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: ***Reflections on Trusting Trust***
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: Usable security

Welcome!

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

Prerequisites

Goal: Transition from **simplistic 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** (3rd ed.), Wiley, 2020.

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

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

Also:
van Oorschot, P. C., **Computer Security and the Internet: Tools and Jewels from Malware to Bitcoin** (2nd ed.), Springer, 2021.

Seminar-style teaching

- Preparation for research and development
  - Trace intellectual history
  - Study evolving vocabulary, discourse, and methodology
  - Discuss, learn from, and challenge methodological and narrative aspects of the research
  - Appreciate (+critique) research as published -- and various styles of academic analysis and presentation
  - Consider contemporary implications; contrast with original research context
  - Discuss future research directions
- 6x sessions: Student-led presentation + discussion
- 1x session: Small-group discussions of the essays
- In-person, with remote attendance via Zoom possible for anyone unwell. No recordings.

Presentation weeks (6x)

Each presentation week you will:

1. Critically read three original papers/reports

2. Submit synthesis essays across all readings (unless presenting)

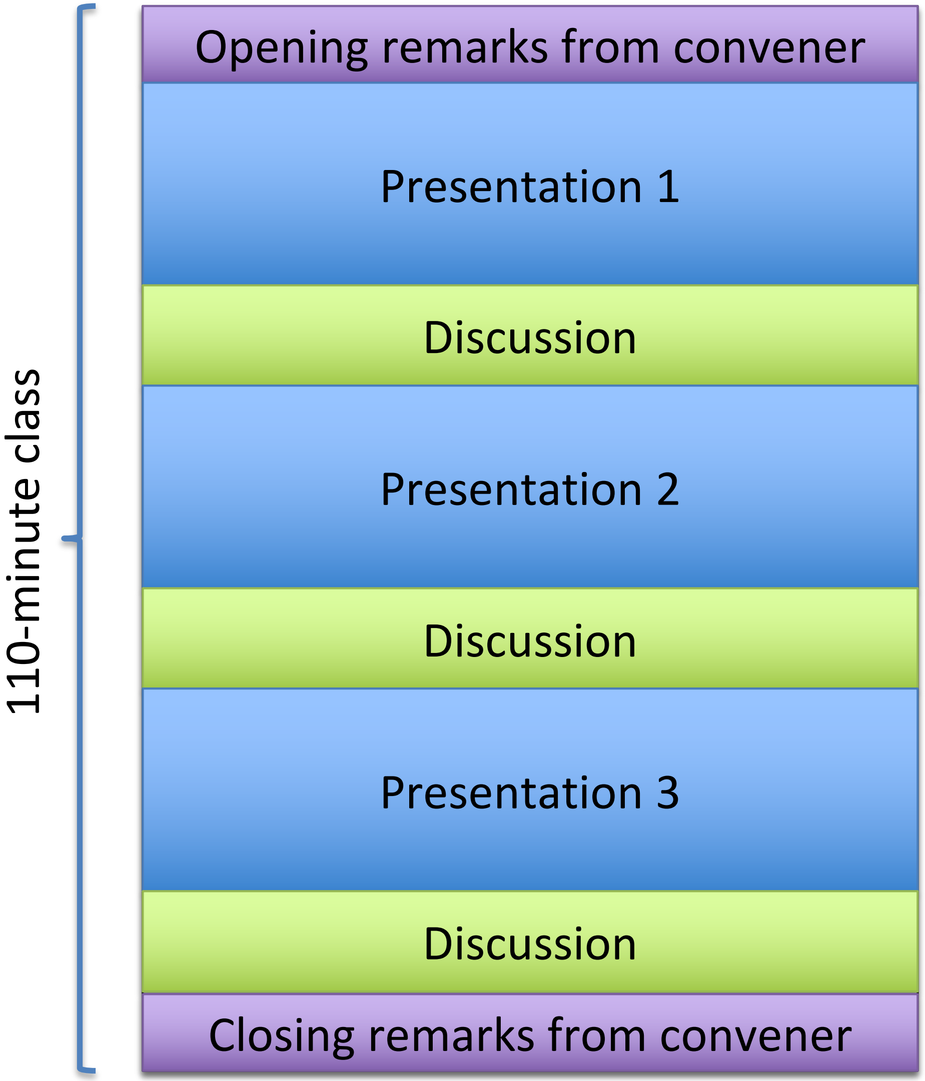
   - or -

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)

Class structure (presentation weeks)



