CS/ECE 347, Spring 1996
Recitation Assignment 9: Measuring the Performance of Memory Systems

Assigned: Tue., Apr. 9
Due: Mon., Apr. 15

1. Introduction

In this assignment, you will get a head start on Lab 3 by measuring the memory system throughputs of two different workstations — DEC stations and SPARC stations — that you will use in the Lab. You should do this assignment in the same groups in which you will do Lab 3.

While measuring the throughputs of the memory systems, you will vary three different parameters:

- The size of an array of words through which your test code must stride.
- The size of the stride. (For example, a stride of 8 bytes means that each access is offset 8 bytes from the previous access.)
- Whether the memory is being read from or written to.

2. Problem 1

2.1. Part A

Measure the throughput of a DEC station's memory system for word reads. Express your results in accesses/second as a function of the array size and the stride. Test all possible combinations of the following array sizes and strides (for a total of 12 tests):

- Array sizes of 8K, 64K, 128K, and 256K bytes (where K=1024).
- Strides of 1, 4, and 8 bytes. Note: for strides of 1 byte, use an array of bytes rather than an array of words, and perform byte reads rather than word reads.

Make sure all times you measure are reasonably accurate. For each throughput measured, time at least 10 trials, and report the minimum and maximum as well as the mean trial times.

Note that while it is not necessary to make your test code tight enough to expose the latency of memory accesses that hit the cache, it must be tight enough to expose the latency of memory accesses that cause cache misses. You should probably compile your code with the -O2 option, but make sure that the compiler doesn't optimize your memory accesses away! (This can usually be accomplished by storing the sum of the array elements in a temporary variable, and then printing out the value of that temporary variable outside of the array-accessing loop.)

Specify precisely which machine you used for these measurements!

2.2. Part B

Produce a three-dimensional plot of the data gathered in Part A, using the size of the array as one variable and the stride as the other. (Use log scales for the array size and the stride.)

2.3. Part C

Repeat Parts A and B, substituting writes for reads.

3. Problem 2

3.1. Part A

Measure the throughput of a SPARC station's memory system for word reads. Express your results in accesses/second as a function of the array size and the stride. Test the following combinations of array sizes and strides:

- Array size 8: strides of 4, 16, and 32 bytes
- Array size 16K: strides of 4, 16, and 32 bytes
- Array size 4M: strides of 32, 256, 1024, 2048, 4096, and 8192 bytes

Again: make sure that your test code is tight enough to expose the latency of memory accesses that miss the cache; report min and max times as well as means; specify precisely which machine you used for your measurements.

3.2. Part B

Produce a 3-dimensional plot of your results from Problem 2A similar to the plot you produced for Problem 1B.

3.3. Part C

Repeat parts A and B, substituting writes for reads.