Spring 2003 Clyde Kruskal

CMSC 411: Practice Final

This is a practice Final Exam. It does not necessarily reflex the length or difficulty of the actual Final Exam.

The following is a fairly good list of the sections covered from the book.

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* Chapter 5: Memory Hierarchy [5.1-5.10, 5.16]
        (5.1) Introduction
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        (5.10) Virtual Memory
        (5.16) Fallacies and Pitfalls

* Chapter 6: Multiprocessors [6.1-6.8, 6.14]
        (6.1) Introduction
                .
                .
                .
        (6.8) Models of Memory Consistency: An Introdcution
        (6.14) Fallacies and Pitfalls

* Parallel Processors: [8.1, 8.5, 8.14]
        (8.1) Introduction
        (8.5) Network Topology
        (8.14) Fallacies and Pitfalls
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(1) (a) Write MIPS code that reads the first ten values in an array of real numbers, squares the values, and finds the sum. Assume the starting location of the array is in register R20. Make your code as clear as possible.

(b) Assume that the bits of a word are numbered 0 to 63 (you can start from either end but state your assumption). Given a word in register $R10$, for all 1 bits, square the associated value, and find the sum. Put the answer into register $R11$. Make your code as clear as possible.

(2) Assume we allow pages in a virtual memory system to have arbitrary size.

(a) What are the advantages and disadvantages of this?

(b) Given that we are going to allow pages to have different sizes, what are the advantages of restricting the page size to be a multiple of the smallest size.

(c) Given that we are going to allow pages to have different sizes, what are the advantages of restricting the page size to be a power of two times the smallest page size (e.g., 1KB, 2KB, 4KB, 8KB, 16KB, etc.)?

(3) Exercise 5.1, p. 513

(4) Exercise 5.12, p. 518

(5) (a) Draw a 4×4 mesh of processors.

(b) What is the farthest distance between two processors in your 4×4 mesh? What about in a $\sqrt{p} \times \sqrt{p}$ mesh?

(c) Suppose that every processor of a $\sqrt{p} \times \sqrt{p}$ mesh holds exactly one value, and we wish to find the sum of all p values. Describe an efficient parallel algorithm for solving this problem. Use as few communication steps as possible, where in each communication step every processor can send exactly one item to a neighbor and receive exactly one item from a neighbor. Exactly how many communication steps does your algorithm use.

(d) What are the advantages and disadvantages of a two-dimensional mesh compared to a tree machine.

(6) Exercise 6.1, p. 665

(7) Exercise 6.17, p. 670

(8) Exercise 6.12, p. 670