CSCI 476: Computer Security

Lecture 4: Introduction to Security + Threat Modeling

Reese Pearsall

Fall 2022

*all images are stolen from the internet

Announcements

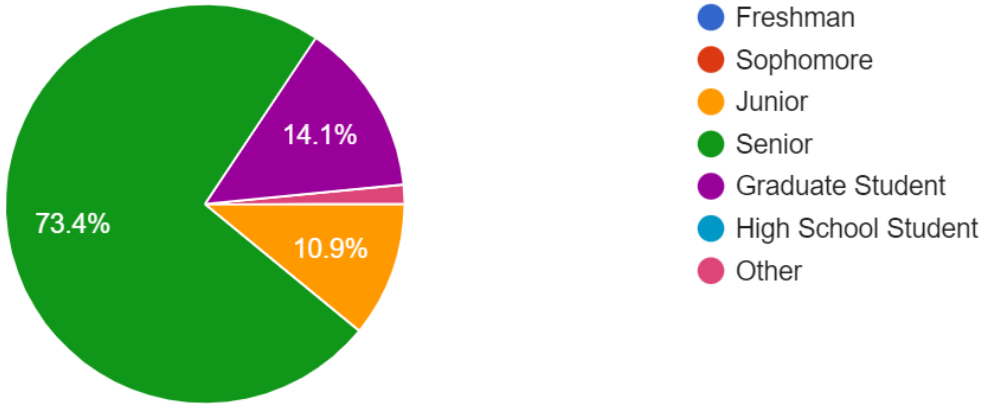
TA

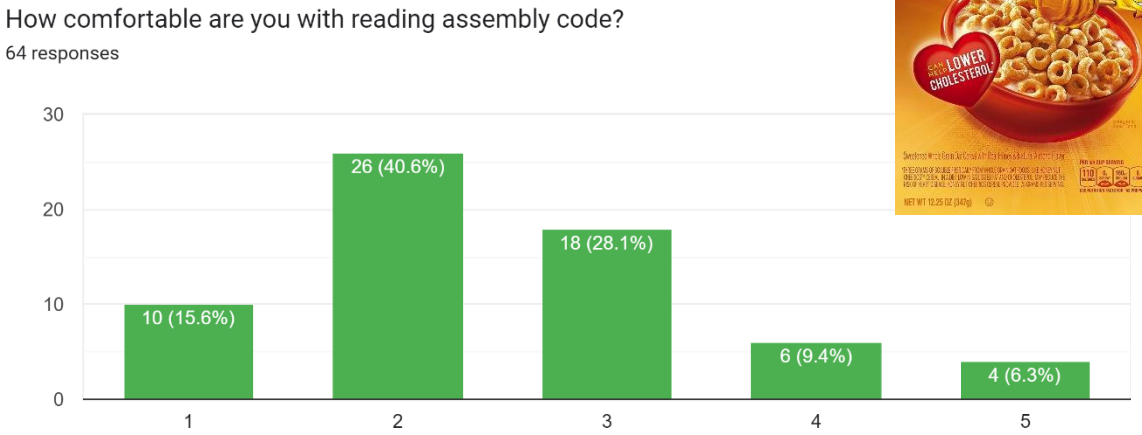
- **Karishma Rahman**
- karishma.rahman.bd@gmail.com
- Office Hours: Tuesdays 1:00 pm to 3:00 pm
- Location: Barnard 259

