COS 109: Computers in our World

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  311 Computer Science
  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
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- web site: www.cs.princeton.edu/courses/archive/fall18/cos109
  (generally nothing on Blackboard)
- fill out the survey
- first problem set due 5pm Wednesday September 26
- first lab due midnight Friday September 28

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? 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

- ~$16.00 at Labyrinth
  - with student discount
- $18.80 at Amazon
- good supplementary reading if you're interested in privacy and security:
  (~ $12)

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)
  - 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