

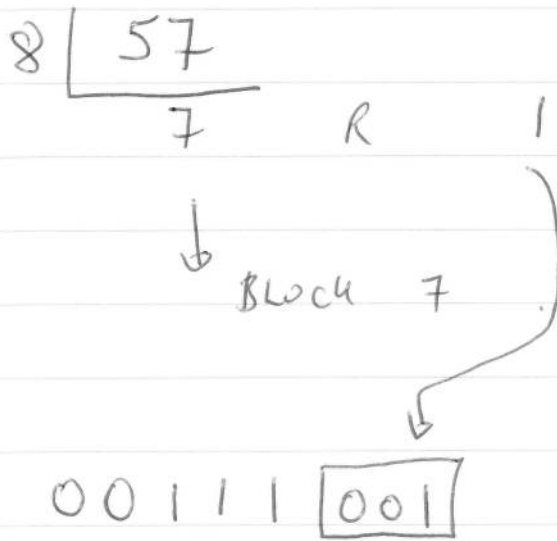
①

CACHE

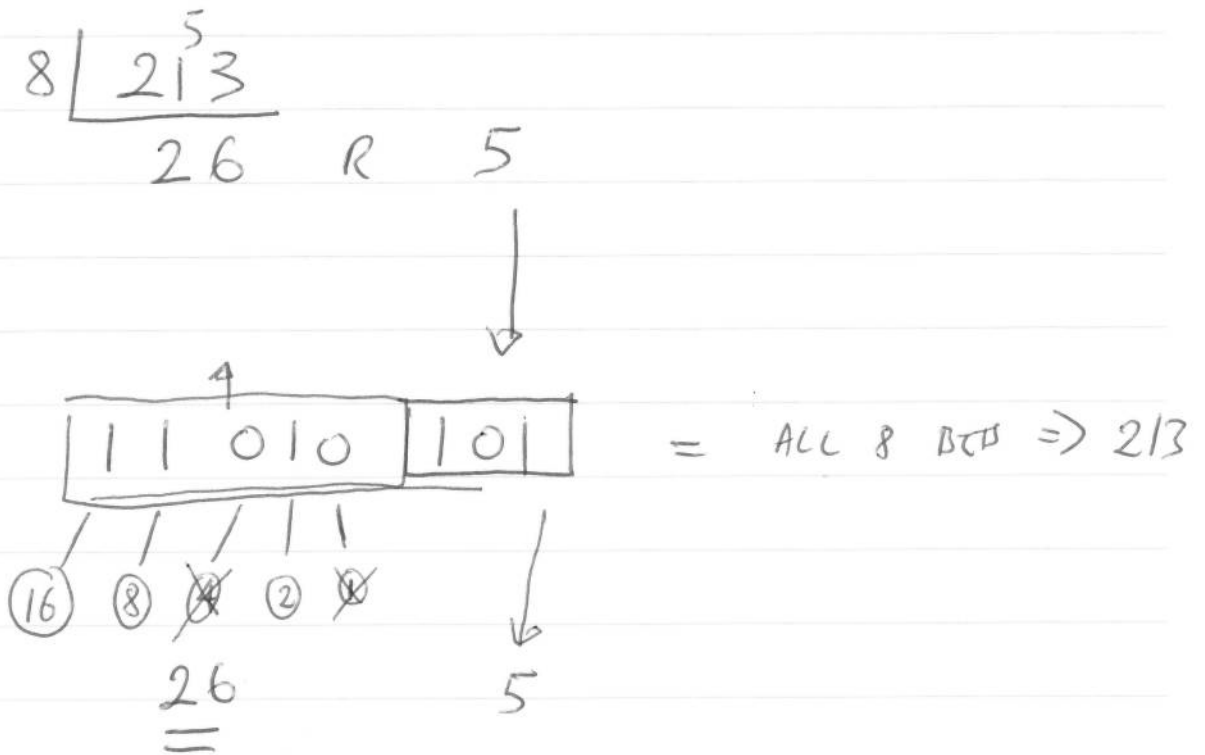
STORAGE HIERARCHY / MEMORY HIERARCHY



(2)



CONVERT ADDRESS 213 TO BINARY USING TABLE.



(3)

What does cache look like?

(ASSUMING 8 CACHE LINES)

INDEX	VALID BIT	TAG	DATA
000	0		
001	0		
→ 010	1	11	Byte 208 209 210 211 212 213 214 215
011	0		
100	0		
101	0		
110	0		
111	0		

ADDRESS TAG INDEX BYTE OFFSET
213: 11:010:101

Block 26 RAM = copied to Block 2 (010) CACHE LINE 2

NOT JUST CONTENTS OF ADDRESS 213 THAT GETS COPIED FROM RAM TO CACHE WHICH OTHER BYTES GET COPIED?

