

Cache and Performance

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Ex1:

Maximum memory size 4GB = 2^{32} → 32 addresses bits

Block size 64 bytes = 2^6

- ⇒ Bits number of block offset : 6
- ⇒ Block number = $2^{(32-6)} = 2^{26}$

a)

Nr of lines = 128 kB / (1 x 64B) = 2048 = 2^{11}

- ⇒ Number of bits in index : 11
- ⇒ Number of bits in tag : 15

b)

Nr of lines = 128 kB / (2 x 64B) = 1024 = 2^{10}

- ⇒ Number of bits in index : 10
- ⇒ Number of bits in tag : 16

c)

Nr of lines = 128 kB / (8 x 64B) = 256 = 2^8

- ⇒ Number of bits in index : 8
- ⇒ Number of bits in tag : 18

Ex2 :

1)

Miss_Penalty_L3 = Main Memory Latency (DDR3-1600 CAS7) = 107

Miss_Penalty_L2 = Hit_Time_L3 + Miss_Rate_L3 x Miss_Penalty_L3

$$= 39 + 0.004 \times 107$$

$$= 39.428$$

Miss_Penalty_L1 = Hit_time_L2 + Miss_Rate_L2 x Miss_Penalty_L2

$$= 11 + 0.012 \times 39.428$$

$$= 11.473$$

AMAT_Nehalem = Hit_Time_L1 + Miss_Rate_L1 x Miss_Penalty_L1

$$= 4 + 0.029 \times 11.473 = 4.332$$

2/ Intel Penryn:

Miss_Penalty_L2 = main memory access = 160

$$\text{Miss_Penalty_L1} = \text{Hit_time_L2} + \text{Miss_rate_L2} \times \text{Miss_Penalty_L2}$$

$$= 15 + 0.004 \times 160 = 15.64$$

$$\text{AMAT_Penryn} = \text{Hit_Time_L1} + \text{Miss_Rate_L1} \times \text{Miss_Penalty_L1}$$

$$= 3 + 0.029 \times 15.64 = 3.453$$

Ex3:

Block number in sets	Referenced block							
	3	2	1	0	2	0	3	1
0				0	1	0	1	2
1			0	1	2	3	3	0
2		0	1	2	0	1	2	3
3	0	1	2	3	3	3	0	1

a) LRU : block 2

b) FIFO: block 3

Ex4:

Address: 0x8F3ED5 with bus 32 bits :

0000 0000 1000 1111 0011 1110 1101 0101

a)

Move it to the right 6 bits (block offset):

0000 0000 1000 1111 0011 1110 11

Or we can write in more appropriate way with 4 bits group: 0000 0000 0000 0010 0011 1100 1111 1011 = 0x23CFB = 146682

b)

Number of bits in tag : 18 → count 18 bits (from the left)

0000 0000 0000 0000 0000 0010 0011 1100 or 0x23C = 572

