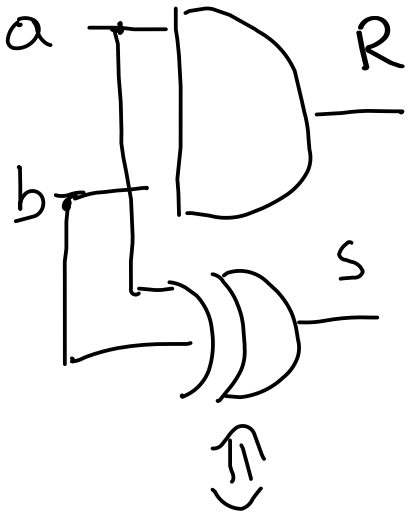
Design de circuit

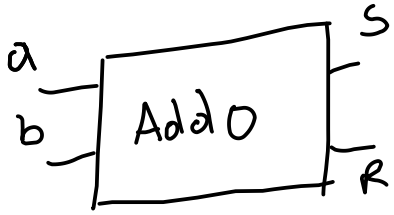
1) Enoncé → table vérité
2) Equation simplifiée (algèbre ou Karnaugh)
3) Shema

Exo 1 additionneur

a) additionneur 1-bit : demi-additionneur

a	b	S	R
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

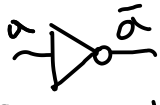




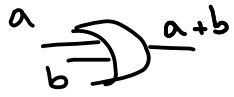
$S = \bar{a}\,b + a\,\bar{b} = a \oplus b$

$R = a.b$

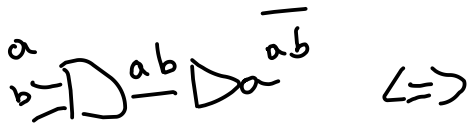
Rappel porte logique

NON : 

ET : 

OU : 

XOR : 



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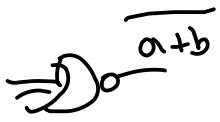
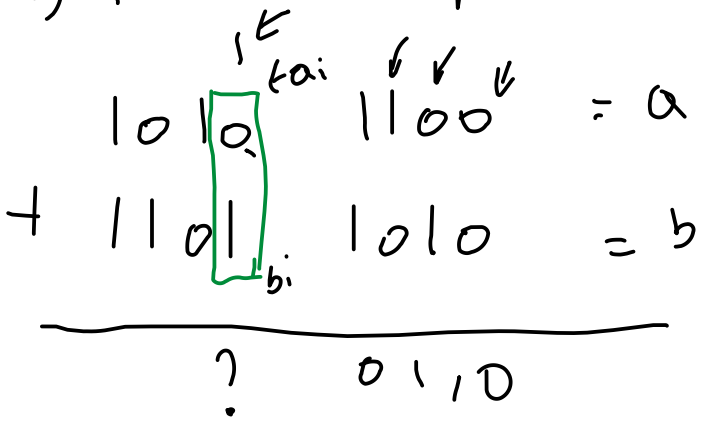


b) Additionneur complet



a_i	b_i	R_{i-1}	S_i	R_i
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

$\bar{a}b + a\bar{b}$

a b	$\bar{a}\bar{b}$	ab	$\bar{a}b + a\bar{b}$
→ 0 0	1	0	0
0 1	0	0	1
1 0	0	0	1
→ 1 1	0	1	0

$\bar{a}\bar{b} + ab = \overline{a \oplus b}$

$S_i = \bar{a_i}\,\bar{b_i}\,R_{i-1} + \bar{a_i}\,b_i\,\bar{R_{i-1}} + a_i\,\bar{b_i}\,\bar{R_{i-1}} + a_i\,b_i R_{i-1}$

$S_i = \bar{a_i}\,(\bar{b_i}R_{i-1} + b_i\bar{R_{i-1}}) + a_i\,(\bar{b_i}\,\bar{R_{i-1}} + b_i R_{i-1})$

