

Assignment 5

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8.21

K = 4-way set associative

Cache size = 32kB = $32 * 1024 = 32768$

Block size, B = 64B,

of blocks, N = $32768 / 64 = 512$

Number of bits in address = 32

Number of sets, S = $N / k = 512 / 4 = 128$

Block offset = $\log_2(B) = \log_2(64) = 6$

Index = $\log_2(S) = \log_2(128) = 7$

Tag = Block address bits - Index - Block offset = $32 - 7 - 6 = 19$

K = 2

Tag = 14 bit

Index = 8 bit

block size = 4B

a) Number of blocks

Number of sets = $2^8 = 256$

2-way set associative, so total number of blocks = $256 * 2 = 512$

b) Number of blocks in memory

Total bits = tag + index + block offset = $14 + 8 + \log_2(4) = 24$

Hence, number of blocks in memory = $2^{24} = 16,777,216$

c)

$(557A02)_{16} = (01010101011110\ 10000000\ 10)_2$

Tag = 01010101011110

Index = 10000000

Offset = 10

Hence, the cached value is C_{216}

d)

$(FFFFFF)_{16} = (11111111111111\ 11111111\ 11)_2$

Tag = 11111111111111

Index = 11111111

Offset = 11

Could not find the tag, hence the value is not present in the cache. Cache miss

Number of blocks available = $8 * 1024 / 64 = 128$

Each block will hold $64 / 8 = 8$ elements

For the Code Fragment A, there will be cache misses every after every 8th element, since it is a direct-mapped cache. The number of cache miss will be:

$$1024 * 1024 / 8 = 131072$$

For the Code Fragment B, the array is being indexed with columns first and rows. Since there are more elements than there are number of blocks available, and entire column will be brought into the cache, and will not be there the next time it will be accessed, causing cache misses.

Hence, the number of cache misses = $1024 * 1024 = 1048576$

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24-bit virtual address

16-bit physical address

1KB = 1024B page size = 2^{10} B

Number of virtual pages =

$$2^{24} / 2^{10} = 2^{14} = 16,384$$

Number of physical pages:

$$2^{16} / 2^{10} = 2^6 = 64$$

Number of bits in virtual page number =

$$24 - 10 = 14$$

Number of bits in physical page number =

$$16 - 10 = 6$$

Number of bits in page offset =

$$\log_2(1024) = 10$$

a)

Data read at 00000000000000 0000000000
There is no address mapping from 00000000000000 .
Hence, it will be access violation.

b)

Data write at 00000000000011 0011001100
physical address is 001010 0011001100
Data write is possible.

c)

Instruction fetch at 111111111111 0000000000
Physical address 001100 0000000000
Access violation, because the flag "not executable" is present at that address.