

Computer Architecture HW #6

Due: Friday, Oct. 29 (5 PM in ITT 305 mailbox or under my door, ITT 313)

Chapter 5. Exercises: 4.11, 4.18, 4.21 **and the following problems:**

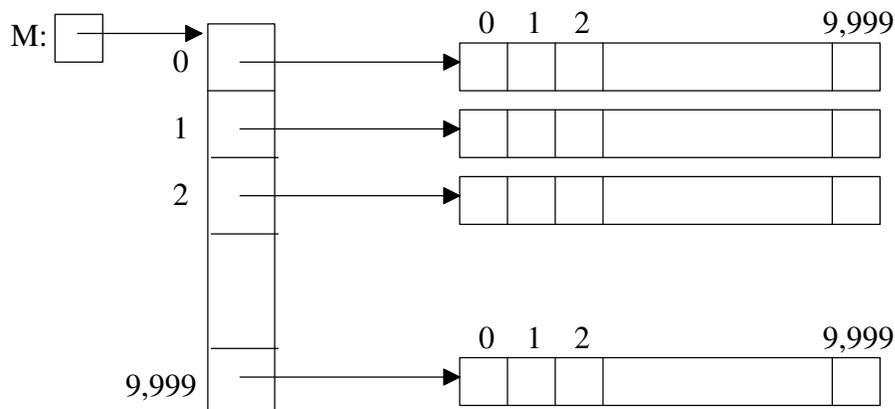
Question A. On a 32-bit computer, suppose we have a 2 GB (2^{31} bytes) memory that is byte addressable, and a 1 MB (2^{20} bytes) cache with 32 (2^5) bytes per block.

- a) How many total lines are in the cache?
- b) If the cache is direct-mapped, how many cache lines could a specific memory block be mapped to?
- c) If the cache is direct-mapped, what would be the format (number of tag bits, cache line bits, block offset bits) of the address? (Clearly indicate the number of bits in each)
- d) If the cache is fully-associative, how many cache lines could a specific memory block be mapped to?
- e) If the cache is fully-associative, what would be the format of the address?
- f) If the cache is 4-way set associative, how many cache lines could a specific memory block be mapped to?
- g) If the cache is 4-way set associative, how many sets would there be?
- h) If the cache is 4-way set associative, what would be the format of the address?

Question B. Consider the following two sections of C code that both sum the elements of a 10,000 x 10,000 two-dimensional array M which contains floating points.

Code A	Code B
<pre>sum = 0.0; for (r = 0; r < 10000; r++) for (c = 0; c < 10000; c++) sum = sum + M[r][c];</pre>	<pre>sum = 0.0; for (c = 0; c < 10000; c++) for (r = 0; r < 10000; r++) sum = sum + M[r][c];</pre>

Explain why Code A takes 1.27 seconds while Code B takes 2.89 seconds. Hint: C uses row-major ordering to store two-dimensional arrays i.e.,



Question C. Assume an 6-disk RAID array. Each disk has 100 MB/sec data transfer rate.

a) Fill in the following table to compare the following RAID levels **assuming no disk failures.**

RAID Level	Data transfer rate for single, large I/O request	Number of concurrent, small READ requests	Number of concurrent, small WRITE requests
0 (large strip)			
0 (bit-wise interleaving)			
1			
2			
3			
4			
5			

b) Fill in the following table to compare the following RAID levels **assuming one disk failure.**

RAID Level	Data transfer rate for single, large I/O request	Number of concurrent, small READ requests	Number of concurrent, small WRITE requests
0 (large strip)			
0 (bit-wise interleaving)			
1			
2			
3			
4			
5			