$S_i = \bar{a_i}\,(b_i \oplus R_{i-1}) + a_i\,\overline{(b_i \oplus R_{i-1})}$

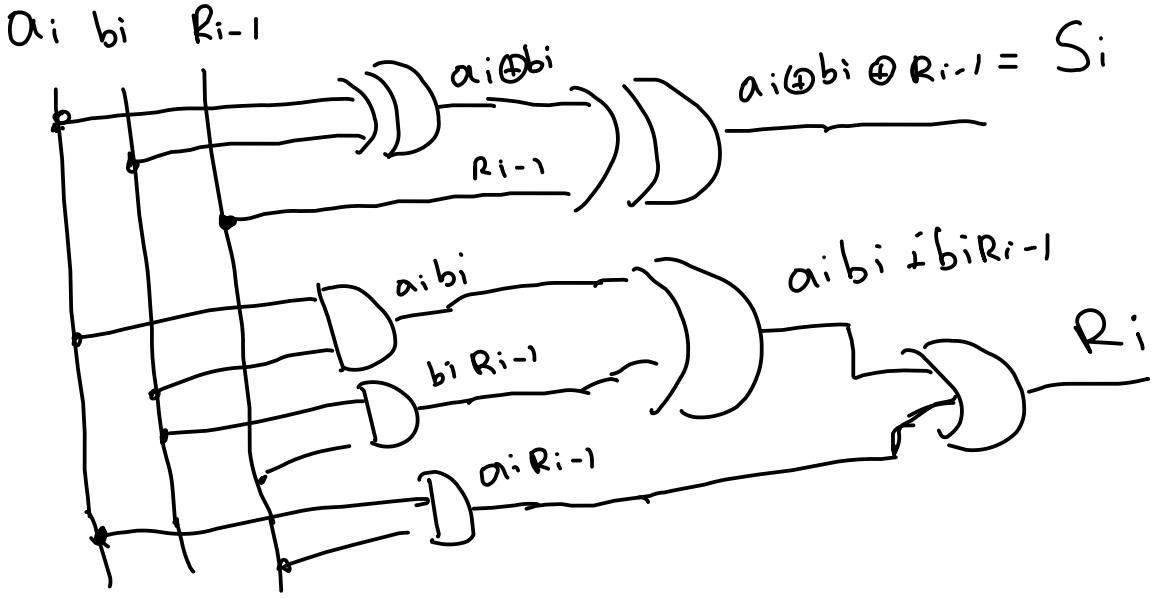
c

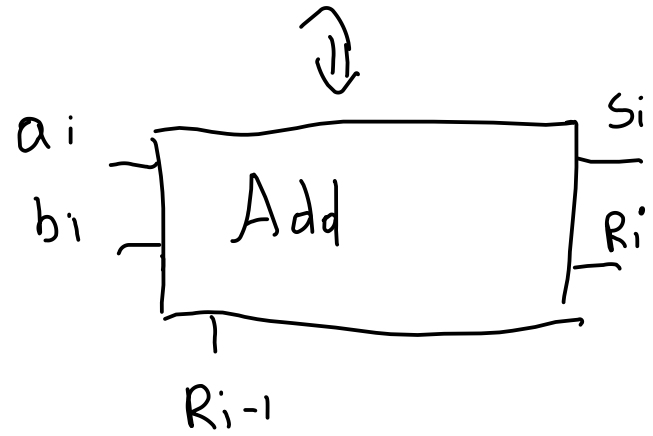
$S_i = \bar{a_i}\,c + a_i\,\bar{c} \Rightarrow a_i \oplus b_i \oplus R_{i-1}$

