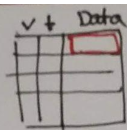
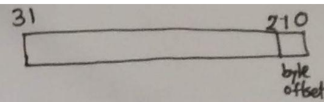




Bits in a Cache

How many bits are required for a direct mapped cache with 4KB of data and 1-word block size?

→ 1 word
$b = 4$ bytes
$= 32$ bits

cache data $= 4KB$
$= 4 \times 1024\,B$
$= 1024 \times 4$ bytes
$= 1024 \times 1$ word

$\#$ row in cache $= \frac{\text{total data}}{\text{block size}}$
$= \frac{1024 \times 1 \text{ word}}{1 \text{ word}}$
$= 2^{10}$

index bit, $n = 10$

Cache size $= 2^n \times (b + t + v)$
$= 2^{10} \times (32 + 20 + 1)$
$=$ ~~43 Kbits~~ 53 Kbits

Index bit, word offset in a block, byte offset

$t = 32 - (n + m + 2)$
$= 32 - (10 + 0 + 2)$
$= 32 - 12$
$= 20$

[block size = 1 word = 2^0 word] [2^m words]

Same problem

16KB of cache data
4-word blocks

Cache data $= 16$ KB
$= 2^{10} \times 16\,B$
$= 2^{10} \times 4 \times 4B$
$= 2^{10} \times 4$ word

$\#$ row $= 2^{10}$
$n = 10$

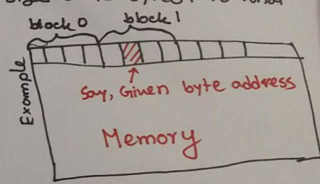
cache size $= 2^{10} \times (b + t + v)$ bits
$= 2^{10} \times (2^4 \text{ Byte} + t + 1)$ "
$= 2^{10} \times (2^7 + t + 1)$ "
$= 2^{10} \times (128 + 19)$ "
$= 147$ Kbits

block size $= 2^m$ word
m word offset

$t = 32 - (n + m + 2)$
$= 32 - (10 + 2 + 2)$
$= 32 - 14$
$= 18$

Mapping an address

Consider a cache with 64 blocks and a block size of 16 bytes. To what block number (in cache) does byte address 1200 (of memory) map?



cache has 64 blocks $= 2^6$ "

block size = 16 bytes

cache block Number = (memory block address) mod (# of blocks in cache)

first find this

$$\text{memory block address} = \left\lfloor \frac{\text{Given byte address}}{\text{\# of bytes in a block}} \right\rfloor = \left\lfloor \frac{1200}{16} \right\rfloor = 75$$

cache block Number = 75 mod 64 = 11

∴ cache block 11

byte address 1200 is in 75th block of memory which maps to 11 th block of cache

Similarly, all addresses between

$\left\lfloor \frac{1200}{16} \right\rfloor \times 16$ and $\left\lfloor \frac{1200}{16} \right\rfloor \times 16 + (16-1)$

or 1200 and 1215 map to 11 th block of cache