CURS 10 — 7.05.2019

3.3. Set-associative mapping

$M_2(0), M_2(1) \dots M_2(j) \dots M_2(2^m - 1)$

$M_1(0), M_1(1) \dots M_1(i) \dots M_1(2^n - 1)$, $m < n$ } blocuri din memoria principala

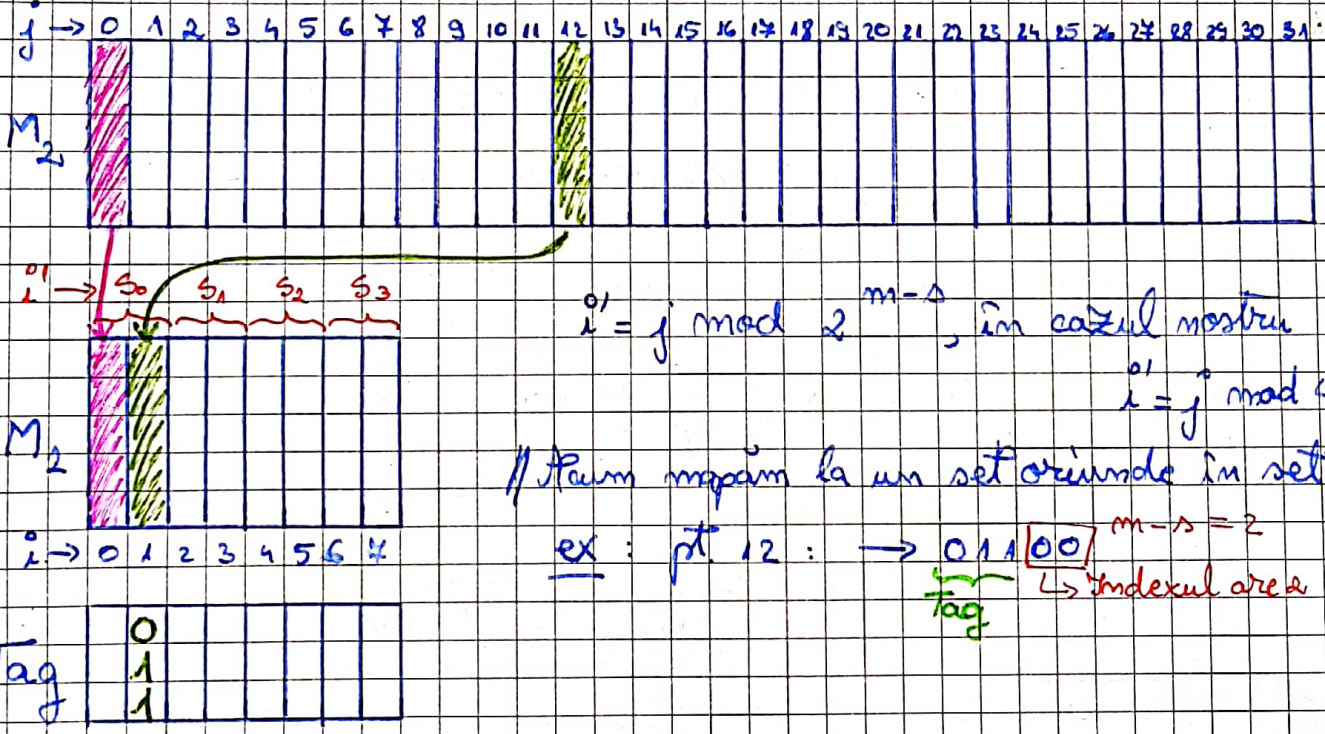
k-way set associative mapping

$k = 2^s$

$M_1'(0), M_1'(1), \dots M_1'(i') \dots M_1'(2^{m-s} - 1)$

Maparea se face: $i' = j \bmod 2^{m-s}$, $m' = m - s$

Example 1: $m = 3$; $n = 5$; $s = 1$ => M_2 : 32 blocuri



$i' = j \bmod 2^{m-s}$, in cazul nostru $i' = j \bmod 4$

// Facem mapam la un set oriunde in set

ex: pt 12: → 011 [00] $m - s = 2$ ↳ Indexul are 2 biti

Tag

Example 2: 2^{24} words - main memory (MM)

1 word = 1 B

1 block = 4 Kwords

Acasa: 2^{24} words = 2^{24} B = $\underbrace{2^4}_{16} \cdot 2^{20}$ B = 16 MiB ↳ mega

