

CSE 240

Introduction to Computer ~~Architecture~~ Systems

<http://www.seas.upenn.edu/~cse240/>

Autumn 2006

What's CSE 240 All About?!

The "new" CSE240:

- Not at 9am!!!
- New approach (bottom up)
- New textbook
- New instructor
- Well integrated into curriculum
- Cooler assignments (demo coming later)
- No assumption that you know C programming
- Third time around

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What's CSE 240 All About?!

*Any sufficiently advanced technology
is indistinguishable from magic.*

Arthur C. Clarke, "Profiles of The Future" (Clarke's 3rd law)

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- No magic
 - Computers should not be magic to computer scientists!
- Bottom up approach
 - Computing systems from transistors on up
- Not about "design"

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Big Picture

Introduction to computer architecture

- How is data represented?
- What are the pieces of a computer?
- How do computers work?

Programming

- How do I "talk" directly to the machine?
- How do I program in "C"?

Computer systems and computation

- How do simple HW/SW elements come together to realize complex computations?

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Course Components

Part 1: Hardware

- Representing data, transistors, gates, digital logic structures, von Neumann machine model

Part 2: Assembly language

- Instructions, (structured) programming, input/output, *relationship to hardware*

Part 3: C programming

- Syntax, operators, control structures, functions, *pointers*, recursion, data structures, *relationship to assembly language*
- Assume already familiar with programming (but not C)

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Assembly Language Programming

What is an instruction?

- Basic unit of (SW) computation
- Very primitive
- *E.g.*, in LC-3:
 - add, branch-on-condition, load-from-memory, store-to-memory

Focus: Where hardware meets software

- We will examine the hardware that executes instructions
- We will compose instructions to create software

Really little example, initially R1 is 10, R2 is 0

```
LOOP  ADD  R2 , R1 , R2
      ADD  R1 , R1 , #-1
      BRp  LOOP
```

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Today

Objectives

Summarize course implementation

- Background/Prerequisites
- Lectures/Reading/Quizzes
- Homework
- Exams
- Grades

Demo

- Sample homework/project!

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Why Take CSE240?

Foundational

- Intersects all aspects of computing

Preparatory/Complementary

- CSE 371: Digital Systems Organization and Design
- CSE 380: Operating Systems
- CSE 341: Compilers and Interpreters
- CSE 260: Mathematical Foundations of CS

Fun!!!

- Who wouldn't want to understand the magic?

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Objectives

Understand role & relationship of hardware and software

Exposure to . . .

- Machine organization (CSE 371 prep)
- Assembly language programming (CSE 341 prep)
- C programming (CSE 380 prep)

Understand how to build entire (slow) computing system

- Hardware and software
- You'll get a chance in CSE 371/2 and CSE 380

Be distinguished from mere programmers

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Why Study Hardware?

Important

- Floater's can't build effective systems!
- Still drives industry

Timely

- Multicore, hyper-threading, SSE, security, . . .

Opens doors

- Yet another option!

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Why Learn Assembly Programming?

Helps understand capabilities of machine

Can be used to exploit processor-specific extensions

- *E.g.*, Intel's MMX and SSE (special media instructions)

Many system components written in assembly

- *E.g.*, microcontrollers, device drivers, media kernels, digital signal processing (DSP) code

It's in the news!

- *E.g.*, stack smashing vulnerabilities

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Why Learn C Programming?

What is C?

- High-level language (than assembly anyway)
- Invented in 1970s to write the Unix operating system
- "Portable assembly language"
- In between assembly and Java/C#

Very common

- Operating systems and even general applications
 - Still the right tool for many tasks
- Foundation for C++/C#/Java
- Assembly-to-C migration for embedded applications

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CSE 240 Implementation

Staff

Background/Prerequisites

Lectures/Reading/Quizzes

Exams

Homework

Academic Integrity

Grades

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Staff

Instructor

- Prof. Milo Martin (milom@cis.upenn.edu)

TAs

- Nick Monfort (grad TA)
- Netta Doron
- Geoffrey Hayes
- Andrew Lagatta
- Amanda Leicht

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Communication

Web site

- <http://www.seas.upenn.edu/~cse240/>
- Assignments, lecture notes, etc.

Office hours

- Fact to face help
- See web page for times

Discussion groups (via blackboard)

- Read by me, TAs, fellow students

E-mail

- Announcements via class e-mail list
- To reach us: cse240@seas.upenn.edu

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Background/Prerequisites

Requirement: Strong background in programming

- CSE 120
- CSE 121 (strongly recommended)

Why?

- Fast pace
- Assume you can program/debug

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Lecture

Expectation

- Read appropriate sections in textbook before lecture
- See class schedule for reading assignments

Quizzes

- Complete easy online quiz *before* each class
- Can work ahead (do a week at once)
- Experimental (appears to be effective)

Lectures

- Will not simply “cover” the material
- Will focus on the “hard stuff”
- Will not stand alone, instead build on reading
- Will be interactive

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Exams

Midterm

- Covers digital logic and some assembly
- *Tentatively* scheduled: Wednesday, October 18th (in class)
- Open book

Final

- Comprehensive: covers assembly and C *and* digital logic
- Scheduled: Wednesday, December 20th (9am)
- Open book

Good news: both exams are open book...

- Bad news: it won't actually help you

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Homework

Paper and pencil assignments

- Problem solving
- Great exam preparation

Programming projects

- Simple exercises
- Challenging projects (Snake game!)

Discussion

- Encouraged! (TAs, discussion group, etc.)
- Work must be completed alone
- Okay: discuss meaning of problem, discuss approaches
- Not okay: comparing answers, solving questions together

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Academic Integrity

The rule is simple

- Claiming another's work as your own *will ruin your life*
- See syllabus for details and examples

Who will know?

- We will (inspection, similarity detectors, exams)
- Your friends will... your parents will...
- You will

Analogies

- Cheating is like going 150 MPH over speed limit while drunk
- Analogous consequences (legal -> educational)

Remember

- If you need to cheat now, you've got much bigger problems

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Grades

Midterm: 25%

Final: 30%

Homework: 35%

- Three extensions allowed (see syllabus)

Quizzes: 5%

Participation, attendance, etc.: 5%

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Assignments

Part I: Hardware (Digital Logic)

- Paper and pencil assignments

Part II: Assembly Programming

- Substantial programming project in assembly

Part III: C Programming

- Two low-level programming assignments in C

See schedule for tentative due dates

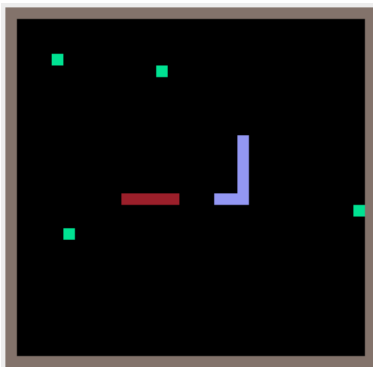
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Demo

Homeworks 6 - 7

- Build “snake” game in assembly language!



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Schedule

See web page

- www.seas.upenn.edu/~cse240/schedule.html
- Subject to change

Notable items

- Midterm Wed. before fall break
- **Wed before Thanksgiving: security & stack smashing**
 - Worth sticking around for

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Next Time

Lecture

- Chapter 1: Introduction to computer systems
- Chapter 2 - 2.2: Integer data types

Reading

- Chapter 1

Quiz

- As always, online; due before start of class

Upcoming

- Homework 1 due Friday, September 15th