ACS/Part III R209
Computer Security: Principles and Foundations

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Introductions

- Name, background
- Interest in security
- What you hope to learn, or better understand, at the end of this module

Today's Class

1. Module introduction
2. Presentation and discussion: ***A Note on the Confinement Problem***
3. Video and discussion: ***Chip and PIN is broken***
4. Presentation and discussion: ***Experimental Security Analysis of a Modern Automobile***
5. Brief summary of next week: Access Control

Welcome!

- *Seminar-style* research readings module
- **R254: Cybercrime** (Michaelmas)
  - Interdisciplinary perspective
  - Focus on key debates, research and policy
  - What cybercrime is, how it is regulated, policed, detected, and prevented
- **R209: Computer Security: Principles and Foundations** (Lent)
  - History, discourse, methodology, and themes
  - Topics include adversarial reasoning, access control, usability, inference control, …
- Ambitious scope, limited time

Prerequisites

Goal: Transition from **factual** understanding to **research engagement** with core debates, intellectual history, methodology, and evolution of the field

- Undergraduate degree in computer science
  - Or similar education/experience
  - Basic background in computer security
  - Also beneficial: OS, networking, programming languages…
- Some topics familiar, but cast as **research** not **fact**
- Other topics will not [yet] be widely taught

Brushing up on computer security

Anderson, R. J., **Security Engineering** (2nd edition), Wiley, 2008.

Gollmann, D., **Computer Security** (3rd edition), Wiley, 2010.

McKusick, M. K., Neville-Neil, G. N., and Watson, R. N. M., **Design and Implementation of the FreeBSD Operating System** (2nd edition): *Chapter 5 – Security*, Pearson, 2014.

Seminar-style teaching (1)

- Preparation for research and development
  - Trace intellectual history
  - Study evolving vocabulary, discourse, and methodology
  - Discuss and learn from methodological and narrative aspects of the research
  - Appreciate (+critique) research as published
  - Consider contemporary implications; contrast with original research context
  - Discuss future research directions
- Student-led presentation and discussion is central to this format

Seminar-style teaching (2)

Each week you will:

