Solution. MidTerm VHDL Exam 20/21 — File 7A Celia

a) N = Nb bits = 10 ; CA2 ; Range [-512, 511]

$$y = a_0 x_0 + a_1 x_1 + \dots + a_7 x_7 \quad \text{(order 8)}$$

$a_0 = a_7 = 0'04727$; $a_2 = a_5 = -0'116$

$a_1 = a_6 = 0$; $a_3 = a_4 = 0'56873$

$$y \cdot \frac{2^k}{2^k} = \sum_{i=0}^{7} a_i x_i \cdot \frac{2^k}{2^k} = \frac{1}{2^k} \sum_{i=0}^{k} \underline{(a_i \cdot 2^k)} x_i$$

$\boxed{a_i \cdot 2^k}$

$$K < \log_2 \frac{2^{N-1}}{|\mathrm{Max}(a_j)|} = \log_2 \frac{2^9}{0'56873} = 9'814..$$

$\boxed{K = 9}$

ENT$(a_i \cdot 2^k) \Rightarrow$

a_0	a_1	a_2	a_3	a_4	a_5	a_6	a_7
24	0	-59	291	291	-59	0	24

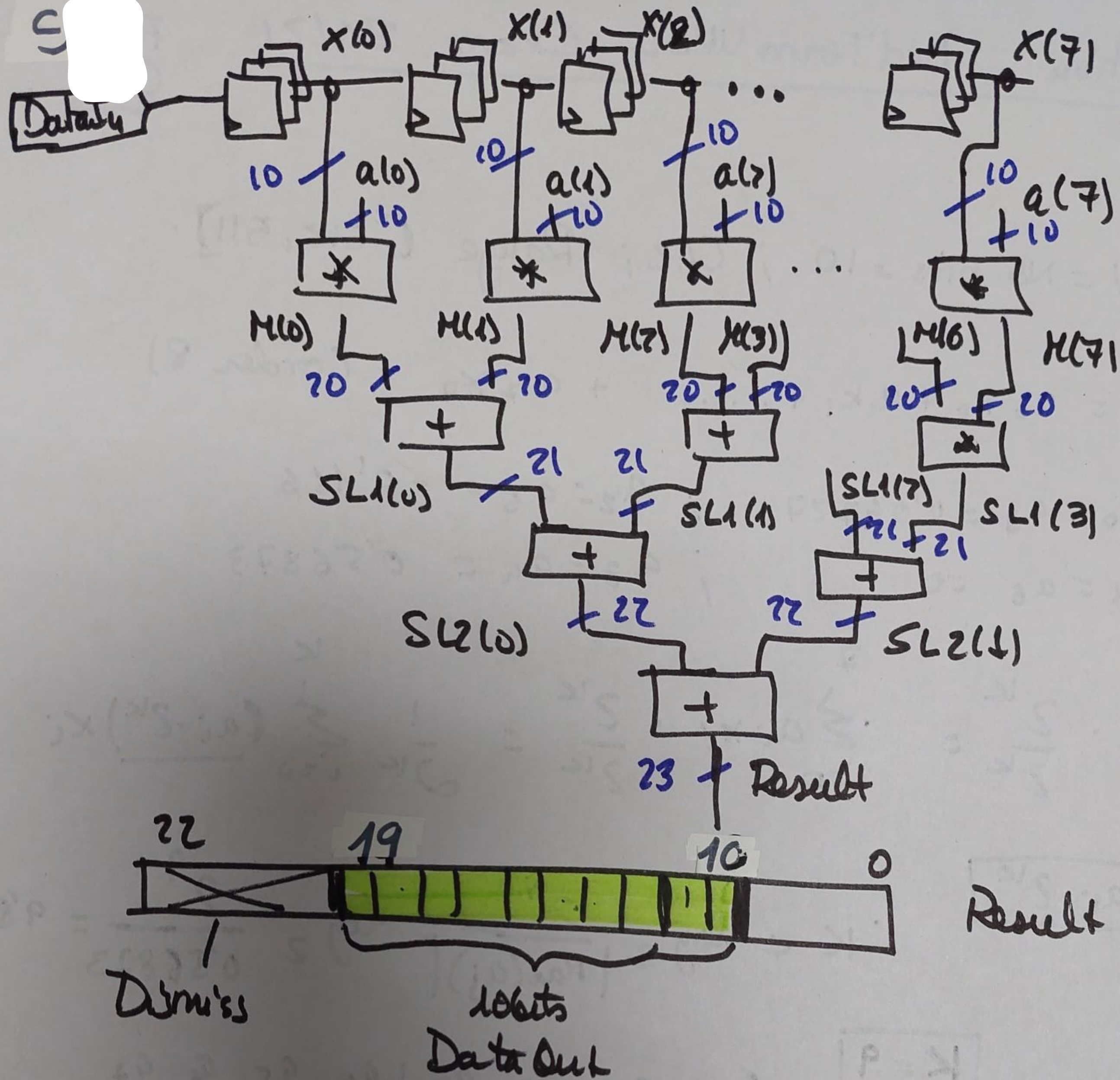
$$\boxed{y = \frac{1}{512}\left[24(x_0 + x_7) - 59(x_2 + x_5) + 291(x_3 + x_4)\right]}$$

b) Coeff's are not as large as to cover the range $[-2^9, 2^9-1]$

So, the maximum result y will be

$$y'_M = 24(511 + 511) - 59(-512 - 512) + 291(511 + 511)$$

$y'_{MAX} = \cancel{367,946}$ 382.346 which can be represented with 20 bits in CA2


Data In
X(0)
X(1)
X(2)
X(7)
a(0)
a(1)
a(2)
a(7)
10
M(0)
M(1)
M(2)
M(3)
M(6)
M(7)
20
SL1(0)
SL1(1)
SL1(2)
SL1(3)
21
SL2(0)
SL2(1)
22
23
Result
22
19
10
0
Dismiss
10bits
Data Out