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
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  - 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 $\rightarrow$ 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?

$$\_\_\_\_\cdot 6^2 + \_\_\_\_\cdot 6^1 + \_\_\_\_\cdot 6^0$$

How to express decimal 79 using base 6?

$$\_\_\_\_\cdot 6^2 + \_\_\_\_\cdot 6^1 + \_\_\_\_\cdot 6^0$$

Reference:

$$6^2 = 36$$
$$6^1 = 6$$
$$6^0 = 0$$

Binary

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

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

  - "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?

$$\_\_\_\cdot 2^5 + \_\_\_\cdot 2^4 + \_\_\_\cdot 2^3 \; \_\_\_\cdot 2^2 + \_\_\_\cdot 2^1 + \_\_\_\cdot 2^0$$

Reference:

$$2^5 = 32$$
$$2^4 = 16$$
$$2^3 = 8$$
$$2^2 = 4$$
$$2^1 = 2$$
$$2^0 = 1$$