CSE 410
Computer Systems

Hal Perkins

Spring 2010

Lecture 1 – Course Introduction

Reading and References

- Reading
  - Computer Organization and Design, Patterson and Hennessy
    - Chapter 1, sec. 1.1-1.3, 1.5 (background)
    - Chapter 2, sec. 2.1-2.5

Administrative

- Instructor:
  - Hal Perkins
  - perkins@cs.washington.edu, CSE548
- TAs:
  - Michael Ratanapintha
  - Euzel Villaneuva
- All class info is on the web site
  - http://www.cs.washington.edu/410

Class Overview

- Provide an introduction to the inner workings of computer systems
- Levels of abstraction
  - – bits, bytes, assembly language
  - – operating system concepts
  - – higher level languages - C, C++, Java, …
  - – application programs

Goal

- You will understand
  - what is actually happening when a computer system is running application programs
- So that you will be able to
  - make good design choices as a developer, project manager, or system customer
  - calibrate your hype-o-meter with facts

Main Topics

- The hardware / software interface
  - the elements of a computer system
  - what parts are visible to the software
  - instruction set architecture (ISA)
  - what happens inside the CPU
- Operating systems
  - services an OS performs for an application
  - design of various OS components
  - OS mechanisms and policies

Course Mechanics

- 3 Lectures/week
- Homeworks most weeks
  - Written problems, small programming exercises
- Office hours tba, scattered through week
  - Use them!
- Online discussion board to stay in touch between classes / office hours

Homework & Exams

- ≈ 6-7 assignments (50%)
- Midterm, tentatively Fri. April 30 or Mon. May 3 (20%)
- Final, Tue. June 8, 2:30 (25%)
- Participation, citizenship, etc. (5%)

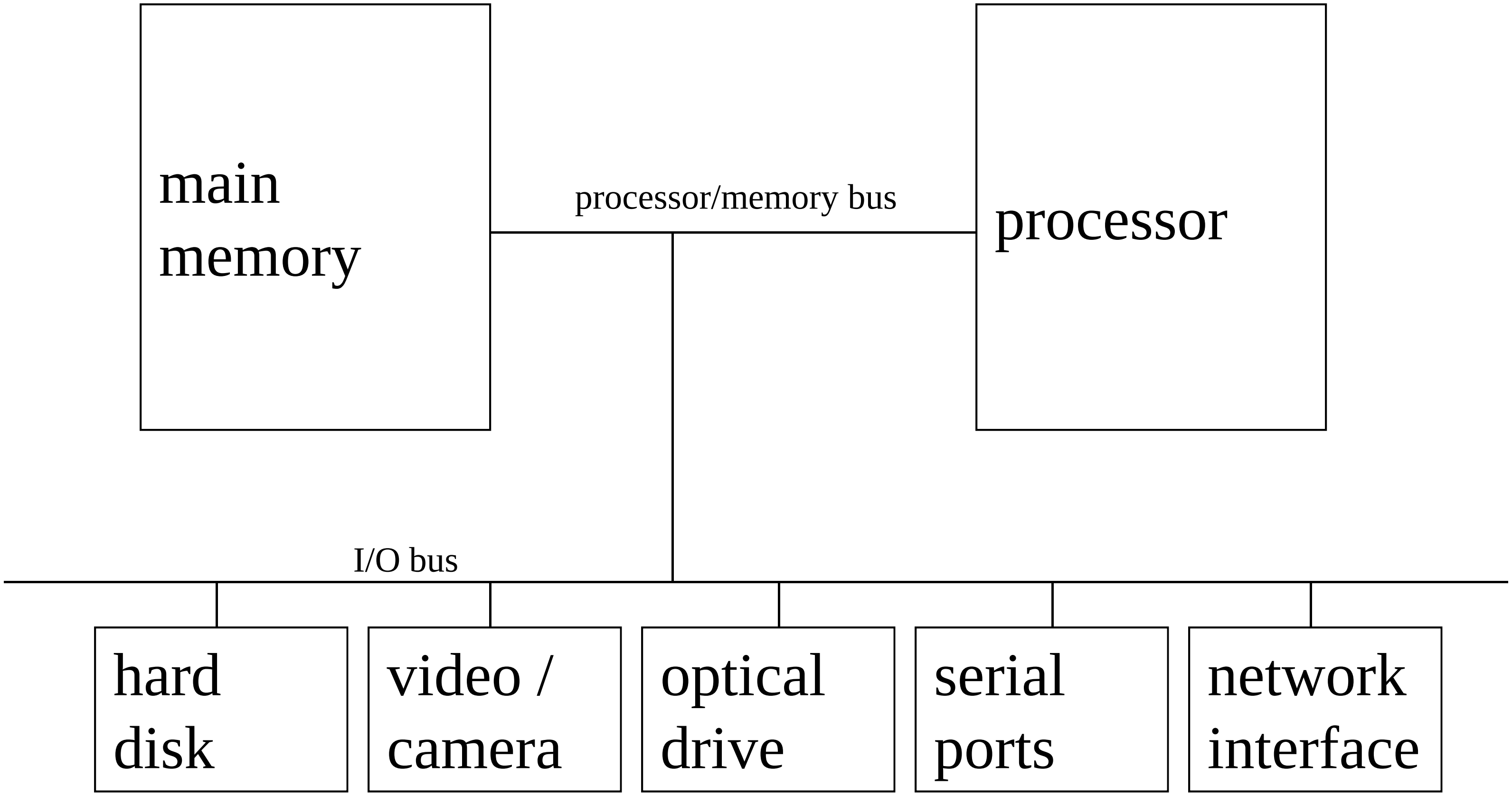
- Late policy: 4 “late days”, at most 2 on any single assignment, counted in 24 hour chunks, otherwise no late assignments.
  - Save late days for later!

