

Lecture 1: Course overview

August 30, 2019

601.229 Computer System Fundamentals



Welcome!

- ▶ Welcome to CSF!
- ▶ Today:
 - ▶ Administrative stuff
 - ▶ Course overview
 - ▶ Binary data representation

Administrative stuff

About the course

- ▶ Instructors
 - ▶ Philipp Koehn, phi@jhu.edu, Hackerman 227
 - ▶ David Hovemeyer, daveho@cs.jhu.edu, Malone 337
- ▶ TAs/CAs
 - ▶ TODO

Where to find stuff

- ▶ Course website: <https://jhucsf.github.io/fall2019>
 - ▶ Syllabus, schedule, lecture notes, assignments, etc.
 - ▶ All public course information will be here
- ▶ Piazza [TODO: link]
 - ▶ Non-public course information such as homework/exam solutions
 - ▶ Discussion forum, Q/A: please post questions here!

Syllabus highlights

- ▶ Please read the syllabus carefully:
<https://jhucsf.github.io/fall2019/syllabus.html>
- ▶ Highlights:
 - ▶ TODO: grading breakdown
 - ▶ TODO: info about homeworks/problem sets
 - ▶ TODO: info about assignments, late policy
 - ▶ TODO: info about exams

Academic integrity

- ▶ Please read the academic integrity policy in the syllabus carefully
- ▶ Highlights:
 - ▶ TODO: policy for homeworks/problem sets
 - ▶ TODO: policy for assignments
 - ▶ Exams are (obviously) individual effort
- ▶ Be careful about using web as a resource
 - ▶ Do *not* copy code
 - ▶ *Always* cite sources used

Class meetings

- ▶ Typical class meeting: lecture/discussion interspersed with peer instruction questions
- ▶ *Do the reading in advance!*
- ▶ Come prepared to actively engage with the material!
 - ▶ Learning is not passive
 - ▶ More productive class time → better outcomes
 - ▶ Ask questions!

Peer instruction

- ▶ How peer instruction works:
 - ▶ Slide with a multiple choice question
 - ▶ Answer individually, discuss with peers, then answer again
 - ▶ Shown to improve outcomes!
 - ▶ Questions may be challenging
 - ▶ Graded for participation only
- ▶ You may have done this in other courses
- ▶ You will need an iClicker (any version)
 - ▶ iClicker remote ID should be registered with Blackboard

Peer instruction etiquette

- ▶ During discussion phase, form a group of 2–4 with people sitting near you
- ▶ Be inclusive! (“Would you like to join our group?”)
- ▶ Be social! (“May I join your group?”)
- ▶ Be respectful:
 - ▶ Let everyone participate
 - ▶ Don’t put down anyone else’s ideas
- ▶ Work together and think carefully about the question!
- ▶ *No electronics use*

First clicker quiz!

Clicker quiz omitted from public slides

Course overview

What the course is about

- ▶ Course is about *computer systems* from the *programmer's perspective*
- ▶ Computer system = hardware + software
 - ▶ Much of our concern is the interaction between hardware and software — how they work together

Goals of course

- ▶ “Deep” understanding of how computers work (down to hardware)
 - ▶ OS and runtime library interfaces
 - ▶ Machine-level ISA / assembly language
 - ▶ Processor features
- ▶ Apply this understanding to...
 - ▶ Optimize application performance
 - ▶ Avoid pitfalls such as security vulnerabilities
 - ▶ Take full advantage of the computer’s capabilities

A computer system

TODO: overview of typical computer system

Binary data representation

Decimal numbers

- ▶ We're all familiar with decimal (base 10) numbers
- ▶ E.g.,

$$42 = 4 \cdot 10^1 + 2 \cdot 10^0$$

- ▶ Digits are 0–9
- ▶ Places are powers of 10

Other bases

- ▶ Base 10 is arbitrary!
- ▶ Representing decimal 42 using base 5:

$$42_{10} = 132_5 = 1 \cdot 5^2 + 3 \cdot 5^1 + 2 \cdot 5^0$$

- ▶ “Digits” are 0–4
- ▶ Places are powers of 5

Try it!

How to express decimal 42 using base 6?

$$\underline{\quad\quad}.6^2 + \underline{\quad\quad}.6^1 + \underline{\quad\quad}.6^0$$

How to express decimal 79 using base 6?

$$\underline{\quad\quad}.6^2 + \underline{\quad\quad}.6^1 + \underline{\quad\quad}.6^0$$

Reference:

$$6^2 = 36$$

$$6^1 = 6$$

$$6^0 = 0$$

Binary

- ▶ Binary = base 2
- ▶ Representing decimal 42 using base 5:

$$\begin{aligned}42_{10} &= 101010_2 \\ &= 1 \cdot 2^5 + 0 \cdot 2^4 + 1 \cdot 2^3 + 0 \cdot 2^2 + 1 \cdot 2^1 + 0 \cdot 2^0\end{aligned}$$

- ▶ “Digits” are 0 and 1
- ▶ Places are powers of 2
- ▶ Computers use binary representations for all data, because
 - ▶ *Digital circuits* use two voltage levels, high and low
 - ▶ By convention, 1=high voltage, 0=low voltage
 - ▶ So, computer hardware fundamentally operates on binary data

Try it!

How to express decimal 29 using base 2?

$$\underline{\quad} \cdot 2^5 + \underline{\quad} \cdot 2^4 + \underline{\quad} \cdot 2^3 + \underline{\quad} \cdot 2^2 + \underline{\quad} \cdot 2^1 + \underline{\quad} \cdot 2^0$$

Reference:

$$2^5 = 32$$

$$2^4 = 16$$

$$2^3 = 8$$

$$2^2 = 4$$

$$2^1 = 2$$

$$2^0 = 1$$