1. Critically read three original papers/reports

2. Submit synthesis essays across all readings

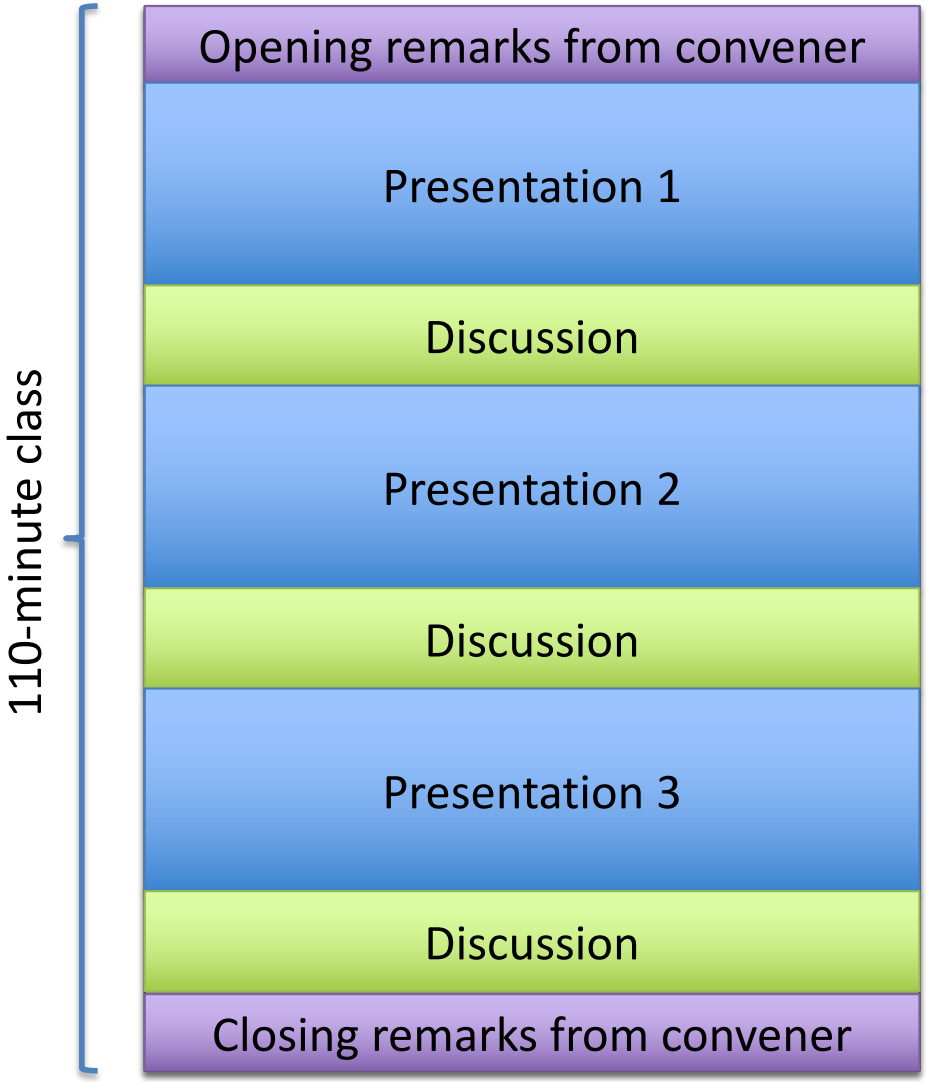
or

2. Present and lead discussion on a specific reading

3. Participate in classroom discussion of the readings

(Guest PhD students, postdocs in the class will present papers but not submit essays)

Typical class structure



- 3x 15–to–20-minute student presentations **(do not run shorter/longer!)**
- 3x 15–to–20-minute student-led discussions
- Discussions are cumulative: pull ideas forward as we look at later papers

Assessment

- One presentation or essay a week
  - R209: Seven total (none today)
- Marking
  - 10 marks per assessed essay or presentation
  - **Lowest mark** each term will be dropped (usually the first)
  - Remaining scores scaled to a total out of 100
- Department heavily penalizes late submissions
  - Instructors cannot grant extensions
  - Contact the graduate education office **as early as possible**

WEEKLY ESSAY

Synthesis Essays

- **Synthesis writing** reports, organizes, and interprets the works of others
  - Not an original research paper!
  - More a series of short answers than an actual essay
- Your essays **will** have the following section headings:

1. **Summaries of readings** (1-2 para/reading)
2. **Three key themes spanning papers** (1 para/theme)
3. **Ideas in our contemporary context** (2 para)
4. **Brief literature review** (2 para)

- All essays **must** include a bibliography
- Word limit (1,250) enforced (excl. bibliography)
- **See Assessment page on module website**

Notes on essay marking

- 10 divided equally across four sections plus 2 marks for overall delivery (quality of writing, …):

0	failed to submit
1-4	seriously lacking
5-6	poor or (minimally) adequate
7-8	good
9-10	strong or exceptional

- First essay will likely have a lower mark than you hope
- If so, it will probably be dropped as the lowest

Essay Submission

- Deadline 16:00 on the Tuesday before we meet
- **Submit via Moodle**
- Bring discussion questions to class and be prepared to ask (and answer) them
- Marks/comments returned via Moodle
- We attempt to return essays to you within two weeks, but sometimes this is not possible

Weekly Presentations

- 7 sessions, 3 talks/session, **15-20 minutes each**
  - You will present at least once per term
  - No essay due for classes where you present
  - Do not run much shorter or longer than 17 minutes!
  - 10 marks per presentation; similar criteria to essays

- Initial presentation schedule has been e-mailed
  - If you like, you can exchange presentation slots…
  - Both students must agree; let us know in advance

