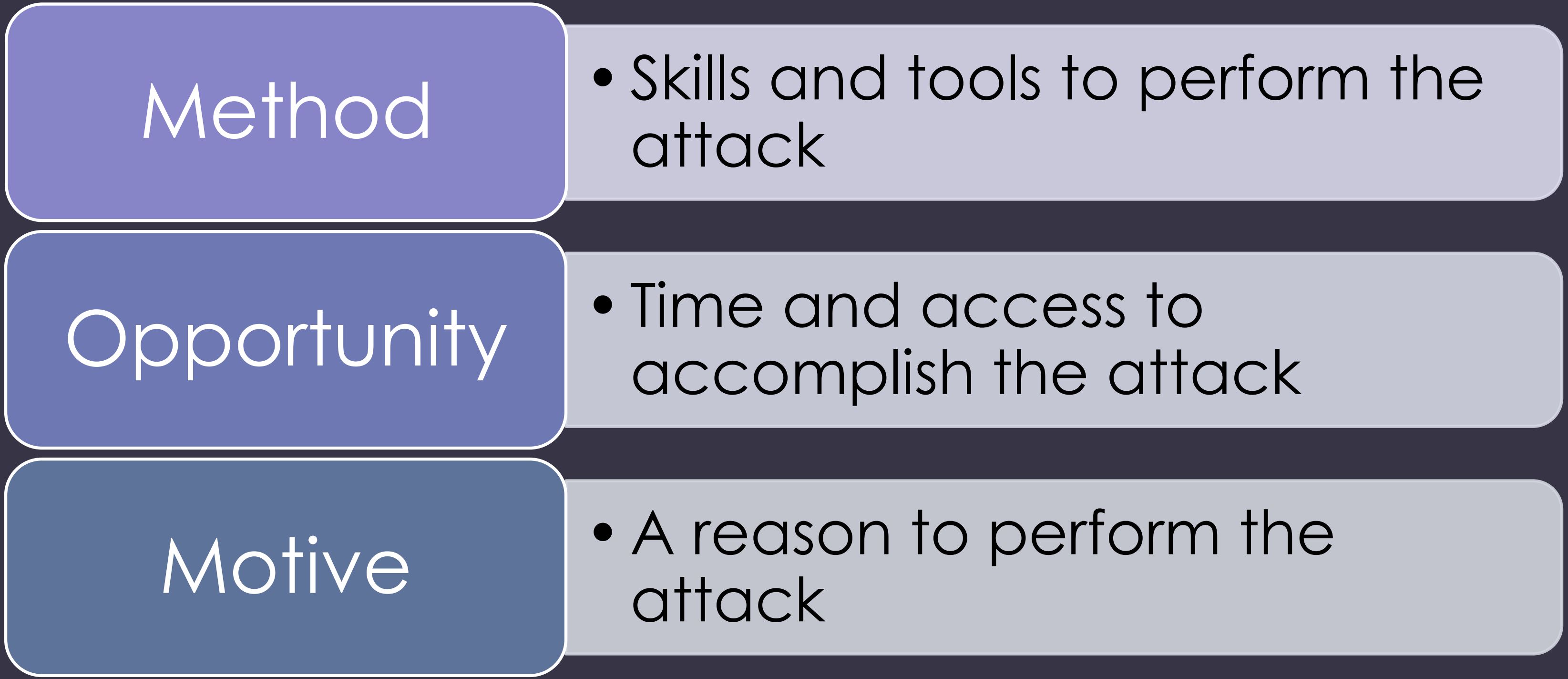
- Interception – Someone accessed something to which they had not been granted access
- Interruption - Something became unavailable or unusable
- Modification - Someone changed something they weren’t supposed to
- Fabrication - Someone created fake data or records

# Risk and Likelihood

- What's the chance of being invaded by hostile aliens?
- Really, really small?
- **Likelihood** is the chance that a threat will happen
- Effect of being invaded by hostile aliens?
  - Death, destruction…
- Impact is the damage that could occur
- Humans overestimate the likelihood of rare and high-impact events, perhaps underestimate the likelihood of more common, potentially less impactful events. Ex: air travel vs auto travel

# Affecting Likelihood: Method, Opportunity, Motive

- As with traditional crime, a computer attacker must have three things:



| | |
|---|---|
| Method | • Skills and tools to perform the attack |
| Opportunity | • Time and access to accomplish the attack |
| Motive | • A reason to perform the attack |

# Controls/Countermeasures

- Defn: “Means to counter a threat”
- Detective – identify when a threat is/has acting(ed) on the vulnerability
  - System monitoring
  - Security alarm system
- Preventive – keep the threat away from acting on the vulnerability
  - Actual prevention – physical, environmental, firewall, encryption
  - Deterrence – Policies/procedures, training, anti-malware
- Corrective – lessen the impact of the threat
  - Backup/recovery
  - Disaster recovery systems

# Controls

- **Prevent**
  - Remove the vulnerability from the system
- **Deter**
  - Make the attack harder to execute
- **Deflect**
  - Make another target more attractive (perhaps a decoy)
- **Detect**
  - Discover that the attack happened, immediately or later
- **Recover**
  - Recover from the effects of the attack

# Physical Controls

- Locks on doors
- Security guards
- Backup copies of data
- Planning for natural disasters and fires
- Simple controls are often the best
  - Attackers will always look for a weak point in your defenses

# Technical Controls

- Software controls:
  - Passwords
- OS and application controls
  - Encryption, access control methods
- Independent control programs
  - Application programs that protect against specific vulnerabilities

- Development controls
  - Quality control for creating software so that vulnerabilities are not introduced
- Hardware controls
  - Smart cards on satellite or cable television set-top boxes
  - Fingerprint or other biometric readers
- Network
  - Firewalls,

# Procedural Controls

- Humans…
  - Policies, procedures, standards
  - Most important: training and awareness
  - Policy examples:
    - Password composition
    - Prohibitions on sharing
    - Confidentiality agreements
  - Legal protections
    - State/Fed laws
    - Common law