Assignment
Cache-Mapping

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A) 2 way set associative cache

→ Data words → 32 bit
→ cache block – 2048
→ CPU address – 32 bit

2048 blocks in cache
Addresses are to word

Solution:

Cache Block Size = 2048 bits
= 2^{11} bits = ~~2^{11} words~~

Bits per word = 32 bits
= 2^5 bits

Therefore, there will be $\frac{2^{11}}{2^5}$ words per block

$\Rightarrow 2^{11-5} \Rightarrow 2^6$

So, ~~we need~~ there are 6 bits in offset.

~~We need 1 less bit~~

We need 1 less bit of index because we are addressing to set

$\Rightarrow$ 2^{11} bits in block / 2^1 block per set

$\Rightarrow$ $2^{11-1} \Rightarrow 2^{10}$ sets.

~~8-way set associative cache~~

Therefore, there are 10 bits in index field.

Now, no. of bits in tag will be

= address bits - bits in offset - bits in index field

$\Rightarrow$ 32 - 6 - 10

Bits in tag $\Rightarrow$ 16 bits

B) 4 way set associative cache

No. of bits in offset = $2^{11}/2^5 = 6$ as data is still word addressed

$\Rightarrow 2^6$

Bits in offset $\Rightarrow$ 6 bits

No. of words in index

We need one less bit of index b'coz we address to the set

Therefore, 2^{11} blocks / 2^2 blocks per set $\Rightarrow 2^{11-2} \Rightarrow 2^9$ sets

9 bits of index needed.

Number of bits in tag => 32 - 6 - 9

= 17 bits

32 - data words
6 - Bits in offset
9 -> Bits in index

c) Total size of Cache

we have total block size = 2048 bits

No. of bits per block = 2048

we know 1 byte = 8 bits

∴ No. of bytes per block = 2048 | 8

= 256

Now,

=> 2048 blocks x 256 bytes => $2^{11} \times 2^{8}$ => $2^{11+8} = 2^{19}$ bytes

2^{19} bytes = 514288 bytes = 514.288 Kb

∴ Total size of cache = 0.5MB

16 bit memory addresses
2K-byte cache → direct mapped
64 bytes per cache block
memory word – 1byte

} given

Solution:

Block size = 64 byte = 2^6 bytes
= 2^0 words (as 1word = 1byte)

Therefore, no. of bits in the word field = 6.

Now, cache size = 2K-byte
→ 2^{11} bytes

- No. of cache Blocks → Cache size / Block size
→ $2^{11} / 2^6$ → 2^5

So, the no. of bits in the Block field = 5

we have total no. of address bits as 16

So, the no. of bits in tag field = address bits – word field bits – Block field bits
= 16 – 6 – 5

No. of bits in tag field = 5

In 16 bit address field, 5 most significant bits, represent the Tag, the next 5 bits represent the block, & 6 least significan bits represent the word.

Therefore,

The no. of bits in each Tag of memory address = 5

The no. of bits in Block field = 5

The no. of bits in word field = 6