CSE447: CRYPTOGRAPHY AND CRYPTANALYSIS
SUMMER 2023

BRAC UNIVERSITY
Inspiring Excellence

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How to get A in this course???

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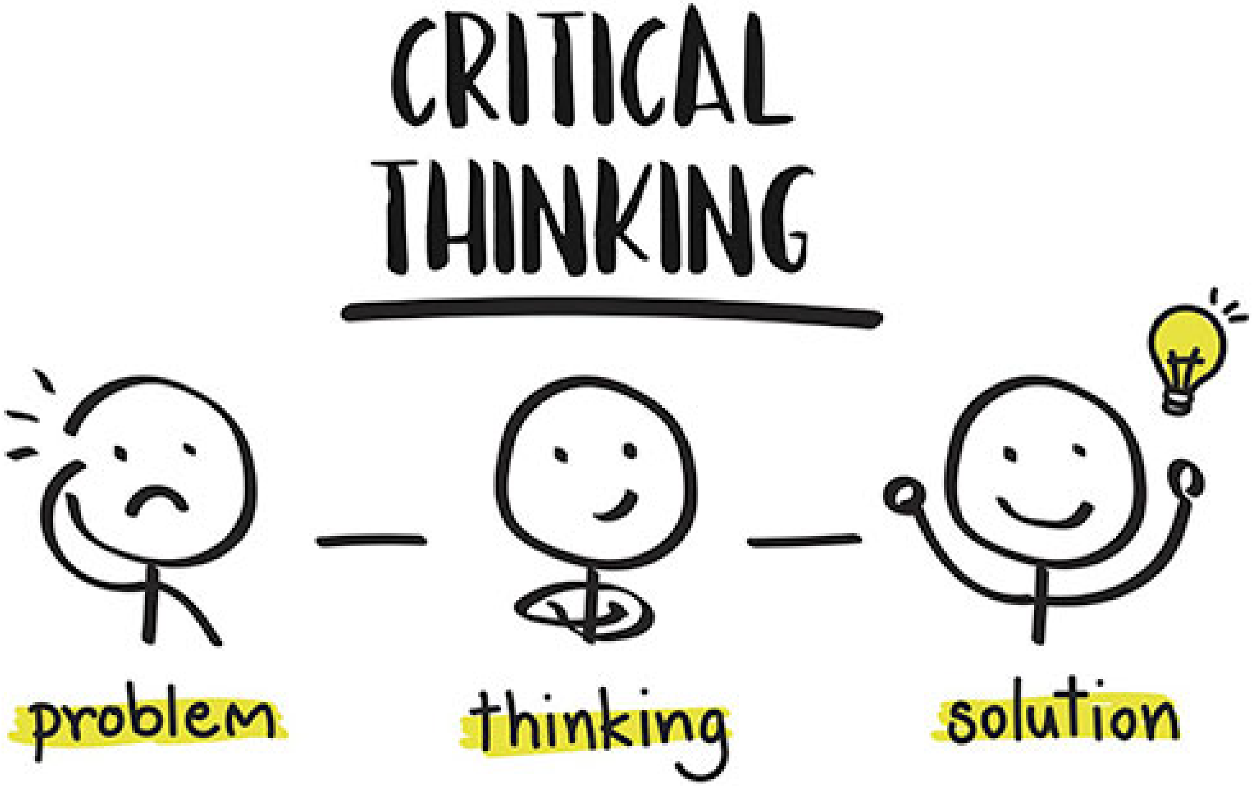


CHAPTER 1 INTRODUCTION

- THE CAST OF CHARACTERS
- ALICE'S ONLINE BANK
- ABOUT THE TEXT BOOK

THE CAST OF CHARACTERS

- Alice and Bob are the good guys

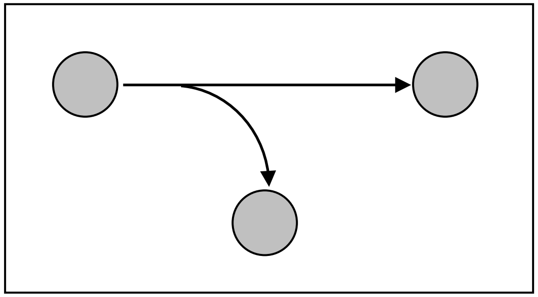
- Trudy is the bad guy
- Trudy is our generic "intruder"

ALICE'S ONLINE BANK

- Alice opens Alice's Online Bank (AOB)
- What are Alice's security concerns?
- If Bob is a customer of AOB, what are his security concerns?
- How are Alice and Bob concerns similar? How are they different?
- How does Trudy view the situation?

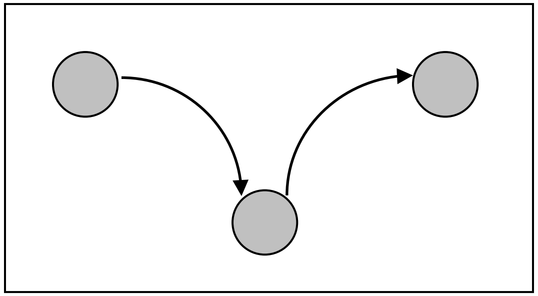
CIA

- CIA: Confidentiality, Integrity, and Availability
- Confidentiality
  - AOB must prevent Trudy from learning Bob's account balance
  - **Confidentiality:** prevent unauthorized reading of information
  - Cryptography used for confidentiality



