

Laborator I

1) Reprezentarea numerelor

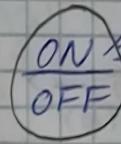
- Schimbări de bază

- Baza 2

- Operări aritmetice, $\forall \in [1, +\infty)$, $\forall \in [0, 1]$

- Aritmetică în complement față de 2

- Reprezentarea numerelor în virgulă mobilă (binary)



presiune
curent și tensiune
bec aprins

2) Funcții logice

Ex.: Dacă plouă sau e prognosă de ploare și nu iau mașina, atunci iau umbrela.

$$(A \mid B) \& !C = Y$$

$2^3 = 8$ (2 - nr. bazei
3 - nr. variabilelor)

A	B	C	Y
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	0

3) Optimizarea funcțiilor logice

- Diagrama Venn

- Vejgh

- V-K

- Numărătoare

- Automate

- Algoritmi de optimizare

14 - Colocviu (venim cu caiet) - 30% nota finală

$$N = (N_{examen}) \cdot 0,4 + N_C \cdot 0,3$$

11.10.2023

Laborator II Conversii de baza de numeratie

$$(1) \text{ rezam} \quad 0,265_{(10)} \rightarrow 2,4,8,16$$

0

$$2 = 2^1 \quad 0,265 \cdot 2 = 0,530 \rightarrow 0$$

$$4 = 2^2 \quad 0,530 \cdot 2 = 1,060 \rightarrow 1$$

$$8 = 2^3 \quad 0,060 \cdot 2 = 0,120 \rightarrow 0$$

$$16 = 2^4 \quad 0,120 \cdot 2 = 0,240 \rightarrow 0$$

$$0,240 \cdot 2 = 0,480 \rightarrow 0$$

$$0,480 \cdot 2 = 0,960 \rightarrow 0$$

$$0,960 \cdot 2 = 1,920 \rightarrow 1$$

1

$$0,265 \cdot 4 = 1,060 \rightarrow 1$$

$$0,06 \cdot 4 = 0,24 \rightarrow 0$$

$$0,24 \cdot 4 = 0,96 \rightarrow 0 \Rightarrow 01003_{(4)}$$

$$0,96 \cdot 4 = 3,84 \rightarrow 3$$

$$0,265 \cdot 8 = 2,120 \rightarrow 2$$

$$0,12 \cdot 8 = 0,96 \rightarrow 0$$

$$0,96 \cdot 8 = 7,68 \rightarrow 7$$

$$\Rightarrow 0204_{(8)}$$

$$0,265 \cdot 16 = 4,24 \rightarrow 4$$

$$0,24 \cdot 16 = 3,84 \rightarrow 3 \quad 043_{(16)}$$

$$16,432_{(10)} \rightarrow 2,4,8,16$$

$$16 \cdot 432 = 16 + 0,432$$

$$0,432 \cdot 2 = 0,864 \rightarrow 0$$

$$0,864 \cdot 2 = 1,728 \rightarrow 1$$

$$0,728 \cdot 2 = 1,456 \rightarrow 1$$

$$0,456 \cdot 2 = 0,912 \rightarrow 0$$

$$0,912 \cdot 2 = 1,824 \rightarrow 1$$

16	0	↑
8	0	
4	0	
2	0	
1	1	
0		

$$0011011$$

2

$$0,856 \cdot 2 = 1,712 \rightarrow 1$$

$$16 \cdot 432 = 16 + 0, 432 = 10000 + 00110111 = \\ = 10000,0110111(2)$$

$$0,432 \cdot 4 = 1,728 \rightarrow 1$$

$$0,728 \cdot 4 = 2,912 \rightarrow 2$$

$$0,912 \cdot 4 = 3,648 \rightarrow 3$$

1232

$$0,648 \cdot 4 = 2,592 \rightarrow 2$$

$$342,2(5) \rightarrow 2,4,8,10,16 \rightarrow 94,4(10)$$

$$2 \cdot 5^{-1} + 2 \cdot 5^0 + 2 \cdot 5^1 + 3 \cdot 5^2 = 0,4 + 2 + 20 + 45 = \\ = 94,4(10)$$

$$94,4 = 94 + 0,4$$

94	2
48	1
24	0
12	0
6	0
3	1
1	1
0	

↑

1100001

$$0,4 \cdot 2 = 0,8 \rightarrow 0$$

$$0,8 \cdot 2 = 1,6 \rightarrow 1$$

$$0,6 \cdot 2 = 1,2 \rightarrow 1$$

0110011

$$0,2 \cdot 2 = 0,4 \rightarrow 0$$

$$0,4 \cdot 2 = 0,8 \rightarrow 0$$

$$0,8 \cdot 2 = 1,6 \rightarrow 1$$

$$0,6 \cdot 2 = 1,2 \rightarrow 1 \quad \vee$$

$$1 \cdot 2^6 + 1 \cdot 2^5 + 0 \cdot 2^4 + 0 \cdot 2^3 + 0 \cdot 2^2 + 1 \cdot 2^1 + 0 \cdot 2^{-1} + 1 \cdot 2^0 + 0 \cdot 2^{-2} + 1 \cdot 2^{-3} + 0 \cdot 2^{-4} + 0 \cdot 2^{-5} + 1 \cdot 2^{-6}$$

