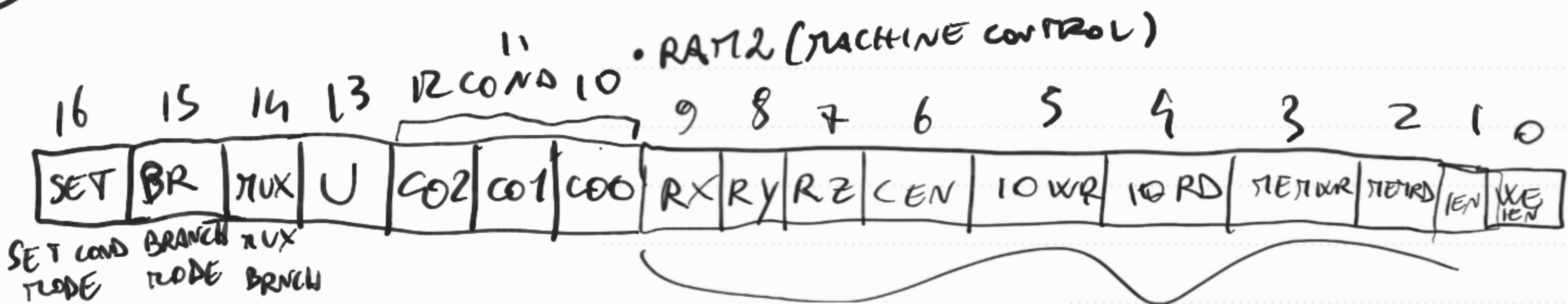
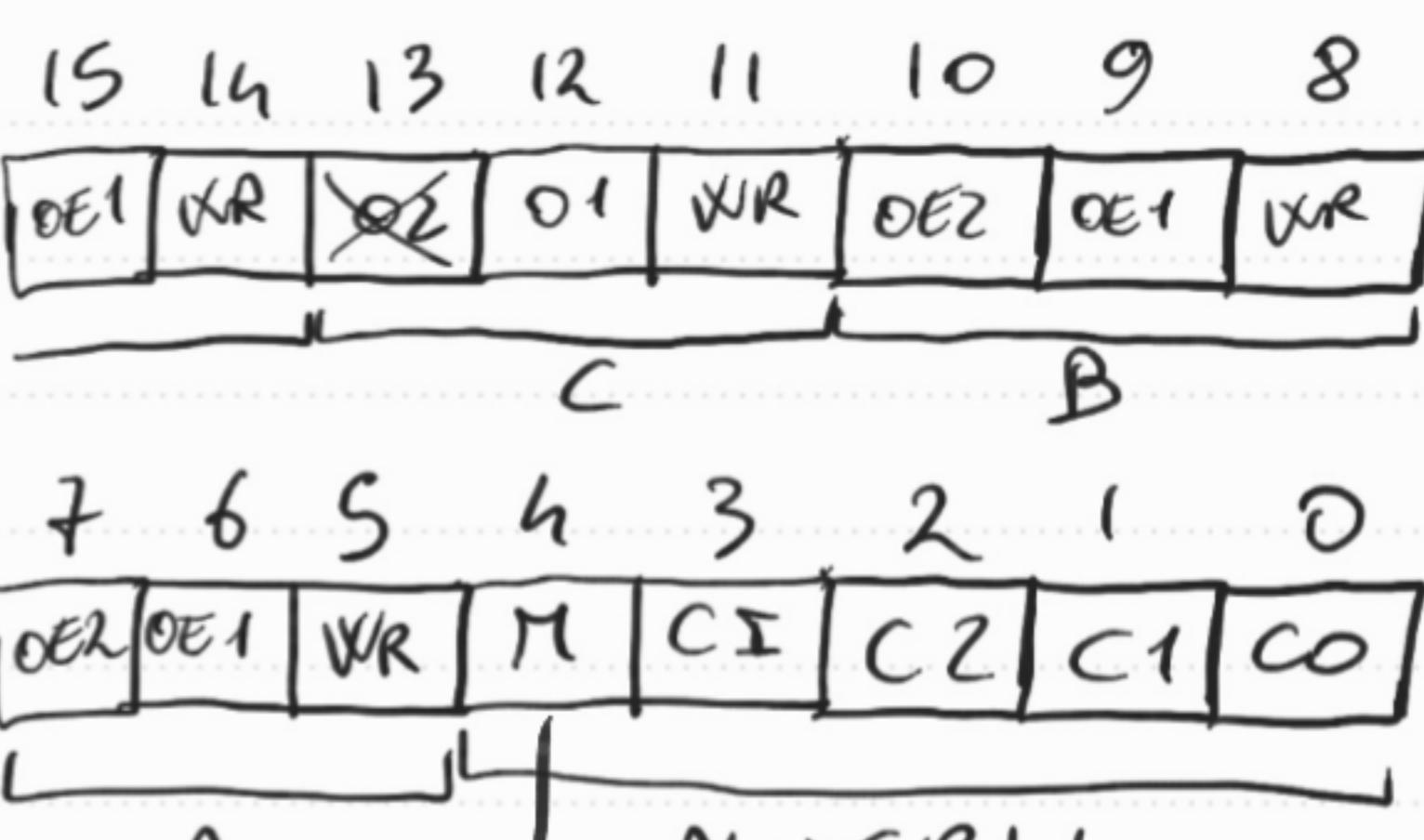
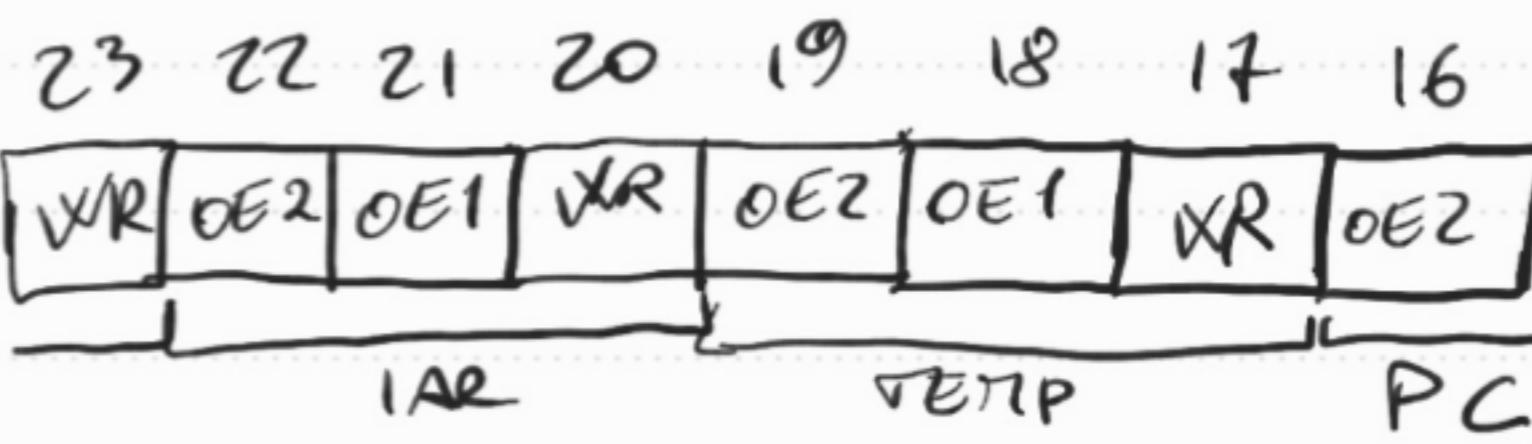
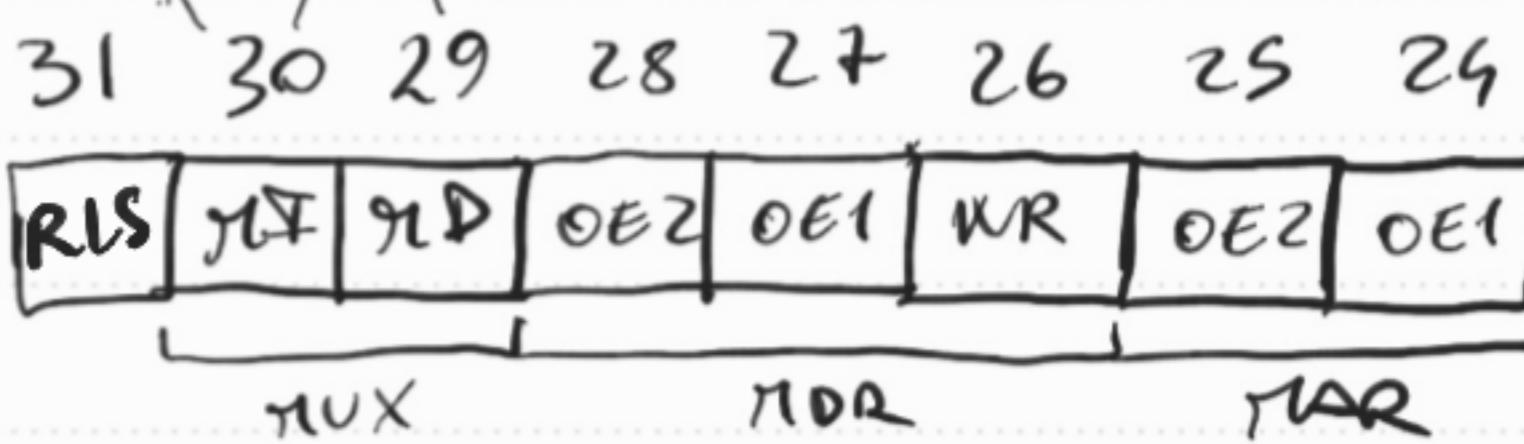


