Introduction into Computer Security

what is “computer security”?

- security -- “safety, or freedom from worry”
- thesaurus: peace of mind, feeling of safety, stability, certainty, happiness, confidence.

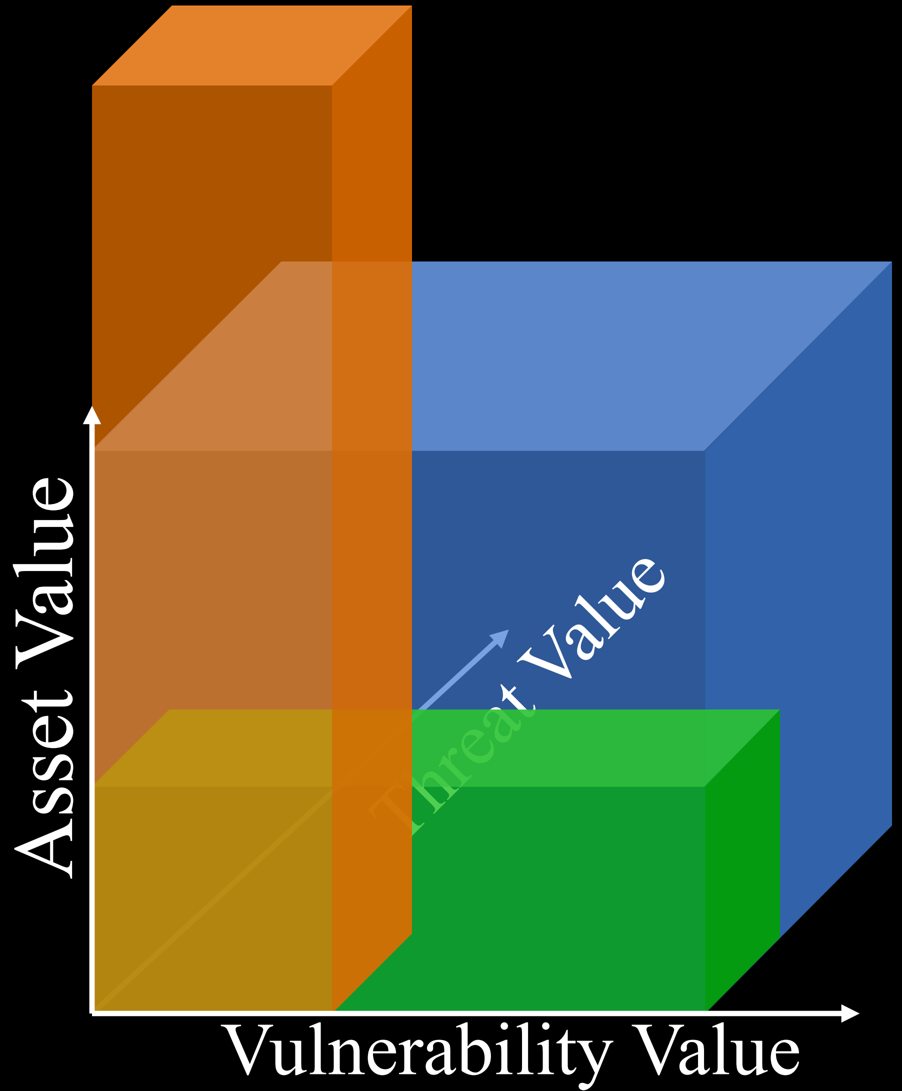
Buddhist chant of metta (loving-kindness)

in Pali	in English
Aham avero homi	May I be safe, free from enmity and danger.
Abyapajjho homi	May I be at peace, free from mental suffering.
Anigha homi	May I be safe, free from physical suffering.
Sukhi attanam pariharami	May I take care of myself, and live happily.

what is “computer security”?