$$0,0052_{(8)} \rightarrow 2, 4, 10, 16 \quad 3 \text{ (ult 3 - BCZ)}$$

$$0,000000101010 = 1 \cdot 2^{-7} + 2^{-9} + 2^{-11} = \frac{1}{2^7} + \frac{1}{2^9} + \frac{1}{2^{11}} = \\ = \frac{1}{2048} + \frac{1}{512} + \frac{1}{128} = \frac{1+4+16}{2048} = \frac{21}{2048}$$

$$\begin{array}{r} 0,10000000101010 \\ \hline 0 \quad 2 \quad A \end{array} \quad 0.02A(16)$$

#	A	B	C	D
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1
A	1	0	1	0
B	1	0	1	1
C	1	1	0	0
D	1	1	0	1
E	1	1	1	0
F	1	1	1	1

0 1 0 0
0 1 1 0
1 0 1 0

1 0 0 1

0 0 0 0

Laborator III

a) Efectuați calculele (în binar)

$$4F + 2A$$

$$A + 4$$

$$12,065 - 6$$

b) Efectuați scăderile folosind complementul de $\frac{1}{2}$

$$4 - 7$$

$$8 - 12,65$$

$$A + 4 = 1010 + 0100 = 1110$$

$$4F + 2A = 01001111 + 00101010 =$$

$$\begin{array}{r} 0\ 1\ 0\ 0\ 1\ 1\ 1\ 1 \\ 0\ 0\ 1\ 0\ 1\ 0\ 1\ 0 \\ \hline 0\ 1\ 1\ 1\ 0\ 0\ 0\ 1 \end{array}$$

$$12,065 - 6$$

$$(12,065/10) = 1100.0001000 - 0110$$

$$\begin{array}{r} 1\ 1\ 0\ 0 \\ 0\ 1\ 1\ 0 \\ \hline 0\ 1\ 1\ 0 \end{array}$$

$$\begin{array}{r} 0\ 1\ 0\ 0 \\ 0\ 1\ 1\ 1 \\ \hline 1\ 1\ 0\ 1 \\ \quad \quad \quad \swarrow \swarrow \end{array}$$

$$\begin{array}{r} 0\ 0\ 10101010 \\ 0\ 0\ 011000 \\ \hline 0\ 0\ 010010 \end{array}$$

$$x - y = x + \lceil y \rceil_2 = x + \bar{y} + 1$$

$$4 - 4 = 4 + \overline{4} + 1 = \begin{array}{r} 0 \ 1 \ 0 \ 0 \\ + 1 \ 0 \ 0 \ 0 \\ \hline 1 \ 1 \ 0 \ 0 \end{array} + 1$$

$$\begin{array}{r} 1 \ 1 \ 0 \ 0 \\ + 0 \ 0 \ 0 \ 1 \\ \hline 1 \ 1 \ 0 \ 1 \end{array}$$

$$8 - 12,65 = 1000 - 00010010, 101100101$$

$$0,65 \times 2 = 1,30 \quad |$$

$$0,3 \times 2 = 0,6 \quad |$$

$$0,6 \times 2 = 1,2 \quad |$$

$$0,2 \times 2 = 0,4 \quad |$$

$$0,4 \times 2 = 0,8 \quad |$$

$$0,8 \times 2 = 1,6 \quad |$$

$$0,6 \times 2 = 1,2 \quad |$$

$$y = 1100,10100111$$

$$\bar{y} = 0011,01011000$$

$$\begin{array}{r} 1 \ 0 \ 0 \ 0 \\ + 0100,01011000 \\ \hline 1 \ 1 \ 00,01011000 \end{array}$$

$$1 - 4 = 0 \ 0 \ 0 \ 1 - 0 \ 1 \ 1 \ 1$$

$$y = 0 \ 1 \ 1 \ 1$$

$$\bar{y} = 1 \ 0 \ 0 \ 0$$

$$\begin{array}{r} \bar{y} + 1 = \begin{array}{r} 1 \ 0 \ 0 \ 0 \\ 0 \ 0 \ 0 \ 1 \\ \hline 1 \ 0 \ 0 \ 1 \end{array} + \\ \begin{array}{r} 0 \ 0 \ 0 \ 1 \\ \hline 1 \ 0 \ 1 \ 0 \end{array} \end{array}$$

$$DA - FD = 11011010 - 11111101$$

$$X = 11111101$$

$$\bar{y} = 00000010$$

$$\begin{array}{r} \bar{y} + 1 = \begin{array}{r} 0 \ 0 \ 0 \ 0 \ 0 \ 0 \ 1 \ 0 \\ 0 \ 0 \ 0 \ 1 \\ \hline 0 \ 0 \ 0 \ 0 \ 0 \ 1 \ 1 \end{array} + \\ \hline \end{array}$$

