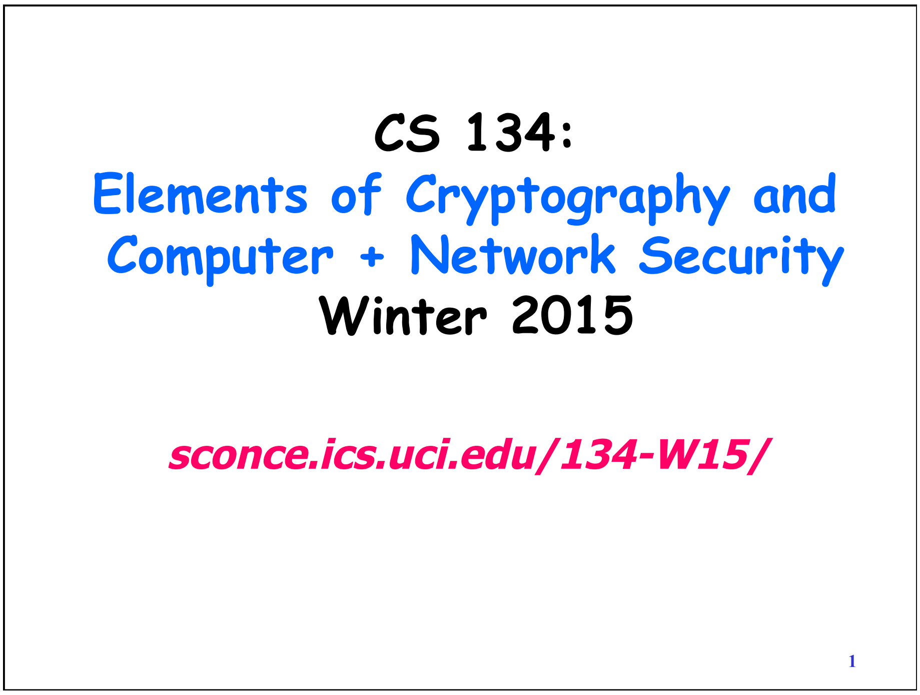
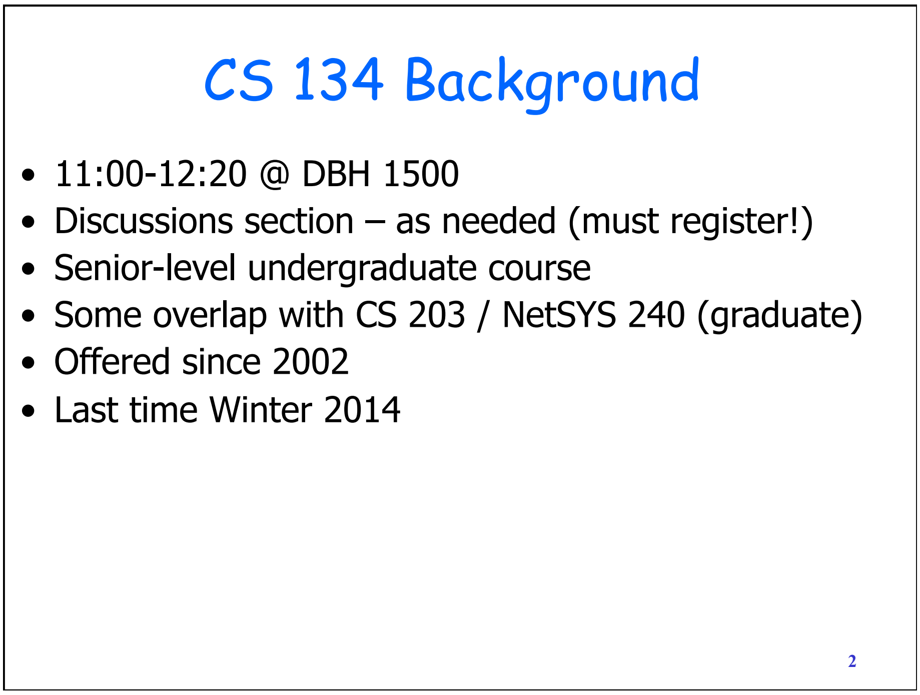


CS 134:
Elements of Cryptography and Computer + Network Security
Winter 2015

sconce.ics.uci.edu/134-W15/



CS 134 Background

- 11:00-12:20 @ DBH 1500
- Discussions section – as needed (must register!)
- Senior-level undergraduate course
- Some overlap with CS 203 / NetSYS 240 (graduate)
- Offered since 2002
- Last time Winter 2014

Why (not) take this course?

