Midterm Exam

- In-class exam
  - Closed book/note exam
  - "cheat sheet" - one page front & back
  - Bring a simple calculator (no wireless devices, e.g., phones)
- Topics: anything we cover before the exam
- Format
  - Short answer, calculations, performance analysis, etc.
- Exam from last few years will be posted (via blackboard)
  - My midterm exam from last year
  - Also, perhaps a few from Prof. Roth (note: somewhat different)

Course Topics Thus Far…

- Introduction
- ISAs
- Digital logic & datapath
- Performance
- Integer and floating point arithmetic
- Pipelining
- Superscalar

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
  - LC4 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
- Micro-operations

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 Arithmetic

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

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)