R209 Weekly Meetings

Date	Topic	Paper	Presenter
23 Jan	Access Control	Bell & LaPadula (1975) Wagner & Tribble (2002) Watson (2013)	tll39 ttb29 jga33
30 Jan	Usable Security	Whitten & Tygar (2014) Herley (2014) Acar et al. (2016)	psb34 ytc36 nm712
6 Feb	Inference Control	Adams & Wortmann (1989) Dwork et al. (2006) Narayanan & Shmatikov (2007)	bjc63 mda46 mgp35
13 Feb	Correctness v. Mitigation	Klein et al. (2009) Bessey et al. (2010) Davis et al. (2019)	lsw37 sps62 rmn30
20 Feb	Adversarial Reasoning II	Razavi et al. (2016) Bond et al. (2014) Kocher et al. (2019)	*** dh623 vv301
27 Feb	Security Economics	Anderson & Moore (2009) van Eeten et al. (2010) Vasek & Moore (2015)	jsl71 htb25 jga33
5 Mar	Passwords	Morris & Thompson (1979) Adams & Sasse (1999) Bonneau et al. (2012)	doaa2 az369 mgp35

*** If you would like to volunteer for a second speaking slot, rather than submitting an essay for that week, please email alice.hutchings@cl.cam.ac.uk

Presentation Structure

- Prepare a teaching- or research-style presentation
  - ⟶ What motivated the work?
  - ⟶ What are the key ideas?
  - ⟶ How were scientific ideas evaluated?
  - ⟶ Critique the argument/evaluation
  - ⟶ Compare to related research – especially other readings
  - ⟶ Consider current-day research and applications
  - ⟶ Prepare for adversarial Q&A – defend the work

- Don’t just follow paper outline
- Slides without pictures (e.g., this one) are uninspiring!

Your Slides

- **You will present with slides**
  - All presentations will be on our computer
  - Slides will be in **PDF format** – no fancy animations
- Submit slides by e-mail no later than 16:00 on the Wednesday via Moodle
  - Failure to prepare or submit will be heavily penalized due to disruption it will cause
- Usually presented roughly in syllabus order

Class Discussion

- Roughly half of each two-hour class is set aside for discussion
  - Bring discussion questions to class and be prepared to ask (and answer) them
- No explicit marks for participation…
  - … but presenter is rewarded for interesting discussion, so mutual benefit to participating!

READING

About the Readings

- Original research papers or early surveys
  - Highly cited and/or first appearance of key ideas
- Questions to consider (in advance)
  - Why have the authors done this work?
  - Has it aged well? Are the ideas used today?
  - How would we attack the system they propose?
  - What methodology do the papers use: Science? Engineering? Mathematics? How does this affect the style, evaluation, etc.?
  - Why did we pick this paper and not another?
  - Is there a retrospective piece?

How to Read (a Lot)

- Read strategically
  - Plan ahead for the time it takes to read and digest papers
  - Skim in the first pass to decide what is important
  - Take notes in moderation
  - With practice, you will get **much** faster at reading papers
- As you read, highlight ideas that answer key questions:
  - Framing/motivation of the paper
  - Key ideas that influenced the paper / related work
  - Key contributions of the paper – and their implications
  - Evaluation approach, limitations
  - Common themes and ideas across the papers
- See Keshav's "How to Read a Paper", CCR 2007

ADMIN THINGS

Module E-mail and ‘Hangers On’

- We will e-mail reading and schedule updates, clarifications, room changes, etc. there!
  - We will use your CRSid (via a class mailing list)
  - If you are not registered, but are sitting in, please e-mail alice.hutchings@cl.cam.ac.uk
- Recurring guests (e.g., PhD students, RAs) will be asked to present 1-2 times during the term

Module Website

- Reading list, marking criteria, etc. found here:
  https://www.cl.cam.ac.uk/teaching/1920/R209/

- Look at the ‘Materials’, ‘Assessment’ pages

R209 Weekly Meetings

Date	Topic	Convener(s)
16 Jan	Adversarial Reasoning	Anderson, Beresford, Watson, Hutchings
23 Jan	Access Control	Watson
30 Jan	Usable Security	Hutchings
6 Feb	Inference Control	Anderson
13 Feb	Correctness v. Mitigation	Beresford
20 Feb	Adversarial Reasoning II	Beresford
27 Feb	Security Economics	Anderson
5 Mar	Passwords	Hutchings

How to Reach Us

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Security Group Seminars & Meetings

- Seminars every Tuesday at 2pm in LT2
  - Coming up: ‘Challenges in the Decentralised Web: The Mastodon Case’ by Gareth Tyson, Queen Mary University of London

- Security group meetings every Friday at 4pm in FW11

QUESTIONS

TODAY'S READINGS