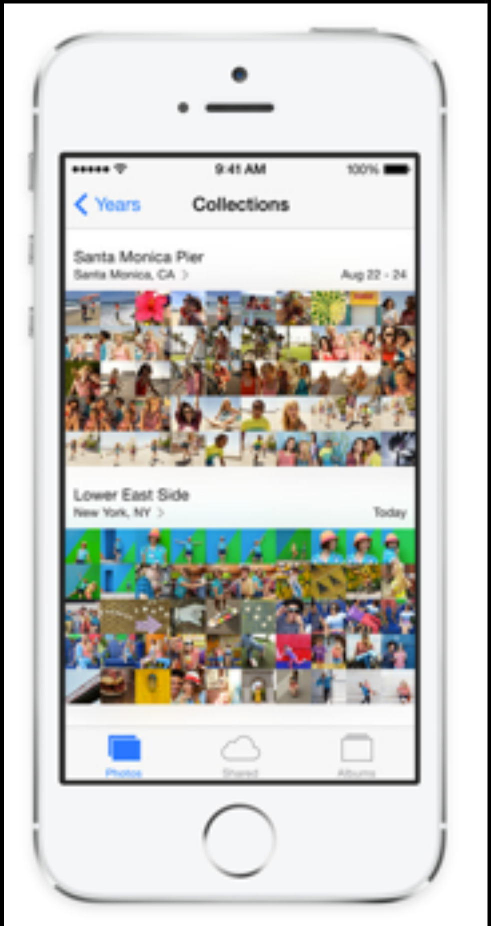
- security -- “safety, or freedom from worry”
- thesaurus: peace of mind, feeling of safety, stability, certainty, happiness, confidence.
    - where does it come from?
- how can it be achieved?
    - make computers too heavy to steal
    - buy insurance
    - create redundancy (disaster recovery services)

it’s all about risk management



Risk = Asset x Vulnerability x Threat

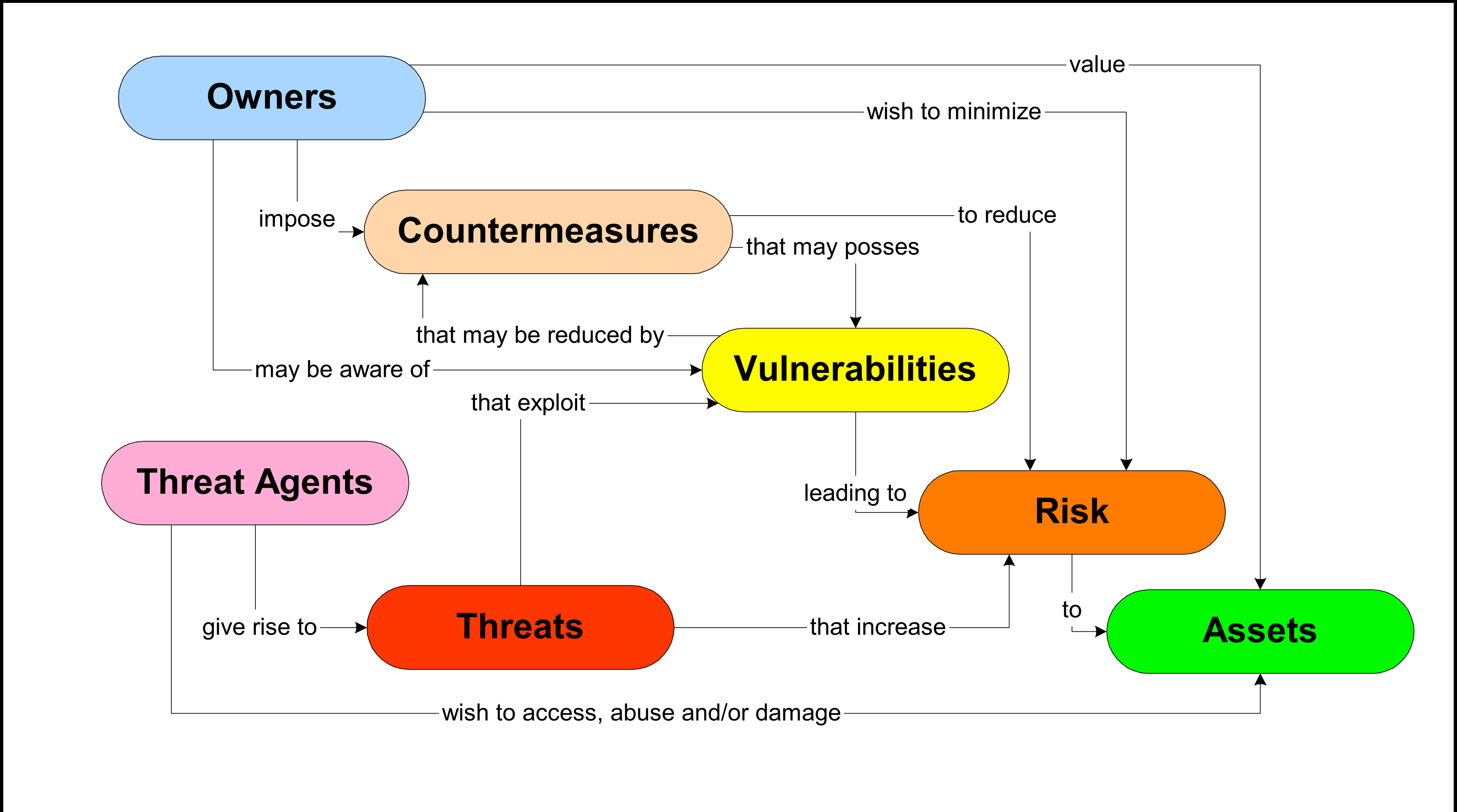
example
(photos on a smartphone)