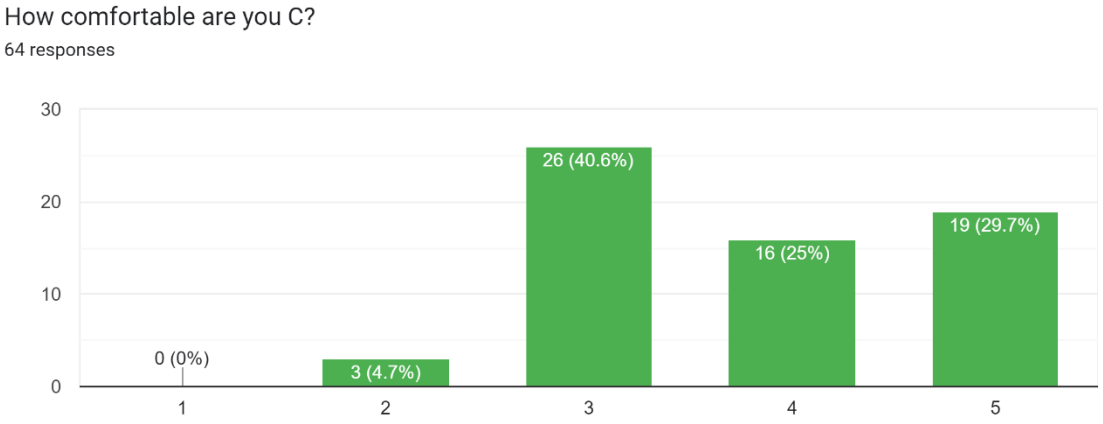
Lab 1 Due Thursday 9/15 @ 11:59 PM

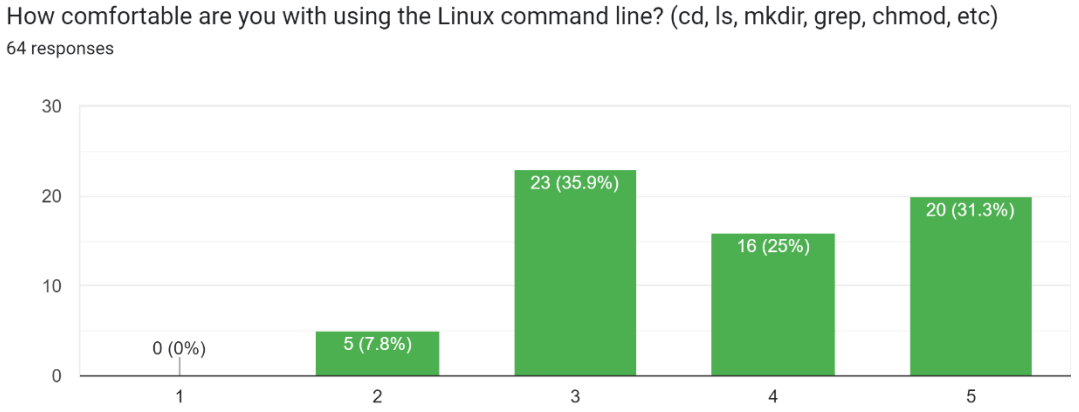
You have one late pass for the semester

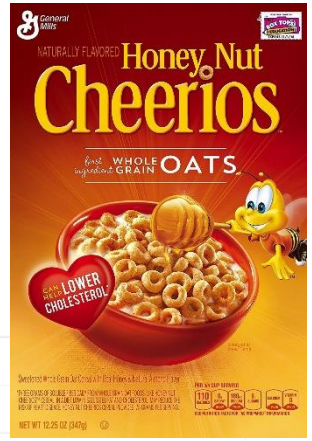
From the questionnaire…





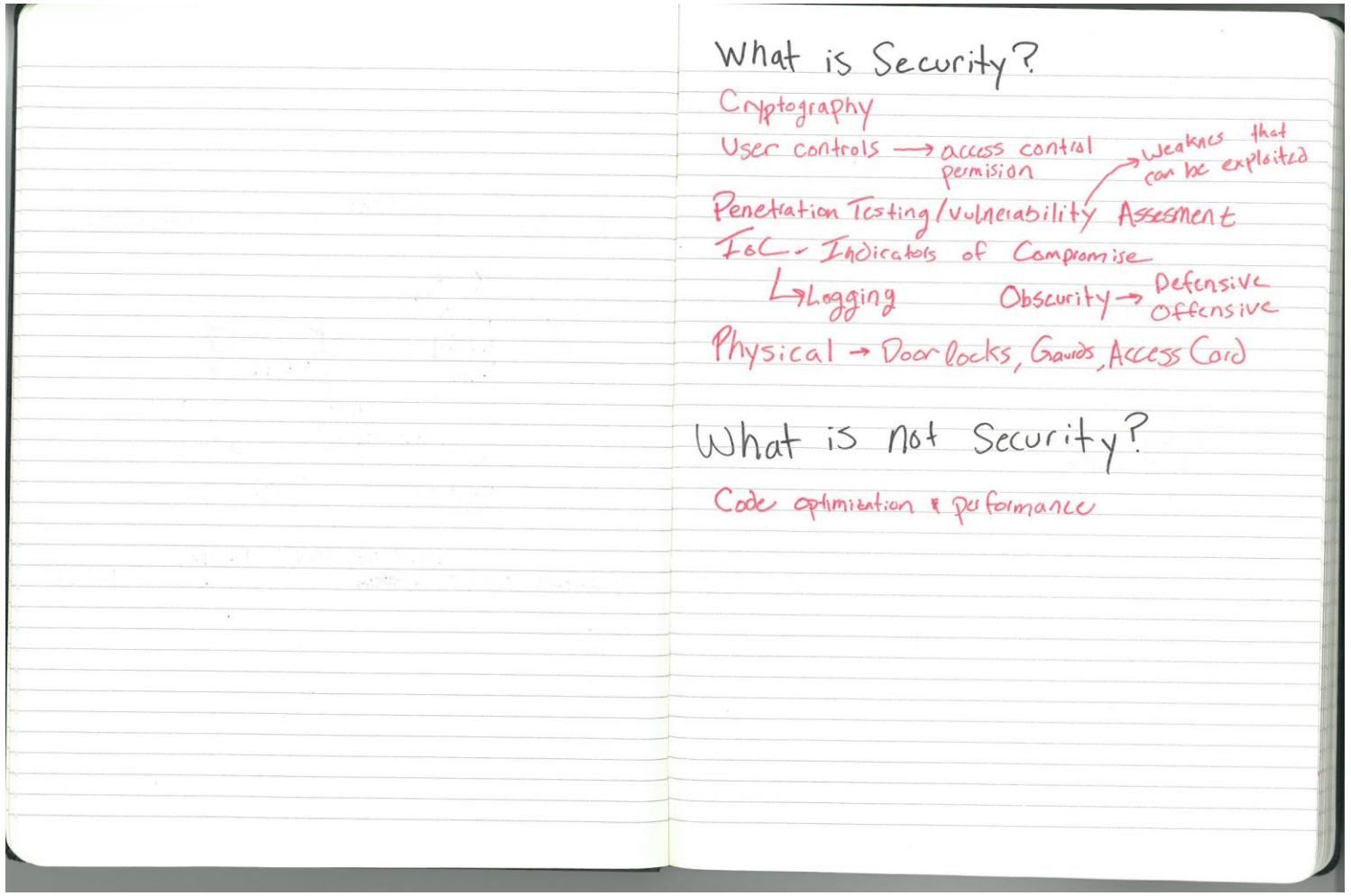




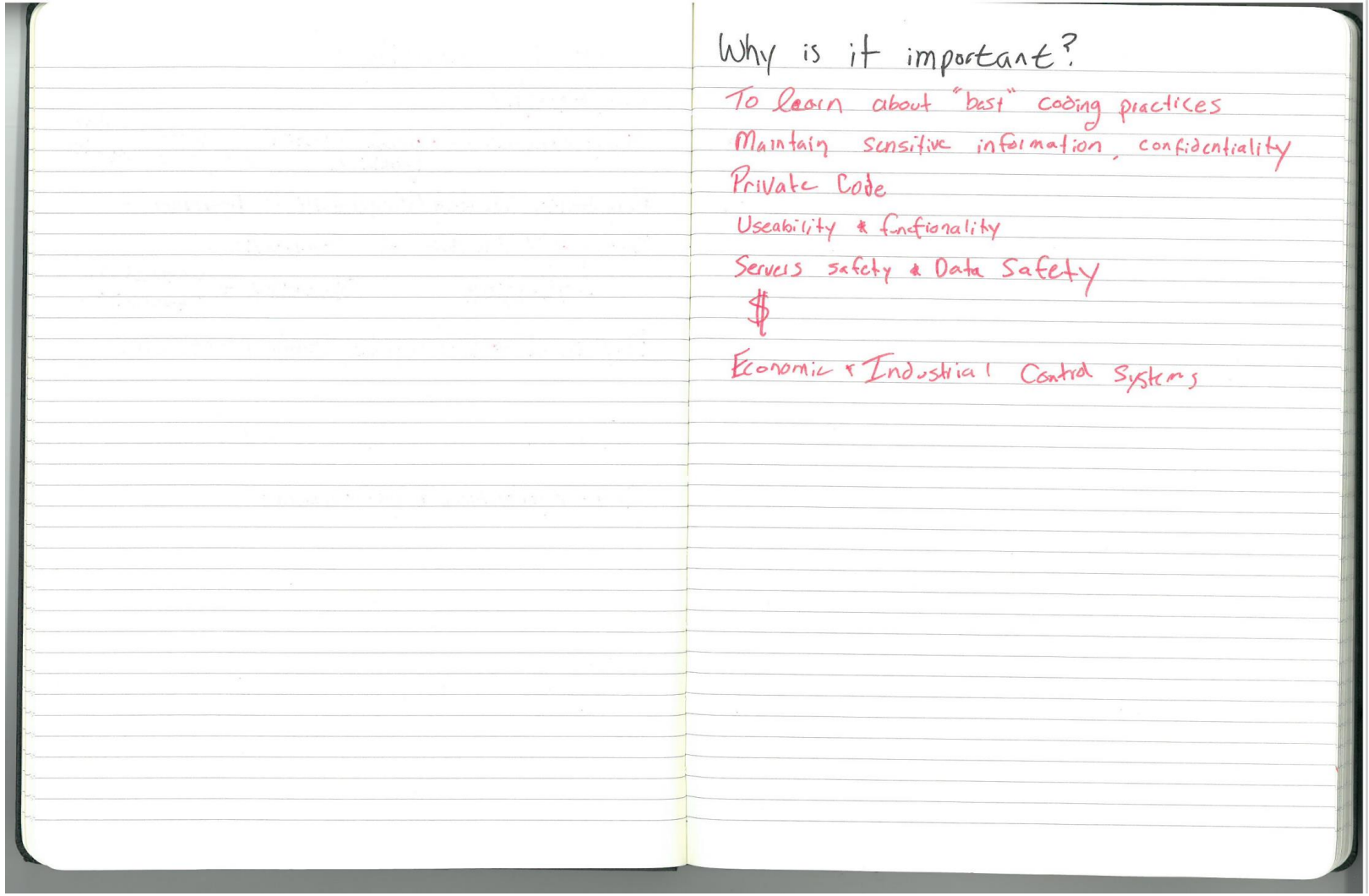


I can't touch on every security topic, but I hope I can cover as many interesting areas as I can ☺

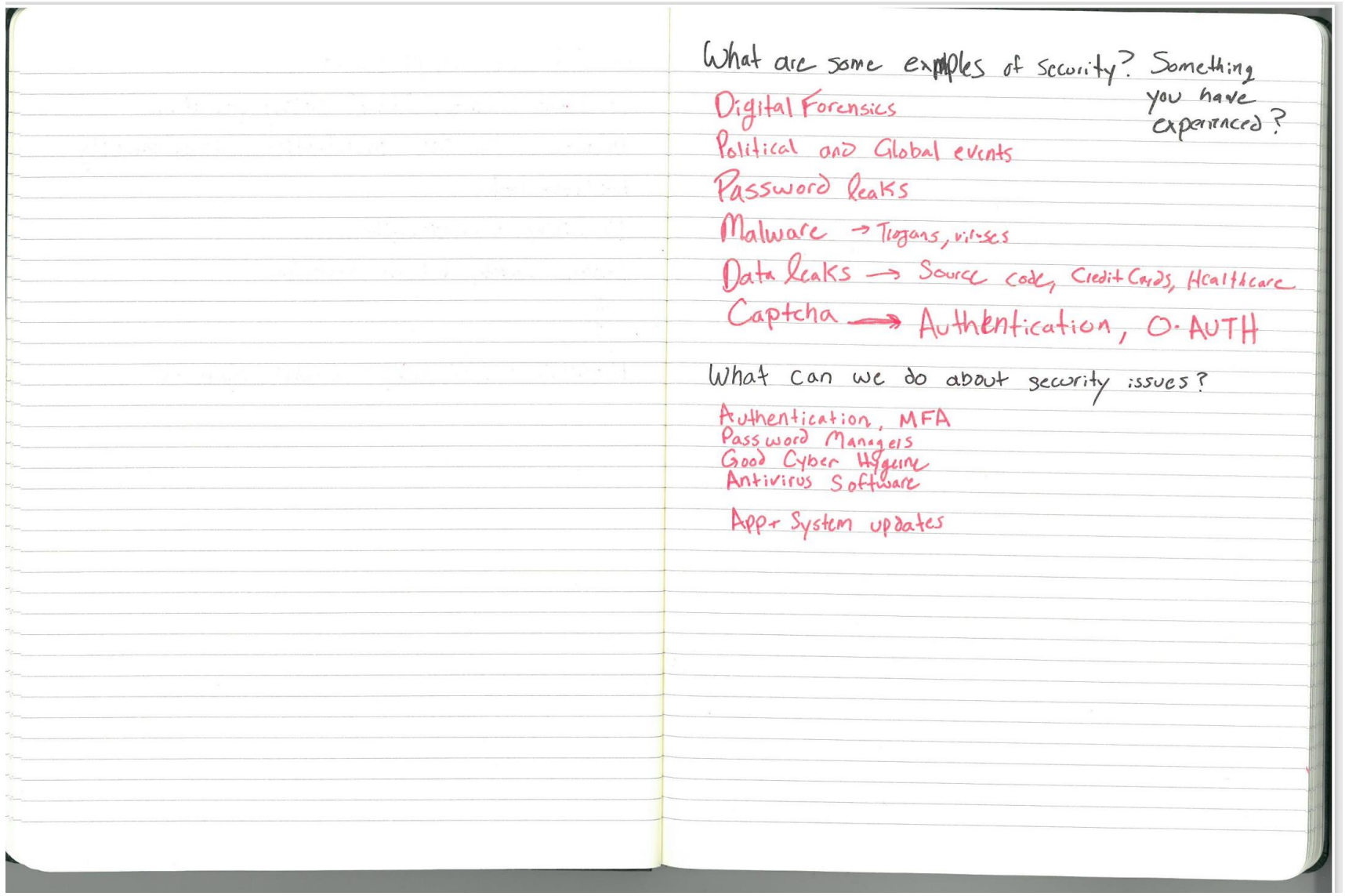
What is security? (What is security **not**?)