Address	M_2				Block number
0	0	1	2	3	0
4	4	5	6	7	1
8					2
12					3
≈					≈
4092					1023
4096					1024
4100	2715				1025
≈					≈
8188					2047
8192	230				2048
≈					≈
12284					3071
12288					3072
12292	170				3073
≈					≈
$2^{29}-4$					$2^{27}-1$

@ Address Code (de la ex. trecute)

8192 → 230
4100 → 2715
12292 → 170

} cu codificările ⊛ (cu 2 pagini mai înainte)

Cache : 1k-block

Cache size = 2^{10} blocks

Cache - 2 way Set Association (SA)

Index values = $\frac{2^{10}}{2^1} = 2^9$

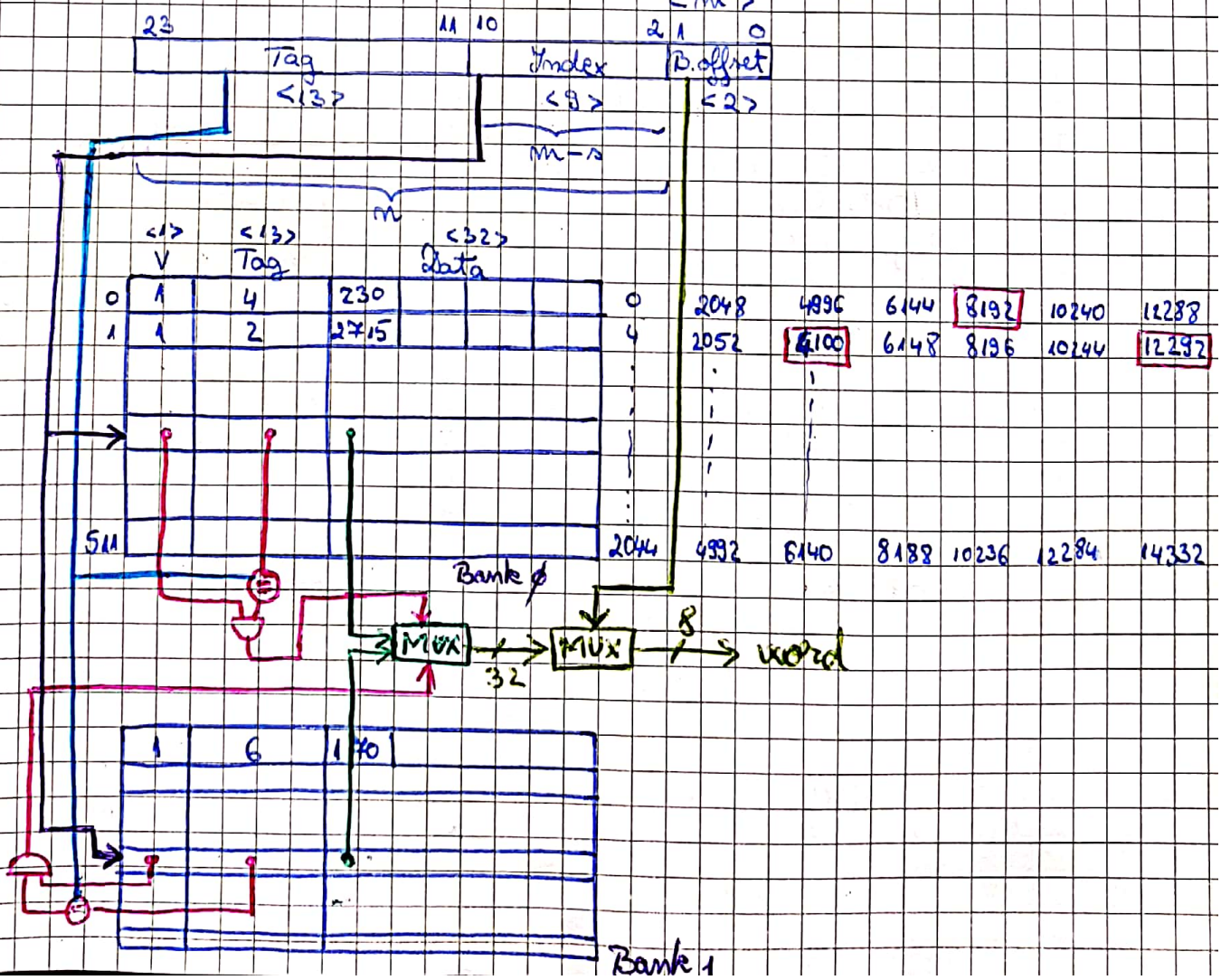
↑ set associativity

DM Address (Direct Mapping)

Tag	Index	B.offset	W.offset
<m-m'>	<m'>	<p>	<r>

2^s k-way SA Add.