# ① CODIFICATION

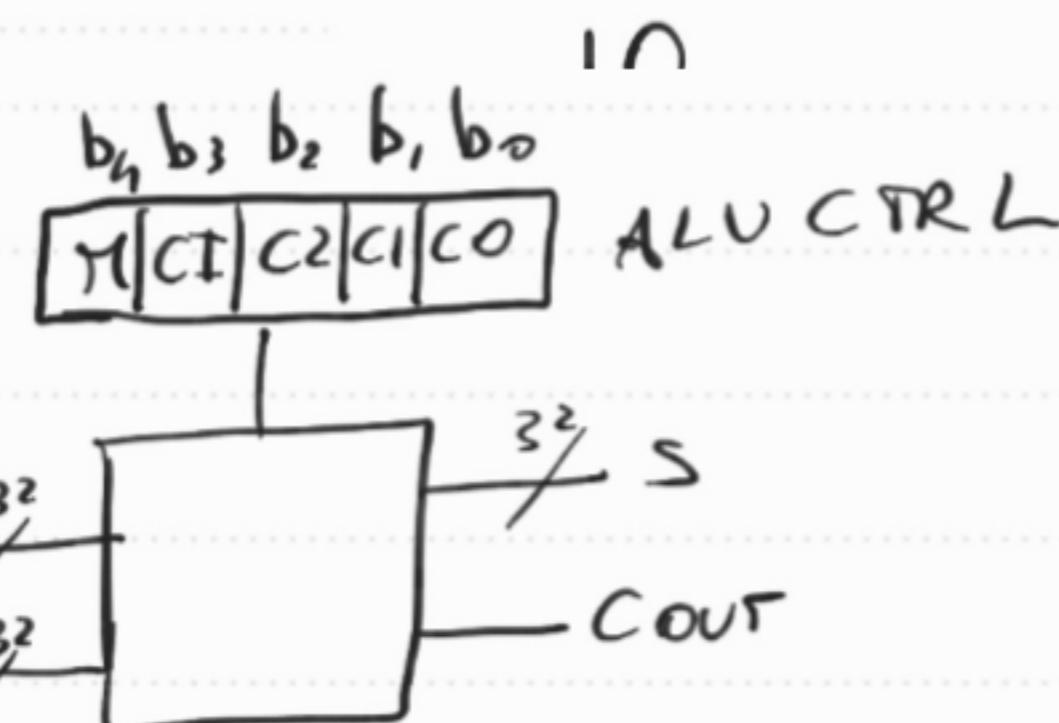


## • RAR 1 (MACHINE CODE)

0=AR 1=PC 0=DALI  
1=INTERNAL



$\circ = \text{active}$ ,  $\circ = \text{disactive}$

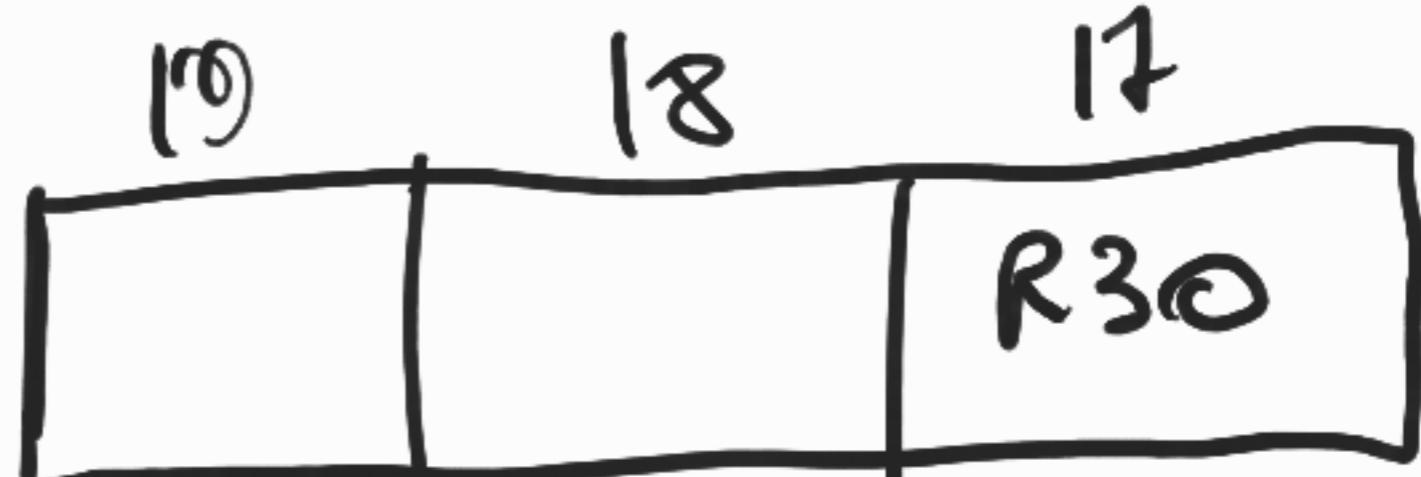


ALU CTRL       $M = \times \oplus$        $M = X$       1

mod. logic

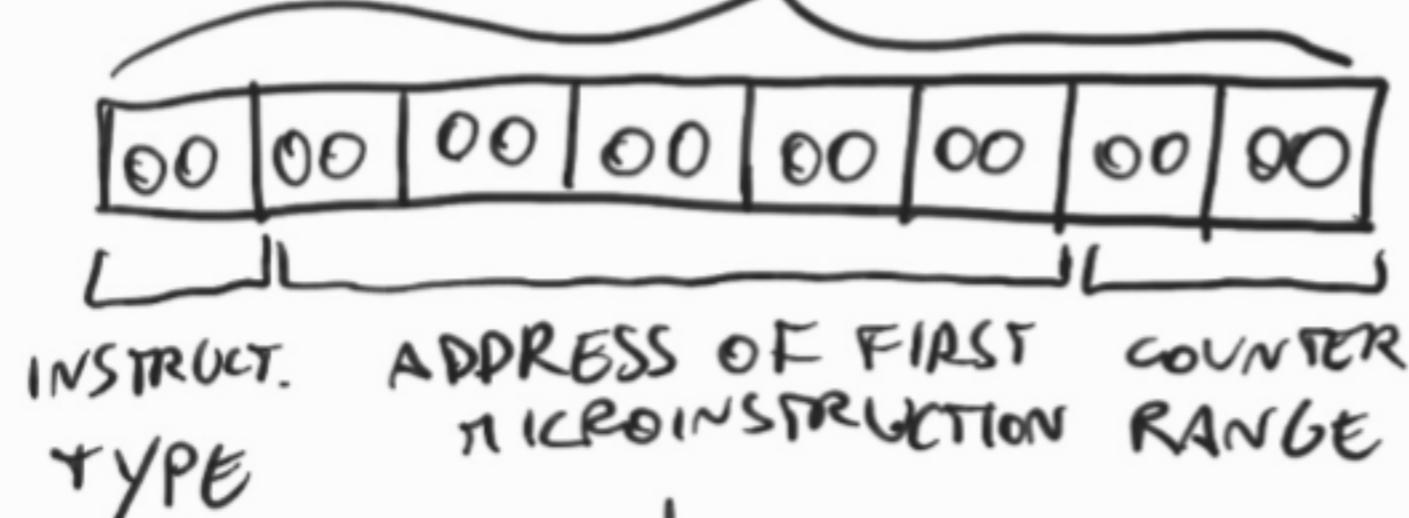
$C_2 C_1 C_0$	$CI = 0$	$CI = 1$	$CI = \text{IND.}$
0 0 0	$X + Y$	$X + Y + 1$	$X \oplus Y$
0 0 1	$X - Y - 1$	$(X - Y)$	$X \oplus Y'$
0 1 0	X	$X + 1$	X