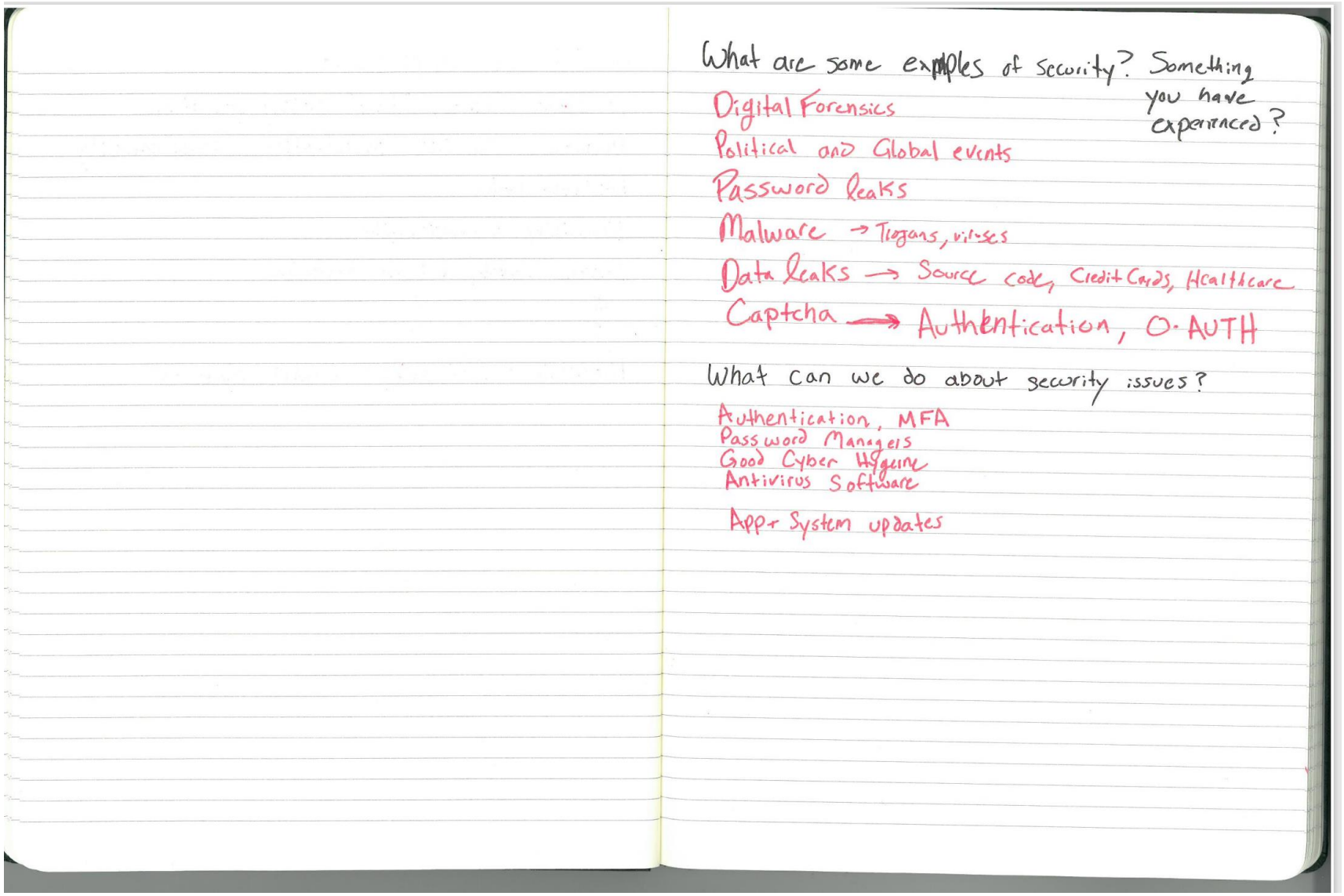
Why is it important?



Popular examples? Examples you've encountered?

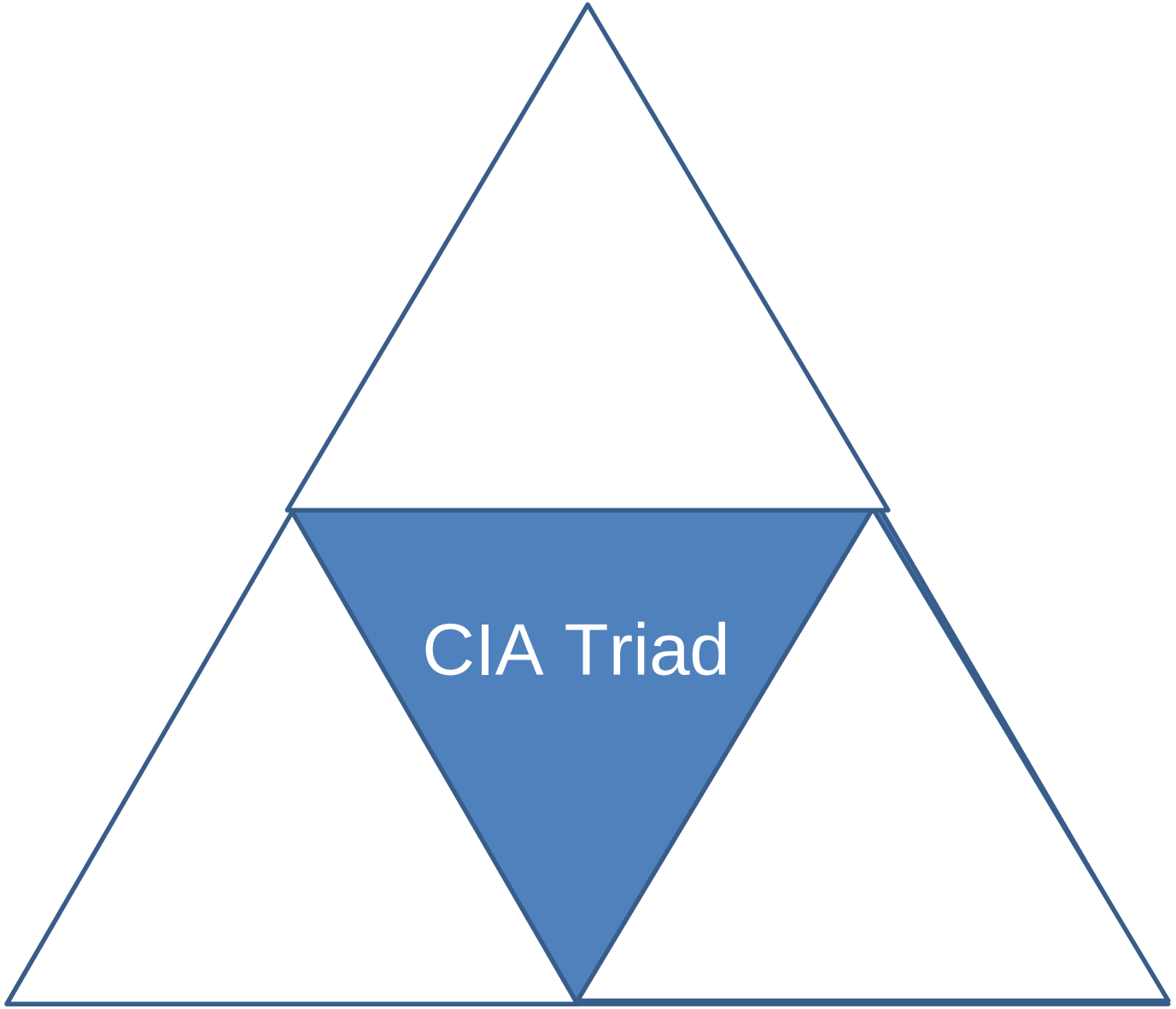


What can we do about security issues?



Security Basics

The **CIA Triad** is a widely accepted model for evaluating the security of a system. Consists of three important principles



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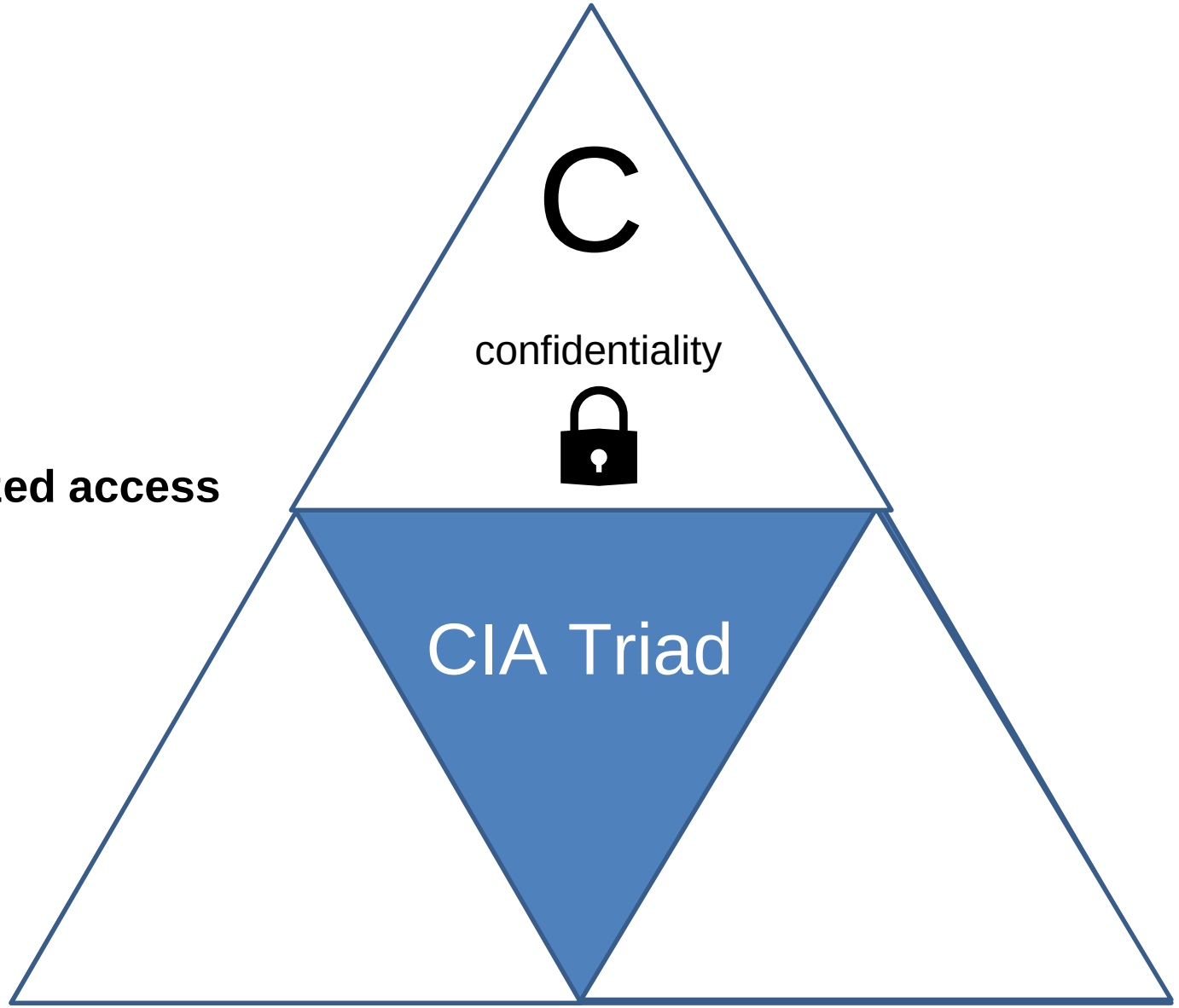
Confidentiality- protection from **unauthorized access**



