

CSE 410 - Computer Systems

Autumn 2001

<http://www.cs.washington.edu/410>

Administrative

- Instructor:
 - Doug Johnson
 - djohnson@cs.washington.edu
- All class info is on the web site
 - <http://www.cs.washington.edu/410>
 - also known as
 - <http://www.cs.washington.edu/education/courses/cse410/01au/>

1-Oct-2001

CSE 410 - Introduction

2

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

1-Oct-2001

CSE 410 - Introduction

3

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
- In other words ...
 - calibrate your hype-o-meter with facts

1-Oct-2001

CSE 410 - Introduction

4

The structure of this class

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

1-Oct-2001

CSE 410 - Introduction

5

Elements of a computer system

- Start with a point of view
 - purchase a CD on the Web
 - get class schedule from MyUW
 - write a resume using Word
 - write a Java program to do image processing
 - write a C program to read real time data
 - write assembly language for matrix operations
 - write microcode for instruction emulation

1-Oct-2001

CSE 410 - Introduction

6

“Top Level” elements

- At any level of abstraction, there are
 - elements at that level
 - the building blocks for those elements
- Rope analogy in the book
 - a cable: three hawsers twisted together
 - a hawser: three strands of many yarns
 - down to the molecular level and beyond

1-Oct-2001

CSE 410 - Introduction

7

Purchase a CD on the Web

- the “top level” system includes
 - your browser, your desktop computer
 - connection to the internet (ISP)
 - server - <http://www.amazon.com/>
 - server application code
 - method="POST"
 - action="/exec/obidos/handle-buy-box=B00005NFZB/..."
 - ...

1-Oct-2001

CSE 410 - Introduction

8

Write a resume using Word

- the “top level” system includes
 - winword.exe - the application program
 - Contemporary Resume.dot - document template
 - resume.doc - the file containing the text
 - Windows Explorer - file manager
 - network file and printer sharing

1-Oct-2001

CSE 410 - Introduction

9

Write assembly language for matrix operations

- the “top level” system includes
 - programmer’s editor (eg, Context)
 - assembler - convert source to machine language
 - linker, loader - build and run executable
 - Instruction Set Architecture (ISA) that you are writing the code for
 - defines the programmer-visible face of the CPU
 - in this class, we will be writing for MIPS 1 ISA

1-Oct-2001

CSE 410 - Introduction

10

Layers of abstraction

- Abstraction
 - isolates a layer from changes in the layer below
 - improves developer productivity by reducing detail needed to accomplish a task
 - helps define a single architecture that can be implemented with more than one organization

1-Oct-2001

CSE 410 - Introduction

11

Architecture and Organization

- Architecture
 - defines elements and interfaces between layers
 - ISA: instructions, registers, addressing
- Organization
 - components and connections
 - how instructions are implemented in hardware
 - many different organizations can implement a single architecture

1-Oct-2001

CSE 410 - Introduction

12

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?
- The MIPS 1 architecture is the basis for the first half of this course

1-Oct-2001

CSE 410 - Introduction

13

Architecture Families

- IBM 360, 370, ...
- PowerPC 601, 603, ...
- DEC PDP-11
- Intel x86 286, 386, 486, Pentium, ...
- Motorola 680x0
- MIPS R2000, R3000, R4000, R5000, ...

1-Oct-2001

CSE 410 - Introduction

14

Computer Organization

- Processor
 - datapath (functional units) manipulate the bits
 - control controls the manipulation
- Memory
 - cache memory - smaller, higher speed
 - main memory - larger, slower speed
- Input / Output
 - interface to the rest of the world

1-Oct-2001

CSE 410 - Introduction

15

Organizations and Architectures

- Architecture is another abstraction layer
- One architecture can be implemented with many organizations
- One organization can support multiple architectures
- Different manufacturing technologies
 - TTL, ECL, PMOS, NMOS, CMOS
 - ropes and pulleys - see Dewdney reference

1-Oct-2001

CSE 410 - Introduction

16

Many possible implementations

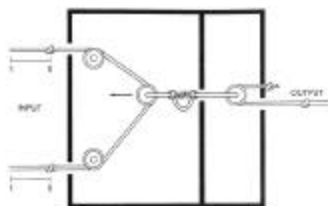


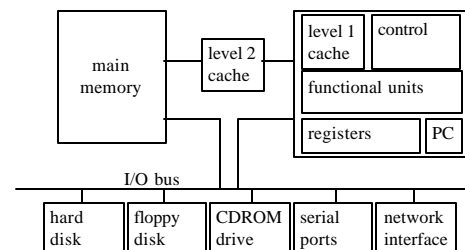
Figure 2.4 The Apperlydian AND gate.

1-Oct-2001

CSE 410 - Introduction

17

A typical organization



1-Oct-2001

CSE 410 - Introduction

18

Change Organization or Architecture?

- Theory
 - Organization changes provide incremental changes in speed and cost for same software
 - Architecture changes enable breakthrough changes in speed and cost for new software
- Real life
 - incremental changes are very rapid
 - breakthrough changes are very costly

1-Oct-2001

CSE 410 - Introduction

19

A quick hardware tour

- System board
 - CPU, memory, I/O bus
- Hard disk
 - 3600+ RPM, 8ms latency, 3-15 ms seek
- Monitor
 - CRT, LCD
- Mouse, keyboard
 - embedded processors

1-Oct-2001

CSE 410 - Introduction

20

Reading and References

- Reading
 - Chapter 1, Patterson and Hennessy, Computer Organization & Design
- Other References
 - A. K. Dewdney, The Rope and Pulley Wonder, in *The Tinkertoy Computer*, W. H. Freeman, New York, 1993

1-Oct-2001

CSE 410 - Introduction

21