0 1 1	$X - 1$	X	$X'$
1 0 0	Y	$Y + 1$	Y
1 0 1	$-Y - 1$	$-Y$	$Y'$
1 1 0	0	1	0000
1 1 1	-1	0	1111

## RAR 2



## πEM 2 (COP πEMORY)

16

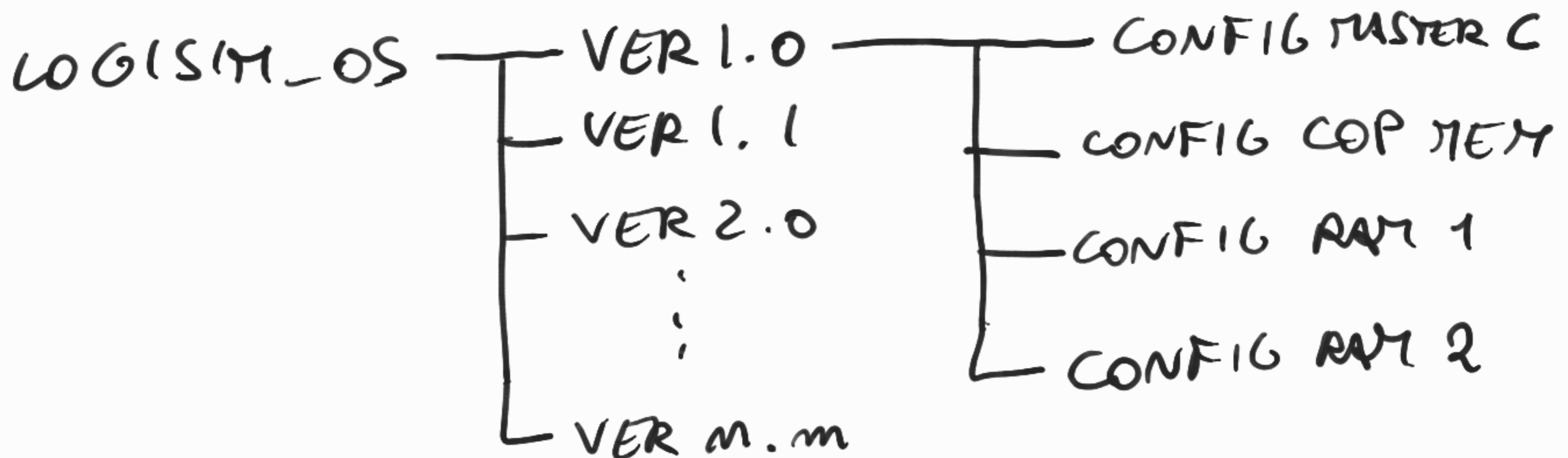




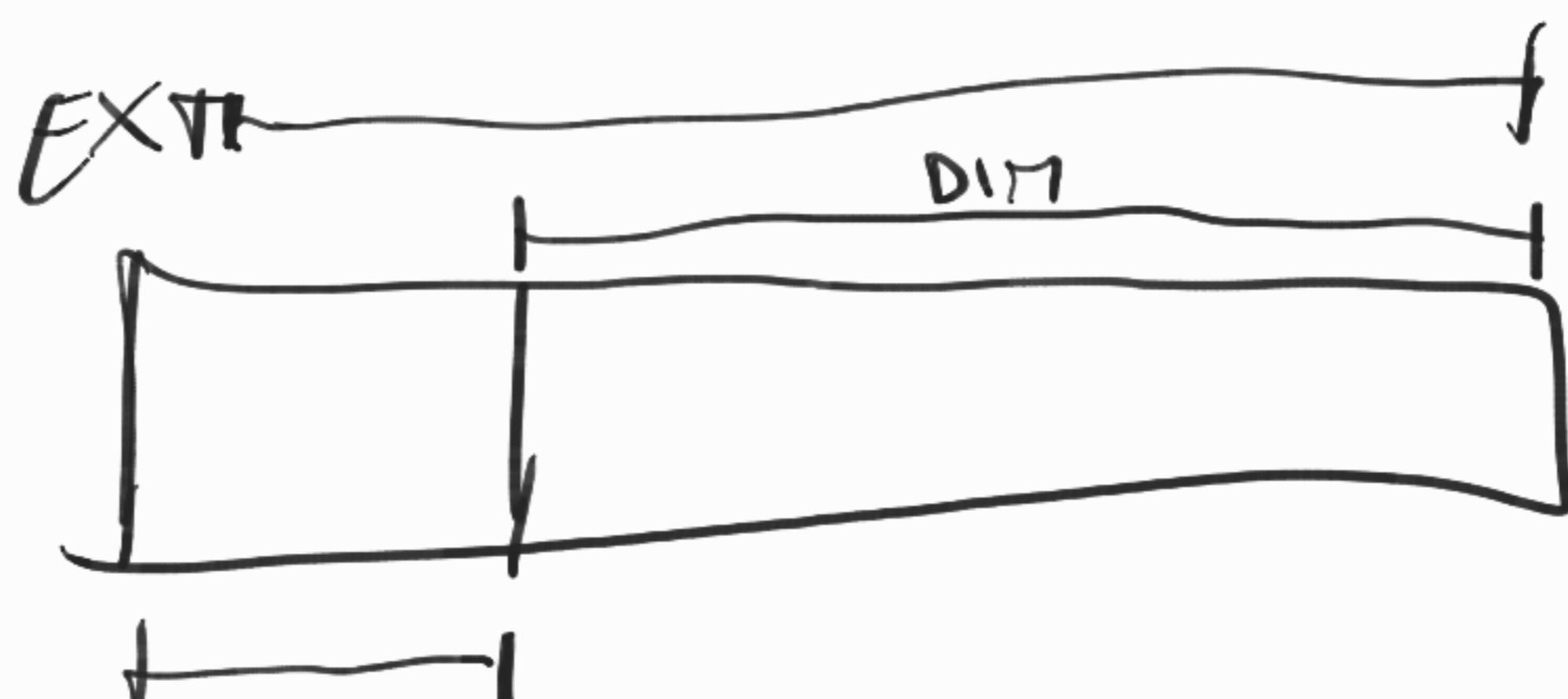
- INSTRUCT. TYPE : 00 → R [COP] / / / /
- 01 → I [COP] / / /
- 11 → J [COP] / / /
- ADDRESS - RISERVATI : 0000000000 (per FETCH)  
0000000001 (per ID)

## 2) OS (operating system)

Cortelle :



- NAME



3) MATLAB

• Groot tool è interfaccia di lavoro.