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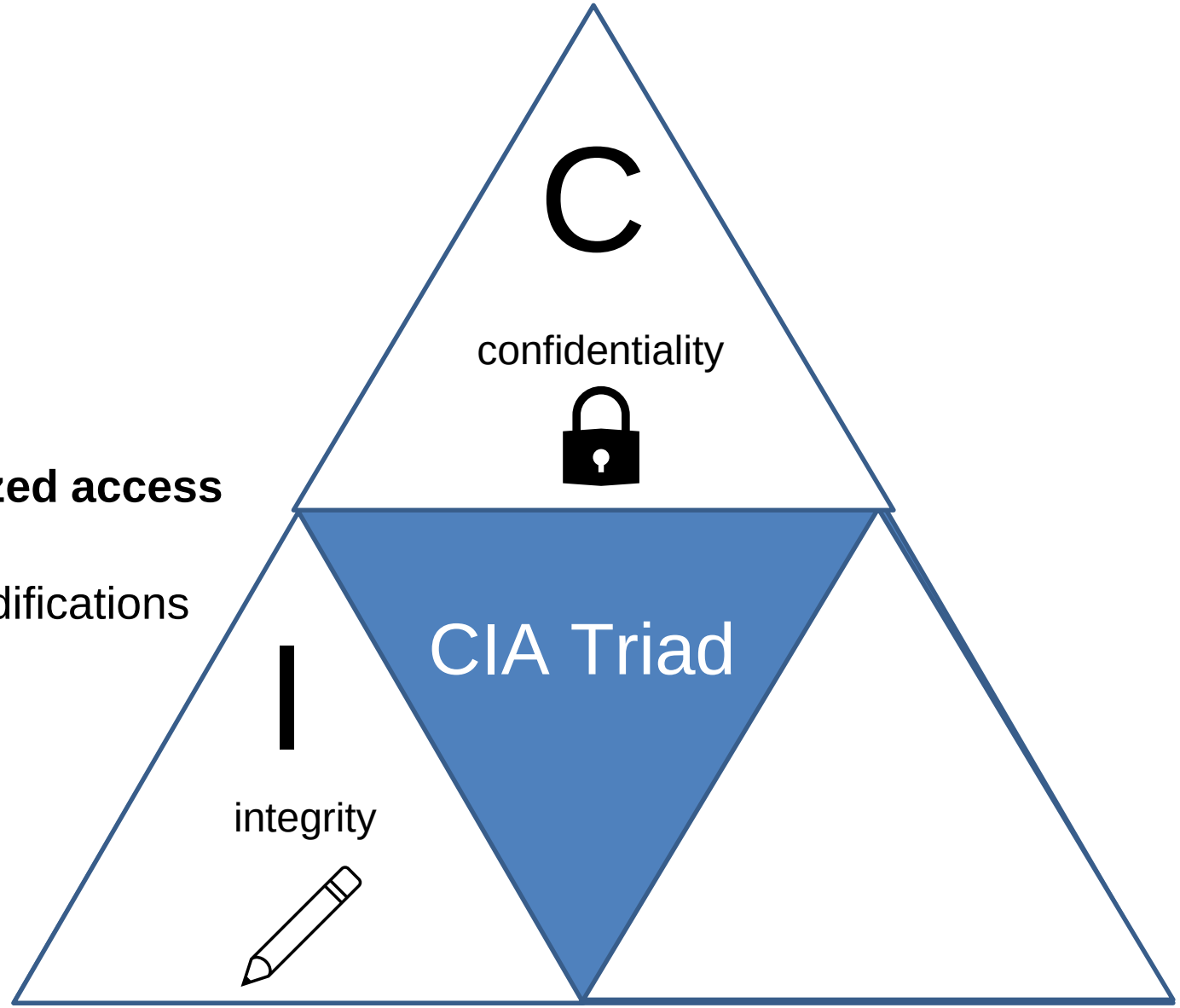

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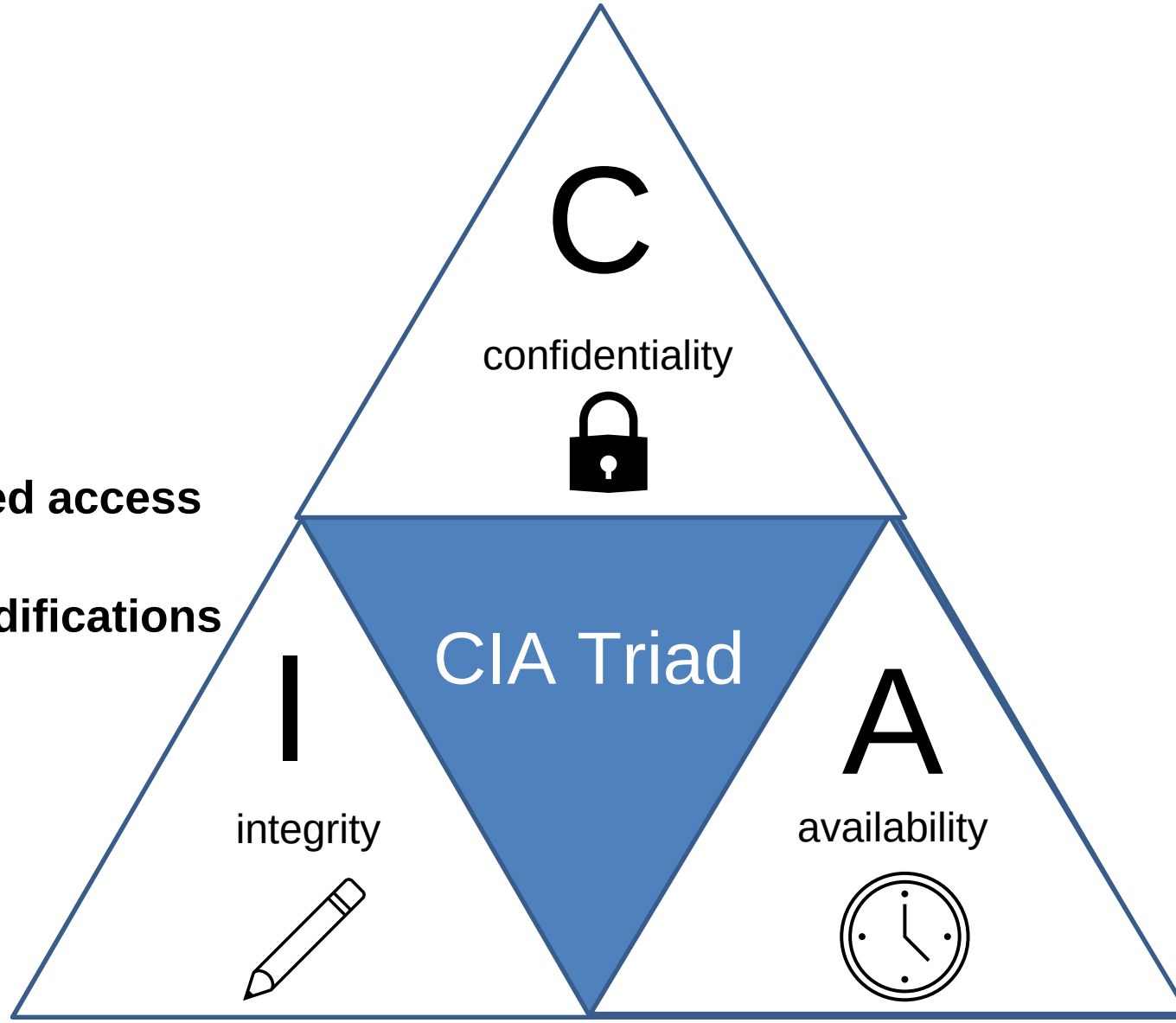
Confidentiality- protection from **unauthorized access**

Integrity- protection from **unauthorized modifications**

Availability- protection from **interruption**



Common Threats & Attack Vectors

Denial of Service (DoS / DDos)- attack with intent to shut down a machine or network

- Violates the **availability** property

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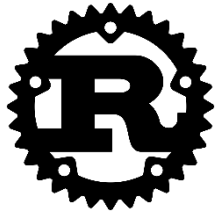
- Violates the **integrity** property

Privilege Escalation- gaining illicit permissions beyond what is intended for that user

- Violates the **confidentiality** property
- Violates the **integrity** property

Defense Mechanisms

- Formal verification
- Software testing
- Refactoring software and safe coding practices
- Built-in mitigations