- Not required for any track or concentration
  - listed as an option in two specializations
- Difficult course material
- There'll be some weird math
- Tough grading
- Lectures often not available ahead of time
- There is no second chance if you mess up
- There is no drop after second week
- No Pass / No-pass option

Contact Information

- Instructor: Gene Tsudik
  - Email: **gene.tsudik** ****AT* uci.edu***
  - Office: DBH 3228 (office hours only)
  - ICS1 458E otherwise (for urgent matters only)
  - Office Hours:
    - Mondays, 11-noon
    - More if needed, e.g., before finals or if out of town on Monday
    - Otherwise, by appointment: contact by email to set up
- TA: Tyler Kaczmarek
  - PhD student, research in security & privacy
  - Email: ***tkaczmar *AT* uci.edu***
  - Office Hours:
    - Wednesdays, 2-3pm @ ICS1 468
    - More if needed

Prerequisites

Ideally, at least 2 of:

- Operating systems (CS 143A)
- Distributed systems (CS 131)
- Computer networks (CS 132)

AND:

- Design/Analysis of Algorithms (CS 161)

Class Info

- Lecture format
  - lecture slides (not always posted before class)
  - 2-3 guest lectures
  - 19 lectures total + midterm
- Course website:

  sconce.ics.uci.edu/134-W15/

  - check it regularly
  - news, assignments, grades and lecture notes (**in PDF**) will all be posted there
- Read your email

Course Textbooks/Readings

"Sort of" REQUIRED:

Network Security: Private Communication in a Public World, 2nd edition
Charlie Kaufman, Radia Perlman, Mike Speciner
Prentice Hall – 2002 – ISBN: 0130460192

OPTIONAL:

Cryptography : Theory and Practice, 3rd edition
Douglas R. Stinson
CRC Press – 2005 – ISBN: 1584885084

Also:
Cryptography and Network Security, 4th edition
William Stallings
Prentice Hall – 2006 – ISBN: 0131873164

Course Grading

- Midterm (25%)
- Final (25%)
- 3 Homeworks (15% each)
- 5% for attendance / participation / enthusiasm

BTW:

- I may or may not grade on a curve
- I will not hesitate giving C-s and worse…

Student Expectations

- Keep up with material
  - – complete relevant readings before class
  - – browse lecture slides
    - Slides will be on-line the same day, after class
- Attend lectures
- No excuses for not reading your email!
- Exams and homework:
  - – No collaboration of any sort
  - – Violators will be prosecuted
  - – An **F** in the course is guaranteed

Drop Policy

- Drop anytime during first 2 weeks…
  - Deadline – January 16
- Thereafter, no drop
- Incompletes to be avoided at all costs
- But,…I have to graduate this quarter ☺

and remember:

- This is not a course for wimps
- You don’t have to be here
- This course is not required
- I am not flexible

However:

- You might have fun…
- I will certainly make mistakes – point them out!
- I want your feedback
- Please ask lots of questions

Complaints about:

- Course content: to me
- Course grading: to me
- TA: to me
- Instructor, i.e., me:
  - ICS Associate Dean of Student Affairs

    or
  - Computer Science Department Chair

Today

- Administrative stuff
- Course organization
- Course topics
- Gentle introduction

Course Topics – tentative and unsorted

- Security attacks/services
- Conventional cryptography
- Public Key cryptography
- Key Management
- Digital Signatures
- Secure Hash Functions
- Authentication + Identification
- Certification/Revocation

- Wireless/Mobile Net security
- DDOS attacks and trace-back
- IP security
- Firewalls
- SSL/TLS
- Kerberos, X.509
- Access Control (RBAC)
- E-cash, secure e-commerce
- Mobile code security
- WSN security
- RFID
- Trojans/Worms/Viruses
- Intrusion Detection

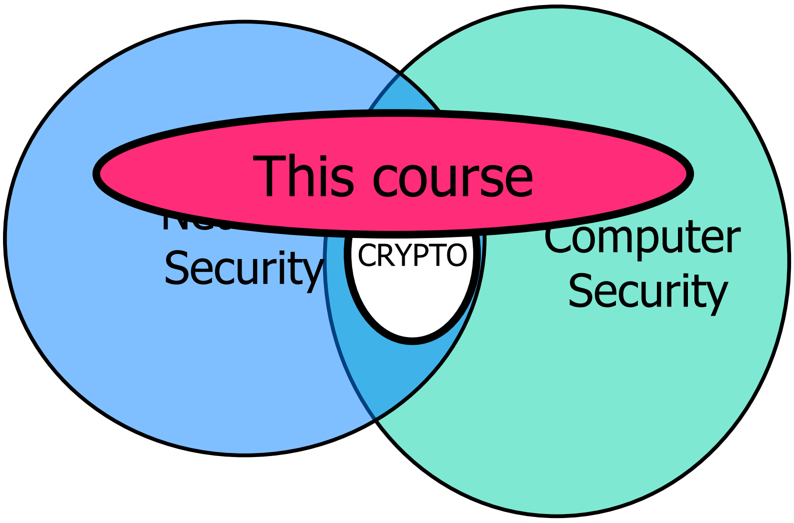
Focus of the class

- Recognize security attacks/threats
- Learn basic defense mechanisms (cryptographic and otherwise)
- Appreciate how much remains to be learned after this course