• BIN → HEX (FUNZIONE)

formattato per  
il formato corretto  
dello utile

a) RTL → LINGUAGGIO MACCHINA

excel → RTL



MATRIX → LING. MACCHINA

RTB

	REG. ARRIVO	REG. PARTENZA	DEA	DEC.	.	.	.
	col 1	col 2					
r1	C	A					
r2	IR	MPC					
.	MDR	MAR					

CONT. MAT

FOR  $i = 1 : \dots$

IF( $i == 1$ ) { // REG. POSI

FOR  $j = 1 : \dots$

$Q = \text{MAT}(i, j)$

SWITCH CASE: Q

CASE "A"

$\text{MATB}(i, 16) = 1$  (sono tutti zero  
ma solo quello che mi serve)

CASE TORAR

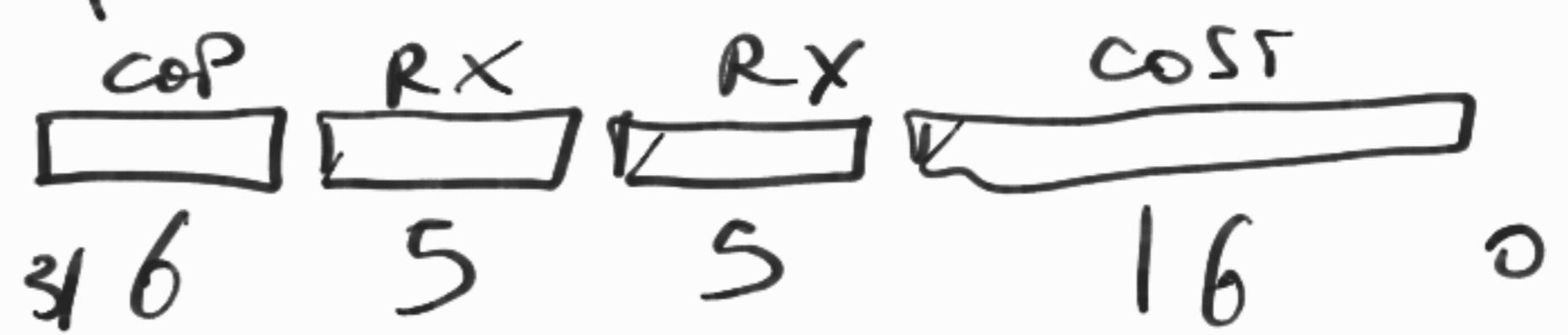
$\text{MATB}(i, 15) = 1$

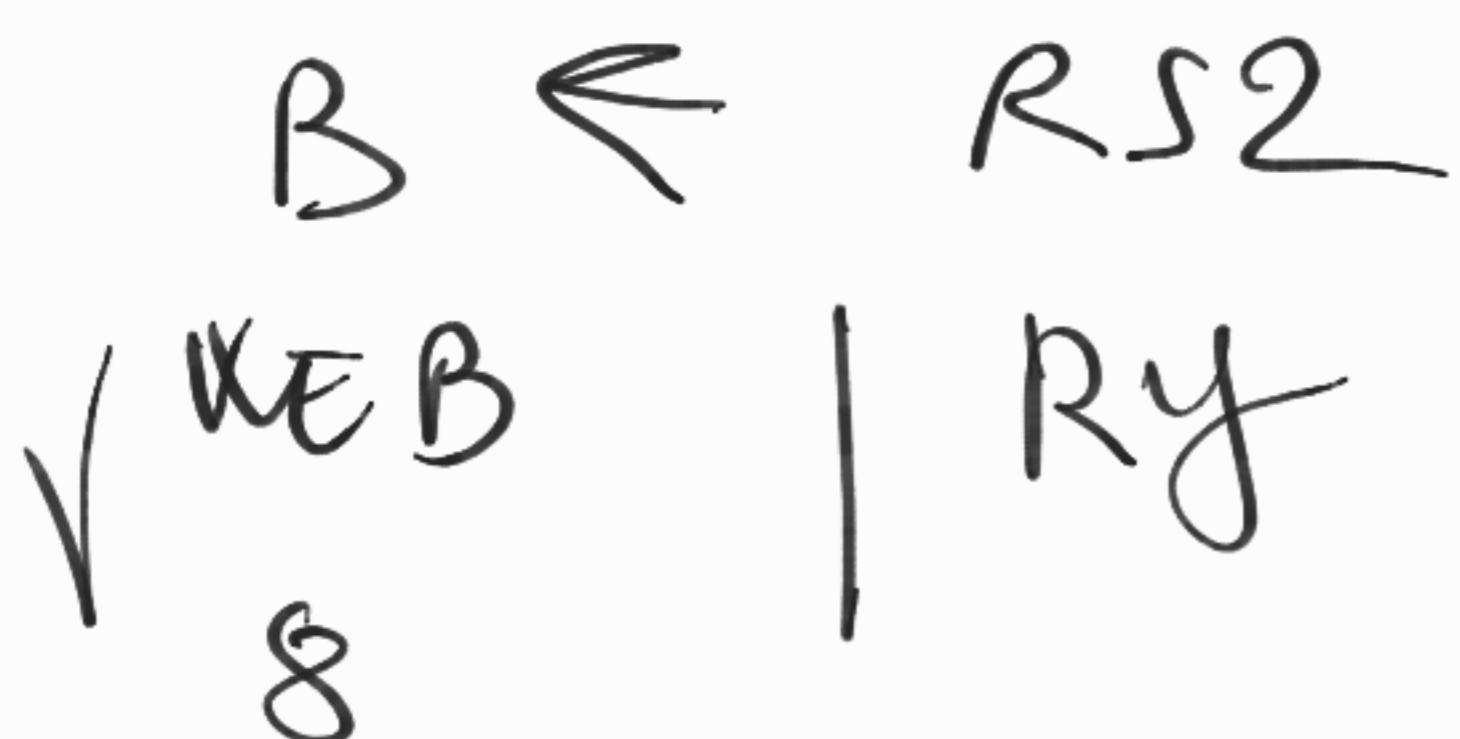
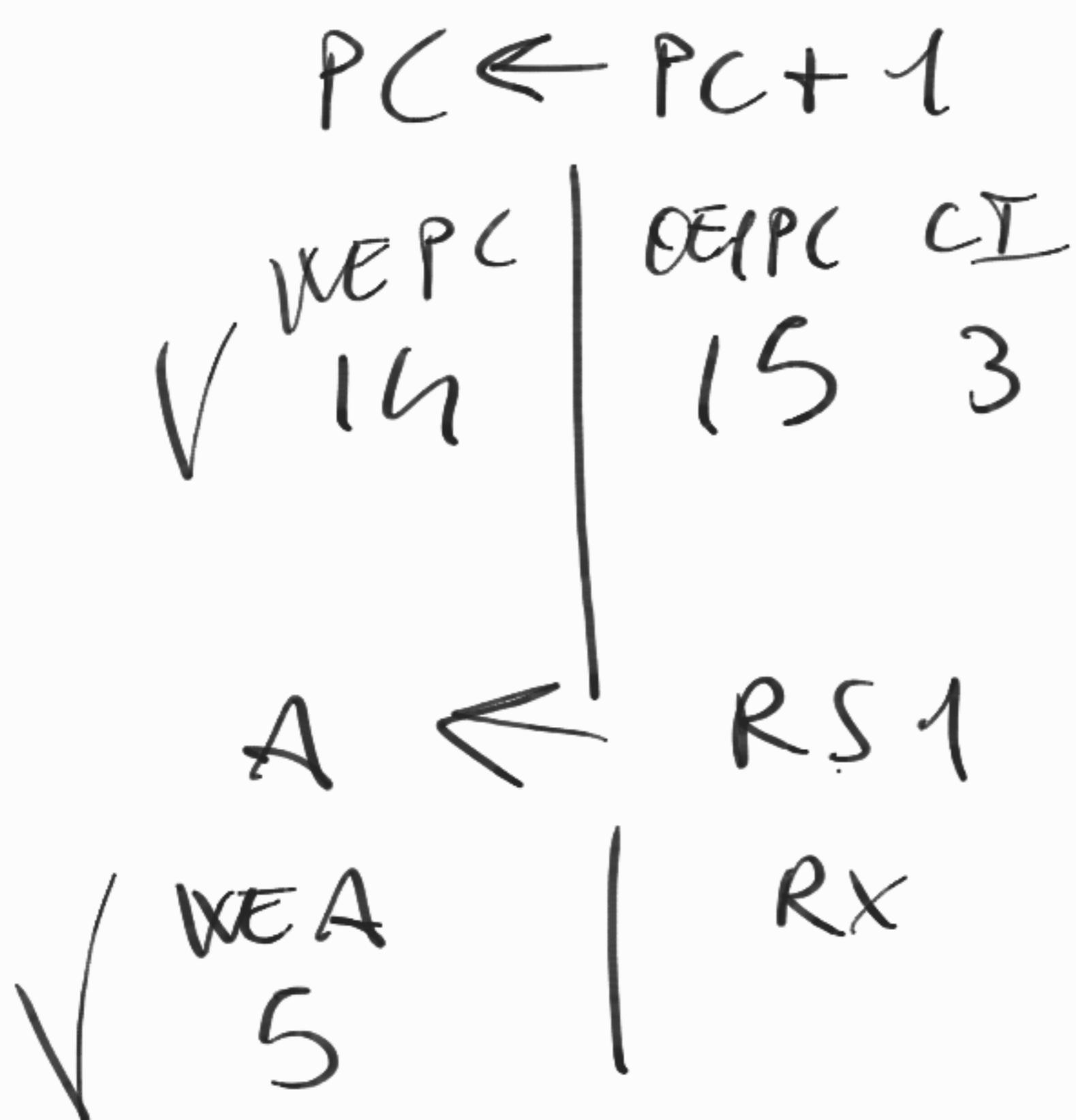
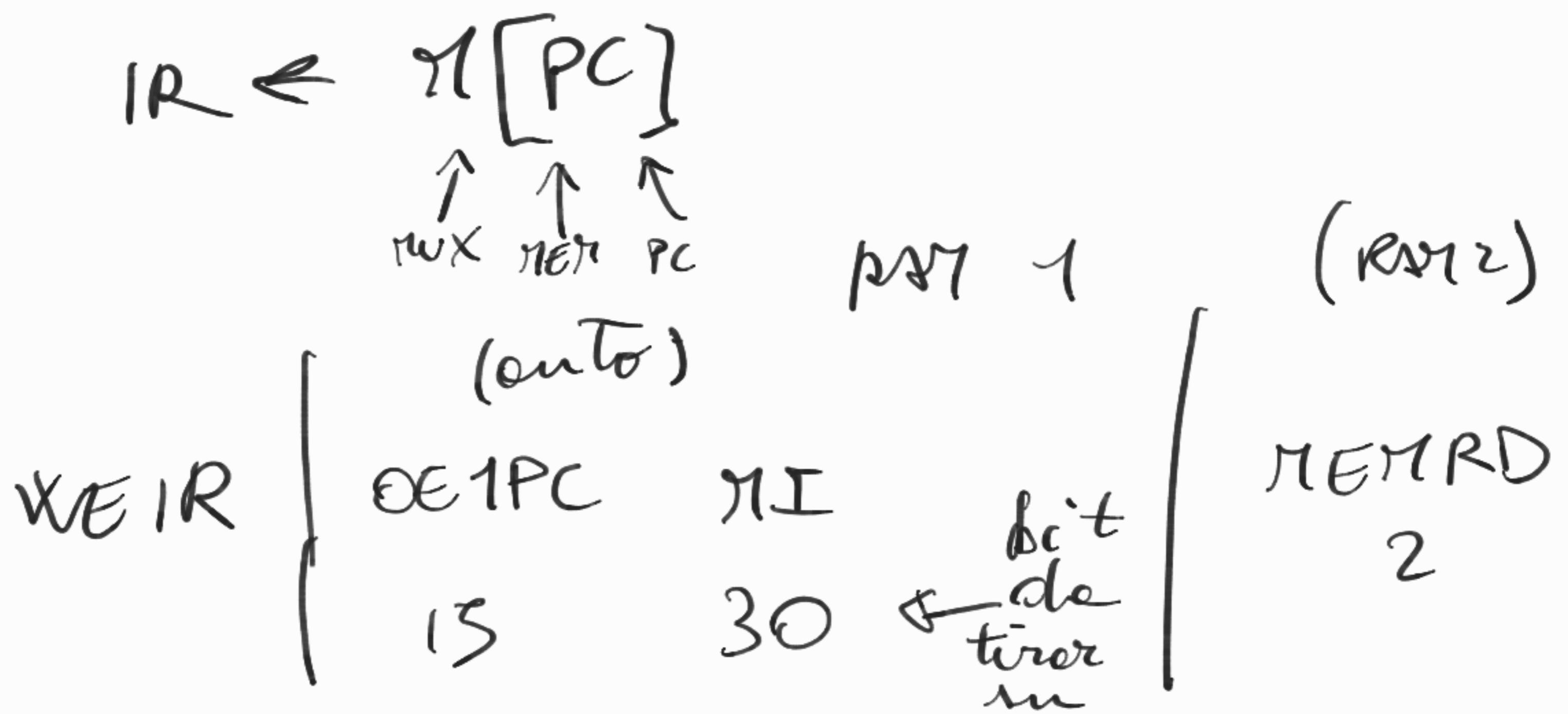
$\text{MATB}(i, 17) = 1$