$$\begin{array}{r} 1 \ 1 \ 0 \ 1 \ 1 \ 0 \ 1 \ 0 + \\ 0 \ 0 \ 0 \ 0 \ 0 \ 0 \ 1 \ 1 \\ \hline 1 \ 1 \ 0 \ 1 \ 1 \ 1 \ 0 \ 1 \end{array}$$

c) Binary 64

$$\begin{array}{r} 1 \ 1 \ 1 \ 0, \\ - 1,0625 \end{array}$$

$$0,625 \times 2 \rightarrow 0,1250 \quad 0$$

$$0,125 \times 2 \rightarrow 0,25 \quad 0$$

$$0,25 \times 2 \rightarrow 0,5 \quad 0$$

$$0,5 \times 2 \rightarrow 1,0 \quad 1$$

$$2^3 + 2^2 + 2^{-9} = 2^3 \left(1 + 2^{-1} + 2^{-7} \right)$$

1 1 0 0 0 0 0 0 0 0 1 0 1 0 0 0 0 0 1

$$1042_{(8)} = 001000100010 =$$

$$= 2^9 + 2^5 + 2^1 = 2^9 \left(1 + 2^{-4} + 2^{-8} \right)$$

$$\text{exp: } 1023 + 1 = 1024 + 2^3$$

0,10000001001,00010001

0 0 0 0 0 1 0 1 1 1 1 0 1

$$2^{-5} + 2^{-4} + 2^{-8} + 2^{-9} + 2^{-10} + 2^{-12} =$$

$$= 2^{-5} \left(1 + 2^{-2} + 2^{-3} + 2^{-4} + 2^{-5} + 2^{-8} \right)$$

$$e_T = -5$$

$$e_A p = \text{offset} + e_T = 1$$

$$\text{offset} = 2^{K-1} = 2^{11-1} = 2^{10} - 1 = 1023$$

$$e_A p = 1023 + (-5) - 1018 = 1024 - 4 - 2 =$$

$$= 1024 - 2^2 - 2^1$$

$$\begin{array}{r} 1 0 0 0 0 0 0 0 0 0 0 0 0 \\ 0 0 0 0 0 0 0 0 1 1 0 \\ \hline 0 1 1 1 1 1 1 0 1 0 \end{array}$$

25.10.2023

Laborator IV

$$\Sigma(1, 3, 4, 5)$$

a) Tabela de adevar

b) FCC / FCD

c) Optimizare

d) Proiectarea circuitului:

#	A	B	C	y
0	0	0	0	0
1	0	0	1	1
2	0	1	0	0
3	0	1	1	1
4	1	0	0	1
5	1	0	1	1
6	1	1	0	0
7	1	1	1	0

$$f: B^n \rightarrow B$$

$$B = \{0, 1\}$$

$$FCC = (A + B + C)($$

$$(A + \bar{B} + C) \quad \{ \bar{A} + (\bar{B} + C)$$

$$(\bar{A} + \bar{B} + \bar{C})$$

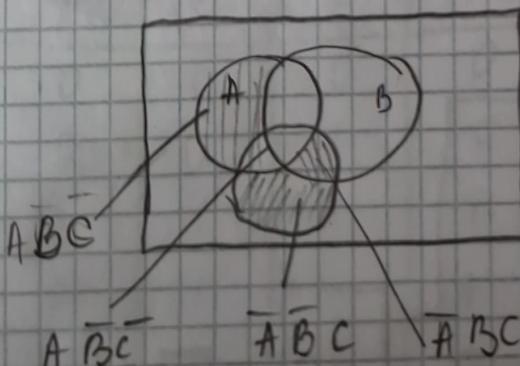
$$FCQ = \bar{A}\bar{B}C + \bar{A}BC + A\bar{B}\bar{C} + A\bar{B}C$$

$$0 \times 2^2 + 0 \times 2^1 + 0 \times 2^0$$

$$1 \times 2^2 + 1 \times 2^1 + 0 \cdot 2^0$$

$$\text{Opt: } f = \bar{B}C (\bar{A} + A) + \bar{A}BC + A\bar{B}\bar{C} \quad | = \\ BC = X$$

$$= \bar{B}C (\cancel{\bar{A}} + A) + \bar{A}X + A\bar{X}$$



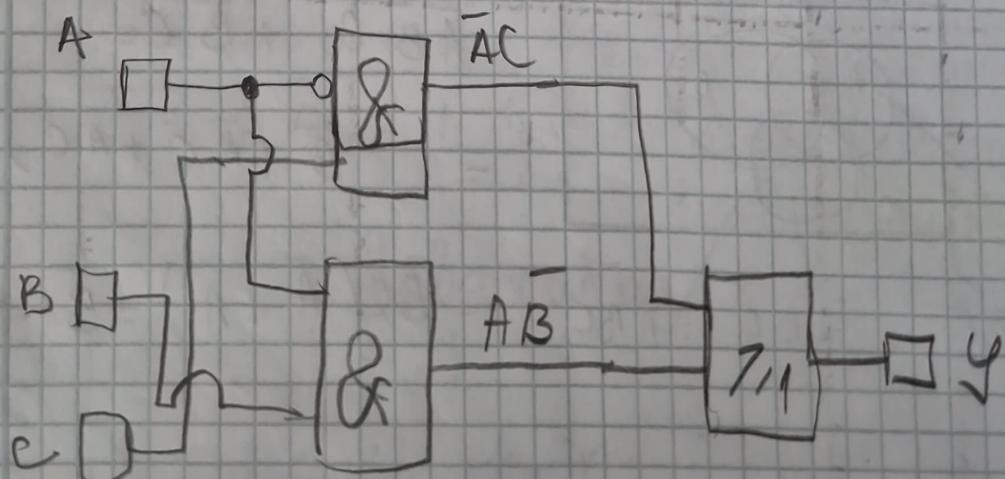
$$\bar{A}\bar{B}\bar{C} + \bar{A}\bar{B}C =$$

