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Corrigé de l'examen Final

Electronique Numerique

LAT 314

Année 2012/2013

Exercice 1 : (06 pts)

1. Plage de representation des nombres entiers signés

- codage sur 8 bits $\rightarrow -2^7 \leq P_1 \leq +2^7-1 \Rightarrow \boxed{-128 \leq P_1 \leq +127}$ 0,5
- codage sur 9 bits $\rightarrow -2^8 \leq P_2 \leq +2^8-1 \Rightarrow \boxed{-256 \leq P_2 \leq +255}$ 0,5

2.1 Representation en CV de A et B ($A=(+115)_{10}$ et $B=(-75)_{10}$)

a) codage sur 8 bits :

0,25 $\boxed{A = 01110011}$ $\boxed{B = 10110101}$ 0,25

b) codage sur 9 bits :

0,25 $\boxed{A = 001110011}$ $\boxed{B = 110110101}$ 0,25

2.2 operations : $S = A+B$, $D_1 = A-B$ et $D_2 = B-A$

a) Dans la representation en CV sur 8 bits :

$S = A+B$ $= C_{n+1}C_n$

$$\begin{array}{rr} & 11 \\ A \rightarrow & 01110011 \\ B \rightarrow & 10110101 \\ \hline S \rightarrow & \cancel{1}\,00101000 \end{array}$$

$\boxed{S = 00101000}$ 0,5

* $C_{n+1}C_n = 11 \rightarrow$ pas depassement de capacité $\Rightarrow$ Resultat juste ($S=(+40)_{10}) \in P_1$ 0,25

$D_1 = A - B = A + CV(B)$

$$\begin{array}{rr} & 01 \\ A \rightarrow & 01110011 \\ CV(B) \rightarrow & 01001011 \\ \hline D_1 \rightarrow & 10111110 \end{array}$$

$\boxed{D_1 = 10111110}$ 0,5

0,25 $C_{n+1}C_n = 01 \Rightarrow$ dépassement de capacité $\Rightarrow$ Resultat faux ($D_1 = -66$), le resultat juste est $+190 \notin P_1$

$D_2 = B - A = B + CV(A)$

$$\begin{array}{rr} & 10 \\ B \rightarrow & 10110101 \\ CV(A) \rightarrow & 10001101 \\ \hline D_2 \rightarrow & \cancel{1}\,01000010 \end{array}$$

$\boxed{D_2 = 01000010}$ 0,5

0,25 $C_{n+1}C_n = 10 \Rightarrow$ dépassement de capacite $\Rightarrow$ Resultat faux ($D_2 = +66$) alors que le resultat juste est $D_2 = -75-(115)$
$= -190 \notin P_1$

b) operations en CV sur 9 bits

$*\ S = A + B$

$$
\begin{array}{lr}
 & \overset{C_{n+1}C_n}{(1\,1)} \\
A \rightarrow & 0\,0\,1\,1\,1\,0\,0\,1\,1 \\
B \rightarrow & 1\,1\,0\,1\,1\,0\,1\,0\,1 \\
\hline
S \rightarrow & \cancel{1}\,0\,0\,0\,1\,0\,1\,0\,0\,0
\end{array}
$$

$\boxed{S = 00101000}$ 0,5

$C_{n+1}, C_n = 11 \rightarrow$ pas de depassement de capacité $\Rightarrow$ Resultat Juste 0,25

$[S = (+40)_{10}]$

$*\ D_1 = A - B = A + CV(B)$

$$
\begin{array}{lr}
 & (0\,0) \\
A \rightarrow & 0\,0\,1\,1\,1\,0\,0\,1\,1 \\
CV(B) \rightarrow & 0\,0\,1\,0\,0\,1\,0\,1\,1 \\
\hline
D_1 \rightarrow & 0\,1\,0\,1\,1\,1\,1\,1\,0
\end{array}
$$

$\boxed{D_1 = 010111110}$ 0,5

$C_{n+1} C_n = 0.0 \rightarrow$ Pas de depassement de capacité 0,25

$\rightarrow$ Resultat Juste $(D_1 = +190)$.

