CSE 484 / CSE M 584: Computer Security and Privacy

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Tadayoshi (Yoshi) Kohno
yoshi@cs.Washington.edu

UW Instruction Team: David Kohlbrenner, Yoshi Kohno, Franziska Roesner. Thanks to Dan Boneh, Dieter Gollmann, Dan Halperin, John Manferdelli, John Mitchell, Vitaly Shmatikov, Bennet Yee, and many others for sample slides and materials ...

Hello ☺

- Instructor: Yoshi Kohno (he/him)
- Staff:
  - Aroosh Kumar
  - Wenqing Lan
  - Kelvin Ng
  - Kentrell Owens
  - Noah Ponto
  - John Taggart
  - William Travis
  - Shaoqi Wang

Course Plan

- Lectures and Sections and (most) Office Hours in-person
  - Lectures are recorded (please attend!)*
    - * Sections may be only partially recorded
    - * Office hours will not be recorded
    - * Recordings include student questions and should not be shared outside the class
  - Access the recordings via Canvas
- Largely the same curriculum as usual
  - Labs and homeworks and final project; **no exams**
  - We will adapt throughout the quarter as needed
- If you are struggling with anything, let us know!

Course Resource Cheat Sheet

- **In Person:** Lectures, sections, office hours (planned)
- **Zoom:** Limited office hours (planned)
- **Canvas:** Links to recordings, assignment submissions, grades
- **Course website:** Schedule, assignment details, readings, policies
- **Ed:** Discussion board
- **Course mailing list:** Announcements (though most go to Ed)
- **Email:** Reach course staff privately (generally best: cse484-tas@cs – this email goes to all course staff)

What Does "Security" Mean to You?

What are topics you are excited about?

- It is also okay if you don't know what topics you are interested in yet!
- The course's final project will give you the opportunity to explore something not covered in class in depth.

How Systems Fail

Systems may fail for many reasons, including:

- Reliability deals with accidental failures
- Usability deals with problems arising from operating mistakes made by users
- Design and goal oversights deals with oversights, errors, and omissions during the design process
- Security deals with intentional failures created by intelligent parties
  - Security is about computing in the presence of an adversary
  - But security, reliability, usability, and design/goals oversights are all related

Challenges: What is "Security"?

- What does security mean?
  - Often the hardest part of building a secure system is figuring out what security means ("threat modeling")
  - Who are the **stakeholders** for which we are considering "security"?
  - What are the **assets** to protect?
  - What are the **threats** to those assets?
  - Who are the **adversaries**, and what are their **resources**?
  - What is the **security policy or goals**?
- **Perfect security does not exist!**
  - Security is not a binary property
  - Security is about risk management

Multiple assignments and activities are designed to exercise your thinking about these issues.

Privacy?

- Privacy often strongly overlaps security
- Privacy may also consider when systems *work as intended*!
- Not a hard-and-fast distinction
  - Privacy and security are generally intertwined
  - They might sometimes (but not always) be at odds

Two Key Themes of this Course

1. How to **think** about security and privacy
   - The "Security Mindset" – a "new" way to think about systems
   - (This mindset will be valuable even outside of the security context, e.g., to consider diverse stakeholders of a system)
2. **Technical aspects of security and privacy**
   - Vulnerabilities and attack techniques
   - Defensive technologies
   - Topics including: software security, cryptography, malware, web security, web privacy, smartphone security, authentication, usable security, anonymity, physical security, security for emerging technologies

Theme 1: Security Mindset

- Thinking critically about designs, challenging assumptions
- Being curious, thinking like an attacker, exploring use cases not considered by the designers,
- "That new product X sounds awesome, I can't wait to use it!" versus "That new product X sounds cool, but I wonder what would happen if someone did Y with it; I wonder if the designers thought of Z…"
- Why it's important
  - Technology changes, so learning to think like a security person is more important than learning specifics of today's systems
  - Will help you design better systems/solutions
  - Interactions with broader context: law, policy, ethics, etc.