$$= -\bar{B} (\bar{A}C + AC)$$

$$= \bar{B}C (\bar{A} + A) - \bar{B}C \bar{A}B\bar{C}$$

A	B	C	$\bar{B}C$	O_2	BC	$A \oplus BC$	O_2
0	0	0	0	0	0	0	0
0	0	1	1	1	0	0	1
0	1	0	0	0	0	0	0
0	1	1	0	1	1	1	1
1	0	0	0	0	0	1	1
1	0	1	1	1	0	1	1
1	1	0	0	0	0	1	1
1	1	1	0	0	0	0	0

A	B	C	$\bar{A}C$	$A\bar{B}$	$\bar{A}C + A\bar{B}$
0	0	0	0	0	0
0	0	1	1	0	1
0	1	0	0	0	0
0	1	1	1	0	1
1	0	0	0	1	1
1	0	1	0	1	1
1	1	0	0	0	0
1	1	1	0	0	0



A	B	C	Y	$\pi = \{0, 1, 4, 7\}$
0	0	0	0	
0	0	1	0	
0	1	0	1	
0	1	1	1	
1	0	0	0	
1	0	1	1	
1	1	0	1	
1	1	1	0	

$$FCD = \pi(0, 1, 4, 7) = M(0, 1, 4, 7) =$$

$$= (A+B+C)(A+B+\bar{C})(\bar{A}+B+C)(\bar{A}+\bar{B}+\bar{C})$$

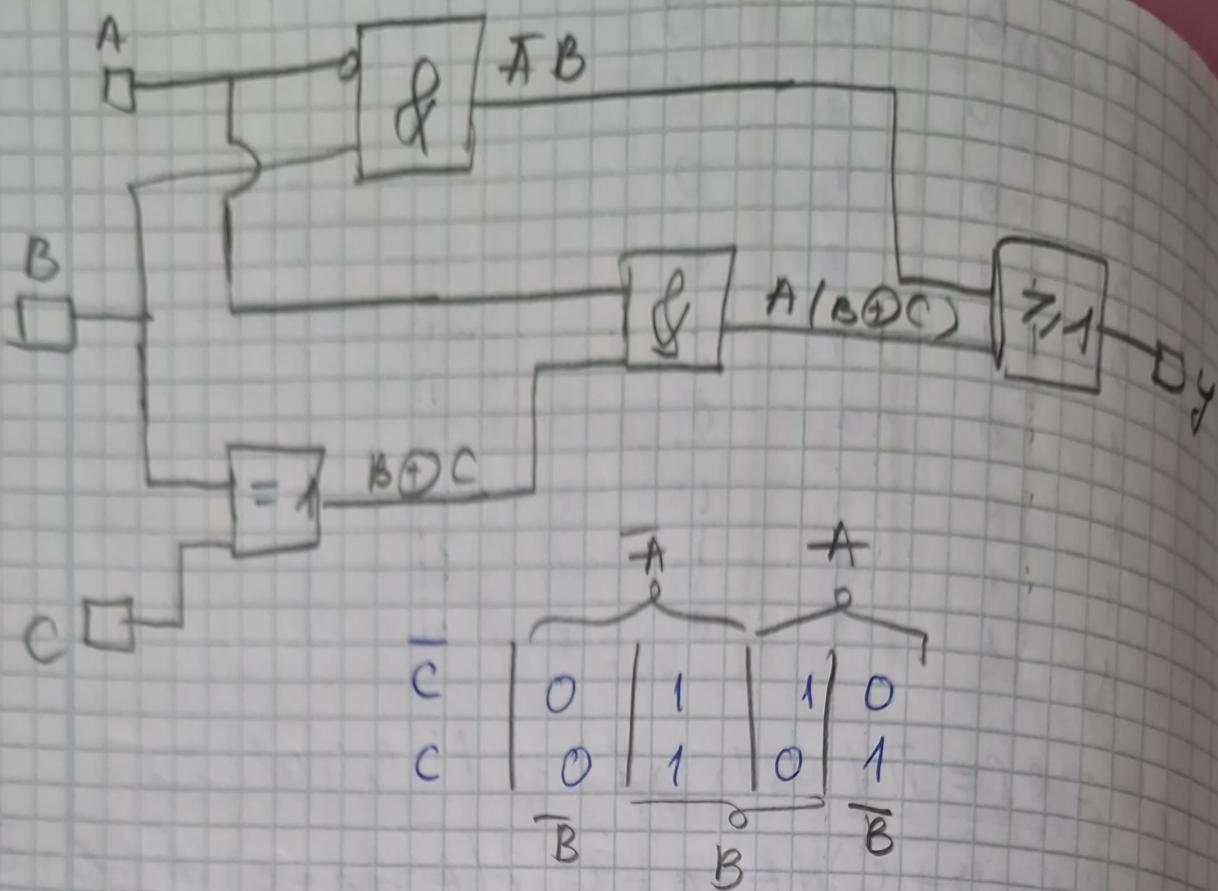
$$FCD = \sum(2, 3, 5, 6) = m(2, 3, 5, 6) =$$