$*\ D_2 = B - A = B + CV(A)$

$$
\begin{array}{lr}
 & (1\,1) \\
B \rightarrow & 1\,1\,0\,1\,1\,0\,1\,0\,1 \\
CV(A) \rightarrow & 1\,1\,0\,0\,0\,1\,1\,0\,1 \\
\hline
D_2 \rightarrow & \cancel{1}\,1\,0\,1\,0\,0\,0\,0\,1\,0
\end{array}
$$

$\boxed{D_2 = 101000010}$ 0,5

$C_{n+1} C_n = 11 \rightarrow$ pas de depassement de capacité 0,25

$\Rightarrow$ Resultat Juste $(D_2 = -90)$.

c)

Exercice 2 : (04 pts)

1. Tableau de Karnaugh

1

c \ ba	00	01	11	10
0		1	1	1
1			1	

$S = \sum_{cba} 1, 2, 3, 7$

$S = \bar{c}\bar{b}a + \bar{c}b\bar{a} + \bar{c}ba + cba.$

2. Simplification

c \ ba	00	01	11	10
0		1	1	1
1			1	

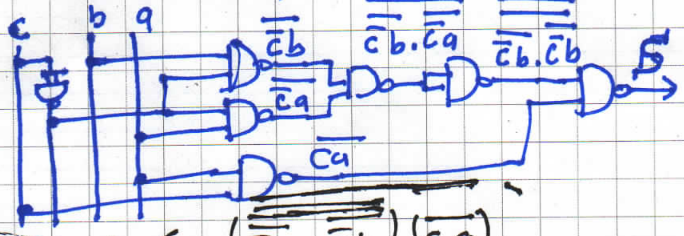
1 $\rightarrow \boxed{S = \bar{c}a + \bar{c}b + ca}$

3. Logigramme avec des NAND de 2 entrées

$S = \bar{\bar{S}} = \overline{\overline{\bar{c}a + \bar{c}b + ca}}$

$= \overline{(\overline{\bar{c}a}).(\overline{\bar{c}b}).(\overline{ca})}$

$S = \overline{\overline{\overline{(\overline{\bar{c}a}).(\overline{\bar{c}b})}}.\overline{ca}}$ 1



$\rightarrow S = \overline{(\overline{\overline{\bar{c}a}.\overline{\bar{c}b}}).(\overline{ca})}$

4. Logigramme avec des NOR à 2 entrées.

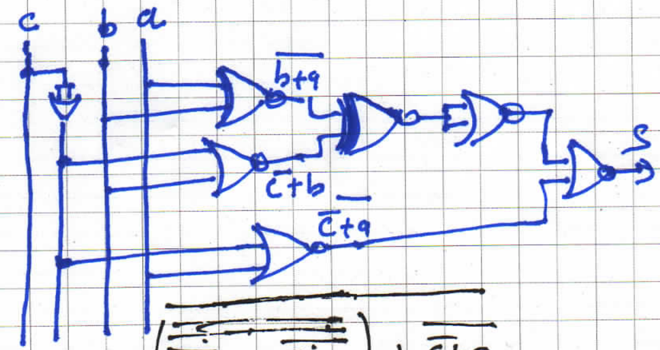
$\bar{S} = \sum_{cba} 0, 4, 5, 6$

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

$S = \overline{\bar{b}\bar{a} + c\bar{b} + c\bar{a}}$ 1

$S = \overline{\overline{\overline{\bar{b}\bar{a}}} + \overline{\overline{c\bar{b}}} + \overline{\overline{c\bar{a}}}}$

$S = \overline{\left(\overline{\overline{\overline{b+a} + \overline{\bar{c}+b}}}\right) + \overline{\bar{c}+a}}$



$\rightarrow S = \overline{\left(\overline{\overline{\overline{b+a} + \overline{\bar{c}+b}}}\right) + \overline{\bar{c}+a}}$

Exercice 3 : (06 pts)

$$F = \bar{d}a + \bar{b}c + \bar{c}ba$$

Tableau de Karnaugh :

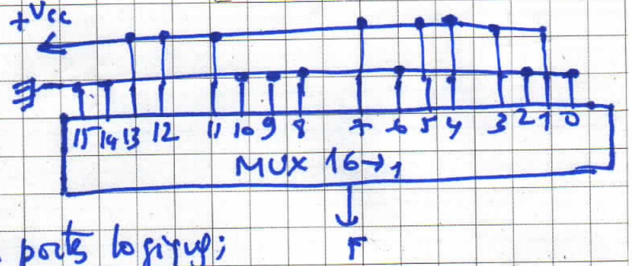
dc \ ba	00	01	11	10
00		1	1	
01	1	1	1	
11	1	1		
10			1	

$\longrightarrow F = \sum_{dcba} 1, 3, 4, 5, 7, 11, 12, 13$

a) Logigramme avec un MUX 16→1 :