a_i	b_i	R_{i-1}	S_i	R_i
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

R_{i-1} \ $a_i b_i$	00	01	11	10
0	0	0	1	0
1	0	1	1	1

$$R_i = a_i b_i + R_{i-1} b_i + a_i R_{i-1}$$



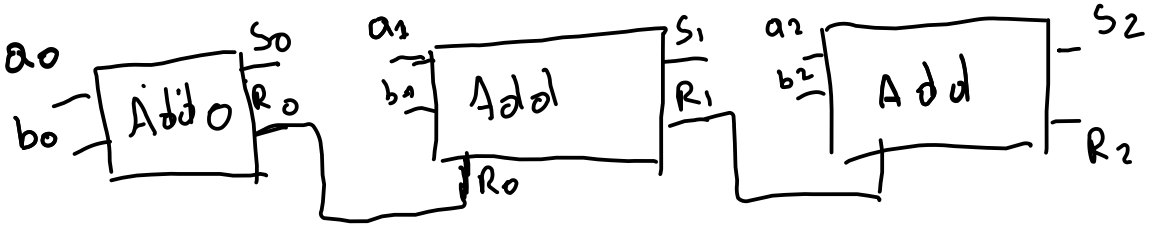


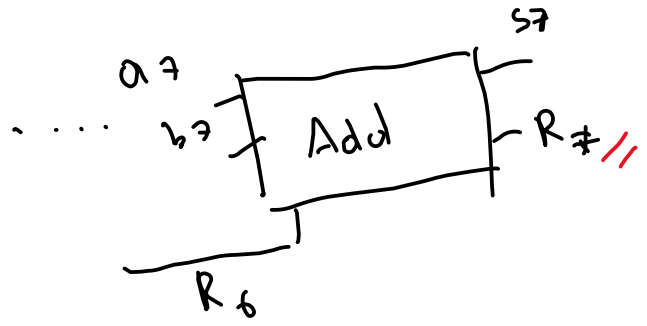
3) Addition sur 1 octet

$a = a_7 a_6 \dots a_0$

$b = b_7 b_6 \dots b_0$

$$\begin{array}{r} a_7\ a_6\ a_5 \dots a_1\ a_0 \\ + \quad b_7\ b_6 \dots \quad \dots \quad b_1\ b_0 \\ \hline S_7\ S_6 \quad \dots \quad S_1\ S_0 \end{array}$$





R_7 peut indiquer un overflow

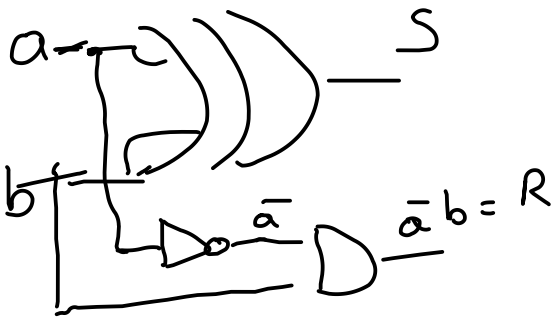
$$\begin{array}{r} 1111\ \ 1111 \\ + \quad 0000\ \ 0001 \\ \hline 1\ \ 0000\ \ 0000 \end{array}$$

Exo 2 : soustracteur

a) Demi soustracteur :

10 - 1 =

a	b	S	R
0	0	0	0
1	0	1	0
1	1	0	0
0	1	1	1



$S = a\bar{b} + \bar{a}b = a \oplus b$

$R = \bar{a}\,b$

b) Soustracteur complet

R_{i-1}

$a_i - (b_i + R_{i-1})$

$a_i - b_i - R_{i-1}$

a_i	b_i	R_{i-1}	S_i	R_i
0	0	0	0	0
0	0	1	1	1
0	1	0	1	1
0	1	1	0	1
1	0	0	1	0
1	0	1	0	0
1	1	0	0	0
1	1	1	1	1

$$
\begin{array}{r}
1\ \ 10\ \ 1 \\
-\ \ 0\!\to\!1\ \ 1\ \ 1 \\
\hline
0\ \ 1\ \ 0
\end{array}
$$