Computer Architecture

CSE313/CSE 3313

Assignment 2

Section: **C**

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1. No Answer

size of cache = 1 KB

= 2^{10} Bytes

words per block = 2

$\therefore m = 1$

size of memory address = 32 bits.

a. number of block s = $\frac{2^{10}}{2 \times 2^2}$ = 2^7

$\therefore$ there are 2^7 blocks in cache.

b. 6:

Block address = $\left\lfloor \frac{6}{8} \right\rfloor = 0$

Block number = $0 \% 2^7 = 0$

$(0 \times 8) - (0 \times 8 + 8 - 1)$

0 - 7 (copied)

$\therefore$ miss

11:

Block address = $\left\lfloor \frac{11}{8} \right\rfloor = 1$

Block number = $1 \% 2^7 = 1$

$[1 \times 8] - [1 \times 8 + (8-1)]$

8 - 15 (copied)

$\therefore$ miss

31:

Block address $= \left\lfloor \frac{31}{8} \right\rfloor = 3$

Block number $= 3 \% 2^7 = 3$

[3x8] - [3x8+(8-1)]

24 - 31 (copied)

miss

1027:

Block address $= \left\lfloor \frac{1027}{8} \right\rfloor = 128$

Block number $= 128 \% 2^7 = 0$

1024 - 1031 (replaced)

Miss

5:

Block address: $\left\lfloor \frac{5}{8} \right\rfloor = 0$

Block number: ~~[287.~~ $0 \% 2^7 = 0$

0 - 7 (replaced)

Miss

12:

Block address: $\left\lfloor \frac{12}{8} \right\rfloor = 1$

Block number: $1 \% 2^7 = 1$

8-15

Hit

4:

Block address: $\left\lfloor \frac{4}{8} \right\rfloor = 0$

Block number: $0 \% 2^7 = 0$

0 - 7

Hit

$\therefore$ Hit rate $= \frac{2}{8} = \frac{1}{4}$

c. We know,

$n = 7$

$m = 1$

$\therefore$ offset $= m + 2 = 3$

tag bits $= 16 - (n + m + 2) = 16 - 7 + 1 + 2$

$= 6$ bits

d. Words per block $= 8 = 8 \times 4$ bytes

$= 32$ bytes

6: Block address $= \left\lfloor \frac{6}{32} \right\rfloor = 0$

Block number $= 0 \% 2^7 = 0$

0 - 31 (Miss and copied)

11: Block address $= \left\lfloor \frac{11}{32} \right\rfloor = 0$

Block number $= 0 \% 2^7 = 0$

0 - 31 (Hit)

31: Block address $= \left\lfloor \frac{31}{32} \right\rfloor = 0$

Block number $= 0 \% 2^7 = 0$

0 - 31 (Hit)

1027:

Block address $= \left\lfloor \frac{1027}{32} \right\rfloor = 32$

Block number $= 32 \,\%\, 2^7 = 32$

1024 - 1055 (Miss and copied)

5:

Block address $= \left\lfloor \frac{5}{32} \right\rfloor = 0$

Block number $= 0 \,\%\, 2^7 = 0$

0 - 31 (Hit)

1032:

Block address $= \left\lfloor \frac{1032}{32} \right\rfloor = 32$

Block number $= 32 \,\%\, 2^7 = 32$

1024 - 1055 (Hit)

12:

Block address $= \left\lfloor \frac{12}{32} \right\rfloor = 0$

Block number $= 0 \,\%\, 2^7 = 0$

0 - 31 (Hit)

4:

Block address $= \left\lfloor \frac{4}{32} \right\rfloor = 0$

Block number $= 0 \,\%\, 32 = 0$

0 - 31 (Hit)

Miss rate $= \frac{2}{8} = \frac{1}{4}$

Miss rate for 2 words per block $= \frac{6}{8} = \frac{3}{4}$

So, we can say, by extending words per block we have reduced miss rate.

2. No. Answer

a) bits for index, $n = 32$

$\therefore$ numbers of blocks $= 2^{32}$

bits for offset $= 18$

$\therefore m = 18 - 2 = 16$

$\therefore$ bytes per block $= 2^{16} \times 4 = 2^{18}$

b)

actual size of cache $= 2^n \times [2^m \times 32 + 64 - (n+m+2) + 1]$

$= 2^{32} \times [2^{18} \times 32 + 64 - (32+16+2) + 1]$

$= 2^{32} (2^{23} + 15)$ bits

$= \frac{2^{32}(2^{23}+15)}{2^{23}}$ KB

$= 2^9 (2^{23}+15)$ KB

$= 4 \times 2.29 \times 10^9$ KB