$$= \bar{A}B\bar{C} + \bar{A}BC + A\bar{B}C + AB\bar{C}$$

$$\text{Opt: } \bar{A}B(C+\bar{C}) + A(\bar{B}C + B\bar{C}) -$$

$$= \bar{A}B + A(B \oplus C)$$

A	B	C	$\bar{A}B$	$B \oplus C$	$A(B \oplus C)$	O
0	0	0	0	0	0	0
0	0	1	0	0	0	0
0	1	0	1	1	0	1
0	1	1	1	0	0	1
1	0	0	0	0	0	0
1	0	1	0	1	1	1
1	1	0	0	1	1	1
1	1	1	0	0	0	0

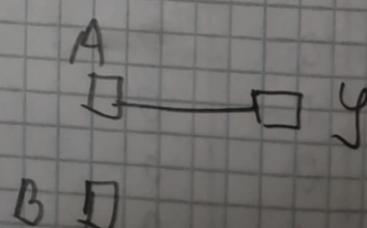
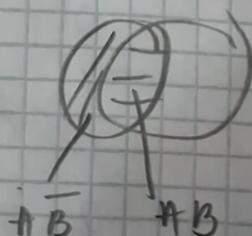


$$\bar{A}B + B\bar{C} + A\bar{B}C = B(\bar{A} + \bar{C}) + A\bar{B}C$$

$A(B+A\bar{B})$	A	B	$A\bar{B}$	$B + A\bar{B}$	$A(B+A\bar{B})$
	0	0	0	0	0
	0	1	0	1	0
	1	0	1	1	1
	1	1	0	1	1

$$F_C = \pi(0, 1) = m(0, 1) = (A \cdot B)(A + \bar{B})$$

$$\begin{aligned}
 F_C &= \Sigma(2, 3) = m(2, 3) = A\bar{B} + A\bar{B} = \\
 &= A(B + \bar{B}) = A
 \end{aligned}$$



$$\overline{AB} + A$$

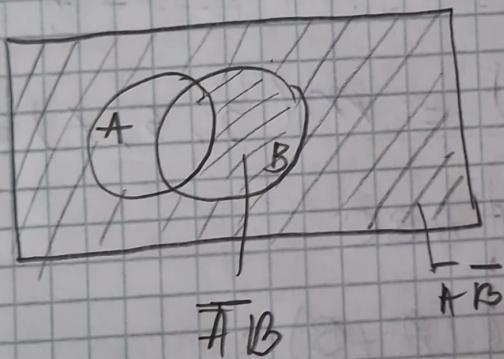
$$(A \rightarrow BC)(\bar{A} + C)$$

$$\overline{AB} + BC$$

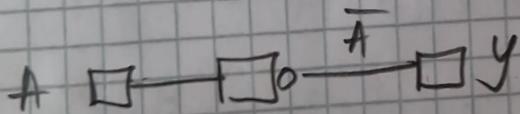
	A	B	\overline{AB}	$\overline{AB} + A$	$\overline{AB} + \bar{A}$
0	0	0	0	0	1
1	0	1	0	0	1
2	1	0	1	1	0
3	1	1	0	1	0

$$FCC = \pi(2, 3) = M(2, 3) = (\bar{A} + B)(\bar{A} + \bar{B})$$

$$FCD = \varepsilon(0, 1) = m(0, 1) = \\ = \overline{A}\bar{B} + \bar{A}B = \bar{A}(\bar{B} + B)$$



$$\begin{matrix} 0 & FCC(d\bar{a}0) \\ 0 & FCD(d01) \end{matrix}$$



B □

$$Y = (A + BC)(\bar{A} + C)$$

A	B	C	\bar{A}	BC	$(A+BC)$	$\bar{A}+C$	y
0	0	0	1	0	0	1	0
1	0	0	1	0	0	1	0
2	0	1	1	0	0	1	0
3	0	1	1	1	1	1	0
4	1	0	0	0	1	0	1
5	1	0	0	0	1	1	0
6	1	1	0	0	1	0	1
7	1	1	1	0	1	1	1