		(4)
208:		0 0 0
209:		0 0 1
210:		0 1 0
211:		0 1 1
212:		1 0 0
213:	1 1 0 1 0	1 0 1
214:		1 1 0
215:		1 1 1

↑

↓

Bytes 208 through to 215 are copied.

These are all in block 26

①

CACHE

The cache we have looked at is
a Direct Mapped Cache

	000	001	010	<u>BLOCKS</u> 011	100	101	110	111
<u>CACHE</u>	0	1	2	3	4	5	6	7

	TAG	BLOCKS							
MAIN	0	0	1	2	3	4	5	6	7
MEMORY	1	8	9	10	11	12	13	14	15
	2	16	17	18	19	20	21	22	23
	3	24	25	<u>26</u>	27	28	29	30	31

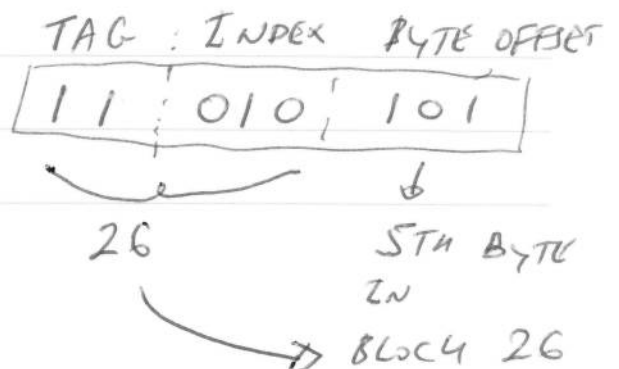
SHIFT "The boundary between the tag and the cache line index" one place to the right

DOUBLE THE NO. OF TAGS

HALVE THE NO. OF CACHE LINES

e.g. Address 81213 e.g. Address 213

26 R 5
↑
BLOCK



(2)

Address e.s.

T , I , B
1 1 0 1 0 1 0 1

→ 1 PLACE TO RIGHT

T , I , B
1 1 0 1 0 1 0 1

CACHE

(3)

DIRECT MAPPED CACHE

	VALID BIT	TAG	DATA
000			
001			
010			
011	1		BLOCK 7 BLOCK 11
100			BLOCK 4
101			
110			
111			

TWO WAY SET ASSOCIATIVE

	VALID BIT	TAG	DATA	VALID BIT	TAG	DATA
00						
01			BLOCK 5			BL. 4
10			BLOCK 6 BLOCK 6			BLOCK 6
11						

CACHE 0 1 2 3 4 5 6 7

RAM	TAG	0	1	2	3	4	5	6	7
0		0	1	2	3	4	5	6	7
1		8	9	10	11	12	13	14	15
2		16	17	18	19	20	21	22	23
3		24	25	26	27	28	29	30	31

CACHE

CACHE 0 1 2 3

RAM	0	1	2	3
0	0	1	2	3
1	4	5	6	7
2	8	9	10	11
3	12	13	14	15
4	16	17	18	19
5	20	21	22	23
6	24	25	26	27
7	28	29	30	31

ADDRESS	TAG	INDEX	BYTE OFFSET
	2 BITS	3 BITS	3 BITS

TAG	
0	00
1	01
2	10
3	11

ADDRESS	TAG	INDEX	BYTE OFFSET
	3 BITS	2 BITS	3 BITS
TAG	0 000		
	...		
	7 111		

④

Consider things in blocks!

e.g.

Assuming: 8 bytes/block.

Block no.

ADDRESSES IN RAM

5

~~000~~

$5 \times 8 = 40 \dots 47$

1

$1 \times 8 = 8 \dots 15$

17

$17 \times 8 = 136 \dots 143$

DIRECT MAPPED

TWO WAY SET ASSOC.

TAG 00

TAG 001

INDEX 101

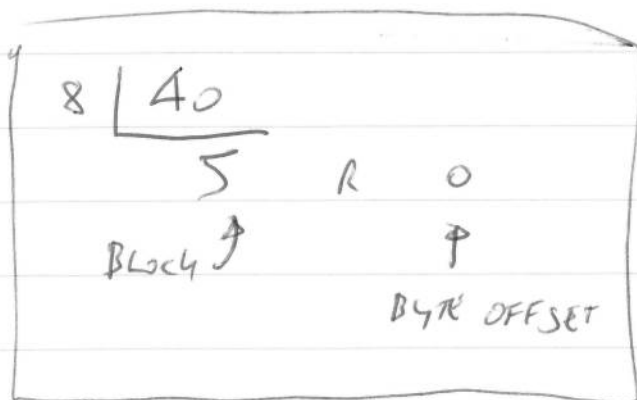
INDEX 01

BYTE OFFSET 000

BYTE OFFSET 000

00101000

00101000



5

32 BIT ADDRESS

TAG	INDEX	BYTE OFFSET
19 19	10	3