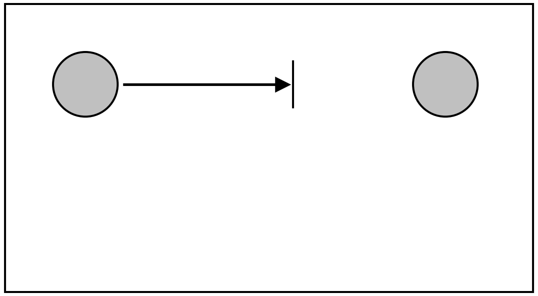
CIA

- Integrity
  - Trudy must not be able to change Bob's account balance
  - Bob must not be able to improperly change his own account balance
  - **Integrity:** prevent unauthorized writing of information
    - Cryptography used for integrity



CIA

- Availability
  - AOB's information must be available when needed
  - Alice must be able to make transaction
    - If not, Bob'll take his business elsewhere
  - **Availability:** Data is available in a timely manner when needed
  - Availability is a "new" security concern
    - In response to denial of service (DoS)



BEYOND CIA

- CIA are only beginning of the Inf Sec.
- Case 1: when Bob logs on his computer
  - How does Bob's computer know that "Bob" is really Bob and not Trudy?
- Bob's password must be verified
  - This requires some clever **cryptography**
- What are security concerns of pwds?
- Are there alternatives to passwords?

BEYOND CIA

- Case2: when Bob logs into AOB
  - how does AOB know that "Bob" is really Bob?
- As before, Bob's password is verified
- Unlike standalone computer case, network security issues arise
- What are network security concerns?
  - **Protocols** are critically important
  - Crypto also important in protocols

BEYOND CIA

- Once Bob is *authenticated* by AOB, then AOB must restrict actions of Bob
  - Bob can't view Charlie's account info
  - Bob can't install new software, etc.
- Enforcing these restrictions is known as authorization
- **Access control** includes both authentication and authorization

BEYOND CIA

- Cryptography, protocols, and access control are implemented in **software**
- What are security issues of software?
  - Most software is complex and buggy
  - Software flaws lead to security flaws
  - How does Trudy attack software?
  - How to reduce flaws in software development?
- And what about malware?

BEYOND CIA

- Some software is intentionally evil
    - Malware: computer viruses, worms, etc.
- How do the malwares work?
- What can Alice and Bob do to protect themselves from malware?
- What can Trudy do to make malware more "effective"?

BEYOND CIA

- Operating systems enforce security
  - For example, authorization
- OS: large and complex software
  - Win XP has 40,000,000 lines of code!
  - Subject to bugs and flaws like any other software
  - Many security issues specific to OSs
  - Can you trust an OS?

TEXT BOOK

- The text consists of four major parts
  - **Cryptography**
  - **Access control**
  - **Protocols**
  - **Software**
- Note: Our focus is on technical issues

THE PEOPLE PROBLEM

- People often break security
  - Both intentionally and unintentionally
  - Here, we consider the unintentional
- For example, suppose you want to buy something online
  - To make it concrete, suppose you want to buy from amazon.com

THE PEOPLE PROBLEM

- To buy from amazon.com…
  - Your Web browser uses SSL protocol
  - SSL relies on cryptography
  - Access control issues arise
  - All security mechanisms are in software
- Suppose all of these security stuff works perfectly
  - What could possibly go wrong?

THE PEOPLE PROBLEM

- What could go wrong?
- Trudy can try man-in-the-middle attack
  - SSL is secure, so attack doesn't "work"
  - Web browser issues a warning
  - What do you, the user, do?
- If user ignores warning, attack works!
  - None of the security mechanisms failed
  - But user unintentionally broke security

CRYPTOGRAPHY

- "Secret codes"
- The book covers
  - Classic cryptography
  - Symmetric ciphers
  - Public key cryptography
  - Hash functions
  - Advanced cryptanalysis

ACCESS CONTROL

- Authentication
  - Passwords
  - Biometrics and other
- Authorization
  - Access Control Lists and Capabilities
  - Multilevel security (MLS), security modeling, covert channel, inference control
  - Firewalls and Intrusion Detection Systems

PROTOCOLS

- Simple” authentication protocols
  - Focus on basics of security protocols
  - Cryptography used a lot in protocols
- Real-world security protocols
  - SSH, SSL, IPSec, Kerberos
  - Wireless: WEP, GSM (Global System for Mobile communications)

SOFTWARE

- Software security-critical flaws
  - Buffer overflow
  - Other common flaws
    - Incomplete Mediation
    - Race Conditions
- Malware
  - Specific viruses and worms
  - Prevention and detection
  - The future of malware

SOFTWARE

- Software reverse engineering (SRE)
  - How hackers "dissect" software
- Digital rights management (DRM)
  - Shows difficulty of security in software
  - Also raises OS security issues
- Software and testing
  - Open source, closed source, other topics

SOFTWARE

- Operating systems
  - Basic OS security issues
  - “Trusted” OS requirements
  - NGSCB(“n-scub): Microsoft’s trusted OS for PC
    - Next Generation Secure Computing Base
- Software is a big security topic
  - Lots of material to cover
  - Lots of security problems to consider
  - But not nearly enough time available…

THINK LIKE TRUDY

- Good guys must think like bad guys!
- A police detective
  - Must study and understand criminals
- In information security
  - We want to understand Trudy's motives
  - We must know Trudy's methods
  - We'll often pretend to be Trudy

THINK LIKE TRUDY

- Is all of this security information a good idea?
- “It’s about time somebody wrote a book to teach the good guys what the bad guys already know.” — Bruce Schneier

THINK LIKE TRUDY

- We must try to think like Trudy
- We must study Trudy's methods
- We can admire Trudy's cleverness
- Often, we can't help but laugh at Alice and Bob's stupidity
- But, we **cannot act** like Trudy
  - Except in this class…

IN THIS COURSE…

- Always think like the bad guy
- Always look for weaknesses
- Strive to find a weak link
- It's OK to break the rules
- Think like Trudy!
- But don't do anything illegal…