CSci 5271
Introduction to Computer Security
Day 1: Introduction and Logistics

Stephen McCamant (he/him)
University of Minnesota, Computer Science & Engineering

Outline

Big-Picture Introduction

Course Logistics

What is computer security?

- Keep "bad things" from happening
- Distinguished by presence of an adversary

Two sides of security

- Defenders / white-hats / good guys[sic]
- Attackers / black-hats / bad guys[sic]
- Each side's strategy depends on the other
- In some ways like a game

Classic security goals

- Confidentiality
- Integrity
- Authenticity
- Availability

Managing risk

- Threat model, likely adversary goals
- Expected damage
- Expected attack rate

Course areas

- Software security
- OS security
- Cryptography
- Network application security
- Other topics

Software security

- Security bugs aka *vulnerabilities*
  - Some specific to low-level languages like C, others not
- Arms race
  - Attack techniques
  - Defenses against unknown bugs
  - Countermeasures against defenses
- Defensive programming and design

OS security

- Classic area for secure design and security policies
  - Some specific examples from Unix/Linux
- Access control and capabilities
- Multi-level security and information flow
- Assurance and trust

Cryptography

- Mathematical techniques for protecting information
- Symmetric-key techniques (e.g. AES)
- Public-key techniques (e.g. RSA)
- Cryptographic protocols
- What can go wrong (lots!)

Security and the network

- Network protocols, basic and "S"
- Firewalls, NATs, intrusion detectors
- Web servers and web clients
- Network malware and network DoS

Short topics

- Electronic voting
- Privacy-enhancing network overlays
- Threats from LLMs
- Security and usability

Learning goals

- Think like your adversary
- Recognize and eliminate vulnerabilities
- Design and build systems securely
- Apply security principles to research problems

Outline

Instructor information

- Stephen McCamant
- Office: 4-225E Keller
- Office hours: Mondays 4-5pm, or by appointment
- Email: `mccamant@cs.umn.edu`

Teaching assistants

- Kefu Wu
- Andrew Guerra
- Office hours TBA

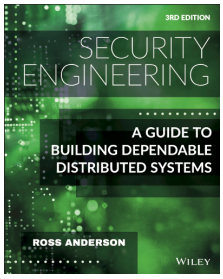
Prerequisites

- Undergraduate-level OS, e.g. 4061
- Machine code and compilation
  - E.g. 2021, transitive for 4061
- Useful: networks (4211)
- Graduate level maturity and resourcefulness
- C, Unix, (Perl | Python | Ruby | · · ·)

Reading materials

- Posted on the course web site
- Download, perhaps with library proxy
- Read before corresponding lecture
- Readings and lecture may not match
  - Both may appear on exams

Textbook



(or 

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Evaluation components

10% Written exercise sets (4)
15% Hands-on assignments (2)
20% Midterm exam
25% Final exam
30% Group research project

Exercises

- Four sets, roughly by topic areas
- Do individually or in groups of up to 3
- Mostly thinking and writing, not much programming
- Submit one set per group in PDF, via Canvas/Gradescope

Hands-on assignments

- Two assignments, by large topic divisions
- Do individually or in groups of up to 3
- Mostly programming and attacking
- Draws heavily on your C and Unix skills
- First up: penetrate-and-patch HA1

Exams

- Open book, open notes, no laptops/calculators/phones
- Mix of multiple-choice/true-false and short-answer
- Midterm: Wednesday October 23rd in class
- Final: Saturday December 14th 10:30am-12:30pm
- Mark your calendars!

Group research project

- Single most important and time-consuming part of course
- Groups of 4-6, preferably 5 or 6
- Engage with a recent research paper
  - Reproduce and extend, or
  - Reproduce and attack

Project milestones

- Pre-proposal (due Sep. 18)
- Progress meetings and reports (monthly)
- Short in-class presentation (last two weeks)
- Paper-style final report (due Dec. 11)

Pre-proposal (Sep. 18)

- Who: group members
- What: paper you're engaging with
- Why: are you suited for this project
- How: preliminary action plan
- When: available times for progress meetings

Project evaluation

15% Originality
15% Scholarship
30% Strength of evaluation
40% Individual contribution

Late assignments

- Due dates usually 11:59:00pm Central Time
- 1 sec late - 23:59:59 late: 75%
- 24 hrs - 47:59:59 late: 50%
- 48 hrs - 71:59:59 late: 25%
- After that: 0

Collaboration, within groups

- Main kind of collaboration expected in class
- Think about how you structure your collaboration
- For best results, but also to learn from teammates

Collaboration, between groups

- Be careful: "no spoilers"
- OK to discuss general concepts
- OK to help with side tech issues
- Sharing code or written answers is never OK

External sources

- Many assignments will allow or recommend outside (library, Internet) sources
- But you must appropriately acknowledge any outside sources you use
- Failure to do so is plagiarism

What about AI?

- General principle: what if you got similar help from a person outside the class?
  - Always okay to use for concept understanding, or non-graded activities
- Avoid substituting for your own understanding or effort in graded assignments
  - Bad for your learning
  - Also not allowed, unless the assignment says otherwise
- Also beware the AI's answers might not be right!

AI usage for first two assignments

- As an experiment, there will be a liberal policy for AI usage on the first two assignments
  - Exercise set 1 and hands-on assignment 1
- You can use an AI system as long as you credit it in the same way as your human group members
- It may not be in your interest to do this
  - I don't expect AIs can do the tricky parts of HA1
  - The design goal of exercise sets is that an AI could at most get a B or a C.

Security ethics

- Don't use techniques discussed in class to attack the security of other people's computers!
- If we find you do, you will fail, along with other applicable penalties

Academic misconduct generally

- Don't cheat, plagiarize, help others cheat, etc.
- Minimum penalty: 0 on assignment, report to OCS
- More serious: F in course, other OCS penalties

Course web site

- Department web site under `csci5271`
- Also linked from my home page `~mccamant`
- These slides will be posted after class

Canvas

- Assignment submissions (maybe Gradescope)
- Gradebook viewing

Mostly Piazza

- Online Q&A
  - Can be anonymous and/or private
  - Both students and staff can answer
- Course announcements
  - Can control delivery preferences, defaults to email
- Reserve email for personal, administrative issues

Challenging course aspects

- Stressing C, low-level, and Unix skills
- Thinking like an attacker
- Thinking like a researcher
- Time management

4271 vs. 5271

- Designed so you can take either or both
  - 5271 easier but still worthwhile after 4271
- 4271 has more of: threat modeling, software engineering, writing support
- 5271 has more of: research perspectives, novel/difficult attacks

Hands-on Assignment 1

- Weekly attacks 9/20-10/18
- Attack a badly coded extensible text editor (BCEMACS)
- Test your attacks using Linux virtual machines

Exploiting BCEMACS

- BCEMACS can run as super-user ("root")
- Bugs allow a regular user to gain root privileges (shell)
- Challenge: many steps from bug to working exploit
- Challenge: bugs fixed over time

Detailed material starts next week

- Readings, projects, exercise set
- See you on Monday!