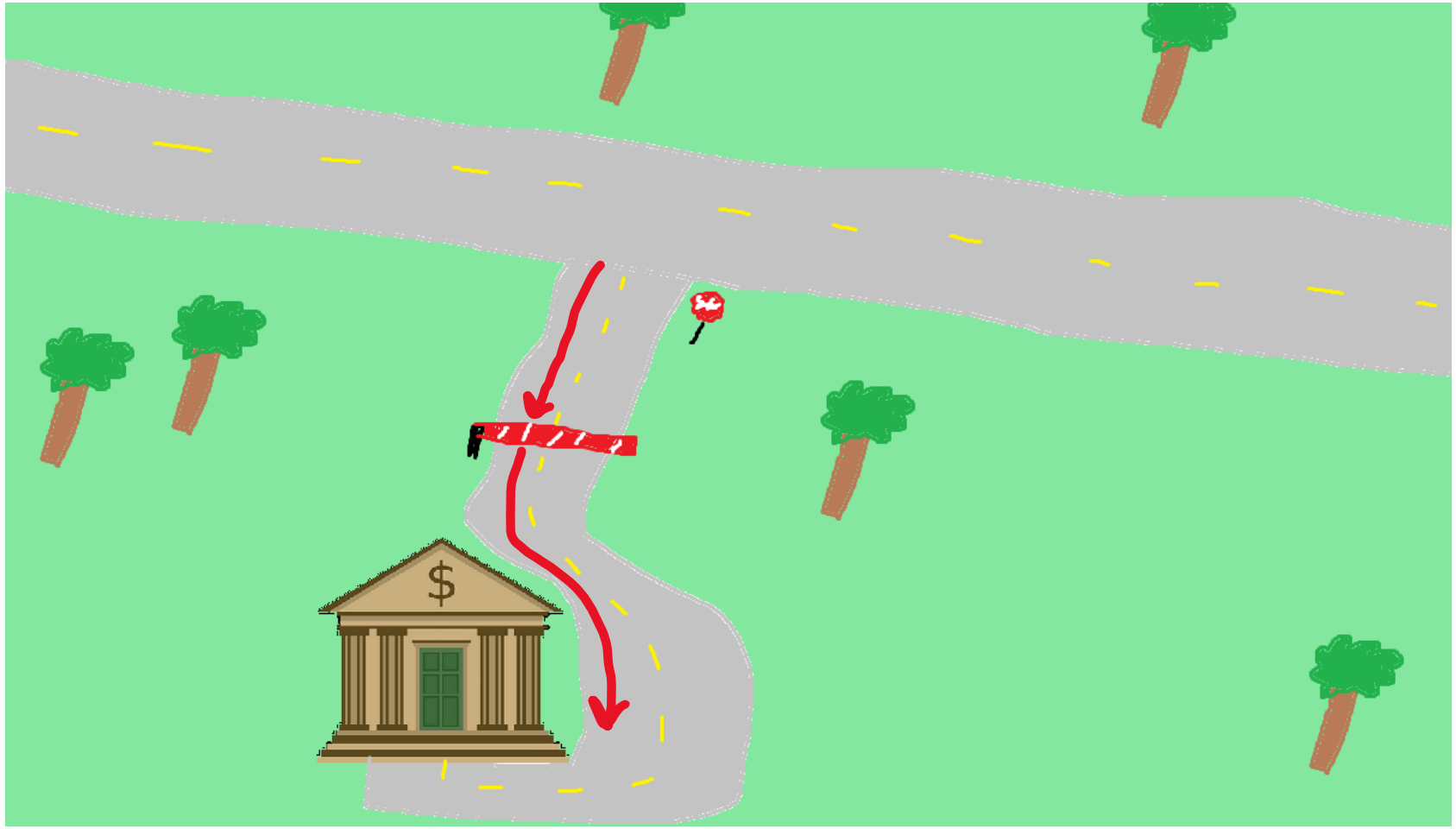


Threat Modeling

NEED: a consistent and structured approach for defense and assessing risk

Assessing Risk

We expect users to interact with our system in a certain way



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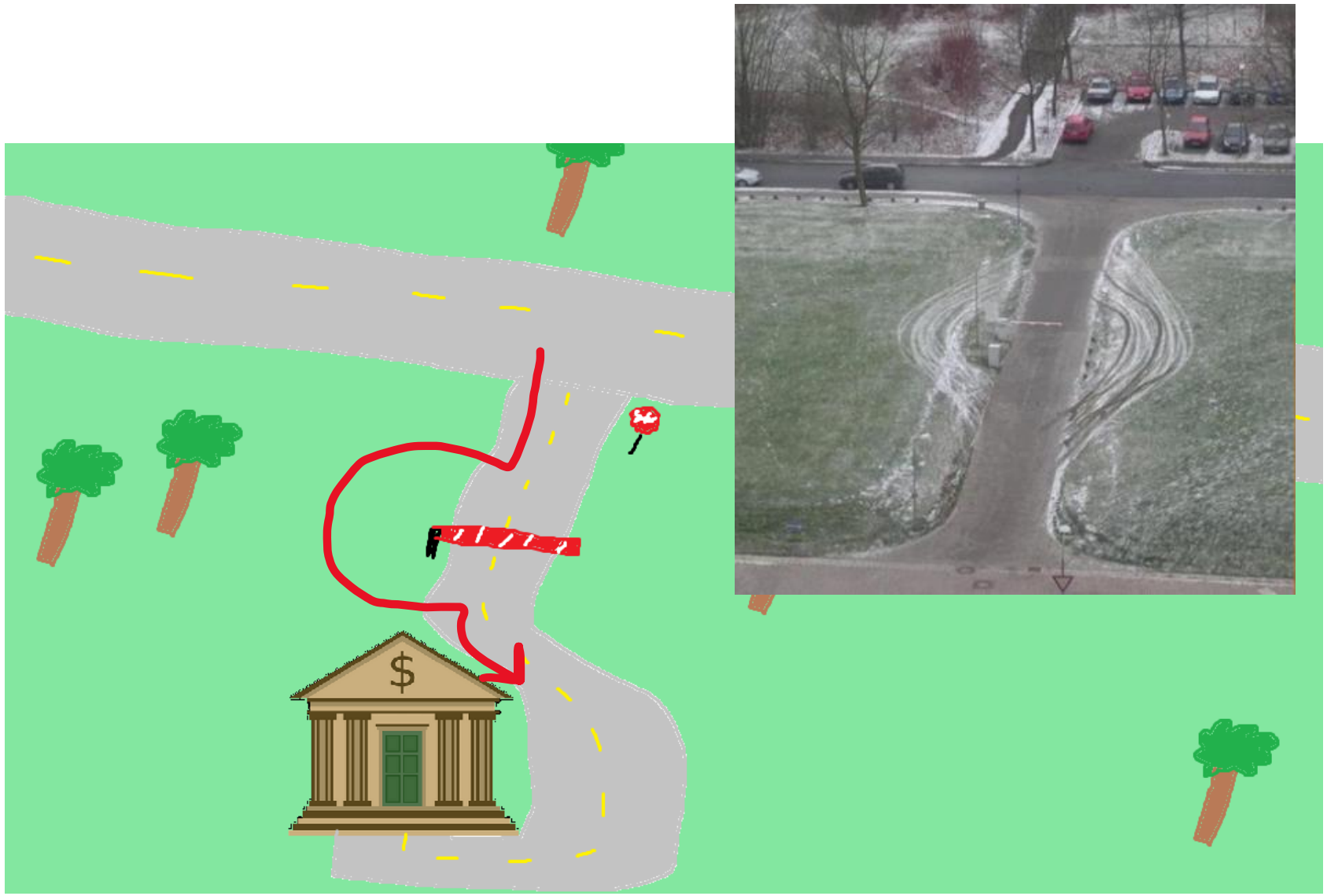
When someone interacts with our system in a way that we did not intend… it could have harmful consequences



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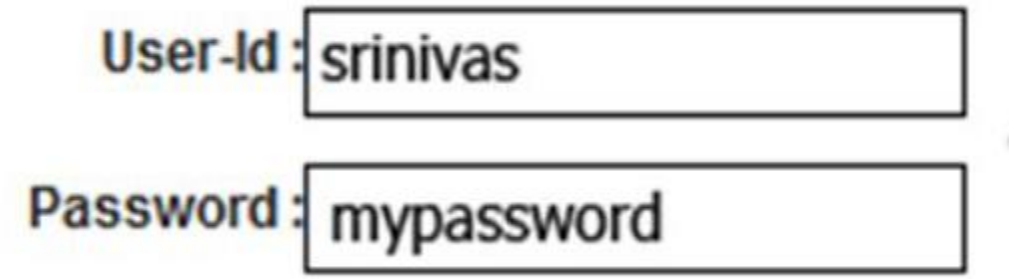

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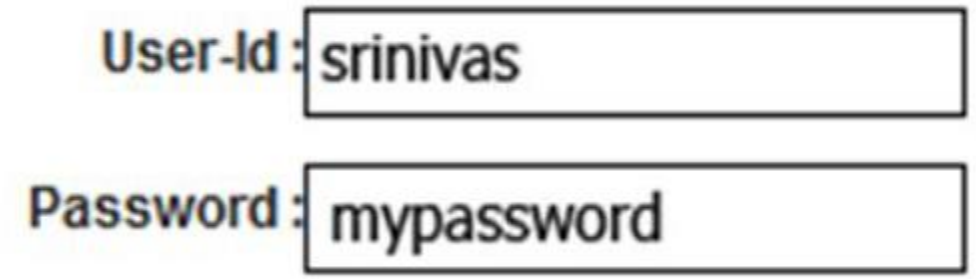

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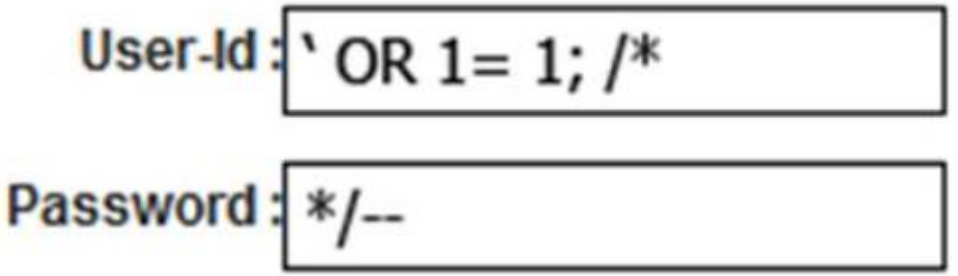
What if they did something…….. weird?