$\vdots$   
 $\vdots$

IF( $i == 2$ ) {

2 9  
10,1001





8	0
4	0
2	0
1	1

$\dim = 8$

2 1 2 3 4 5 6 7 8

1 7 6 5 4 3 2 1 0

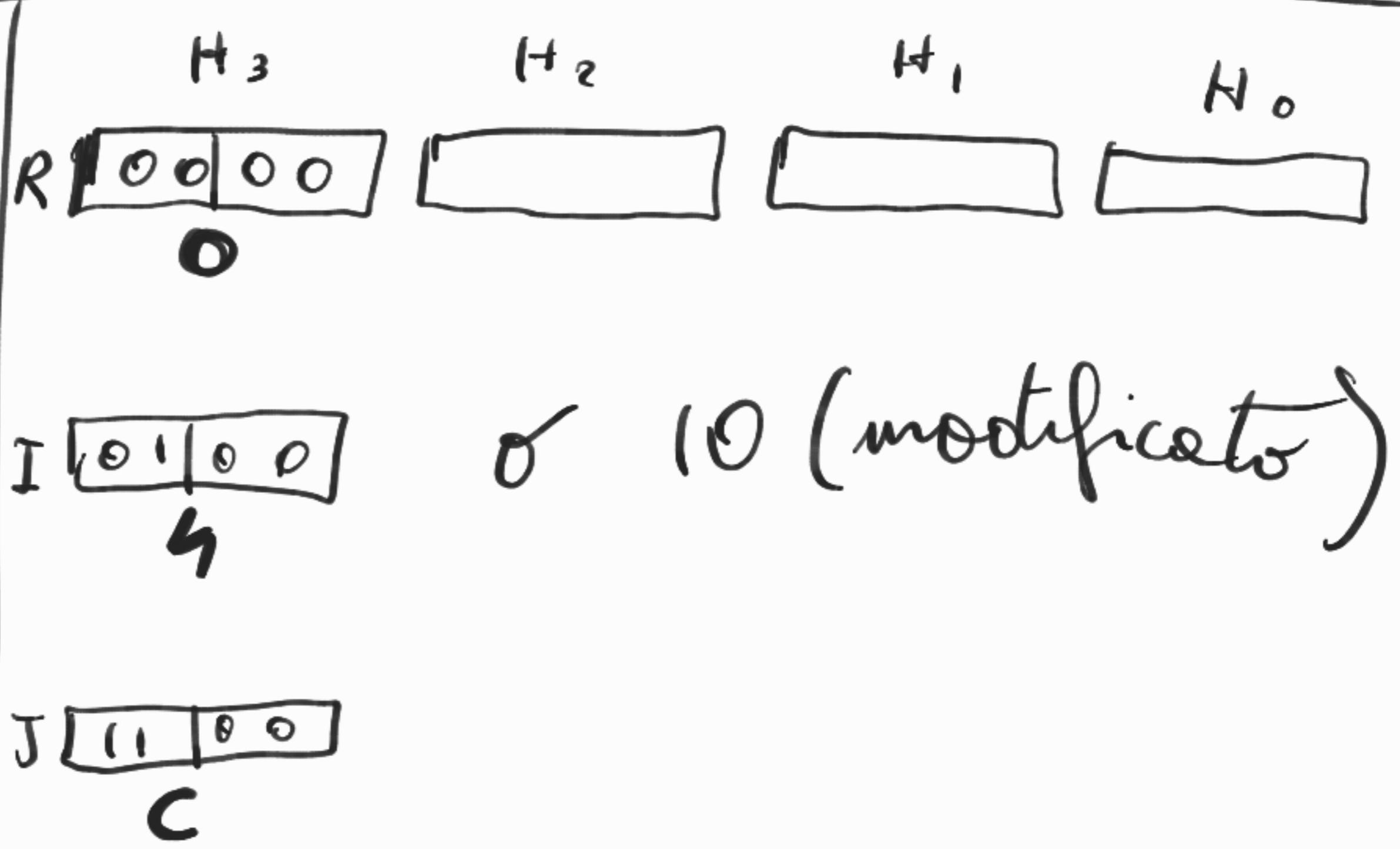
$$P_1 = D(M) - P_2$$



$$P_2 = D(M) - P_1$$

$a + b$

DE1A DE2b



ADP

DATA

- 0 IR  $\leftarrow \#PC$
- 1 PC  $\leftarrow PC + 1$ , A  $\leftarrow RS1$ , B  $\leftarrow RS2$
- 2 TEMP  $\leftarrow B$
- 3 C  $\leftarrow A + TEMP$
- 4 RD  $\leftarrow C$
- 5 TEMP  $\leftarrow B$
- 6 C  $\leftarrow A - TEMP$
- 7 RD  $\leftarrow C$

H<sub>3</sub>      H<sub>2</sub>      H<sub>1</sub>      H<sub>0</sub>  
0      0      2      2  
↓  
tipi di istruzione      ind. nella rot  
↓  
tempo di wait