from www.apple.com/ca/ios/whats-new/

what can be done about risk?

- avoid
- transfer
- reduce
- accept



Source: Common Criteria for Information Technology Security Evaluation. 1999

example: food for thought

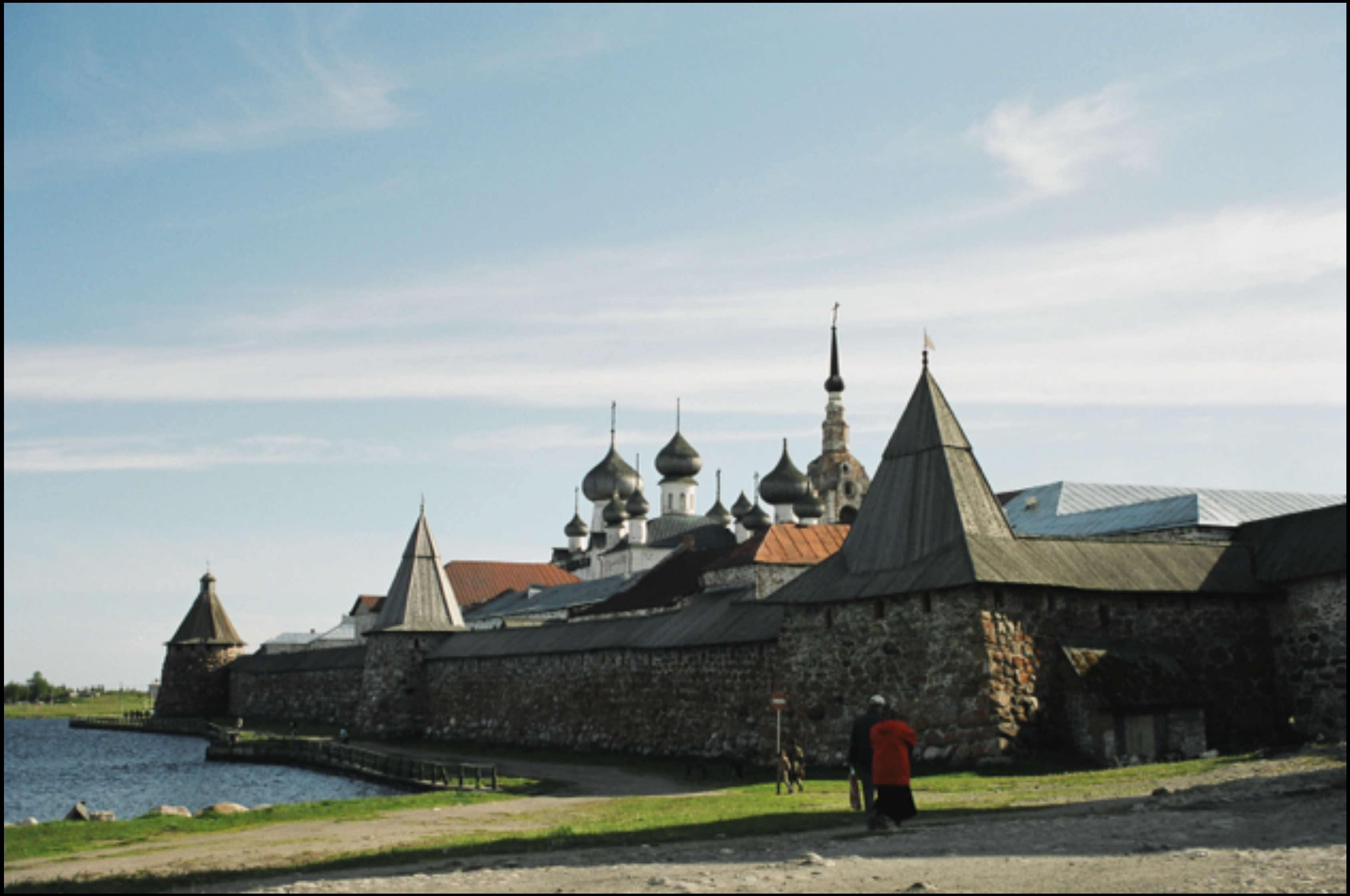
analyze and suggest

1. assets at risk and their value
2. threats to these assets
3. threat agents
4. risk management

goals of computer security

- deterrence
  - Deter attacks
- prevention
  - Prevent attackers from violating security policy
- detection
  - Detect attackers’ violation of security policy
- recovery
  - Stop attack, assess and repair damage
  - Continue to function correctly even if attack succeeds
- investigation
  - Find out how the attack was executed: forensics
  - Decide what to change in the future to minimize the risk

Solovki Monastery, White Sea, Russia