$$\begin{aligned}
 F_{CC} &= \pi(0, 1, 2, 4, 6) = M(0, 1, 2, 4, 6) = \\
 &= (A+B+C)(A+B+\bar{C})(A+\bar{B}+C)(\bar{A}+B+C) \\
 &\quad (\bar{A}+\bar{B}+C)
 \end{aligned}$$

$$\begin{aligned}
 F_{CD} &= \Sigma(3, 5, 7) = m(3, 5, 7) = \\
 &= \bar{A}BC + A\bar{B}C + ABC
 \end{aligned}$$

$$y = BC + AC = C(A+B)$$

\bar{C}	0	0	0	0
C	0	1	1	1

01.11.2023

Laboratorium 5

Semidsumator

A	B	S	C_0
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

$$S = A \oplus B$$

$$C_0 = AB$$

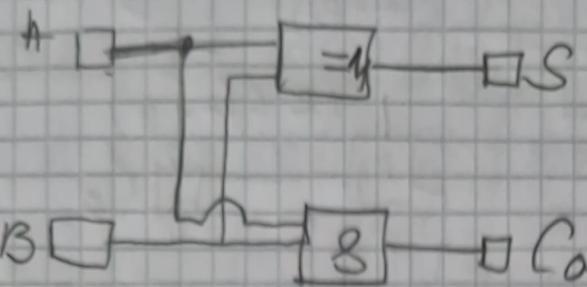
$$F_{CCS} = (A+B)/(\bar{A}+\bar{B})$$

$$F_{CDS} = \bar{A}B + A\bar{B}$$

$$FCS_{C_0} = (A+B)(A+\bar{B})(\bar{A}+B)$$

$$FC\bar{D}_{C_0} = A \cdot B$$

C_0 - carry out



	A	B	C_i	S	C_0	summaor complet
0	0	0	0	0	0	
1	0	0	1	1	0	
2	0	1	0	1	0	
3	0	1	1	0	1	
4	1	0	0	1	0	
5	1	0	1	0	1	
6	1	1	0	0	1	
7	1	1	1	1	1	

$$FCC = (A+B+C_i)(A+B+\bar{C}_i)(A+\bar{B}+C)(\bar{A}+B+C_i)$$

$$FC\bar{D} = \bar{A}BC_i + A\bar{B}C_i + A\bar{B}\bar{C}_i + A\bar{B}C_i$$

SUM

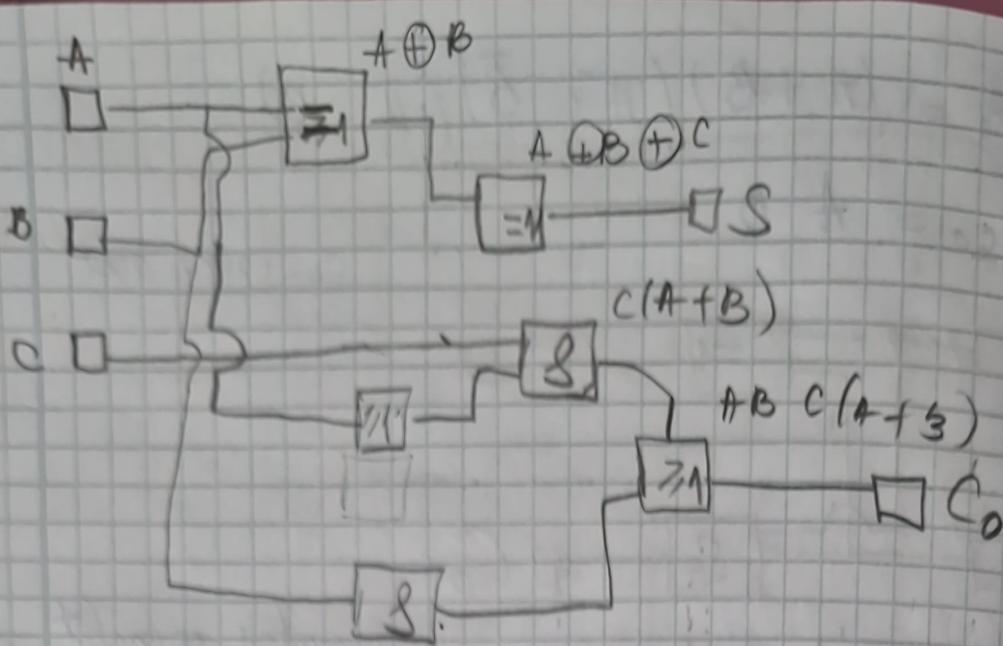
$$FCC = (A+B+C_i)(A+\bar{B}+\bar{C}_i)(\bar{A}+B+\bar{C}_i)(\bar{A}+\bar{B}+C_i)$$

$$FC\bar{D} = \bar{A}\bar{B}C_i + \bar{A}B\bar{C}_i + A\bar{B}\bar{C}_i + A\bar{B}C_i$$

$$S = A \oplus B + C_i \quad C_i - \text{carry in}$$

$$C_0 = BC + AB + AC = AB + C(A+B)$$

	00	01	11	10
0	0	0	1	0
1	0	1	1	1



Semicăzatorul (HS)