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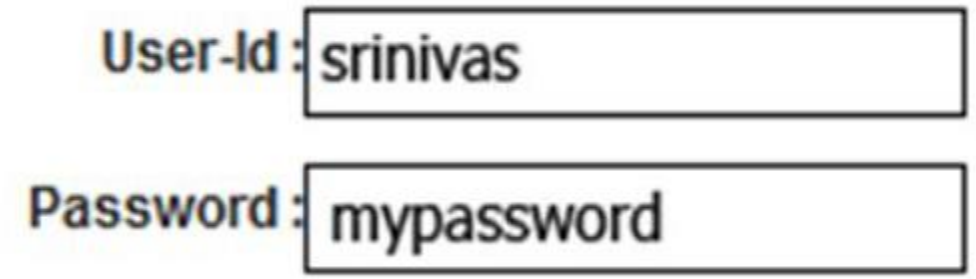

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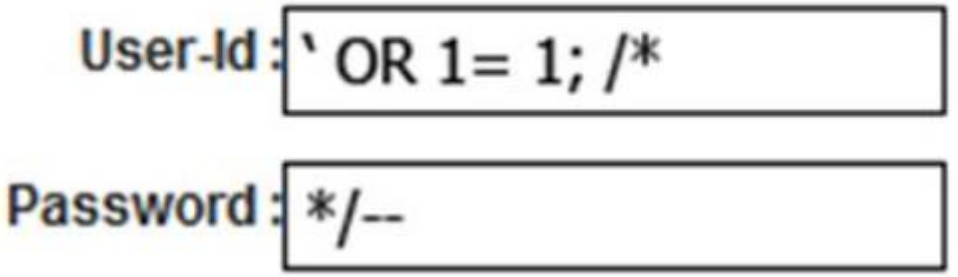


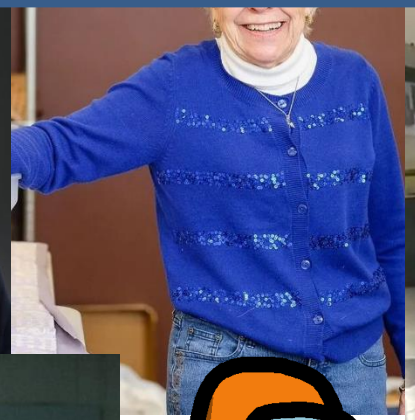
LOGIN SUCCESS

Who do we trust?

Are they honest? Are they reliable? Are they dependable? What are their intentions?

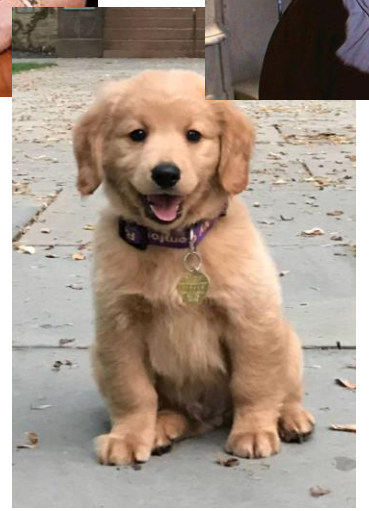
Who do we trust?

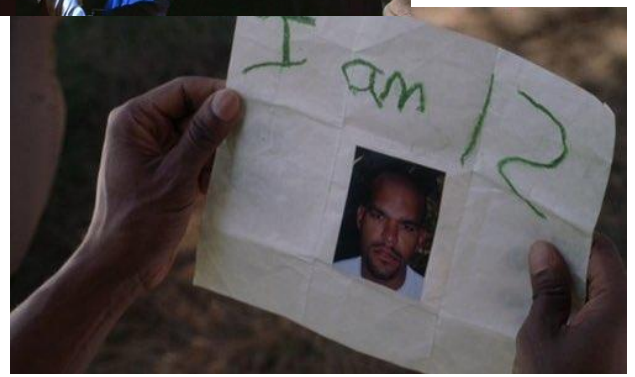
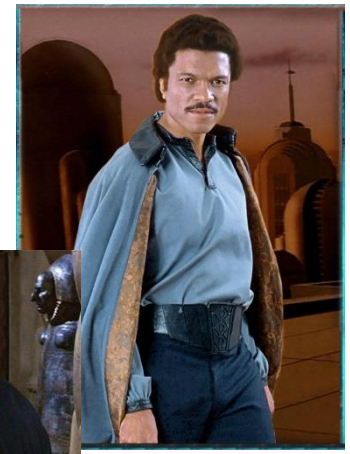
Trust as little as possible







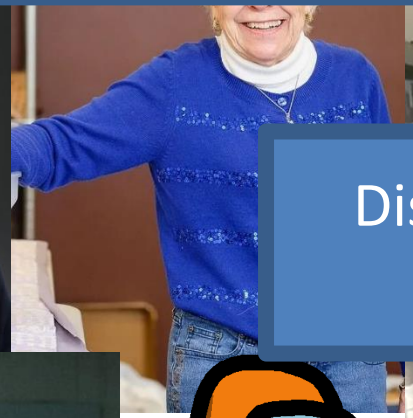
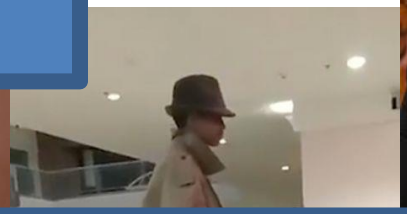




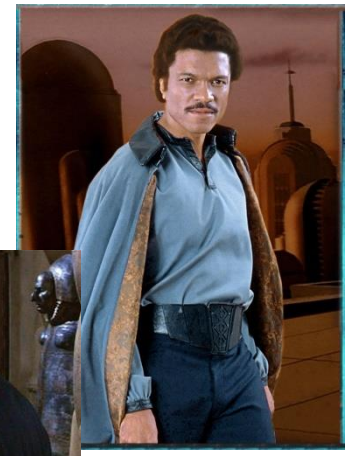
Are they honest? Are they reliable? Are they dependable? What are their intentions?

Who do we trust?

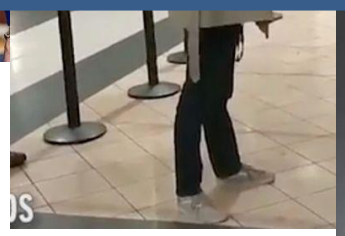
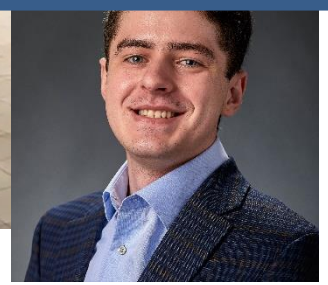
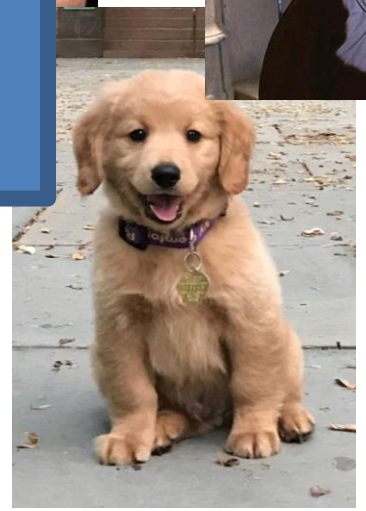
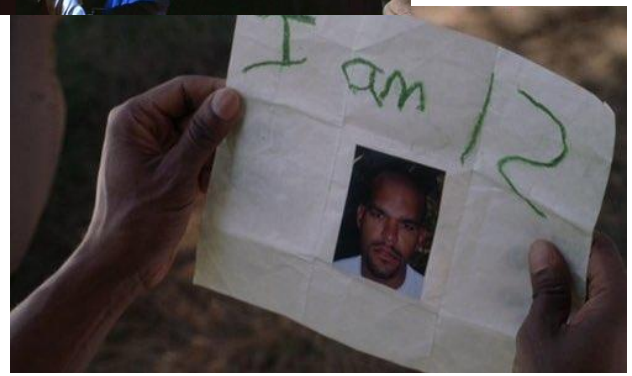
Trust as little as possible

Distrust proportionally to level of risk



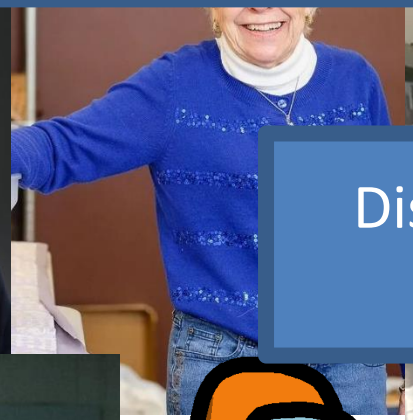
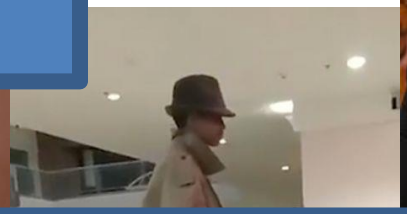
Are they honest? Are they reliable? Are they dependable? What are their intentions?

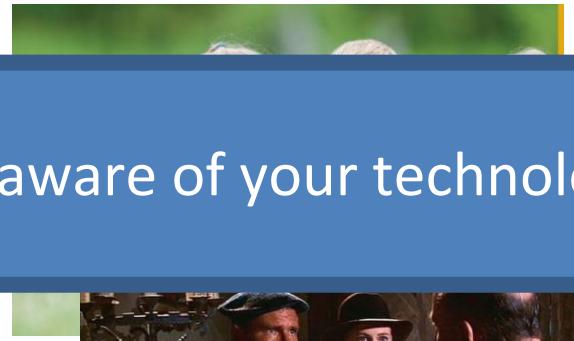
Who do we trust?

