Comp 790-185: Research Topics in Computer Security

Introduction

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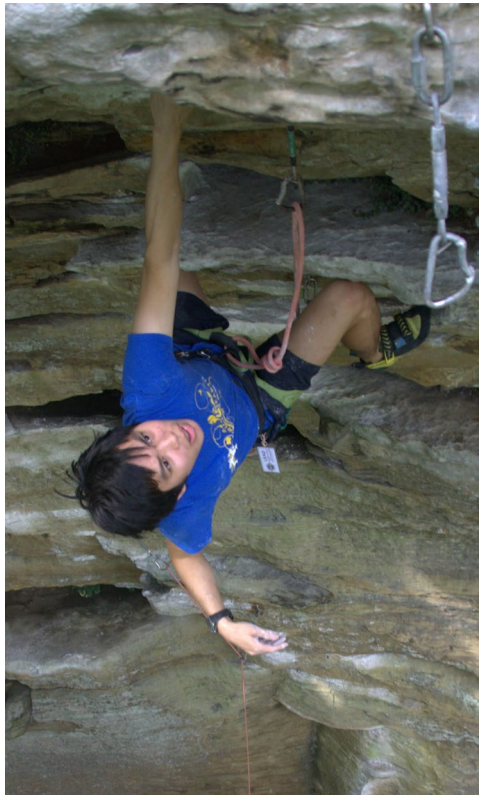
Slides adapted from Alex Halderman's EECS 588

Department of Computer Science

THE UNIVERSITY
of NORTH CAROLINA
at CHAPEL HILL

Today's Class

- Introductions
- Course Goals
- What is Security Research?
- Security Mindset
- Course Structure



Who am I?

- Andrew Kwong
  - Assistant Professor

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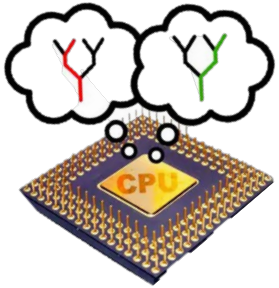
- Email: andrew@cs.unc.edu
- Office: FB 340



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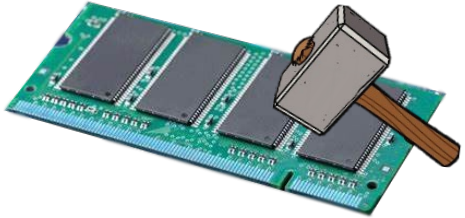
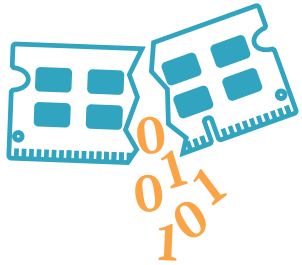


Rowhammer



RAMBleed

My Research

- Hardware Security:
  - Memory
  - CPU
  - Applied-crypto
- Will talk more next class!

Course Goals

- Learn how to conduct security research
  - Broad overview of topics in computer security
    - Foundational works (e.g. Test of Time Award winning papers)
    - Recently Influential papers (Best paper awards)
  - Exposure to useful techniques

- Improve research, reading, writing, presentation skills
  - All are important!
- Develop a security mindset

