

COS 109: Computers in our World

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tentative office hours Mon 3:00-4:30 & Tue 2:30-4:30
or make an appointment (with wase.princeton.edu or by email)
or just drop in any time

- **TAs: Xi Chen, Darby Haller**



- **web site: www.cs.princeton.edu/courses/archive/fall19/cos109**
(generally there's nothing on Blackboard)
- **fill out the survey**
- **first problem set due 5pm Wednesday September 25**
- **first lab due midnight Friday September 27**

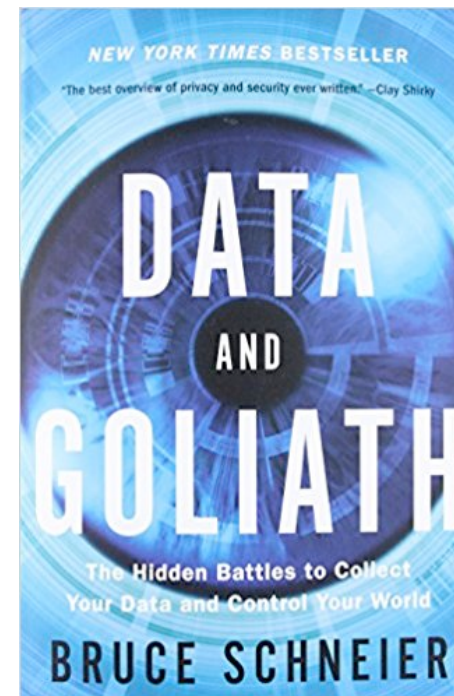
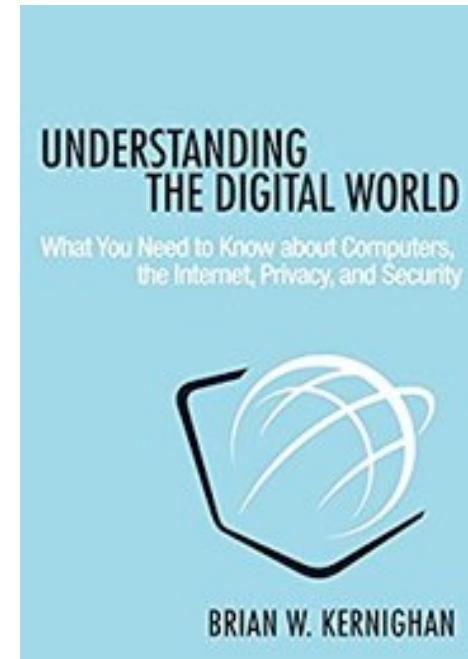
Administrivia (check the web page!)

- notes will be posted online
 - but not everything will be in them or in the textbook
- readings: ~ 1 hour/week, before class
- 8 problem sets: ~ 1-2 hours/week
 - posted Wednesday, due following Wednesday 5pm
- 8 labs: ~ 2-3 hours/week plus reading to prepare
 - posted by Sunday, due Friday midnight
 - you can do the labs on your own, anywhere, any time
 - there will be lab assistants to help
- open-book midterm during midterm week
 - (take-home or in-class? not sure yet)
- open-book final exam in January
- grading (approximately):
 - 20% problem sets + 20% labs + 20% midterm + 40% final
 - class participation helps; frequent absences will definitely hurt
 - remember that P/D/F has three possible outcomes

Textbook

- \$17.21 at Labyrinth
 - with additional student discount?
- \$19.20 at Amazon

- good supplementary reading if you're interested in privacy and security:
(~ \$8 @ Amazon)



House rules

- don't use your laptop, phone, or tablet except for notes
 - it distracts you
 - it distracts your neighbors
 - it distracts me
- sleeping is ok; please don't snore
- stay home if you're sick
- ask questions about anything any time

Outline

- hardware (3-4 weeks)
 - how computers represent and process information
 - what's inside a computer, how it works, how it's built
- software (3-4 weeks)
 - how we tell computers how to do things
 - a very gentle introduction to programming in Javascript
- communications (3-4 weeks)
 - how the Internet and Web work
 - big data, machine learning, artificial intelligence
 - threats and defenses: privacy, security, cryptography
- along the way
 - current events, history, QR, ...

Hardware: tangible devices and gadgets

- **how computers represent and process information**
 - universal digital representation of information:
everything is represented as numbers
 - bits, bytes, binary
- **a computer is a universal digital processor**
 - it stores data and instructions in the same memory
 - the instructions are numbers
 - it's a general purpose machine:
change the numbers and it does something different
 - your phone is a computer
- **hardware has been getting smaller, cheaper, faster exponentially for 50+ years**

Software: telling computers what to do

- **algorithms**
 - precise sequences of steps to perform various tasks
 - what's possible, what's feasible, what's efficient
 - some problems are intrinsically very hard (we think)
- **programs and programming**
 - implementation of algorithms to be run on a computer
 - programming languages: how to express the steps
 - real programs: operating systems and applications
- **software intellectual property issues**
 - patents, copyrights, standards, ...

Communications: computers talking to each other

- **the Internet is a universal digital network**
 - depends on protocols, standards, agreements, cooperation
- **we can easily communicate with people anywhere**
 - we are visible to and accessible by strangers everywhere
- **information passes through many sites**
 - where it can be inspected, modified, blocked, slowed down, ...
- **personal privacy and security are at risk**
 - tracking, data aggregation, surveillance (government and commercial)
 - phishing, identity theft, ...
 - viruses, worms, bots, hijacking, trolls, disinformation, ...
- **everything on the Internet is vulnerable**
 - cyber attacks
 - Internet of Things

It's not just computers

- computers and networking are spreading into devices
- devices are increasingly powerful
- devices and systems are increasingly connected to the Internet: "Internet of Things"

phones

games

consumer electronics: Alexa et al, smart TVs, Fitbit, ...

cars (self-driving or not)

planes

telephone, power, transportation, infrastructure

medical systems

weapons

...

Privacy

- data for shopping, banking, taxes, ..., is all digital
 - public records are increasingly digital too
 - e.g., election contributions often include home addresses
- data is easy to collect, store, copy, analyze, sell
- technically, it's impossible to control access
 - we're vulnerable to bugs, incompetence, stupidity, theft
- legally, in USA, we don't control data about ourselves
 - anyone can collect and sell anything about all of us
 - laws are different in different countries (e.g., European Union GDPR)
 - some (but not all) countries are more restrictive

Security

- **the universal network makes us vulnerable to strangers**
 - the Internet has no geography
 - it's easy to lie about who you are and where you are
 - the bad guys are usually far away
- **general-purpose computers are everywhere**
 - "active content": web pages, email can contain programs
- **leads to spam, phishing, viruses, spyware, botnets, ...**
 - tracking and surveillance by governments and businesses
 - theft by criminals everywhere
- **it's impossible to control such programs**
 - and to eliminate tracking and surveillance
 - and trolling, fake news, influencing

Goals

- **understanding of how digital systems work**
 - hardware, software, communications
 - representation, processing, storage, transmission of information
 - principles, not just today's details and buzzwords
 - a handful of useful skills
- **some sense of the past and possible futures**
 - history, trends, potential, intrinsic limitations, tradeoffs
- **some appreciation of computer science as a discipline**
 - great ideas, algorithms, capabilities and limits of computers
 - and its usefulness in other academic fields
- **useful quantitative reasoning**
 - numeracy: reasoning, estimation, assessing numbers, ...
 - judgment: do the numbers make sense? are they plausible?
- **intelligent skepticism about technology**