Tag	Index	B.offset	W.offset
<m-m'+s>	<m'-s>	<p>	<r>



Example 3 : 4 - way SA

8 - sets

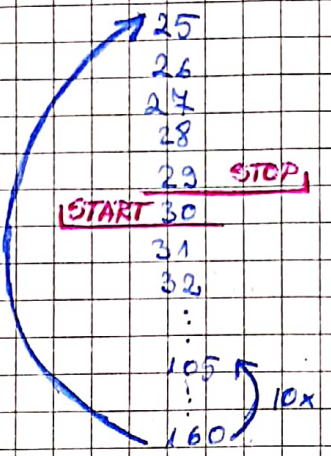
1 block = 4 words

Cache initially empty

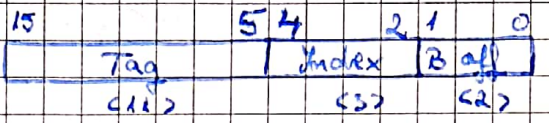
1 word = 1 byte

MM size = 2^{16} words

Instruction cache : $\frac{2^{16}}{2^2} = 2^{14}$ blocks



Address word format?



Saltul la instrucțiune se face de 10 ori. Care este Hit rate?

Bazându-ne pe tabelul de pe pagina următoare, obținem:

	V	Tag	Date
0	1	1	32 - 35
1	1	1	36 - 39
2	1	1	40 - 43
3	1	1	44 - 47
4	1	1	48 - 51
5	1	1	52 - 55
6	1	~~1~~ 0	~~56 - 59~~ 24 - 27
7	1	~~0~~	~~28 - 31~~ 156 - 159

Block 0

	V	Tag	Date
0	1	3	96 - 99
1	1	3	100 - 103
2	1	3	104 - 107
3	1	3	108 - 111
4	1	3	112 - 115
5	1	3	116 - 119
6	1	3	120 - 123
7	1	2	92 - 95

Block 2

$\begin{pmatrix} 1M \\ 1H \end{pmatrix} \begin{pmatrix} 1M \\ 3H \end{pmatrix} \times 32 \begin{pmatrix} 1M \\ 0H \end{pmatrix}$

$\begin{pmatrix} 0M \\ 360H \end{pmatrix} \cdot \begin{pmatrix} 1M \\ 2H \end{pmatrix} \begin{pmatrix} 1M \\ 1H \end{pmatrix}$

	V	Tag	Date
0	1	2	64 - 67
1	1	2	68 - 71
2	1	2	72 - 75
3	1	2	76 - 79
4	1	2	80 - 83
5	1	2	84 - 87
6	1	2	88 - 91
7	1	~~1~~	~~60 - 63~~
		0	28 - 31

Block 1

	V	Tag	Date
0	1	4	128 - 131
1	1	4	132 - 135
2	1	4	136 - 139
3	1	4	140 - 143
4	1	4	144 - 147
5	1	4	148 - 151
6	1	4	152 - 155
7	1	3	124 - 127

Block 3

$\begin{pmatrix} 36M \\ 661H \end{pmatrix}$

$\Rightarrow$ Hit rate $= \frac{661}{607} \approx 95\%$

M_2

Address	Block index
0 - 3	0
4 - 7	1
8 - 11	2
12 - 15	3
16 - 19	4
20 - 23	5
24 - 27	6
28 - 31	7
32 - 35	8
36 - 39	9
40 - 43	10
44 - 47	11
48 - 51	12
52 - 55	13
56 - 59	14
60 - 63	15
64 - 67	16
68 - 71	17
72 - 75	18
76 - 79	19
80 - 83	20
84 - 87	21
88 - 91	22
92 - 95	23
96 - 99	24
100 - 103	25
104 - 107	26
108 - 111	27
112 - 115	28
116 - 119	29
120 - 123	30
124 - 127	31
128 - 131	32
132 - 135	33
136 - 139	34
140 - 143	35
144 - 147	36
148 - 151	37
152 - 155	38
156 - 159	39
160 - 163	40