BTW:

- You certainly won’t become an expert
- You might be (I hope) interested to study the subject further

Bird’s eye view



Outline

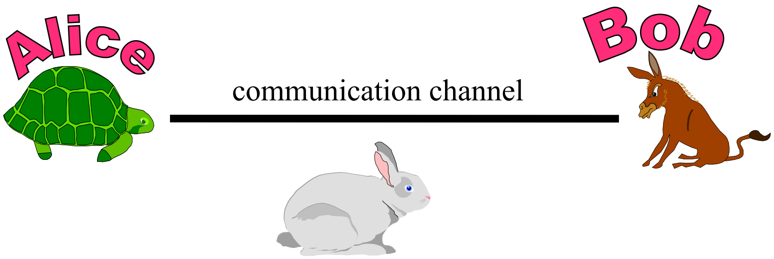
- The players
- Terminology
- Attacks, services and mechanisms
- Security attacks
- Security services
- Methods of Defense
- A model for network Security

Computer Security: The cast of Characters

Attacker or Adversary

Your computer

Network Security: the cast of characters



Alice

communication channel

Bob

EVE

Terminology (crypto)

- Cryptology, Cryptography, Cryptanalysis
- Cipher, Cryptosystem
- Encryption/Decryption, Encipher/Decipher
- Privacy/Confidentiality, Authentication, Identification
- Integrity
- Non-repudiation
- Freshness, Timeliness, Causality
- Intruder, Adversary, Interloper, Attacker
- Anonymity, Unlinkability/Untraceability

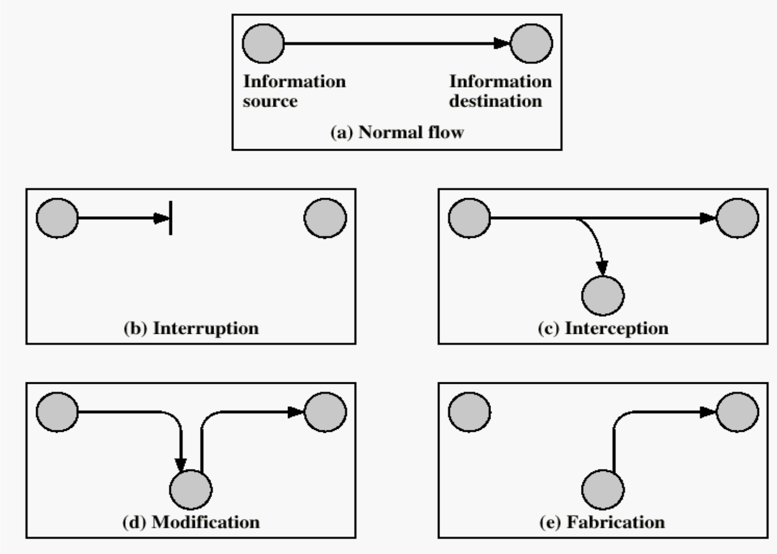
Terminology (security)

- Access Control & Authorization
- Accountability
- Intrusion Detection
- Physical Security
- Tamper-resistance
- Certification & Revocation

Attacks, Services and Mechanisms

- **Security Attack:** Any action that aims to compromise the security of information
- **Security Mechanism:** A measure designed to detect, prevent, or recover from, a security attack
- **Security Service:** something that enhances the security of data processing systems and information transfers. A "security service" makes use of one or more "security mechanisms"
- Example:
  - Security Attack: Eavesdropping (Interception)
  - Security Mechanism: Encryption
  - Security Service: Confidentiality