0      0      5      2  
(S) + time exec

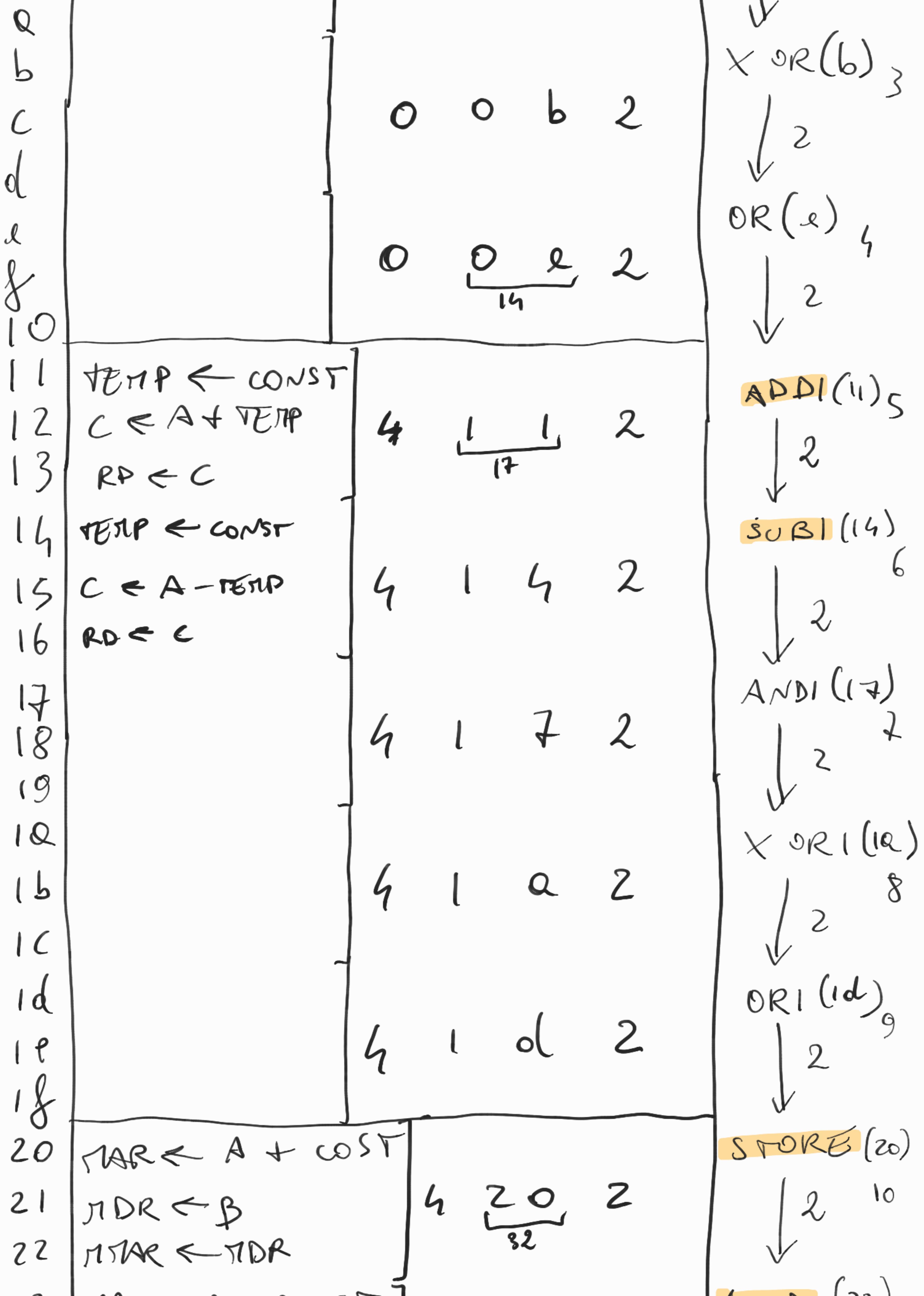
IF

ID

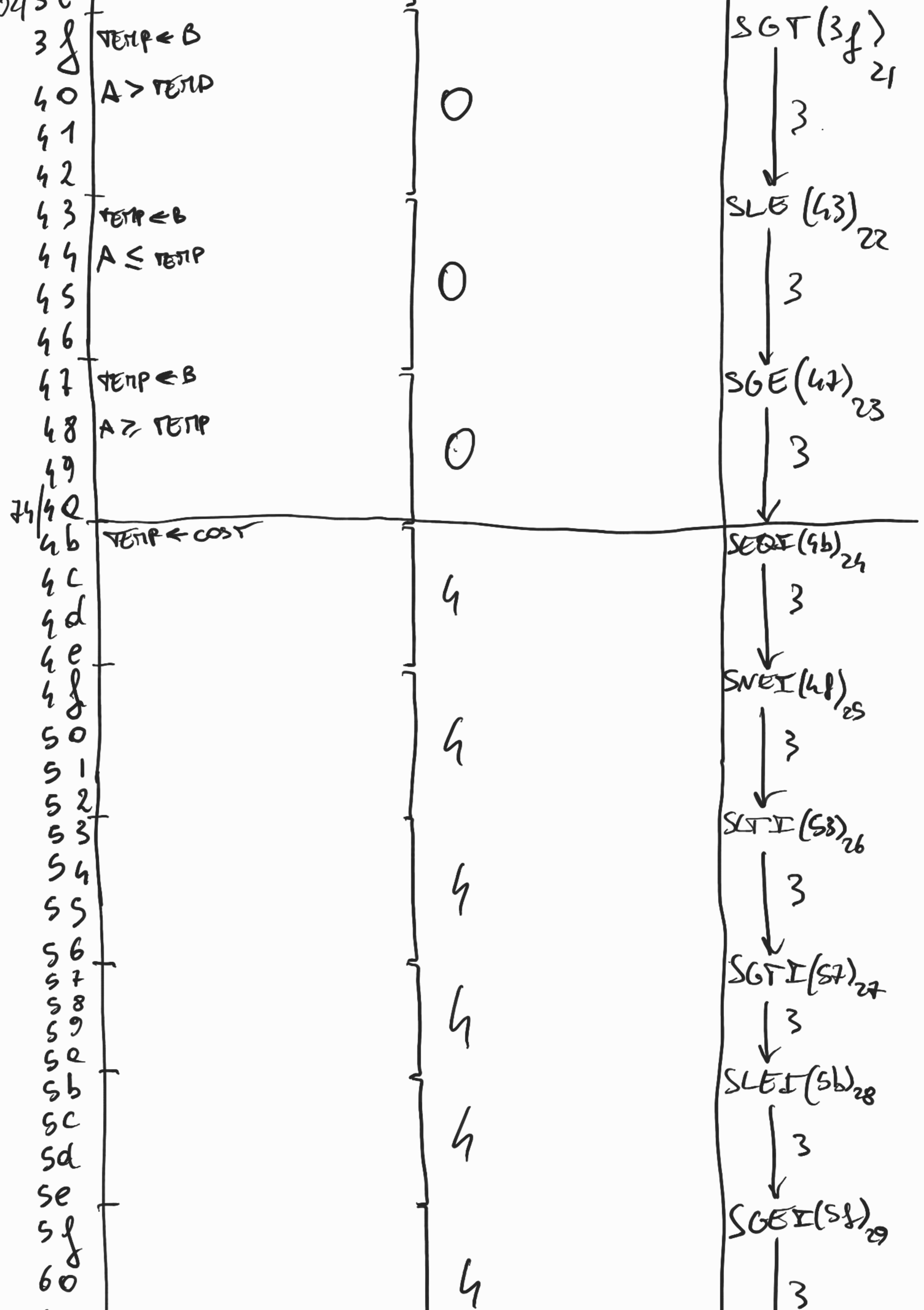
ADD (2)<sup>COP</sup>

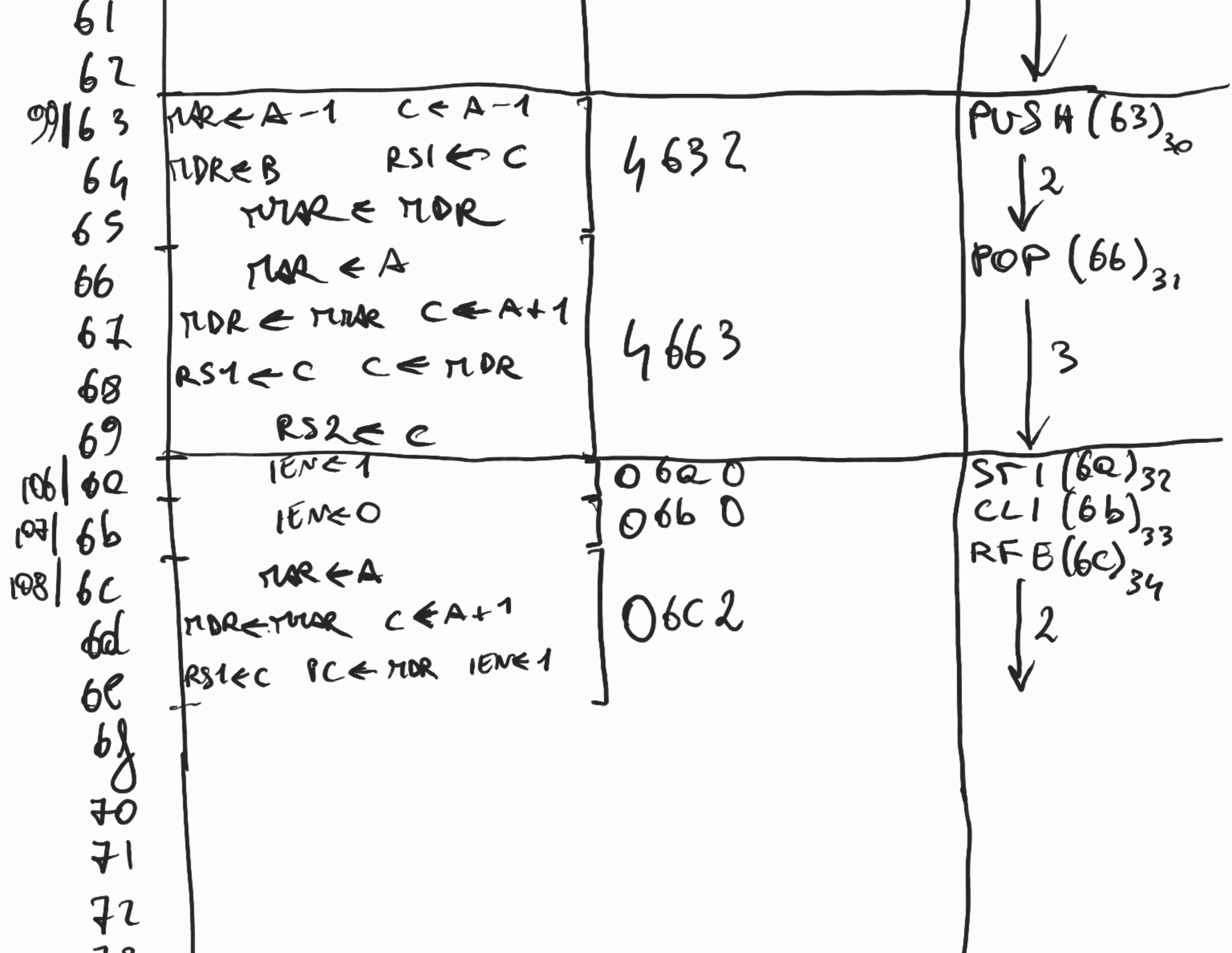
SUB (5)