A	B	D	B ₀
0	0	0	0
0	1	1	1
1	0	1	0
1	1	0	0

= 1 XOR

≥ 1 OR

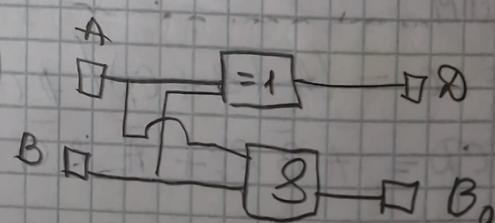
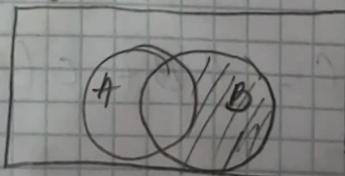
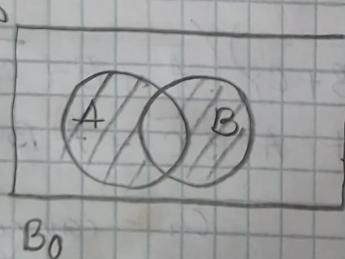
$$F_{CC} = (A+B)(\bar{A}+\bar{B})$$

$$F_{CD} = \overline{AB} + A\overline{B}$$

Borrow out

$$F_{CC} = (A+B)(\bar{A}+B)(\bar{A}+\bar{B})$$

$$F_{CD} = \overline{AB}$$



$$D = A \oplus B$$

$$B_0 = \overline{AB}$$

A	0	1
B	0	1
B _i	0	1

A	0	1
B	0	0
B _i	1	0

Scăzătorul complet (FS)

A	B	B _i	D	D ₀
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

B - Borrow in
B₀ - Borrow out

$$P. FCC = (A + B + B_i)(\bar{A} + \bar{B} + \bar{B}_i)(\bar{A} + B + \bar{B}_i)$$

$$(\# \bar{F} \bar{B} + B_i)$$

$$FC\bar{D} = \bar{A} \bar{B} B_i + \bar{A} B \bar{B}_i + \bar{A} \bar{B} \bar{B}_i + A B B_i$$

A	B	00	01	11	10
C	0	1	0	1	-
1	1	0	1	0	-

$$\bar{D} = \# \oplus B \oplus B_i$$

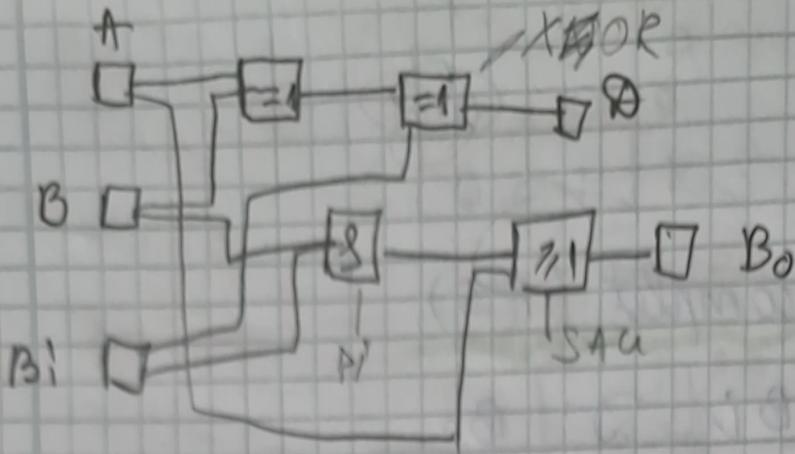
Borrow out

$$FCC = (A + B + B_i)(\bar{A} + B + \bar{B}_i)(\bar{A} + \bar{B} + B_i)(\bar{A} + \bar{B} + \bar{B}_i)$$

$$FC\bar{D} = \bar{A} \bar{B} B_i + \bar{A} B \bar{B}_i + \bar{A} \bar{B} \bar{B}_i + A B B_i$$

B_i	00	01	11	10
0	0	1	0	0
1	1	1	1	0

$$\bar{A} B_i + \bar{A} B_i + B B_i = \bar{A} B + B_i (\bar{A} + B)$$



01.11.2023

Tema pentru acasă.

Pentru B.

