

Question 9: Cache performance analysis

For a **64KB** direct-mapped cache with **32**-byte blocks on a machine with **32**-bit address space, consider the following code snippet. *Note: The memory is byte addressable as always and data is stored in row-major order. Assume that the cache is initially empty.*

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

```
#define LENGTH 6144
long long A[LENGTH], B[LENGTH];
long long sum;

for (int i = 0 ; i < 4 ; i++) {           // outermost loop
    for (int j = 0 ; j < LENGTH ; j++) {
        sum += A[j];
    }

    for (int k = 0 ; k < LENGTH ; k++) {
        sum += B[k];
    }
}
```

Assume that **sum**, **i**, **j**, and **k** are allocated to registers for the duration of the code. Assume that the memory instructions are executed in the order specified by the program. You should also assume that arrays **A** and **B** are contiguous in memory. **A** is stored starting at address **0xCE98A200** and **B** is stored starting at address **0xCE996200**.

Grading Scheme for Number of Accesses and Number of Misses:

- Answers within 2% tolerance will get full credit.
- Answers within 5% tolerance will get 98% credit.
- Answers within 10% tolerance will get 90% credit.
- Answers within 20% tolerance will get 66% credit.
- Answers within 30% tolerance will get 33% credit.

**Part(a)** Write down the first 3 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
<div>0x<div>?</div></div>	<div><input type="radio"/> (a) Hit</div> <div><input type="radio"/> (b) Miss</div>
<div>0x<div>?</div></div>	<div><input type="radio"/> (a) Hit</div> <div><input type="radio"/> (b) Miss</div>
<div>0x<div>?</div></div>	<div><input type="radio"/> (a) Hit</div> <div><input type="radio"/> (b) Miss</div>

0

HEX

DEC

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

**Part(b)** Select all of the following elements that are in the cache after the first iteration of the outermost loop. Partial credit will be added to your final score but Part(b) score will appear 0% till you select all correct options. **[10% points]**

Array A:	Array B:
<div><input type="checkbox"/> (a) A[1222]</div>	<div><input type="checkbox"/> (a) B[3877]</div>
<div><input type="checkbox"/> (b) A[4236]</div>	<div><input type="checkbox"/> (b) B[1588]</div>
<div><input type="checkbox"/> (c) A[5049]</div>	<div><input type="checkbox"/> (c) B[2430]</div>
<div><input type="checkbox"/> (d) A[2921]</div>	<div><input type="checkbox"/> (d) B[4889]</div>
<div><input type="checkbox"/> (e) None of the above</div>	<div><input type="checkbox"/> (e) None of the above</div>

**Part(c)** Compute the number memory accesses and cache misses for i=0, that is, for the first iteration of the outermost loop. **[50% points]**

Number of Accesses	Number of Misses
<div>Accesses:<div>?</div></div>	<div>Misses:<div>?</div></div>

**Part(d)** Compute the number of misses for i=1, that is, for the second iteration of the outermost loop. **[10% points]**

Total # of Misses:

?

**Part(e)** Compute the number of misses for i = 1, that is, for the second iteration of the outermost loop. assuming the cache is fully associative (instead of direct-mapped). Assume the cache uses an LRU (Least Recently Used) replacement policy. **[10% points]**

Total # of Misses:

?

Practice Quiz 6

Assessment overview

Question 9

Status:

unanswered

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

Total points: — /40

Auto-graded question

Previous questionNext question

Personal Notes

No attached notes

- Attach a file
- Add text note

✦✦

✎A

✦✦

✎A

✦✦

✎A