Castle of Chillon

from www.picture-newsletter.com/chillon/

conventional fortress-based security

Goal: Prevent people from violating system’s security policy

Means:

Fortification

- provides safety
- involves layering
- expensive
- requires maintenance
- eventually compromised

Some points about fortresses

- no absolute safety
- one weakness/error sufficient
- extra layers at extra cost
- important to understand threats
- limited defender’s resources
- adjust to attacks
- resource suppliers
- distinguishing noncombatants from attackers
- containment

limitations of the fortress analogy

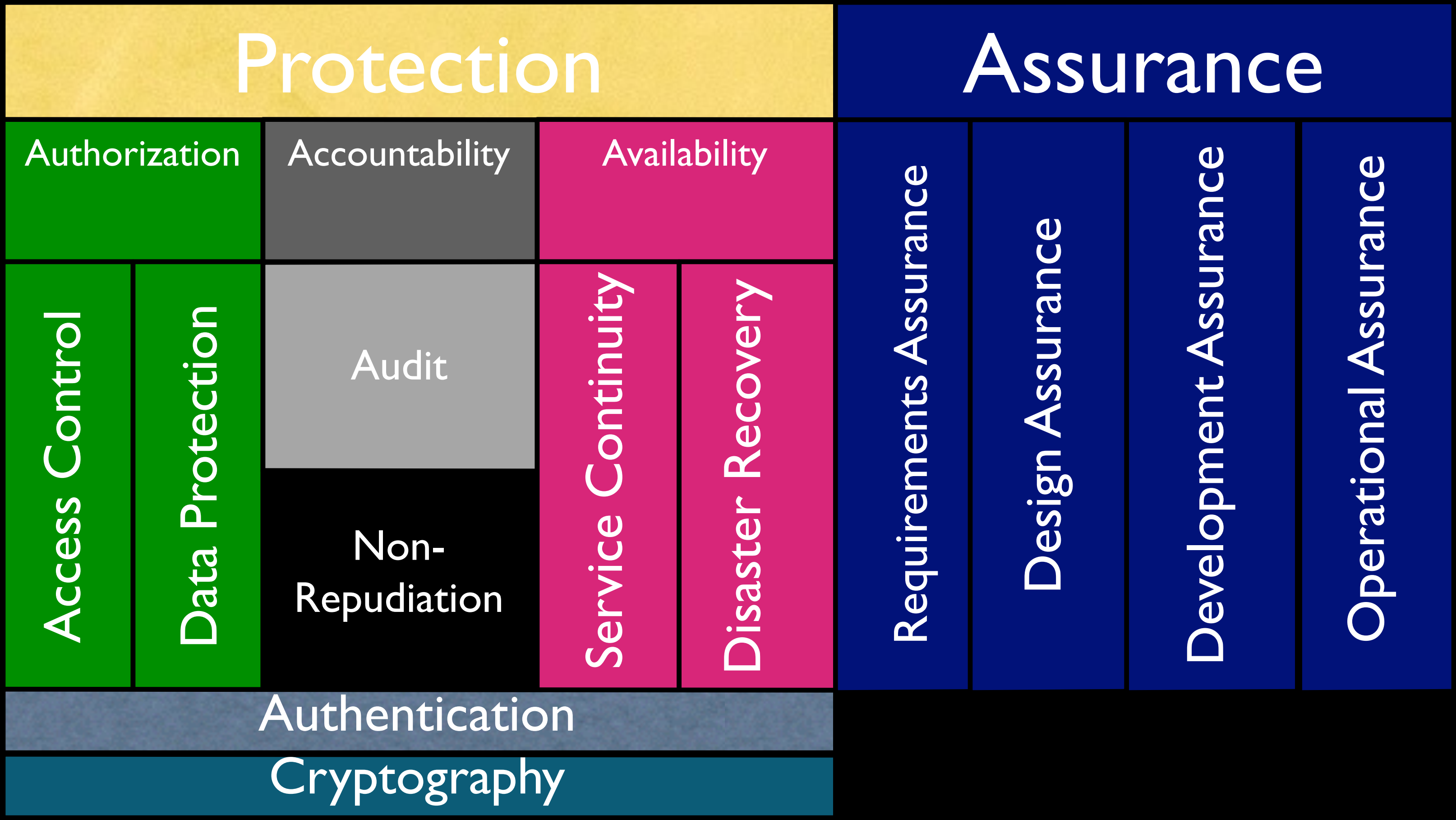
fortress	computer security
against external attackers	control of insiders
protects only insiders	has to keep system usable
defences cannot change	has to protect from new types of attacks

