Direct Mapping

In direct mapping,

- A particular block of main memory can be mapped to one particular cache line only.
- Block ‘j’ of main memory will map to line number (j mod number of cache lines) of the cache.
- There is no need of any replacement algorithm.

PRACTICE PROBLEMS BASED ON DIRECT MAPPING-

Problem-01:

Consider a direct 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-

- 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-

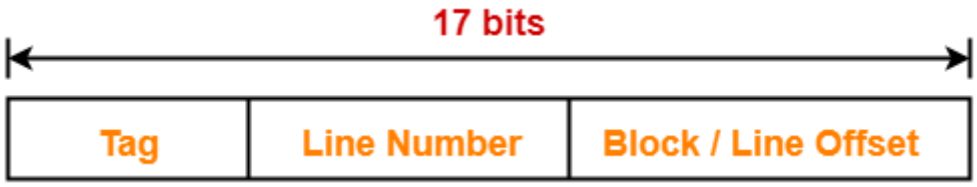
We have,

Size of main memory

= 128 KB

= 2^{17} bytes

Thus, Number of bits in physical address = 17 bits



Number of Bits in Block Offset-

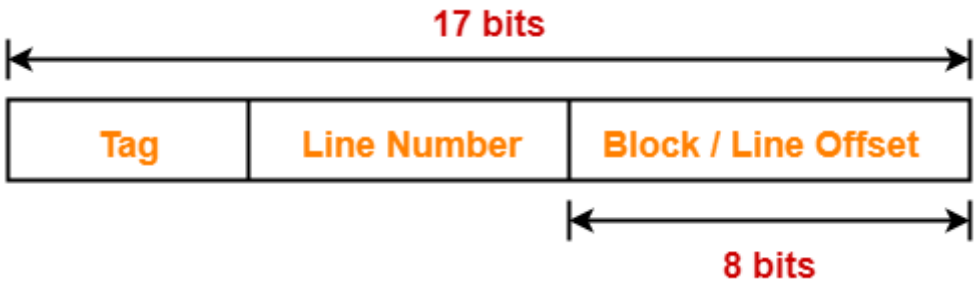
We have,

Block size

= 256 bytes

= 2^8 bytes

Thus, Number of bits in block offset = 8 bits



Number of Bits in Line Number-

Total number of lines in cache

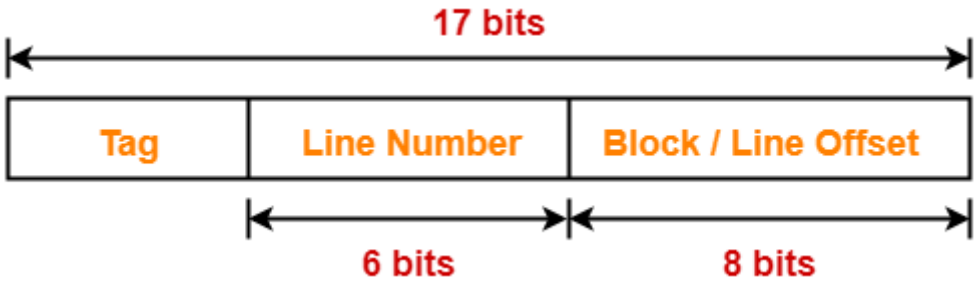
= Cache size / Line size

= 16 KB / 256 bytes

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

= 2^6 lines

Thus, Number of bits in line number = 6 bits



Number of Bits in Tag-

Number of bits in tag

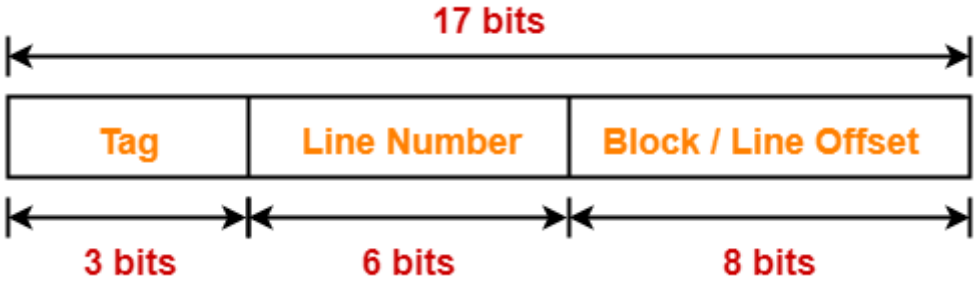
= Number of bits in physical address – (Number of bits in line number + Number of bits in block offset)

= 17 bits – (6 bits + 8 bits)

= 17 bits – 14 bits

= 3 bits

Thus, Number of bits in tag = 3 bits



Tag Directory Size-

Tag directory size

= Number of tags x Tag size

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

= 2^6 x 3 bits

= 192 bits

= 24 bytes

Thus, size of tag directory = 24 bytes