Some Classes of Security Attacks



(a) Normal flow

(b) Interruption

(c) Interception

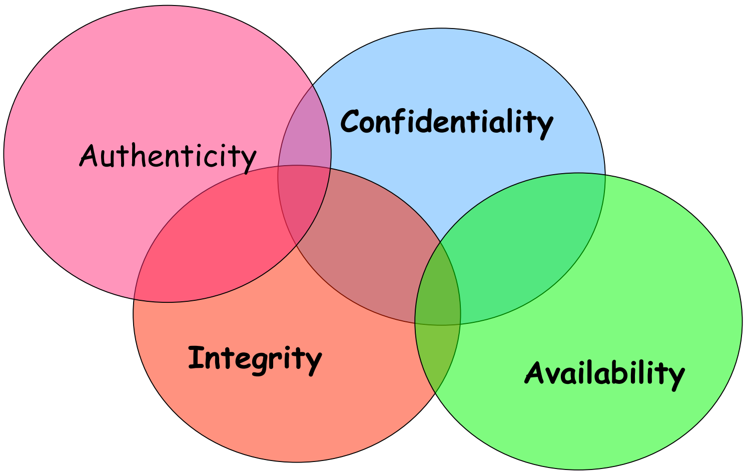
(d) Modification

(e) Fabrication

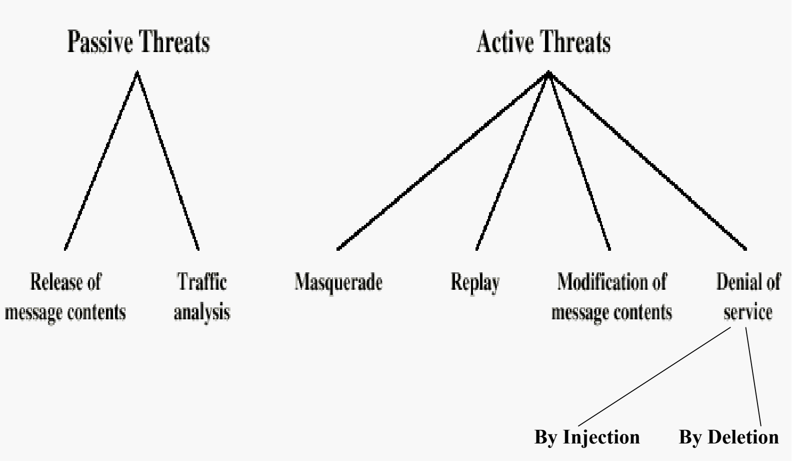
Security Attacks

- **Interruption:** attack on availability
- **Interception:** attack on confidentiality
- **Modification:** attack on integrity
- **Fabrication:** attack on authenticity

Main Security Goals



Security Threats
threat vs attack?



Passive Threats

Release of message contents

Traffic analysis

Active Threats

Masquerade

Replay

Modification of message contents

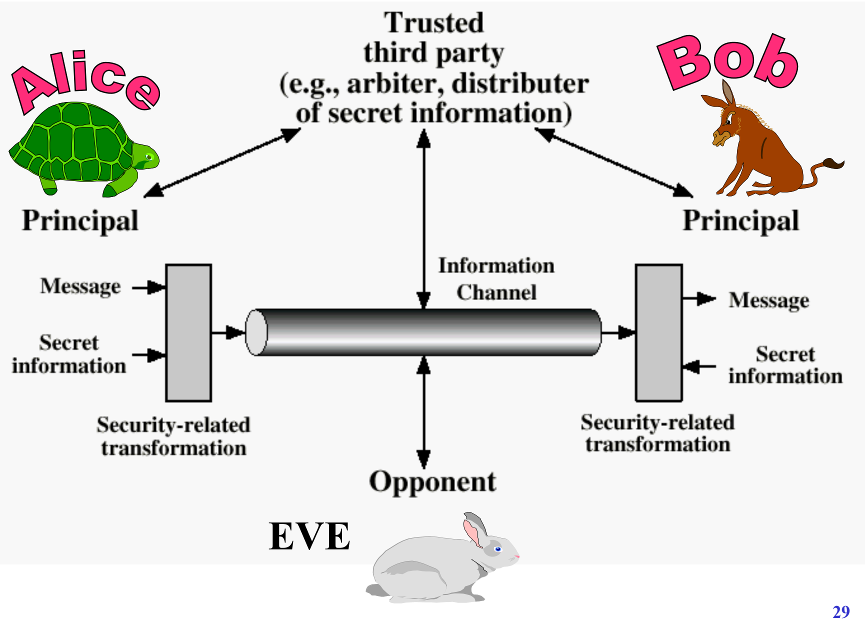
Denial of service

By Injection

By Deletion

Example Security Services

- Confidentiality: to assure information privacy
- Authentication: to assert who created or sent data
- Integrity: to show that data has not been altered
- Access control: to prevent misuse of resources
- Availability: to offer permanence, non-erasure
  - Denial of Service Attacks
    - e.g., against a name server
  - Viruses that delete files



Alice

Bob

Trusted third party (e.g., arbiter, distributer of secret information)

Principal

Principal

Message

Secret information

Security-related transformation

Information Channel

Message

Secret information

Security-related transformation

Opponent

EVE

Some Methods of Defense

- Cryptography → confidentiality, authentication, identification, integrity, etc.
- Software Controls (e.g., in databases, operating systems) → protect users from each other
- Hardware Controls (e.g., smartcards, badges) → authenticate holders (users)
- Policies (e.g., frequent password changes, separations of duty) → prevent insider attacks
- Physical Controls (doors, guards, etc.) → control access