Study Guide for Final Exam
Computer Architecture CSCI 320 – Fall 2007
December 3, 2007

Final Exam: Thursday, December 13, 2007 at 3 PM - 6 PM in room 65 Breakiron.

Closed book and closed notes.
A sheet of formulas will be provided with the exam. To see the sheet, look at URL:

`http://www.eg.bucknell.edu/~cs320/2007-fall/formulas.html`

The format of the exam will be similar to the midtem exam.

I will make up the exam to take about 90 minutes but you will have the full three hours. I encourage you to study in study groups.

Exam Covers: The Exam covers some material that was on the midterm exam, i.e., starting with Appendix A, and the new material since the midterm exam. The exam will stress the material since midterm exam.

The following sections in text are covered:

Appendix A - all of it!
Chapter 2 - skip sections 2.7, 2.8 and 2.9.
Appendix C - all of it!
Chapter 6 - skip sections 6.6, 6.7 and 6.8.
Chapter 3 - only section 3.5.
Chapter 4 - only section 4.1.

I expect you to carefully read and study these sections. For these sections, I will test concepts and application of those concepts not specific facts.

Also covered on the exam are the following:

Google Cluster article
Your paper on Cell processor

Student Learning Outcomes: The successful CSCI 320 student will be able to:

1. Apply the fundamentals of computer design including locality, measuring performance and Amdahl's Law.
2. Apply the concepts of instruction pipelining to reduce or eliminate hazards to increase processor performance.
3. Define structural, data and control hazards.
4. Identify data hazards and remove them by forwarding.
5. Explain and apply the delayed branch technique.
6. Identify control hazards and associated stalls.
7. Describe and identify the three types of data dependencies.

8. Describe and identify structural and control hazards.
9. Describe and apply renaming to eliminate WAW and WAR hazards in an instruction stream.
10. Discuss the characteristics, strengths and limitations of pipelining to exploit Instruction Level Parallelism (ILP).
11. Discuss the characteristics, strengths and limitations of scoreboarding to exploit Instruction Level Parallelism (ILP).
12. Discuss the characteristics, strengths and limitations of Tomasulo's algorithm to exploit Instruction Level Parallelism (ILP).
13. Discuss the characteristics, strengths and limitations of speculation to exploit Instruction Level Parallelism (ILP).
14. List the steps in speculation and explain what happens in each step.
15. Explain out-of-order execution and why it is used.
16. Describe branch prediction and where it is used.
17. Explain what we mean when an instruction is committed.
18. Describe the abstraction of cache memory.
19. Define the following terms for caches: tag, index, block, block frame, block offset, cache line, direct mapped, set associative, and fully associative.
20. Describe and apply the four fundamental questions of cache technologies, i.e., 1. Where can a block be placed in cache? 2. How is a block found if it is in the cache? 3. Which block should be replaced on a cache miss? 4. What happens on a write? Describe and evaluate alternatives for each, e.g., write through vs. write back.
21. Apply the CPU time formuala refined to include cache misses.
22. Describe compulsory, compacity and conflict cache misses.
23. In a write-through cache, describe the write buffer technique.
24. Given a small assembly language program, its layout in memory and a level 1 cache organization, determine the read hits, read misses, write hits and write misses.
25. Describe the abstraction of virtual memory.
26. Explain the reasons for virtual memory.
27. Describe protection mechanisms in virtual memory.
28. Describe and apply the TLB mechanism for implementing virtual memory.
29. Describe the interactions when implementing both abstractions for cache memory and virtual memory.
30. Apply the concepts of cache memories to analyze other storage systems such as virtual memory, file caches and TLBs.
31. Apply the principles of queuing theory to analyze I/O requests in storage systems.
32. Describe the differences between reliability amd availability.
33. Describe computer clusters and give examples of their characteristics and use.