Set-associative mapping

In set associative mapping,

- A particular block of main memory can be mapped to one particular cache set only.
- Block ‘j’ of main memory will map to set number (j mod number of sets in cache) of the cache.
- A replacement algorithm is needed if the cache is full.

PRACTICE PROBLEMS BASED ON SET ASSOCIATIVE MAPPING-

Problem-01:

Consider a 2-way set associative mapped cache of size 16 KB with block size 256 bytes. The size of main memory is 128 KB. Find-

1. Number of bits in tag
2. Tag directory size

Solution-

Given-

- Set size = 2
- Cache memory size = 16 KB
- Block size = Frame size = Line size = 256 bytes
- Main memory size = 128 KB

We consider that the memory is byte addressable.

Number of Bits in Physical Address-

We have,

Size of main memory

= 128 KB

= 2^{17} bytes

Thus, Number of bits in physical address = 17 bits

Number of Bits in Block Offset-

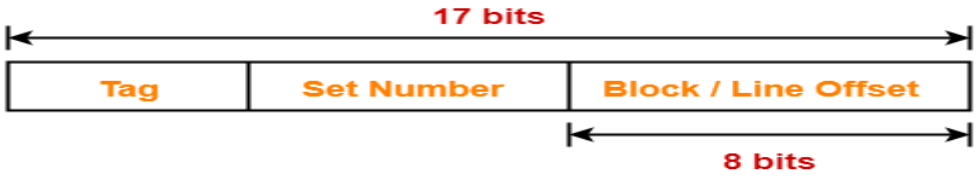
We have,

Block size

= 256 bytes

= 2^8 bytes

Thus, Number of bits in block offset = 8 bits



Number of Lines in Cache-

Total number of lines in cache

= Cache size / Line size

= 16 KB / 256 bytes

= 2^{14} bytes / 2^8 bytes

= 64 lines

Thus, Number of lines in cache = 64 lines

Number of Sets in Cache-

Total number of sets in cache

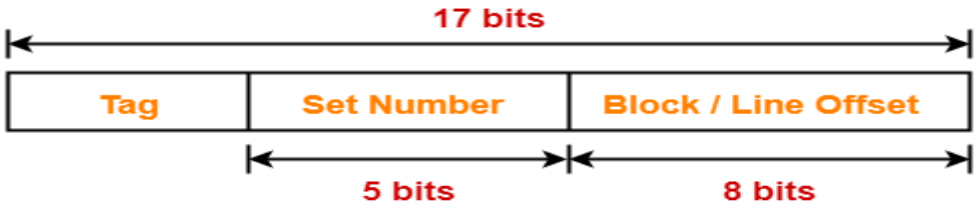
= Total number of lines in cache / Set size

= 64 / 2

= 32 sets

= 2^5 sets

Thus, Number of bits in set number = 5 bits



Number of Bits in Tag-

Number of bits in tag

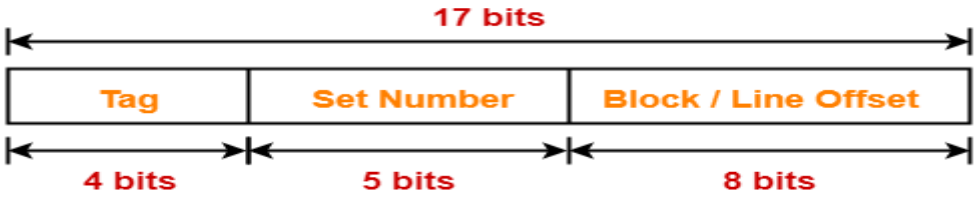
= Number of bits in physical address – (Number of bits in set number + Number of bits in block offset)

= 17 bits – (5 bits + 8 bits)

= 17 bits – 13 bits

= 4 bits

Thus, Number of bits in tag = 4 bits



Tag Directory Size-

Tag directory size

= Number of tags x Tag size

= Number of lines in cache x Number of bits in tag

= 64 x 4 bits

= 256 bits

= 32 bytes

Thus, size of tag directory = 32 bytes