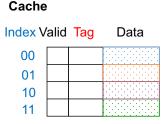


Name: _____

ID:

Question: Direct Mapping Cache Hit Rate

Consider a 4-block empty Cache, and all blocks initially marked as not valid, Given the main memory word addresses "0 1 2 3 4 3 4 15", calculate Cache hit rate.





00	Mem(0)

1 miss

00

)	Mem(0)	
)	Mem(1)	
	. ,	

2 miss

00	Mem(0)
00	Mem(1)
00	Mem(2)

3 miss

00	Mem(0)
00	Mem(1)
00	Mem(2)
00	Mem(3)



3 hit

01	Mem(4)
00	Mem(1)
00	Mem(2)
00	Mem(3)

4 hit

		_
01	Mem(4)	
00	Mem(1)	
00	Mem(2)	
00	Mem(3)	11

15 miss

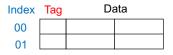
	01	Mem(4)	
	00	Mem(1)	
	00	Mem(2)	
1	00	Mem(3)	
			15

• 8 requests, 6 misses

Question: Multiword Direct Mapping Cache Hit Rate

Consider a 2-block empty Cache, and each block is with 2-words. All blocks initially marked as not valid. Given the main memory word addresses "0 1 2 3 4 3 4 15", calculate Cache hit rate.

Cache



0 miss			1 hit					2 miss		
00	Mem(1)	Mem(0)		00	Mem(1)	Mem(0)		00	Mem(1)	Mem(0)
								00	Mem(3)	Mem(2)

3 hit			01 5 11100			3 hit			
00	Mem(1)	Mem(0)	Ŭ	00	Mem(1)	Mem(0)	01	Mem(5)	Mem(4)
00	Mem(3)	Mem(2)		00	Mem(3)	Mem(2)	00	Mem(3)	Mem(2)

4 hit

15 miss

Mem(5)	Mem(4)	1101	Mem(5)	Mem(4)
Mem(3)	Mem(2)	90	Mem(3)	Mem(2)

• 8 requests, 4 misses

01

00

Question: Bit number in a Cache

How many total bits are required for a direct mapped cache with 16KB of data and 4-word blocks assuming a 32-bit address?

Question: Bit number in a Cache

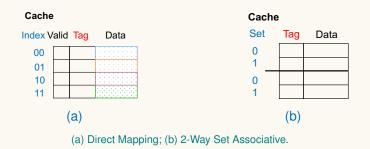
How many total bits are required for a direct mapped cache with 16KB of data and 4-word blocks assuming a 32-bit address?

Solution

- 16K bytes == 4K words == 1K blocks
- Tag field size = 32-(10+2+2) = 18
- ▶ $2^{10} \times [4 \times 32 + 18 + 1] = 2^{10} \times 147 = 147$ Kbits

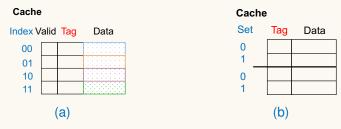
Question: Direct Mapping v.s. 2-Way Set Associate

Consider the following two empty caches, calculate Cache hit rates for the reference word addresses: "0 4 0 4 0 4 0 4"



Question: Direct Mapping v.s. 2-Way Set Associate

Consider the following two empty caches, calculate Cache hit rates for the reference word addresses: "0 4 0 4 0 4 0 4"



(a) Direct Mapping; (b) 2-Way Set Associative.

- Direct mapping: 0 hit (Ping pong effect)
- 2-Way Set Associative: 6 hits