Trust as little as possible

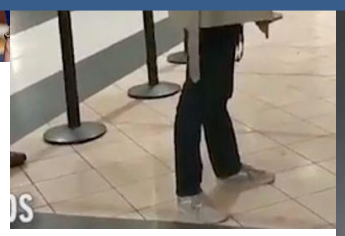
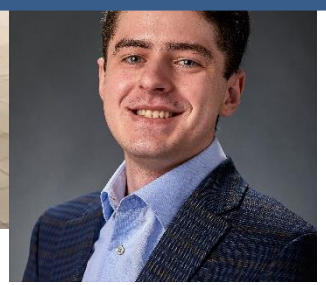
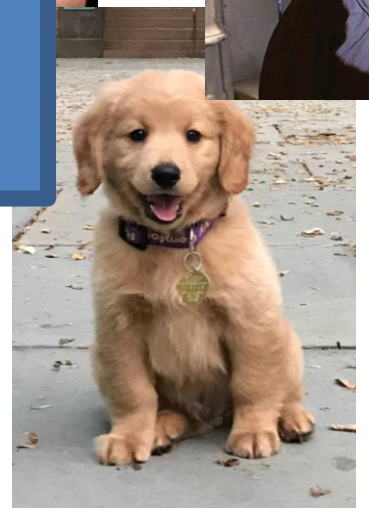
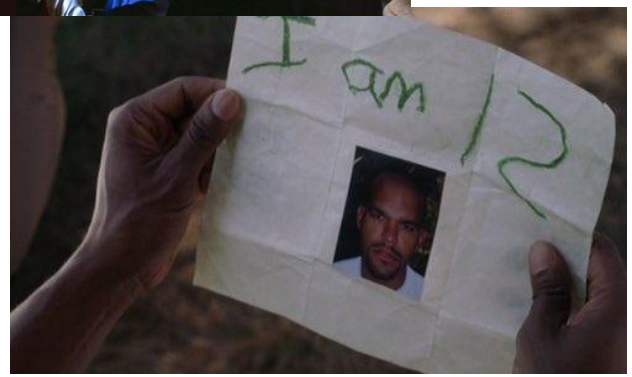
Be aware of your technology

Distrust proportionally to level of risk





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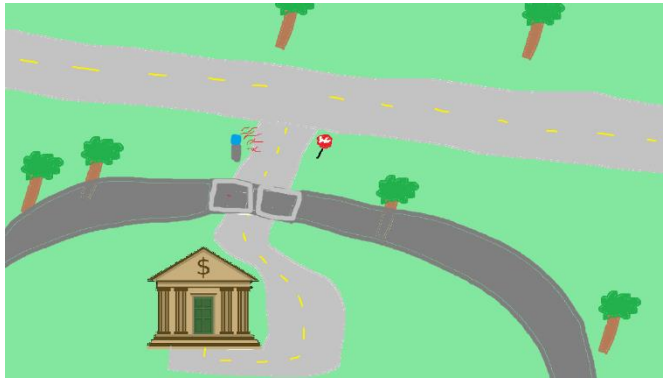
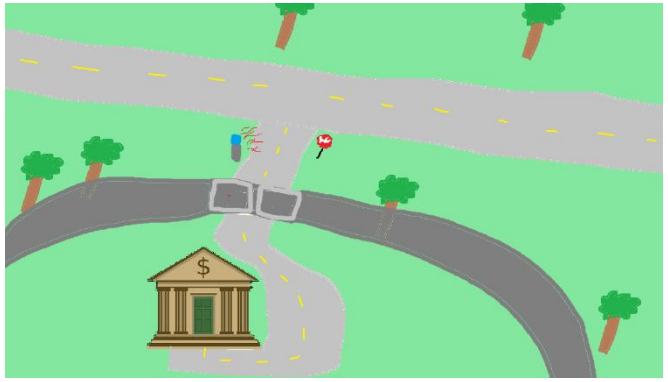
Perfect security is impossible



Perfect security is impossible

- New **assets**



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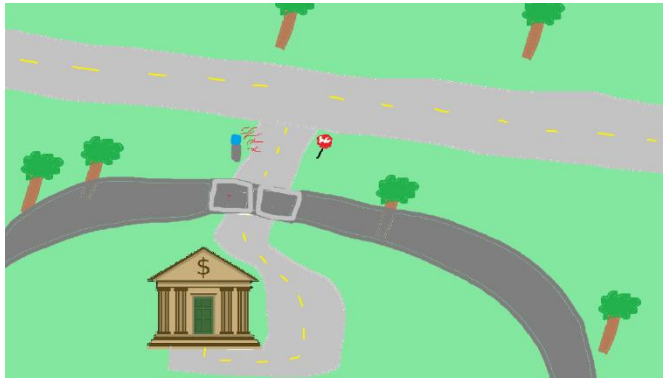

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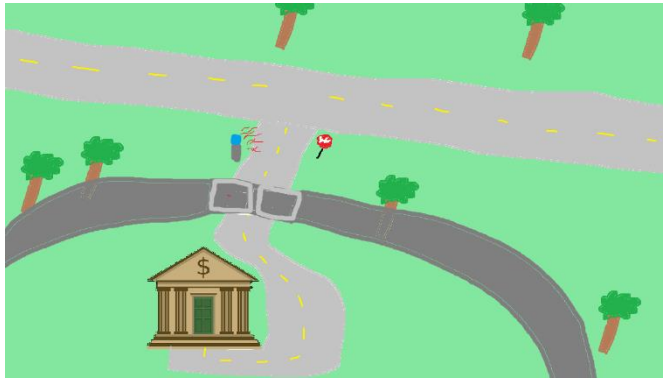
- New **assets**
- New **threats**
- New **capabilities**



Perfect security is impossible

- New **assets**
- New **threats**
- New **capabilities**
- New **technology**

Apache LOG4J™

Perfect security is impossible

- New **assets**
- New **threats**
- New **capabilities**
- New **technology**

My goal is to teach you important cybersecurity principles that are universal across any system

Apache LOG4J™

Threat Modeling

You develop a threat model by focusing on four key questions

1. What are you building?
2. What are the assets?
3. What can go wrong?
4. What should you do about those things that can go wrong?
5. Did you do a decent job of analysis?

Threat Modeling

Brainstorming

1. **Free-form brainstorming-** gather around a whiteboard; enumerate threats/possible defenses
2. **Scenario Analysis-** Propose a scenario and ask “what might go wrong?”
3. **Pre-Mortem**- Assuming a failure or compromise, what do you do next?
4. **Movie plotting** – Pick outrageous ideas; what happens next?
5. **Literature review-** study systems that are similar to yours

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Let's develop a threat model

You are at a bar, and you hand your phone to a cute person …

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Let's develop a threat model

You are at a bar, and you hand your phone to a cute person …

What are your assets?
What can go wrong?
What things can be done to prevent those things?
If something bad happens, what can we do?

Th

Let

We are at a bar. We hand our phone to a cute person?

What are the assets?

Venmo balance
Physical phone
Medical Health
Passwords + Credit phone
Contact Information
photos → Blackmail
Password
Nudes
~~Access~~ Authentication Device
Social Media
App accounts
Reddit Account
Amazon Account Email
Security
Tesla

what can go wrong?

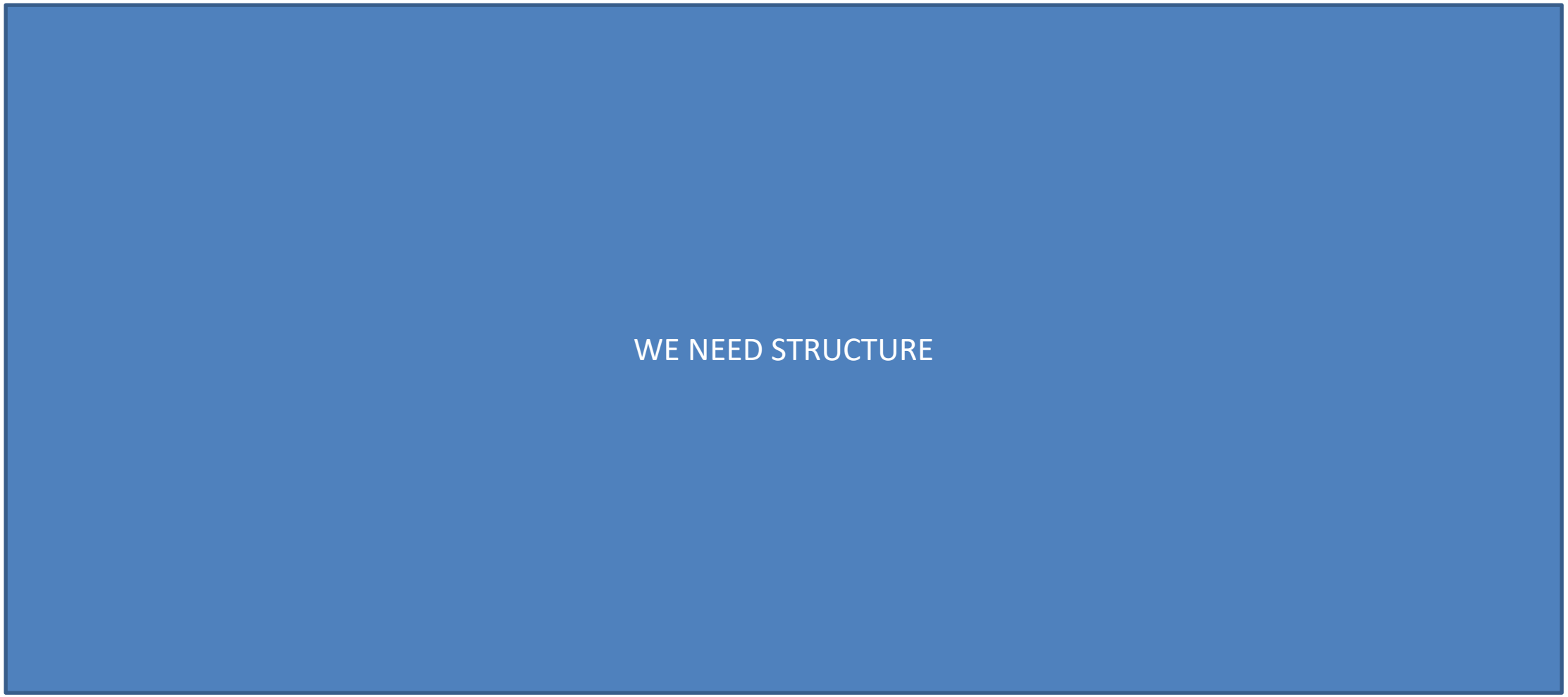
Dropping of Phone
Download malicious software
Factory Reset
Send money to themselves
Use your social
Order Amazon product,
Steal Passwords, information
Change Permissions
Scams + Covid!
Put illegal stuff

What can we do?