1,5

$F = \sum_{dcba} 1, 3, 4, 5, 7, 11, 12, 13 \rightarrow$



b) Logigramme avec un MUX 8→1 et des portes logiques ;

$$F = (\bar{d}\bar{c}\bar{b})a + (\bar{d}\bar{c}b)a + (\bar{d}c\bar{b})\bar{a} + (\bar{d}c\bar{b})a + (\bar{d}cb)a + (d\bar{c}b)a + (dc\bar{b})\bar{a} + (dc\bar{b})a$$

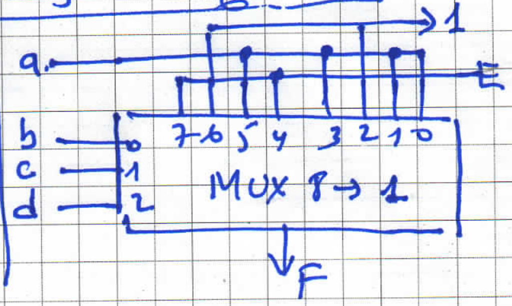
$$F = (\bar{d}\bar{c}\bar{b})a + (\bar{d}\bar{c}b)a + (\bar{d}c\bar{b})(\bar{a}+a) + (\bar{d}cb)a + (d\bar{c}b)a + (dc\bar{b})(\bar{a}+a)$$

$$\boxed{F = \underbrace{(\bar{d}\bar{c}\bar{b})}_{0}.a + \underbrace{(\bar{d}\bar{c}a)}_{1}.a + \underbrace{(\bar{d}c\bar{b})}_{2}.1 + \underbrace{(\bar{d}cb)}_{3}a + \underbrace{(d\bar{c}b)}_{5}.a + \underbrace{(dc\bar{b})}_{6}.1}$$

Liaison à faire :

1,5

$$\begin{cases} E_0, E_1, E_3, E_5 \longrightarrow a \\ E_2, E_6 \longrightarrow 1 \\ E_4, E_7 \longrightarrow 0 \end{cases}$$



c) Logigramme avec un MUX 4→1 et des portes logiques.

$$F = (\bar{d}\bar{c})\bar{b}a + (\bar{d}\bar{c})ba + (\bar{d}c)\bar{b}\bar{a} + (\bar{d}c)\bar{b}a + (\bar{d}c)ba + (d\bar{c})ba + (dc)\bar{b}\bar{a} + (dc)\bar{b}a$$

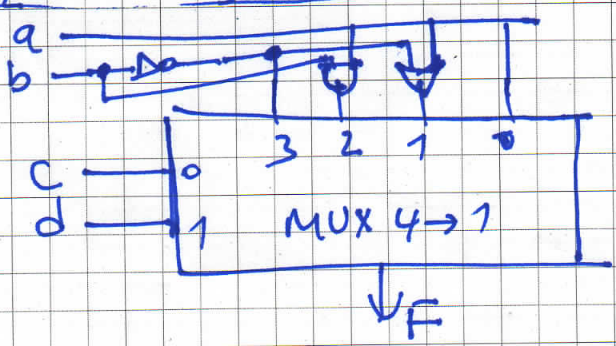
$$F = (\bar{d}\bar{c})(\bar{b}a + ba) + (\bar{d}c)(\bar{b}\bar{a} + \bar{b}a + ba) + (dc)(b.a) + (d\bar{c})(ba) + (dc)(\bar{b}\bar{a} + \bar{b}a)$$

$$\boxed{F = \underbrace{(\bar{d}\bar{c})}_{0}.a + \underbrace{(\bar{d}c)}_{1}(\bar{b}+a) + \underbrace{(d\bar{c})}_{2}.ba + \underbrace{(dc)}_{3}.\bar{b}}$$

Liaison à faire :

1,5

$$\begin{cases} E_0 \rightarrow a \\ E_1 \rightarrow \bar{b}+a \\ E_2 \rightarrow ba \\ E_3 \rightarrow \bar{b} \end{cases} \Rightarrow$$

