COS 109: Computers in our World

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- **311 Computer Science Building, 258-2089 (email is always better)**
- **office hours Mon & Tue 2:30-4:00,**
  or make an appointment, or just drop in any time

- **TAs: Tianqiang Liu (tianqian), Taewook Oh (twoh), Peng Sun (pengsun)**

- **fill out the survey, including your lab preferences**
- **labs start next week**
- **check the COS 109 web site daily:**
  www.cs.princeton.edu/courses/archive/fall11/cos109

Administration (check the web page daily!)

- **notes will be posted online before class**
  - **but not everything will be in them or in the textbook**
- **readings: ~1 hour each week, before class**
- **8 problem sets: 1-2 hours/week**
  - **the first one is posted, due Wed Sept 28**
- **8 labs: 2-3 hours/week plus reading to prepare**
  - **labs start next week somewhere in Friend Center**
    posted Sunday evening, due Friday midnight
  - **let us know your preferred sections so we can plan**
    come to any, all, or no sessions any time
    you can do most labs in your own room on your own computer, but no help from us
- **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 PDF has three possible outcomes

House rules

- **please ask questions about anything any time**
- **please turn cell phones off**
- **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)**
- **please stay away if you're sick**

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, …**
- **systems / case studies (1-2 weeks)**
  - **putting things together: search engines, cellphones, peer to peer, ...**

Four fundamental ideas

- **universal digital representation of information**
  - **it's all just numbers**
- **universal digital computer that processes information**
  - **its instructions and its data are just numbers**
- **universal digital network that carries information**
  - **instructions, data and everything else are just numbers**
- **universal availability of digital systems**
  - **digital technology gets smaller, faster, cheaper all the time**
- **and it's all changing very fast**

Universal digital representation

Music is just numbers
Pictures are just numbers
Movies are just numbers
TV and radio are just numbers
Telephone calls are just numbers
Books and newspapers are just numbers

They're all just numbers

Universal digital processor

- **computers just process numbers**

- **computer memory stores the data to work on**
- **and the instructions that say what to do with the data**

- **computer programs are just numbers**

- **computers are general-purpose:**
  - **we can change what the computer does**
  - **by storing different numbers in its memory**

Universal digital network

- **the Internet just carries numbers**

- **to and from universal digital processors**

- **it doesn't know or care what the numbers mean**

- **it's easy to build services on top of it**
  - **web, mail, chat, peer to peer, phone, movies**

- **it's hard to control what flows through it**
  - **it's just numbers**

Universal availability of digital systems

- digital computers are everywhere
- connected to a digital network that's everywhere
- moving digital data everywhere
- available to everyone cheaply

- universal digital devices ("convergence")

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

Intellectual property: patents

- **more and more devices and systems are entirely controlled by software**

- **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**

cell phones
cable TV
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, limits of computers**

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

- **Intelligent skepticism about technology**