what computer security policies are concerned with?

- **Confidentiality**
  - keeping data and resources hidden
- **Integrity**
  - data integrity (integrity)
  - origin integrity (authentication)
- **Availability**
  - enabling access to data and resources

CIA

conventional approach to computer security



Protection

Assurance

Authorization

Accountability

Availability

Access Control

Data Protection

Audit

Non-Repudiation

Service Continuity

Disaster Recovery

Requirements Assurance

Design Assurance

Development Assurance

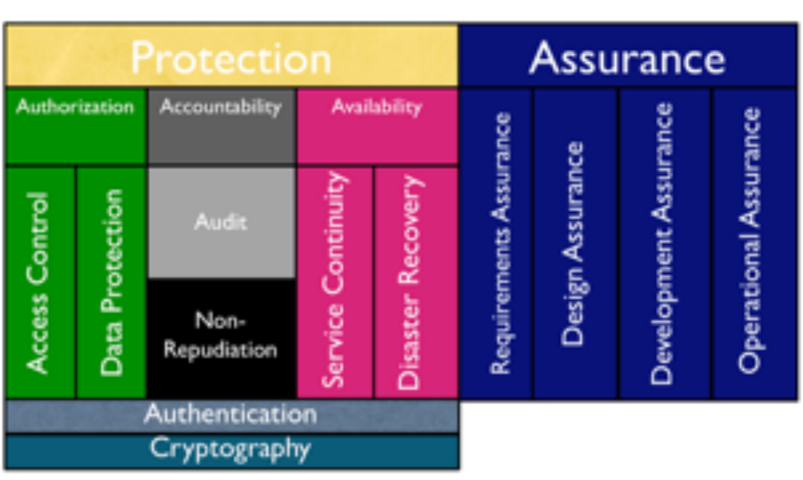
Operational Assurance

Authentication

Cryptography

Protection

provided by a set of mechanisms (countermeasures) to prevent bad things (threats) from happening

