COS 109: Computers in our World

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  311 Computer Science Building, 258-2089  (email is always better)
  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; frequent absences will definitely hurt
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