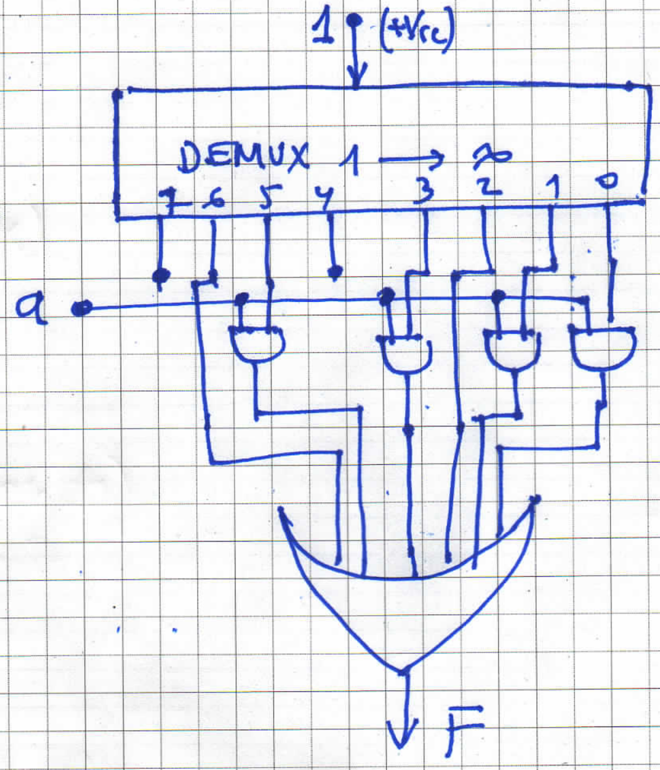


d) Logigramme avec un démultiplexeur et des portes logiques.

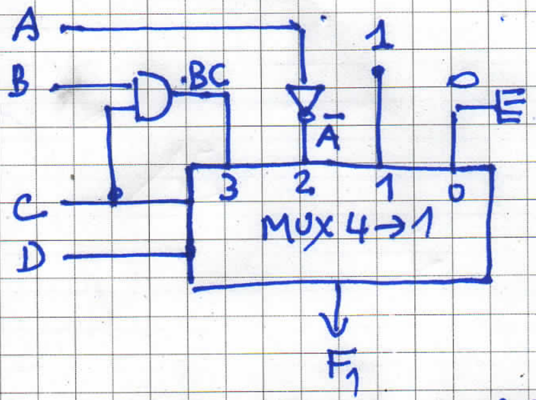
$$F = (\underbrace{\bar{d}\bar{c}\bar{b}}_{0})a + (\underbrace{\bar{d}\bar{c}a}_{1})a + (\underbrace{\bar{d}c\bar{b}}_{2}).1 + (\underbrace{\bar{d}cb}_{3})a + (\underbrace{d\bar{c}b}_{5})a + (\underbrace{dc\bar{b}}_{6}).1$$

d'où :

1,5



Exercice 4 : (04 pts)



$$F_1 = (\bar{D}\bar{C}).0 + (\bar{D}C).1 + (D\bar{C})\bar{A} + (DC).BC$$

$$\boxed{F_1 = \bar{D}C + D\bar{C}\bar{A} + DCB}$$

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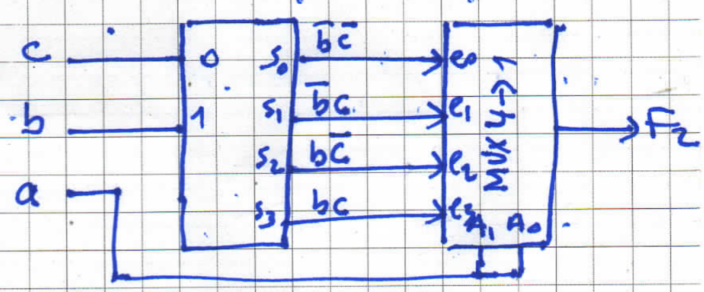

$$F_2 = (\bar{A}_1\bar{A}_0)e_0 + (\bar{A}_1A_0)e_1 + (A_1\bar{A}_0)e_2 + (A_1A_0)e_3$$

$$\begin{cases} e_0 = s_0 = \bar{b}\bar{c} \\ e_1 = s_1 = \bar{b}c \\ e_2 = s_2 = b\bar{c} \\ e_3 = s_3 = bc \end{cases} \quad \text{et} \quad \begin{cases} A_0 = a \\ A_1 = a \end{cases}$$

$$\Rightarrow F = (\bar{a}\bar{a})\bar{b}\bar{c} + (\underbrace{\bar{a}.a}_{0})e_1 + (\overbrace{a.\bar{a}}^{0})e_2 + (a.a)bc$$

$$\boxed{F = \bar{a}\bar{b}\bar{c} + abc}$$

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