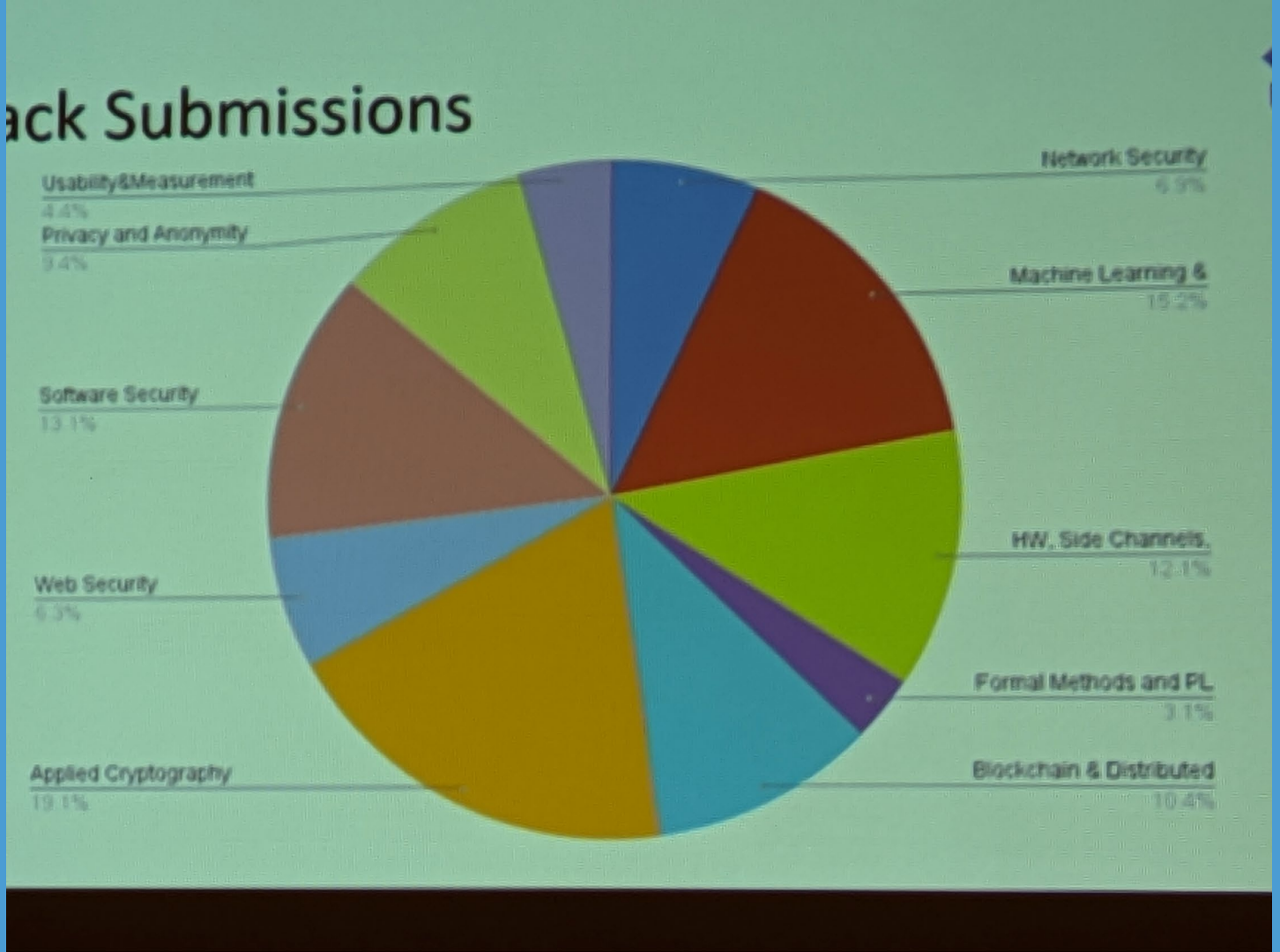
Who are you?

- Research Field
- Hobby/interesting fact
- Something you want to learn from this course.

What is Security Research?

- Pwning?
  - Scientific term for writing a binary exploit that gives the attacker root

ack Submissions

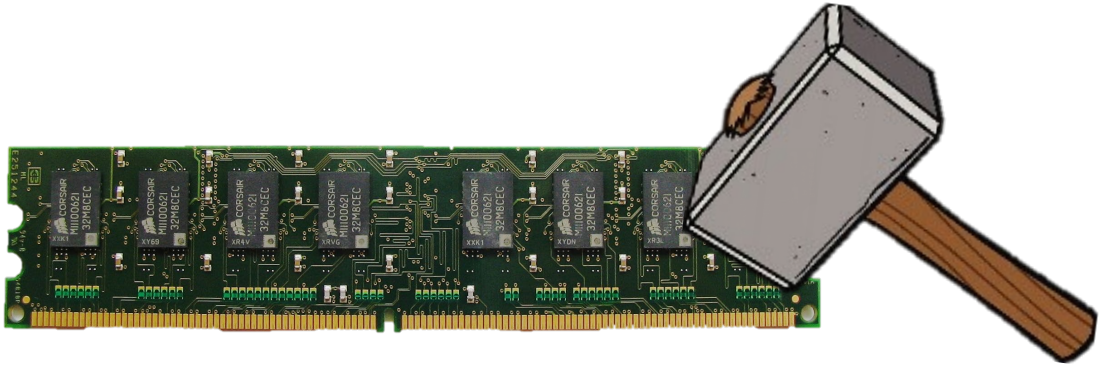


ack Acceptance Rates

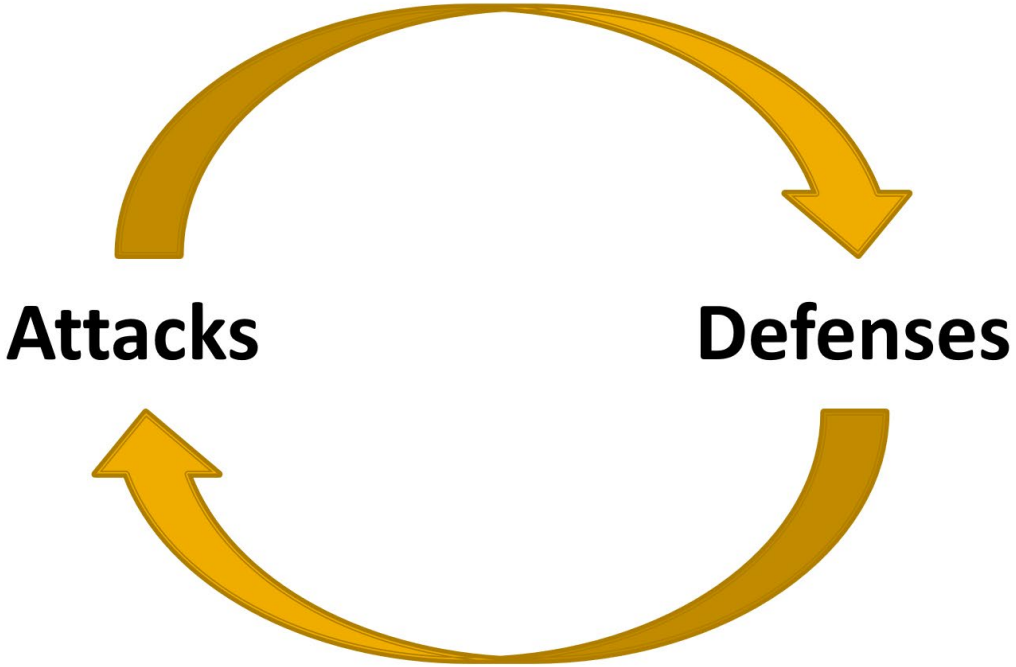
What is Security Research?