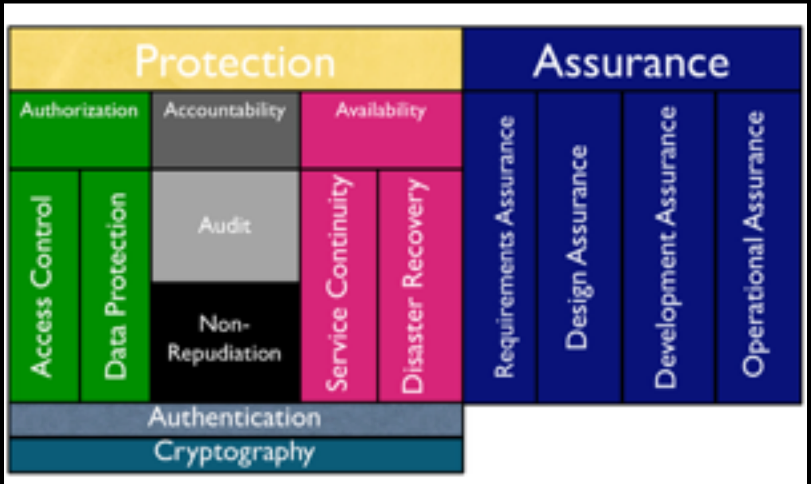


Authorization

protection against breaking rules

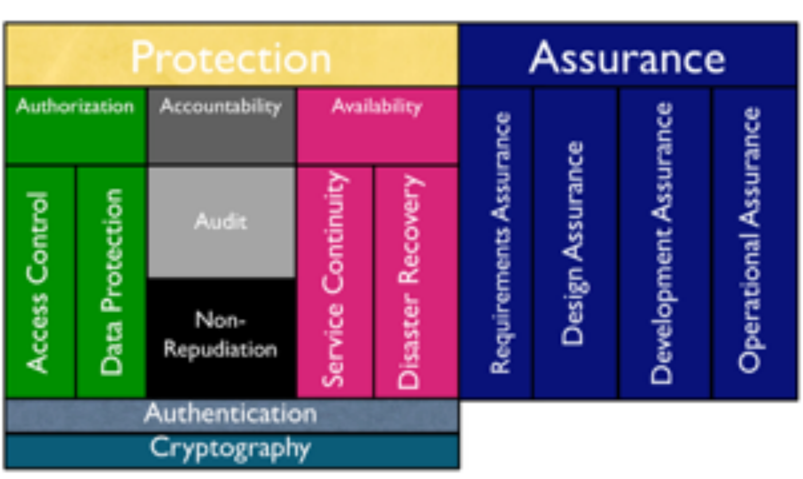
Rule examples:

- Only registered students should be able to take exam or fill out surveys
- Only the bank account owner can debit an account
- Only hospital's medical personnel should have access to the patient's medical records
- Your example…



Authorization Mechanisms: Data Protection

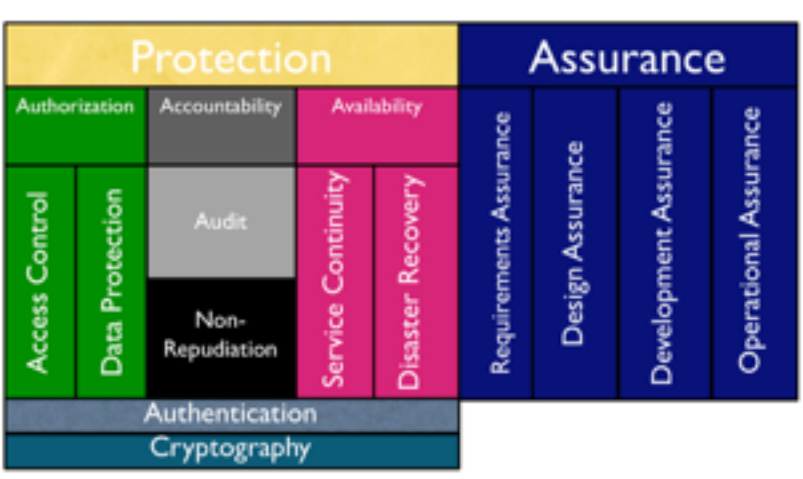
- No way to check the rules
  - e.g. telephone wire or wireless networks
- No trust to enforce the rules
  - e.g., mobile devices



Accountability

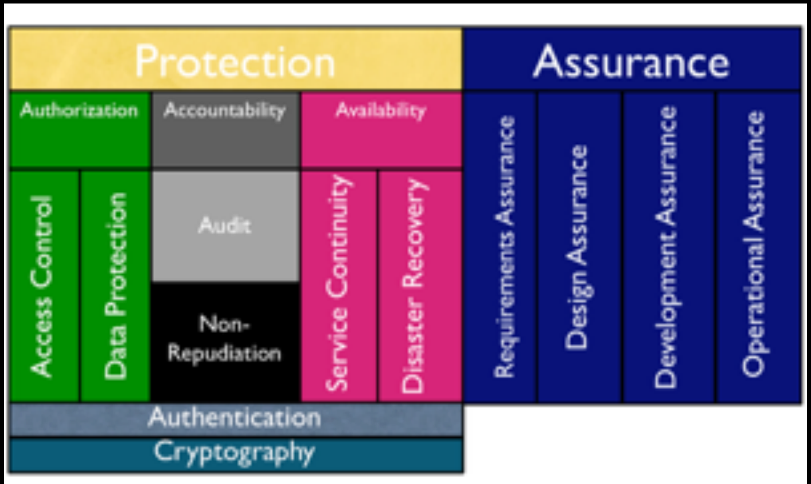
You can tell who did what when

- (security) audit -- actions are recorded in audit log
- Non-repudiation -- evidence of actions is generated and stored

