Question 10: Cache Performance Analysis

This is the hardest question possible in the Practice Quiz. No question on the actual quiz will be this hard. If you can reason about this question on your own, you are probably ready for the quiz.

For a **1**KB **2**-way set associative cache with **32**-byte blocks on a machine with **32**-bit address space, consider the following code snippet. The cache uses a Least Recently Used replacement policy. *Note: The memory is byte addressable as always and data is stored in row-major order. Assume that the cache is initially empty.*

You may also assume that expressions in C code get evaluated in the order from left to right - e.g. `a += b * c` accesses `a` then `b` then `c` then `a`.

`double` and `long long` are 8B; `float` and `int` are 4B; `short` are 2B, and `char` are 1B.

```
#define M 4
#define N 64
long long A[N][N], B[M];
for (int k = 0 ; k < M; k++) { // Loop 1
    for (int i = 0; i < N; i+= pow(2,k)) { // Loop 2
        for (int j = 0; j < N; j+= pow(2,k)) { // Loop 3
            B[k] += A[i][j];
        }
    }
}
```

Only data structures `A` and `B` are stored in memory, and all other variables are register allocated. `A` is stored starting at address `0xB608CAD8` and `B` is stored starting at address `0xE90860D8`.

Part(a) For the second iteration of Loop 1 (`k=1`), write down the first 6 addresses accessed and if each access is a cache HIT or MISS. For Hit/Miss, partial credit will be added to your final score but Hit/Miss for an address will appear 0% till you get full points on Part (a). [20% points]

Address	Hit/Miss
0x	(a) Hit (b) Miss
0x	(a) Hit (b) Miss
0x	(a) Hit (b) Miss
0x	(a) Hit (b) Miss
0x	(a) Hit (b) Miss
0x	(a) Hit (b) Miss

0

HEX
DEC

1	2	3	CE
4	5	6	+
7	8	9	-
A	B	C	÷
D	E	F	×
COPY	0	=	%

Part(b) Calculate the number of accesses and misses for arrays `A` and `B`.

Number of Accesses		Number of Misses	
Array A:		Array A:	
Array B:		Array B:	

Part(c) compute the number of misses if we change the cache to a direct-mapped one.

Total # of Misses:

Part(d) For the original cache configuration, compute the number of misses if the Loops 2 and 3 were swapped.

Total # of Misses:

Save & Grade *6 attempts left* | Save only

40 points available for this attempt
(following attempts are worth: 36, 32, 25, 15, 5)

Practice Quiz 6

Assessment overview

Question 10

Status: unanswered

Available points: 40, 36, 32, 25, 15, 5

Total points: — /40

Auto-graded question

Previous question | Next question

Personal Notes

No attached notes

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