Authentication
Ask them, not give
Never share passcode
hold their phone or wallet as collateral
Dont leave the house
Secondary Phone
Dont Keep personal stuff phone

monitor settings
ask for their phone

Structured Approaches



- Attack Lists & Libraries (ie. Common and Current vulnerabilities)

There is no “right” choice

Structured Approaches

- **Asset-centric**: focus on things of value: things attack want; things you want to protect
- **Attacker-centric**: focus on attackers/archetypes/personas and their capabilities
- **Software-centric**: focus of SW; most SW is backed by structured models (CFG, State diagrams, etc)

Methodologies

- STRIDE
  - **S**poofing, **T**ampering, **R**epudiation, **I**nfo Disclosure, **D**enial of Service, **E**levation of Privilege
    (https://docs.microsoft.com/en-us/azure/security/develop/threat-modeling-tool-threats)
- Attack Trees
- Attack Lists & Libraries (ie. Common and Current vulnerabilities)

There is no “right” choice

Attack Trees

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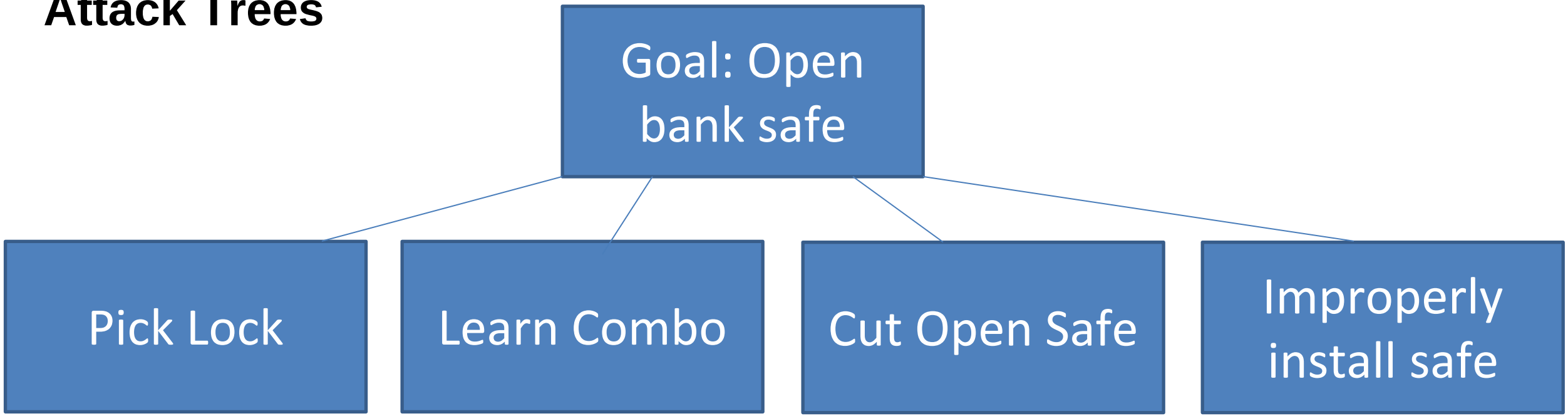
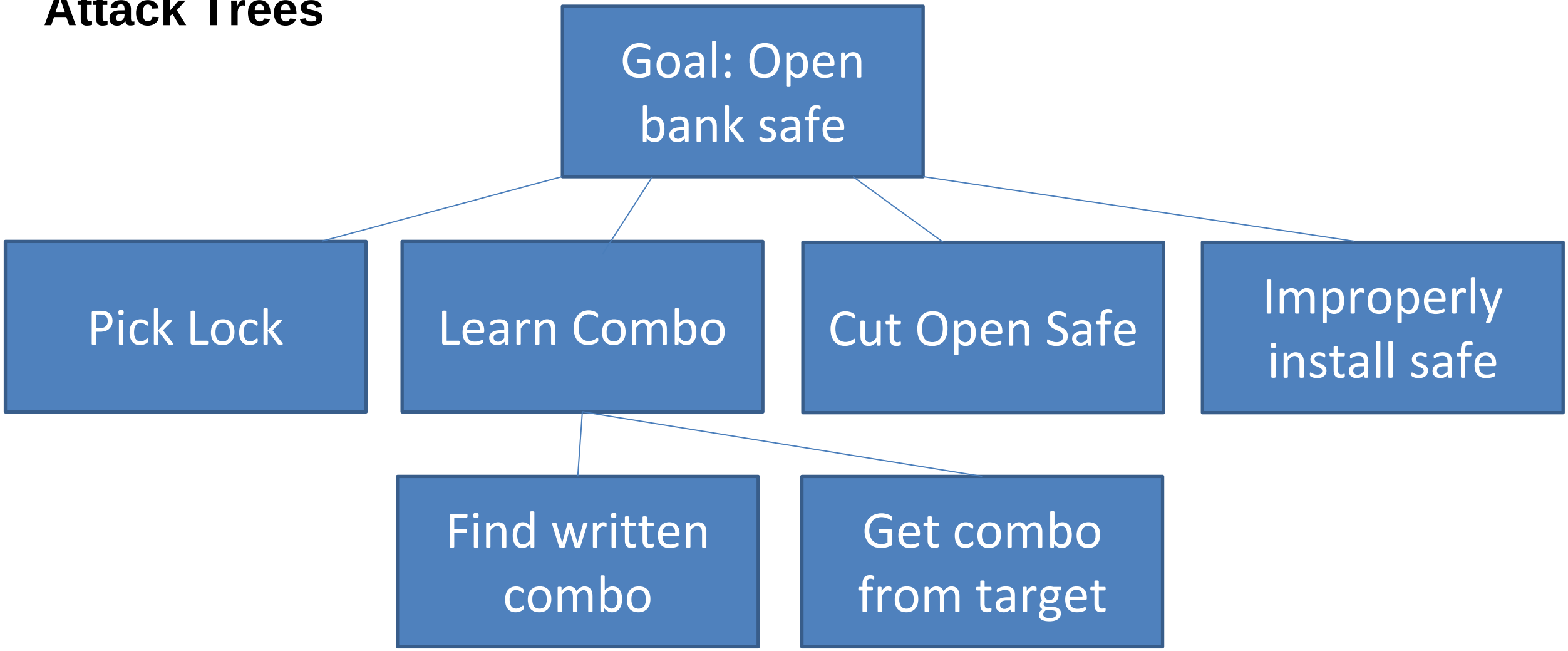


Attack Trees



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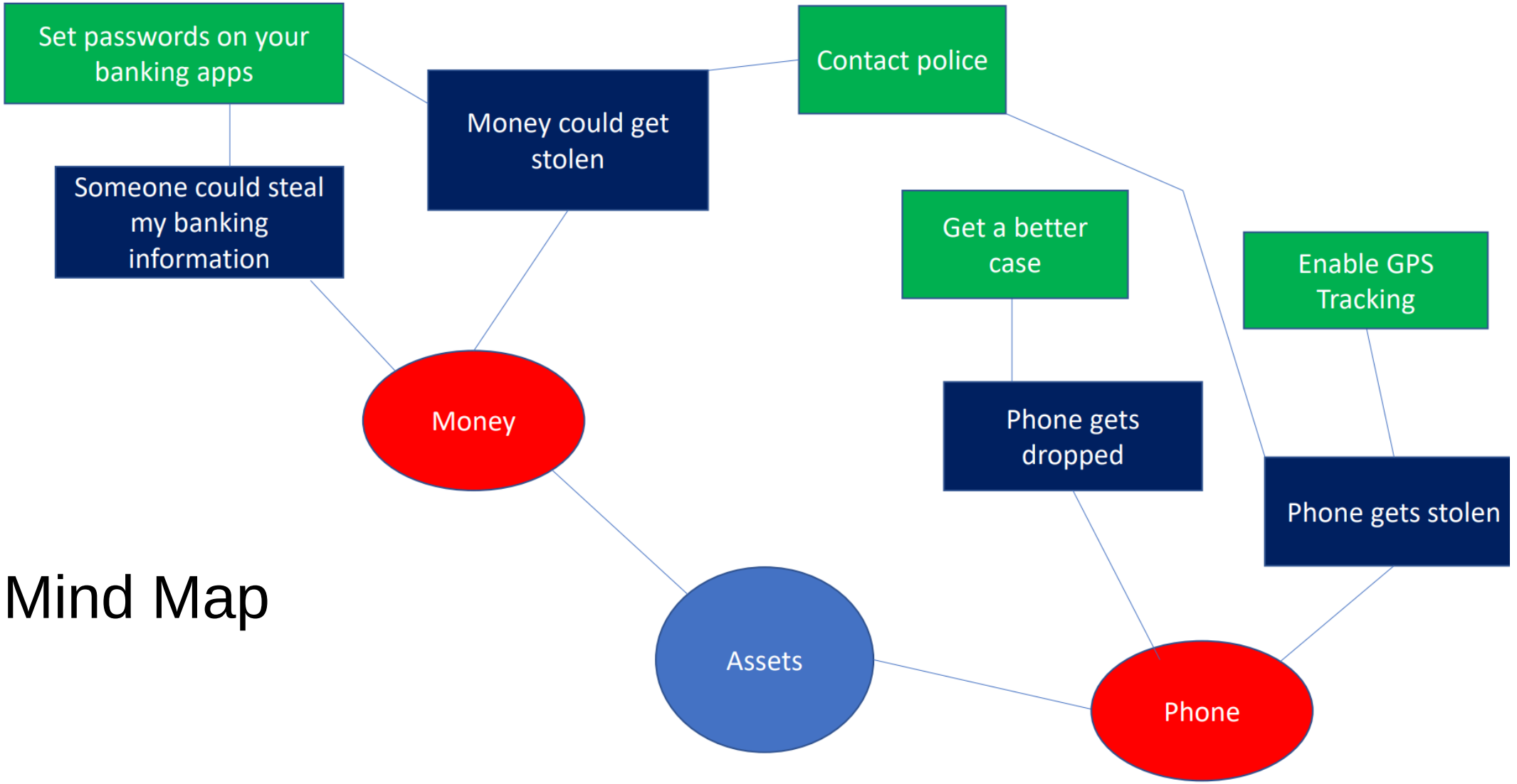
Mind Map


Set passwords on your banking apps
Someone could steal my banking information
Money could get stolen
Contact police
Get a better case
Enable GPS Tracking
Money
Phone gets dropped
Phone gets stolen
Assets
Phone