Computer Architecture

Introduction and Administration

Course Coordinator

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  - CTO IC Design, ASTC
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Course Objectives

- To develop an understanding of
  - How a modern computer works
  - How it supports execution of software
  - How design alternatives affect performance and cost

Textbooks

- Required textbook
  - Computer Organization & Design, RISC-V Edition, Patterson & Hennessy, MKP, 2017
  - Available in print (ISBN 9780128122754)or as e-book (ISBN 9780128122761)
- Another good read
  - The Pentium Chronicles, Robert P. Colwell, Wiley-IEEE Computer Society Press, 2005
- Advanced reading
  - Computer Architecture: A Quantitative Approach, 5th Edition, Hennessy & Patterson, MKP, 2012

Teaching Arrangements

- Self-directed learning from textbook
  - See recommended weekly reading schedule
- Lectures
  - Macbeth Lecture Theatre
  - Thursdays 2:10pm – 4:00pm
- Practice Exercises: based on weekly reading and lectures
- Homework problems
  - Due end of odd weeks from week 3 onwards
- Assignment
  - Stages due end of mid-semester break and week 13
- Workshops
  - Odd weeks from week 3 onwards
  - Consulting on exercises, homework problems, and assignment
- Course website (myuni.adelaide.edu.au)
  - All course material will be posted there
  - Discussion forums

Teaching Arrangements

- Questions
  - Use the MyUni discussion forums as a first resort
  - I will participate actively, class members should also participate
  - Please observe good etiquette!
- Contacting me: peter.ashenden@gmail.com
  - Only for matters that should remain private
  - I'll forward technical questions and answers to the on-line forum
- Access Plans
  - Please advise me by email or in person to discuss arrangements

Assessment

- Short quizzes each week, due Fridays 5pm: 10%
- Homework problems: 30%
- Assignment: 30%
- Two-hour final exam: 30%
  - Based on textbook and workshop problems
- Two course codes: 3005 U/G and 7026 P/G
  - P/G requires additional assignment work and different exam paper
- See Assessment Information slides

Assumed Knowledge

- From CS1 & Computer Systems
  - Binary representation of integers
  - Basic binary arithmetic
  - Basic computer organization
  - Assembly language programming
- Programming in C/C++ or Java
- Common technical knowledge
- This is not a course in computer hardware engineering! (Well, only a bit…)

Computer Systems

- General concepts in digital hardware, machine instructions, assembler programming, compilers, operating systems
- Very simplified, *c.f.* real computer systems

Binary Representation

- Coding values in n bits
- Hexadecimal: shorthand for binary
- Unsigned integers
- 2s-complement signed integers

Arithmetic Operations

- Unsigned addition
- 2s-complement negation

Basic Computer Organization

- Processor
  - Fetch/decode/execute cycle
  - PC, registers
- Memory
  - Linear addressing
  - Bytes, halfwords, words, byte addressing
  - Read/write operations
- I/O controllers
  - Control, status and data registers
- Bus connections

Assembler Programming

- Instruction set, coded in binary
- Opcode, operands
- Assembler: translates to binary

Powers of 2

- 2^0 to 2^{12} by rote
- Multiplying/dividing by adding/subtracting exponents
- Prefixes: K, M, G, T
  - cf decimal multipliers
  - also, Ki, Mi, Gi, Ti

Common Knowledge

- Physical units: time (s), power (W)
- Multipliers: m, μ, n, p, k, M, G
- Frequency and period
  - Hz ≡ cycles/sec, f = 1/period
- Common sense estimation
  - orders of magnitude
  - real-world feasibility

Background Knowledge Quiz

- On MyUni course page
  → Quizzes → Practice Quizzes
  → Useful background knowledge quiz

Assignment

- RISC-V Instruction Set Simulator
  - Stage 1: Instruction execution
  - Stage 2: Exeptions and privileged architecture
- Specifications on course website
- Watch forum for announcements
  - Testing, hints, Q&A, web submission
- Ask questions on forums and group consulting sessions
- Demo