Academic Integrity

- Policy on the course web. **Read it!**
- Do your own work – always explain any unconventional action on your part
- I trust you completely
- I have no sympathy for trust violations – nor should you
- Honest work is the most important feature of a university. It shows respect for your colleagues and yourself.

What’s a Computer?

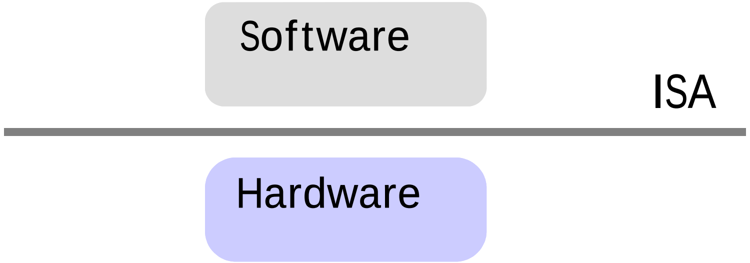
- For our purposes (for now)…



Architecture and Organization

- Architecture (the boxes)
  - defines elements and interfaces between layers
  - ISA (Instruction Set Architecture): instructions, registers, addressing – programmer’s view of the hardware
- Organization / Implementation (inside the boxes)
  - components and connections
  - how instructions are implemented in hardware
  - many different organizations can implement a single architecture
  - One organization can support multiple architectures(!)

Instruction set architectures



- Interface between hardware and software
  - – abstraction: hide HW complexity from the software through a set of simple operations and devices

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add, mul, and, lw, ...
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Computer Architecture

- Specification of how to program a specific computer family
  - what instructions are available?
  - how are the instructions formatted into bits?
  - how many registers and what is their function?
  - how is memory addressed?
  - how does I/O work?

Architecture Families

- IBM 360, 370, … (the first computer family)
- PowerPC 601, 603, …
- DEC VAX, PDP-11
- Intel x86: 286, 386, 486, Pentium, P4, Core…
- Intel IA64 Itanium
- MIPS R2000, R3000, R4000, R5000, ...
- SUN Sparc
- ARM family

MIPS

- In this class, we'll use the MIPS instruction set architecture (ISA) to illustrate concepts in assembly language and machine organization
  - Of course, the concepts are not MIPS-specific
  - MIPS is just convenient because it is real, yet simple (unlike x86)
- The MIPS ISA is still used in many places today. Primarily in embedded systems, like:
  - Various routers from Cisco
  - Game machines like the Nintendo 64 and Sony Playstation 2

Roadmap

- To start: learn to program at the architecture / instruction set / memory level
  - Information representation (bits, bytes, …)
  - MIPS assembly language programming
- Then look at some of the core implementation issues
  - Pipelining
  - Memory hierarchy (caches, virtual memory)
- Hardware from the programmer’s perspective:
  - How does my code run?
  - Why is it fast or slow?

How to Succeed in CSE 410

- Remember the big picture
  - What are we trying to accomplish, and why?
- Read the textbooks
  - They’re clear, well-organized, and well-written (particularly P&H). Work through the examples and try some exercises on your own. Read the “Real Stuff” and “Historical Perspective” sections.
- Talk to each other
  - You can learn a lot from other students, both by asking and answering questions.
- Help us help you
  - Come to lectures and office hours. Use the discussion board. Ask lots of questions! Check out the web pages.