Security Mindset Example

Security Mindset Example

Learning the Security Mindset

- Several approaches for developing "The Security Mindset" and for exploring the broader contextual issues surrounding computer security
  - Homework #1
    - Security reviews and ethics reflections
    - May work in groups of up to 3 people (groups are encouraged – **lots of value in discussing security with others!**)
  - In class/section discussions and activities
  - Participation in Ed discussion board (e.g., thoughts and questions about news stories, technologies)

A Word on Groupwork

- *Strongly* encouraged, in some cases required
  - Beneficial to practice working in groups
    - Especially if you don't like it ☺
  - Attack-based labs require some creativity, where group interactions can help generate ideas
  - Homeworks and security mindset: also benefits from discussion and group interactions
- (Please follow all the usual in-person contact guidelines ☺)

What This Course is Not About

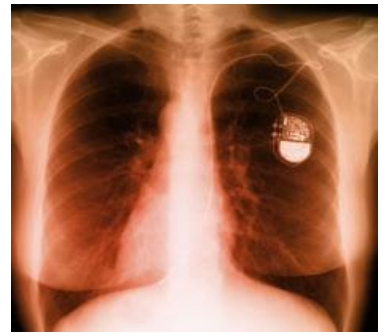
- Not a comprehensive course on computer security
  - Computer security is a broad discipline!
  - Impossible to cover everything in one quarter
  - So be careful in industry or wherever you go!
- Not about all of the latest and greatest attacks
  - Read news, ask questions, discuss on Ed
- Not a course on ethical, legal, or economic issues
  - We will touch on these issues, but the topic is huge
- Not a course on how to "break into" systems
  - Yes, we will learn about attacks … but the ultimate goal is to develop an understanding of attacks so that you can build more secure systems

Security: Not Just for PCs

smartphones

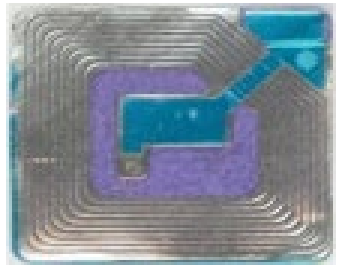
voting machines

EEG headsets



medical devices

wearables



RFID

mobile sensing platforms

cars

game platforms

airplanes

Communication

- yoshi@cs
  - Use this (or instructor office hours) if something is sensitive, personal, confidential, etc.
  - Please put 484 in the subject line and re-email in case email lost / hit spam folder
- cse484-tas@cs.washington.edu
  - Best method to reach all course staff (including instructor)
- Ed Discussion Board
  - Use this if other students in the class would benefit from your question/answers **[common case]**
- Course mailing list: multi_cse484a_wi23@uw.edu
  - We'll use this (and often Ed) for announcements
- We will do our best to be responsive, but **please be professional**, and plan ahead!

Course Materials

- Readings:
  - No textbook; I'll be posting reading materials as we go
  - Some optional, some **strongly recommended**
- Attend lectures
  - Lectures will not follow any textbooks
  - Lectures will focus on "big-picture" principles and ideas
- Attend sections (if you have questions about assignments, best to attend rather than watch later)
  - Details not covered in lecture, especially about homeworks and labs
  - More opportunity for discussion

Guest Lectures

- We will have a few guest lectures throughout the quarter
  - Useful to give you a different perspective: e.g., research, industry, government, legal

Course Logistics (CSE 484)

Security is a contact sport!

- Labs (45% of the grade)
- Homework (25% of grade)
- Participation and in-class activities (10% of the grade)
- Final project (20% of the grade)

Course Logistics (CSE M 584)

Same as before, but…

- Labs (42% of the grade) [-3%]
- Homework (22% of grade) [-3%]
- **Research readings (10%)** **[+10%]**
- Participation and in-class activities (10%)
- Final project (16% of the grade) [-4%]

Labs

- General plan:
  - 2 or 3 labs
    - Plan: First lab out next week (TBD)
  - Topics:
    - Software security (Buffer overflows, …)
    - Web security (XSS attacks, SQL injections, …)
    - Possible third, e.g., on smart homes
  - Submit to Canvas
  - Groups must be configured *on Canvas*

Homework

- 3 homeworks distributed across quarter
  - http://courses.cs.washington.edu/courses/cse484/23wi/assignments
  - First homework is online

- Do now (no later than January 9): sign ethics form!