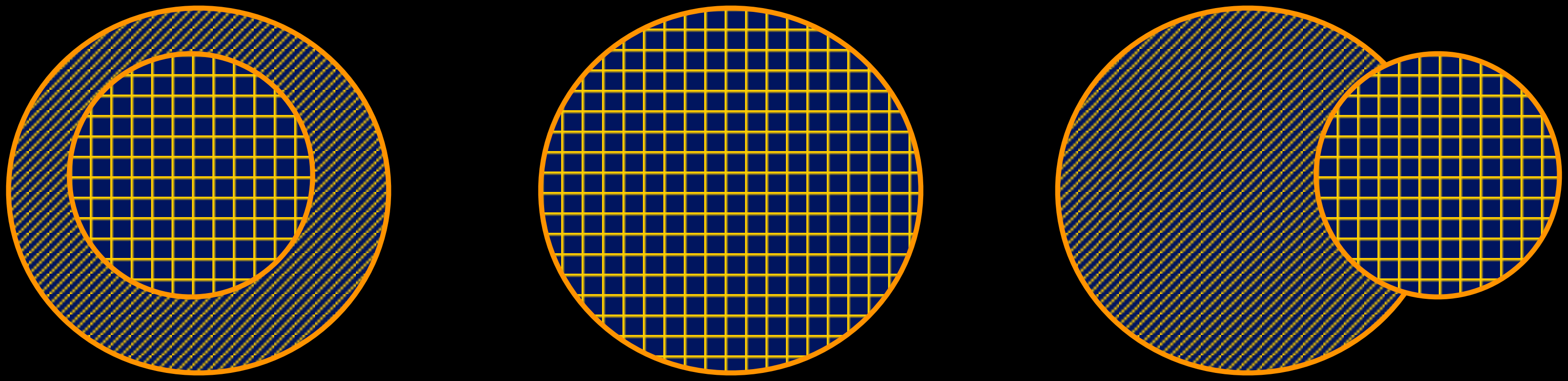


Availability

- Service continuity -- you can always get to your resources
- Disaster recovery -- you can always get back to your work after the interruption



types of mechanisms



secure

precise

broad

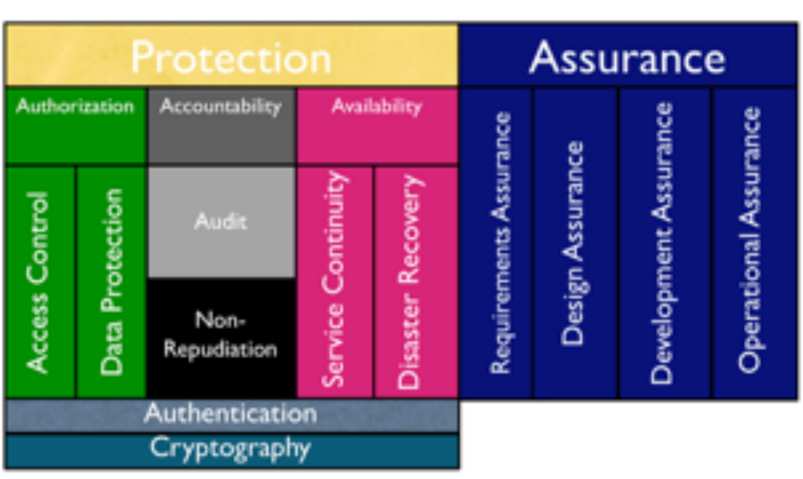
▦ set of reachable states

▨ set of secure states

Assurance

Set of things the system builder and the operator of the system do to convince you that it is really safe to use.

