COS 109: Computers in our World

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  office hours Mon 2:30-4:30 & Tue 2:30-4:30 (tentatively)
  or make an appointment
  or just drop in any time

- **fill out the survey**
- **first problem set is due Sep 17**
- **labs start week of Sept 22**

- **COS 109 web site:**
  www.cs.princeton.edu/courses/archive/fall14/cos109
  (generally nothing on Blackboard)

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**
- **8-9 problem sets: 1-2 hours/week**
  - **the first one is posted, due Wed Sept 17**
- **8 labs: 2-3 hours/week plus reading to prepare**
  - **labs start week of Sept 22 (posted Sunday evening, due Friday midnight)**
  - **you can do the labs on your own, anywhere, any time**
  - **there will be lab assistants to help, in the Friend Center**
- **open-book take-home midterm during midterm week**
- **open-book sit-down-in-a-big-room final exam in January**
- **grading (approximately):**

  20% problem sets + 20% labs + 20% midterm + 40% final

  class participation helps; <u>frequent absences will definitely hurt</u>

  remember that P/D/F has three possible outcomes

House rules

- **please don't use your laptop, phone, or tablet except for notes**
  - **it distracts you**
  - **it distracts your neighbors**
  - **it distracts me**
- **please don't snore (sleeping is ok)**
- **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**
  - **threats and countermeasures: security, privacy, 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

- **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, government surveillance**
  - **phishing, identity theft, ...**
  - **viruses, worms, bots, hijacking, ...**

- **everything on the Internet is vulnerable**

Intellectual property: copyright

- **music, movies, TV, games, etc., are all digital**
  - **copies are free, copies are perfect, distribution is free**

- **technically, it's impossible to prevent copying**
  - **cryptography, watermarking, etc., don't work**

- **legally, it's difficult to prevent copying**
  - **sensible laws are hard to write**
  - **laws are different in different countries**
  - **many countries don't protect intellectual property**

- **warning: it's pretty easy to catch violators here**
  - **don't download copyrighted material like movies and TV shows**

Intellectual property: patents

- **more and more devices and systems are entirely controlled by software**
- **whether it should be or not, software can be patented**
- **technically, it's hard to know what's been patented**
  - **and often the patent is probably not well founded**
- **legally, it's difficult to avoid running into a patent problem**
  - **sensible laws are hard to write, especially for software patents**
  - **laws are different in different countries**

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, and use for good or ill**

- **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**
  - **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, ...**
- **it's impossible to control such programs**

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
cars
planes
medical systems
telephone, power and other infrastructure systems
weapons
...

Goals

- understanding of how digital systems work
  - hardware, software, communications
  - representation, processing, storage, transmission of information
  - principles, not just today's details

- 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

- useful quantitative reasoning
  - numeracy: reasoning, estimation, plausibility, ...
  - judgment: do the numbers make sense?

- intelligent skepticism about technology