CSE 371
Computer Organization and Design

Midterm Review

Introduction

- Binary tree motivating example
  - Average lookup time vs size of tree
  - Distribution of repeated lookups of each leaf in tree

- Abstraction & the hardware/software interface

- Analogy with building architecture
  - Technology, Design Constraints/Goals, Applications/Domains

- Moore’s law
  - Rapid technology change

ISAs

- ISA as hardware/software interface
- Sequential (fetch/execute) model
- Comparative ISAs
  - LC3 vs P37X vs MIPS vs x86 vs ...
- Performance
  - instruction/program * cycles/Instruction * seconds/cycle
- Impact/role of the compiler
- CISC vs RISC
- ISA choices
  - Data types, registers, memory, addressing modes, branching types, instruction encoding
  - Virtual ISAs, micro-operations

Midterm Review

- Introduction
- ISAs
- Digital logic & single-cycle datapath
- Performance
- Integer & floating point arithmetic
- Pipelining

- Resources:
  - Homework solutions
  - Past exams

- Note: cheat sheet, calculator

CPU
Mem
I/O
System software
App
App
App
App
Digital Logic & Single-Cycle Datapath

- Digital logic review
  - Common structures (mux, decoder, PLAs, etc.)
  - Register file

- Simple datapath (single-cycle)
  - Implementing control

Performance

- Latency vs bandwidth (throughput)

- Comparing performance
  - Benchmarks

- Amdahl’s Law

- Clock frequency vs CPI

Integer & Floating Point Arithmetic

- Integer
  - Addition (ripple carry)
  - Addition (carry select)
  - Shift and rotation
  - Multiplication (multi-cycle & tree based)
  - Division (software & hardware)
  - Latency of the above

- Floating point
  - Basic idea (scientific notation)
  - Addition, multiplication, division
  - Range, precision, accuracy
  - Latency of above (and vs integer)

Pipelining

- Pipelining
  - Basic pipelining vs multi-cycle vs single-cycle
  - Pipeline diagrams
  - Performance calculations
  - Structural hazards (& ways to deal with them)
  - Data dependences (& ways to deal with them)
  - Bypassing
  - Load-use delay
  - Multi-cycle operations (multiply)
  - Control dependencies (branches & branch prediction)
  - Pipeline depth

- Superscalar
  - Basic idea of multiple issue (CPI < 1)