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2CSC205 section 1 Spring 2015

Homework 9

How to Submit:

Please submit your solutions (parts A and B separately) through Blackboard. Remember to put your name and homework number on all the documents that you submit as attachments.

Total possible points in this homework: 5 for Part B

(You receive 1 bonus point towards Part A if you get all Part A questions correct.)

Part B

1. [2pts] Consider a system that implements instruction level pipelining, supported by a 2-level memory hierarchy using the sequential access strategy, with level-1 access time *T1*, and level 2 access time *T2*. Let *h* be the hit rate at level 1. Suppose the synchronous pipeline stalls when data fetch is not successful in the level-1 memory.
   1. In terms of the number of instructions processed, how frequently does the pipeline stall due to data access? In terms of time, how much does the stall cost? Explain.

The pipeline will need to stall every time that the result in level 1 is needed to start the process in level 2. The stall in the case of a miss in level 1 will be the number of times until a hit is received multiplied by T1 and a miss in level 2 will be the number of times until a hit is received multiplied by T2 because either level would need receive a hit to continue on if they are dependent of each other.

* 1. What is the minimum stage length of the pipeline? Explain.

With the given information, we have to assume that the worst case scenario is that level 1 is a miss which means h = 0% and that the level 2 is a hit so therefore the minimum stage length for the pipeline would be the time for level 1 plus the time for level 2 which would be T1+T2 = minimum stage length.

1. [Total 2 pts] Read the data locality discussion on StackOverflow at (http://stackoverflow.com/questions/9821720/techniques-for-keeping-data-in-the-cache-locality).
   1. [1pt] In the C/C++ convention, 2D arrays are typically stored row by row. Compare the following two code segments, which perform the same task. Which implementation exploits data locality better?

The data locality for segment 1 is better because it fills a whole row then moves on to the next row and since 2D arrays are stored row by row, this code segment works better for storing.

|  |  |
| --- | --- |
| Code segment 1 | Code segment 2 |
| for (i=0; i<row; i++) {  for (j=0; j<column; j++) {  A[i][j] = 0  }  } | for (j=0; j<column; j++) {  for (i=0; i<row; i++) {  A[i][j] = 0  }  } |

* 1. [1pt] What makes data locality difficult to exploit in Java?

Garbage collection slows down other processes and is not desirable in most of the Java applications. It has a high cost due to all the objects being examined. During the marking phase, data that is marked is placed into a heap which is usually fragmented leads to poor locality of data and causes more misses in cache.

Further reading: http://stackoverflow.com/questions/1478280/what-can-i-do-in-java-code-to-optimize-for-cpu-caching

1. [1pt] Read the article “A cache primer” by Paul Genua (at <http://www.freescale.com/files/32bit/doc/app_note/AN2663.pdf>).
   1. Describe the type(s) of cache misses that L2 cache helps to reduce.

Conflict misses, replaces L1 misses with L2 hits.

* 1. Does L2 cache help improve cache hit? Explain. How large must L2 cache be in order for it to be effective?

L2 cache helps improve the cache hit rate. The L2 cache must be at least double the size of L1 because all the misses in L1 go to L2 therefore if L2 is double in size the hit rate will at least be 50%.