- Pwning?
  - Scientific term for writing a binary exploit that gives the attacker root
- “Computer security studies how systems behave in the presence of an adversary.”
- Adversary:
  - An intelligence that actively tries to cause the system to misbehave.

Adversarial Example



High Level Approach



Attack Research

- Identify vulnerabilities so they can be fixed.
- Create incentives for vendors to be careful.
- Learn about new classes of threats.
  - Determine what we need to defend against.
  - Help designers build stronger systems.
  - Help users more accurately evaluate risk.

More than just finding vulnerabiltiies!

- Generalizable lesson is learned
  - Used to build more effective defenses

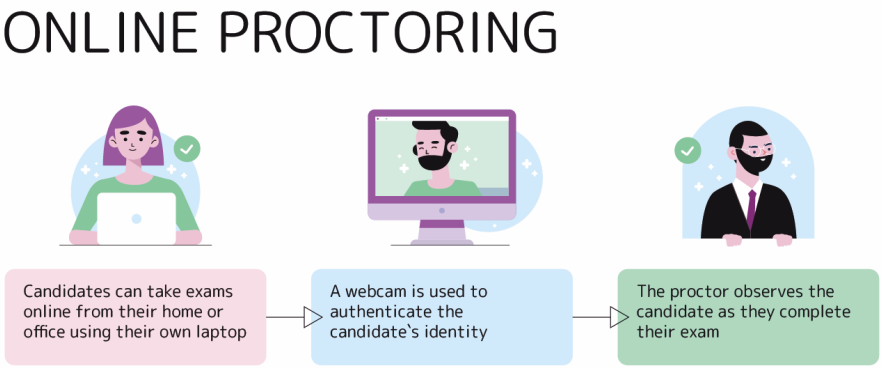
Thinking Like an Attacker

- Look for the weakest links – easiest to attack.
- Identify assumptions that security depends on. Are they false?
- Think outside the box: Not constrained by system designer's worldview.

Practice a Security Mindset:
For every system you interact with, think about what it means for it to be secure, and imagine how it could be exploited.

Exercises

- How to cheat in class?
- How to cheat out of class? (remote proctoring software)



Exercises

- How to steal my password?

Exercises

- How to steal library books?

Exercises

- What are some security systems that you interact with in everyday life?

Thinking Like a Defender

- Security policy
  - What are we trying to protect?
  - What properties are we trying to enforce?
- Threat model
  - Who are the attackers? Capabilities? Motivations?
  - What kind of attack are we trying to prevent?
- Risk assessment
  - What are the weaknesses of the system?
  - What will successful attacks cost us?
  - How likely?
- Countermeasures
  - Costs vs. benefits?
  - Technical vs. nontechnical

Election Security

What Not to do

- Common mistake:
  - Looking for evidence that your system is secure
- Security through obscurity
  - Fails historically!
- Kerckhoff's principle
  - Design of a system should not require secrecy

Course Structure

Grading

- Class Participation – 20%
- Paper Reviews – 20%
- Paper Presentations – 20%
- Course Project – 40%

Class Participation (20%)

- 2 paper readings each class
- Come prepared to contribute/ask questions
- Full points for speaking up and contributing substantial ideas

Paper Reviews(20%)

- 2 paper readings each class
- For each paper:
  - 2 strengths
  - 2 weaknesses
  - 1 question for discussion
- Submit on canvas

Paper Presentations (20%)

- Give conference style talk on assigned papers
- Can make or reuse/augment slides
- Roughly 20 minute presentation
  - High level advertisement for the paper
- Paper list found at https://andrewkwong.org/comp790-185.html
- Send me preferences (at least 5) by Thursday

Course Project (40%)

- Conduct original research on a topic related to computer security over the course of the semester.
- In class proposal/presentation 2nd week of October
- submit a final report (6-12 pages) at end of the course
- Give a conference style talk on results during the final week of class
- Working in groups is allowed, but a more substantial product is expected when working with more people

Your Assignments

- First paper discussion next Monday
- Rate preferences for paper presentations (Give me your top 5 at the very least)
- Start thinking about your course project
  - Proposals due second week of October

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Content Slide Title 1

Content Slide Subtitle