AND (8)<sub>2</sub>

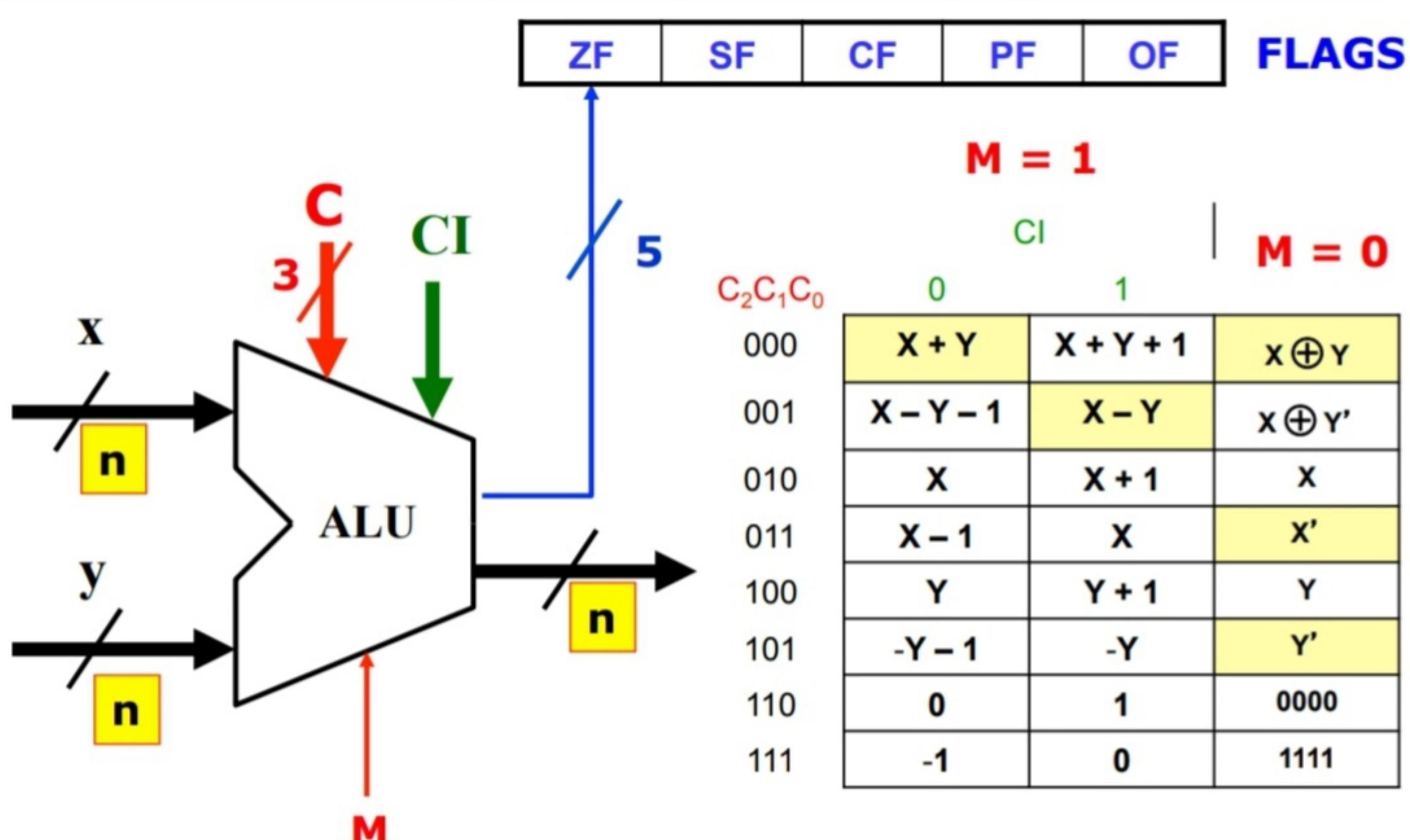


23	$MAR \leftarrow A + COST$			LOAD (23)
24	$MDR \leftarrow MDR$	4 2 3 3		"
25	$C \leftarrow MDR$			3
26	$RD \leftarrow C$			
27	$PC \leftarrow A$	C 27 0		JR (27) 12
28	$C \leftarrow PC$			JALR (28)
29	$PC \leftarrow A$	C 28 2		13
30	$R31 \leftarrow C$			2
31	$C \leftarrow PC$			
32	$PC \leftarrow PC + COST$	C 26 2		JAL (31) 14
33	$R31 \leftarrow C$			
34	$PC \leftarrow PC + COST$	C $\frac{46}{2e} 0$		J (34) 15
35	$A = 0$	00010		BEQZ (35) 16
36	$PC \leftarrow PC + COST$	$\begin{array}{l} ALU \\ \downarrow \end{array}$ 12 FLAG		
37	$A \neq 0$			BNEQZ (36) 17
38	$PC \leftarrow PC + COST$	$\begin{array}{l} ALU \\ \downarrow \end{array}$ 12 FLAG		
39	$TEMP \leftarrow B$	O 33 3		SEQ (39) 18
40	$A == TEMP$	(51)		$A=B$
41	$C \leftarrow R15$			3
42	$RD \leftarrow C$	out constant		
43	$TEMP \leftarrow B$	success		SNE (43) 19
44	$A != TEMP$			
45	$PC \leftarrow B$	O		3
46	$A < TEMP$	O		
47	$PC \leftarrow B$	O		3
48	$A < TEMP$	O		
49	$PC \leftarrow B$	O		3
50	$A < TEMP$	O		





## Sintesi delle operazioni dell'ALU



Quello mostrato è un esempio. Come vedremo, nelle CPU "reali" l'ALU dispone di ulteriori operazioni (es. AND, OR, SHIFT, MOLTIPLICAZIONI,...)



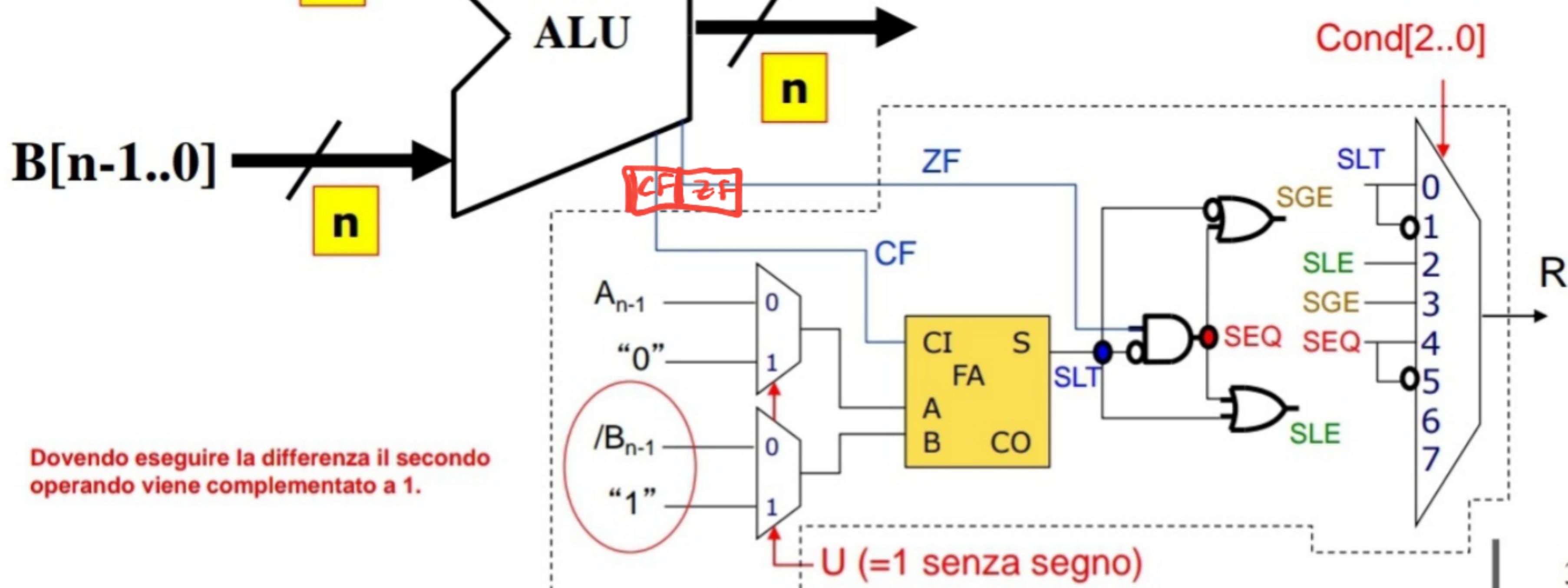
## Rete di controllo per numero con segno

 $M=1$ 

segno



Cond[2..0]	Significato
000	If ( $A < B$ ) then $R = 1$ else $R = 0$
001	If ( $A > B$ ) then $R = 1$ else $R = 0$
010	If ( $A \leq B$ ) then $R = 1$ else $R = 0$
011	If ( $A \geq B$ ) then $R = 1$ else $R = 0$
100	If ( $A = B$ ) then $R = 1$ else $R = 0$
101	If ( $A \neq B$ ) then $R = 1$ else $R = 0$



36

"ISTRUZIONE DI INTERRUPT"

Cop  
111111 (fornito dal mostre control)

383h  
384h  
385h  
386h  
387h

$3f8h$	$A \leftarrow R30$	$3f87$	INTERRUPT ( $3f8h$ ) 63
$3f9h$	$MAR \leftarrow A-1$ $C \leftarrow A-1$	$1017$	
$3fa h$	$MDR \leftarrow PC$ $R30 \leftarrow C$	$1018$	
$3fb h$	$RDRE \leftarrow M$	$1019$	
$3fc h$	$\pi DR \leftarrow \pi DR$	$1020$	
$3fd h$	$\pi DR \leftarrow M$	$1021$	
$3fe h$	$RDRE \leftarrow RDRE * 4$	$1022$	
$3ff h$	$RDRE \leftarrow RDRE$	$1023$	
$3fgh$	$PC \leftarrow TIPR$ $LEN \leftarrow 0$		

$$\begin{array}{c} 2^{10} \\ | \quad \boxed{1 \quad 11 \quad 1111 \quad 1111} \\ 2^{10}-1 \end{array} = 1023$$

