Midterm #2 review  
ECE 429/629  Fall 2003

This midterm will be closed-book, closed-notes.

Midterm will consist of
- Short answer questions
- detailed datapath / control logic questions on a 5-cycle pipelined MIPS machine
- pipeline diagram question (with floating point hardware)
- scoreboard / Tomasulo’s algorithm question

For the midterm, students should be able to
- define the following terms: issue, execute, commit, dependence, hazard, precise exception, exact rounding
- list and describe the different types of dependences and hazards
- for a 5-stage MIPS pipelined machine,
  - explain its relationship to a single-cycle or multi-cycle machine
  - for each cycle of a given program, identify which instruction is in which pipeline register
  - list the values of the pipelined control lines for each cycle of a given program (including forwarding and hazard detection)
  - describe the extra H/W needed to resolve branches in the ID/RF stage
  - explain how the register file “forwards” data to itself by writing in the first half of the clock cycle
- given a piece of assembly code,
  - identify the data dependences
  - identify the potential instructions for a delayed branch slot
  - fill a pipeline diagram (with F,D,X,M,W, etc. – including floating point)
  - fill in a scoreboard diagram
- compare and contrast various static branch prediction techniques
- compute the speedup from pipelining
- identify which hardware modifications lead to out-of-order execution and out-of-order completion, and identify the potential data hazards that result
- explain, at a high level, the advantages of Tomasulo’s algorithm over scoreboard
- for the IEEE 754 floating point spec,
  - list the special floating point numbers
  - given a 32-bit binary number and a description of the spec, derive the floating point number that is represented
  - determine whether adding a certain number (e.g., 0.1 or 0.25) in floating point introduces roundoff error, and why

Sample short answer questions:
- What is the hardest part of designing the control of a computer?
- What is a “precise exception”??
What is the difference between a “dependence” and a “hazard”? 
What are the three types of hazards? 
What are the three types of data hazards? 
What is “register renaming”? What problem does it solve? 
What type of data dependence is introduced by having multiple functional units? 
What may become out-of-order? 
What type of data hazard is caused by out-of-order execution? 
When was the IEEE floating point spec finalized? When did Intel introduce its 8087 math coprocessor? 
What is pipelining? 
What is the hardest part of designing the control of a computer? 
Even if a computer is listed as IEEE 754-compliant, what part of the spec might not be fully implemented?