COS 109: Computers in our World

• Brian Kernighan
  bwk@cs.princeton.edu  311 CS bldg  www.cs.princeton.edu/~bwk
  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