EE 3755—Computer Organization

Call Number 1711 (Spring 2002)

URL: http://www.ece.lsu.edu/ee3755

Offered by:

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Tentative office hours: Mon 15:00-16:00; Wed 9:30-10:30; Tue & Thr 14:00-15:30.

Should already know...
... how to design with logic.

Will learn...
... how to design a rudimentary computer.

Prerequisites

Prerequisite by Course

EE 2730 (Digital Logic II) or equivalent.

Prerequisite by Topic

Logic design.

Binary number representation and arithmetic.

Programming of some kind.

Texts

"Computer organization & design," David A. Patterson & John L. Hennessy (Required).

"Verilog HDL," Samir Palnitkar (Optional).

Additional Verilog reference material on course Web page.

Graded Material

40% Midterm Exam

40% Final Exam

20% Homework (Roughly six assignments.)

Lowest homework grade dropped.

Short Course Outline

00-5

Hardware Description using Verilog

A commonly used language for designing digital hardware.

Computer Arithmetic

How computers add, subtract, multiply, and divide.

Integer and floating-point.

Will use Verilog to design circuits.

RISC Microprocessor Programming

The basics of programming an easy-to-program processor, MIPS.

Computer Organization

Design hardware to execute MIPS programs.

This material will be continued in EE 4720.

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Detailed Course Outline

00-6

Digital Design Hardware Description Languages (HDLs)

Designs for digital parts captured in a *HDL description*.

Popular HDLs: Verilog, VHDL.

An HDL description is fed to:

A *simulator*, to see what the design does.

(Whether it does what it's supposed to do.)

A *synthesis program*, to prepare the design for fabrication or downloading.

Chips may be fabricated using the synthesized description.

The synthesized description might be downloaded to a special chip (FPGA).

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00-7

HDL Material

Language used: Verilog

Subset of the language covered.

Enough to implement processor arithmetic units and other datapath elements.

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00-8

HDL Topics Covered

Writing structural descriptions of hardware.

Writing simple behavioral descriptions of hardware.

Relationship between descriptions and synthesized hardware.

HDL Topics Not Covered

Less-common structural elements and delay specifiers.

Much event- and delay-related behavioral code.

Will not know enough to write a good *testbench*.

Thorough HDL treatment may be given in other courses.

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HDL Software Used

Host System

ECE Sun systems.

Simulator

Model Technology (Mentor Graphics) ModelSim SE Plus

Synthesis

Exemplar (Mentor Graphics) Leonardo Spectrum

Computer Arithmetic Topics

Integer arithmetic algorithms. (Mostly review).

Integer adder implementations.

ALU implementation.

Basic integer multiplication and division implementations.

High-speed integer multiplier implementation.

Floating-point representations.

Floating-point arithmetic algorithms.

Floating-point adder implementation.

RISC Microprocessor Topics

RISC Processor

A type of processor that became popular in 80's.

RISCs simple to program and to implement (design hardware for).

Simplicity allows high-speed implementation.

Starting in 80's all new major processors were RISCs ...
... until now with Intel's IA-64.

(IA-64 covered in EE 4720.)

RISC Families:

MIPS: Ownership: Independent, then Silicon Graphics, now ??.

PA (Precision Architecture): Ownership: Hewlett-Packard.

SPARC: Ownership: Sun Microsystems / SPARC International.

POWER, PowerPC: Ownership: IBM, Apple/IBM/Motorola.

Alpha: Ownership: DEC, Compaq.

MIPS used in Patterson & Hennessy text (and so used in class).

SPARC used in ECE computers.

00-13

Covered for the MIPS processor.

MIPS Processor organization:

- What machine-language programs can access.
- What machine-language instructions can do.

MIPS Programming

- Subset of instructions covered.

Processors Covered in Other Courses

- EE 3750 /3751: IA-32 (Intel 80x86, Pentium)
- EE 4720: DLX, SPARC, some IA-64 and other architectures.

Computer Organization Topics

00-14

Building a "Toy" MIPS Processors

Use Verilog.

Topics

- Functional Simulator: Simple Design, Inefficient Hardware
- Multicycle Hardwired Control
- Multicycle Microprogrammed Control

Material continued in EE 4720.