Ethics

- To learn to defend systems, you will learn to attack them. You must use this knowledge ethically.

- In order to get a non-zero grade in this course, you must electronically sign the "Security and Privacy Code of Ethics" form by 4:30pm on Monday, January 9.

(Linked from the course schedule)

We will also repeatedly consider ethics (more generally) as part of our curriculum throughout course (see HW1, for example).

In-Class Participation

- In-class discussions combined with online tools
  - Canvas "quizzes" (see below)
  - (See also online discussion board for "in-class-like" discussions)
- **Main component: Lightly graded in-class activities**
  - Canvas "quiz" submission (intended for use during class, but can be submitted up until start of next lecture)
  - *Not* a "quiz" in the traditional sense

Late Submission Policy

- 5 free late days, no questions asked
  - Cumulative, throughout the quarter
  - Use up to 3 for one submission
  - All group members use days at once
- After that, late assignments will be dropped 20% per calendar day.
  - Late days will be rounded up
  - So an assignment turned in 26 hours late will be downgraded 40%
  - See website for exceptions -- a small number of assignments must be turned in on time
- **Please write on the assignment how many late days you are using!**

To Do

- Sign ethics form (due January 9)
  - https://forms.gle/R1QM2ZXwU96h8XLTA (link on course web page)
- Homework #1 (due January 20)
  - Start forming groups (e.g., use discussion board) and thinking about technologies you'd like to review.

Mailing List

multi_cse484a_wi23@uw.edu

- Make sure you're on the mailing list
  - We'll send a test email this week
  - If you recently enrolled, wait 24 hours
- URL for mailing list on course website
- We will use the mailing list and/or Ed for **announcements**; please use the Ed Discussion Board for discussions (not the mailing list)

Discussion Board

- We will set up an Ed Discussion Board for this course:
  - https://edstem.org/us/courses/32316/discussion/
- Please use it to discuss the homework assignments and labs and other general class materials
- You can also use it to exercise the "security mindset"
  - Discussions of how books or movies get security right or wrong
  - Discussions of news articles about security (or not about security, but that miss important security-related things)
  - Discussions about security flaws you observe in the real world

Final Project

- **No midterm or final exam!**
- Instead: **12-15 min video** about a security/privacy topic of your choice
  - Groups of up to 3 people (groups strongly encouraged)
  - Security is a broad field, and this class can't remotely cover everything – this is your chance to explore a security or privacy topic in more detail!
  - Multiple checkpoint deadlines throughout quarter
- Details linked from website's Assignments page

Prerequisites (CSE 484)

- Required: Data Abstractions (CSE 332)
- Required: Hardware/Software Interface (CSE 351)
- Assume: Working knowledge of C and assembly
  - One of the labs will involve writing buffer overflow attacks in C
  - You must have detailed understanding of x86 architecture, stack layout, calling conventions, etc.
- Assume: Working knowledge of software engineering tools for Unix environments (gdb, etc)
- Assume: Working knowledge of Java and JavaScript
- **Assume: Ability to learn new programming languages / skills easily**

Prerequisites (CSE 484)

- Useful (not required): Computer Networks; Operating Systems
  - Will help provide deeper understanding of security mechanisms and where they fit in the big picture
- Useful (not required): Complexity Theory; Discrete Math; Algorithms
  - Will help with the more theoretical aspects of this course.

Prerequisites (CSE 484)

- Most of all: Eagerness to learn!
  - This is a 400 level course.
  - We expect you to push yourself to learn as much as possible.
  - We expect you to be a strong, independent learner capable of learning new concepts from the lectures, the readings, and on your own.

  - **At the same time: Take care of yourselves and communicate with us!**

Another Example