110-minute class

Opening remarks from convener

Presentation 1

Discussion

Presentation 2

Discussion

Presentation 3

Discussion

Closing remarks from convener

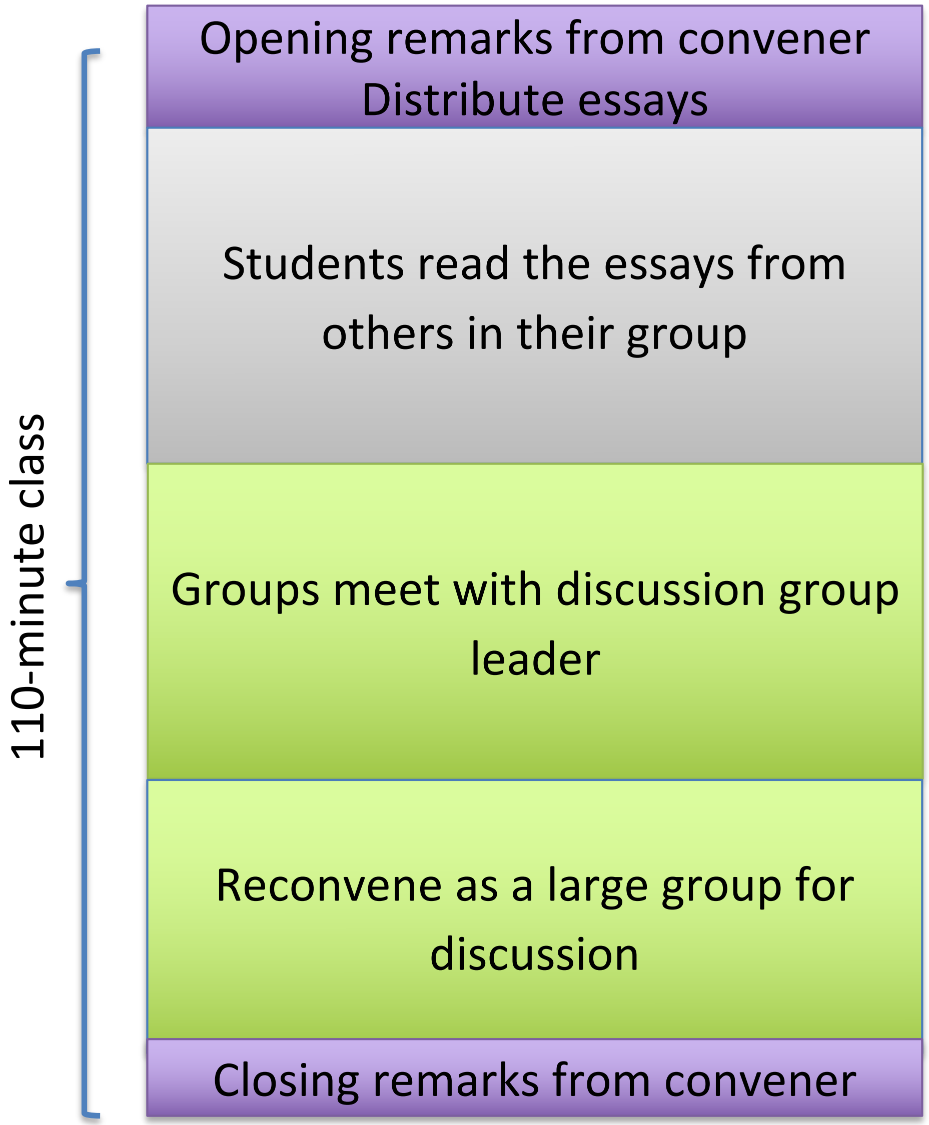
- Weeks 3-8
- 3x 15–to–20-minute student presentations **(do not run shorter/longer!)**
- 3x 15–to–20-minute student-led discussions
- Discussions are cumulative: pull ideas forward as we look at later papers

Essay discussion weeks (1x)

In week 2 you will:

1. Critically read three original papers/reports
2. Submit synthesis essays across all readings
3. Participate in classroom discussion of the readings and essays, first as smaller groups, and then as a single large group

Class structure (essay discussions)



110-minute class

Opening remarks from convener
Distribute essays

Students read the essays from others in their group

Groups meet with discussion group leader

Reconvene as a large group for discussion

Closing remarks from convener

- Week 2 only
- Introductions to the week; distribute essays to others
- Read the essays from others in group
- Group discussion at 14:45
- Reconvene at 15:25 as a large group for discussion
- Closing remarks

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 12:00 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

- 6 sessions, 3 talks/session, **15-20 minutes each**
  - You will present twice 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 Presentations

Date	Topic	Paper	Presenter
19 Oct	Access Control	Bell & LaPadula (1973) Wagner & Tribble (2002) Watson (2013)	ic429 hf390 dm894
26 Oct	Inference Control	Adams & Wortmann (1989) Dwork et al. (2006) Narayanan & Shmatikov (2007)	rm2152 qct20 cw829
2 Nov	Adversarial Reasoning II	Razavi et al. (2016) Bond et al. (2014) Kocher et al. (2019)	eu233 ksw39 tc565
9 Nov	Security Economics	Anderson & Moore (2009) van Eeten et al. (2010) Vasek & Moore (2015)	ic429 rm2152 **
16 Nov	Correctness v. Mitigation	Klein et al. (2009) Bessey et al. (2010) Davis et al. (2019)	hf390 qct20 eu233
23 Nov	Passwords	Morris & Thompson (1979) Adams & Sasse (1999) Bonneau et al. (2012)	dm894 kc642 ksw39

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 Presentations

- **You will present with slides**
  - Slides will be in **PDF format** – no fancy animations
- Submit slides no later than 12:00 on the day you present:
  - Submit slides via Moodle
  - Failure to prepare or submit will be heavily penalized due to disruption it will cause
- Usually presented in syllabus order

Class Discussion

- Presentation weeks: Roughly half of each two-hour class is set aside for discussion
- Essay discussion week: All discussion

- Bring discussion questions to class and be prepared to ask (and answer) them
- No explicit marks for participation…
  - … but presenters are 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.
  - 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/2324/R209/

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

R209 Weekly Meetings

Date	Topic	Convener(s)
5 Oct	Adversarial Reasoning	Anderson, Watson, Hutchings
12 Oct	Usable Security	Hutchings
19 Oct	Access Control	Watson
26 Oct	Inference Control	Anderson
2 Nov	Adversarial Reasoning II	Anderson
9 Nov	Security Economics	Anderson
16 Nov	Correctness v. Mitigation	Watson
23 Nov	Passwords	Hutchings

How to Reach Us

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Security Group Seminars & Meetings

- Seminars every Tuesday at 2pm https://www.cl.cam.ac.uk/research/security/seminars/

- Security group meetings every Friday at 4pm https://www.cl.cam.ac.uk/research/security/meetings/

QUESTIONS

TODAY’S READINGS