- the system can enforce the policy you are interested in, and
- the system works as intended



securing systems

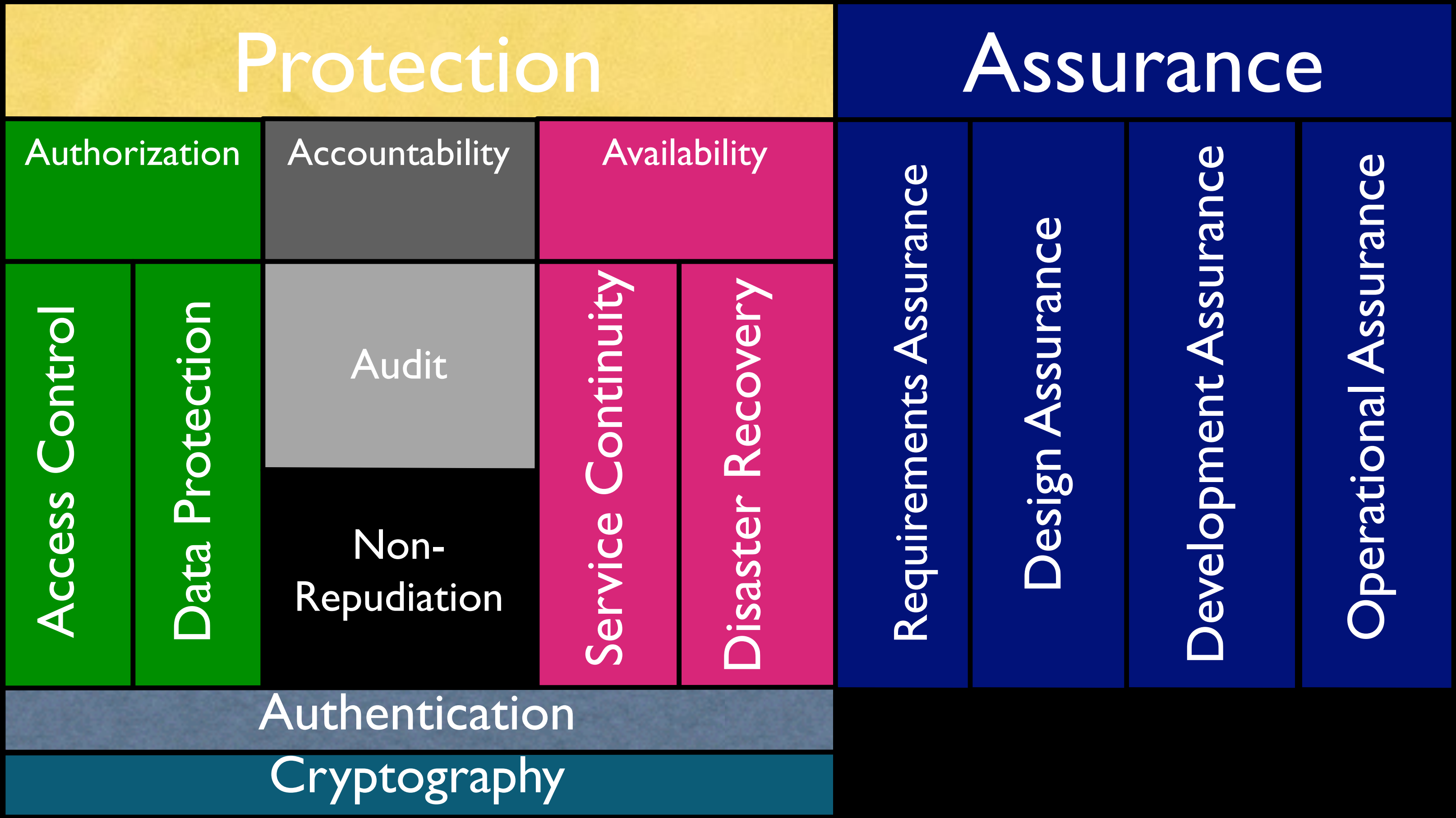
steps of improving security

1. analyze risks
    - asset values
    - threat degrees
    - vulnerabilities
2. develop/change policies
3. choose & develop countermeasures
4. assure
5. go back to the beginning

in the following scenario, analyze

1. Assets at risk and their value
2. Threats to these assets
3. Threat agents
4. Ways to manage risk

Key Points



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key points (cont-ed)

- secure, precise, and broad mechanisms
- Risk = Asset × Vulnerability × Threat
- steps of improving security
- classes of threats
  - disclosure
  - deception
  - disruption
  - usurpation