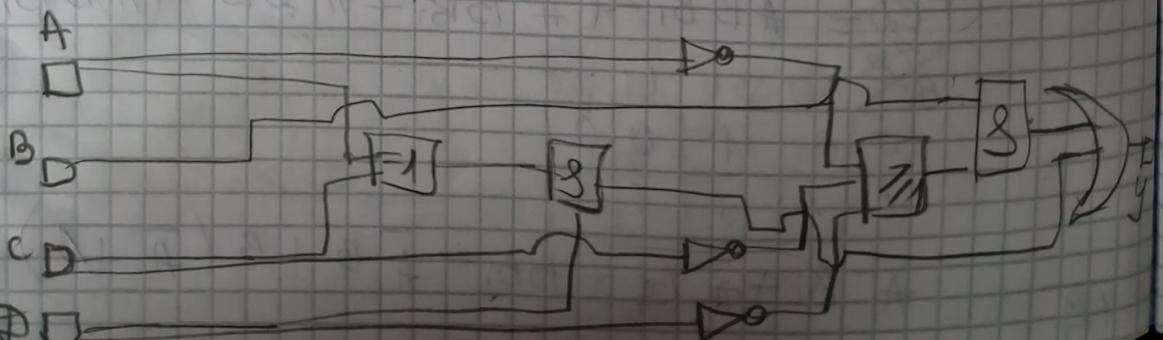
$$\begin{aligned}
 FCD &= \pi(5, 6, 11, 12, 14, 15) = M(5, 6, 11, 12, 14, 15) \\
 &= (A + \bar{B} + C + \bar{D})(A + \bar{B} + \bar{C} + D)(\bar{A} + B + \bar{C} + \bar{D}) \\
 &\quad (\bar{A} + \bar{B} + C + D)(\bar{A} + \bar{B} + \bar{C} + \bar{D})(\bar{A} + \bar{B} + \bar{C} + D)
 \end{aligned}$$

$$\begin{aligned}
 FCD &= \sum (0, 1, 2, 3, 4, 7, 8, 9, 10, 13) = \\
 &= m(0, 1, 2, 3, 4, 7, 8, 9, 10, 13) = \\
 &= \bar{A}\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}\bar{C}D + \bar{A}\bar{B}C\bar{D} + \bar{A}\bar{B}CD + \bar{A}B\bar{C}\bar{D} + \\
 &\quad + \bar{A}B\bar{C}D + \bar{A}BC\bar{D} + \bar{A}B\bar{C}\bar{D} + \bar{A}B\bar{C}D + AB\bar{C}\bar{D}
 \end{aligned}$$

	00	01	11	10
00	0	1	0	1
01	1	0	1	0
11	0	1	1	0
10	1	0	0	1

$$FCD = \bar{A}\bar{B} + \bar{B}\bar{C} + \bar{B}\bar{D} + A\bar{C}\bar{D} + \bar{A}C\bar{D}$$

$$Y = \bar{B}(\bar{A} + \bar{C} + \bar{D}) + \bar{D}(A \oplus C)$$



Pentru c.

$$FCC = \overline{P} (2, 12, 14, 15) = M(2, 12, 14, 15)$$

$$= (A + B + \bar{C} + \bar{D}) (\bar{A} + \bar{B} + C + D) (\bar{A} + \bar{B} + \bar{C} + D)$$

$$(\bar{A} + \bar{B} + \bar{C} + \bar{D})$$

$$FC\bar{D} = \sum (0, 1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 13) =$$

$$= m(0, 1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 13) =$$

$$= \bar{A}\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}C\bar{D} + \bar{A}\bar{B}C\bar{D} + \bar{A}\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}\bar{C}\bar{D}$$

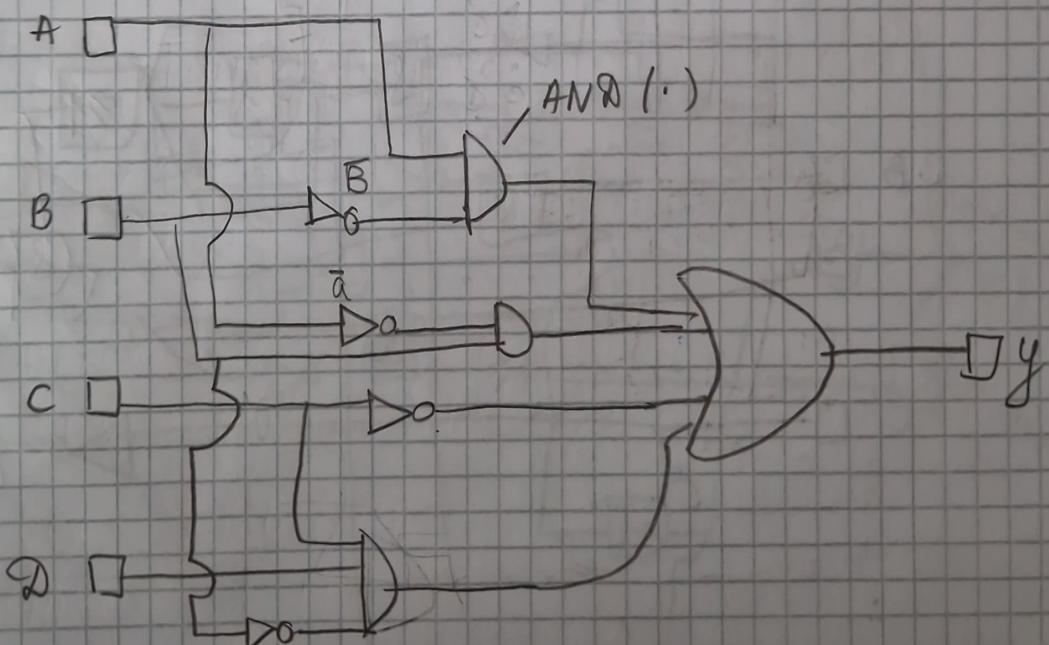
$$+ \bar{A}B\bar{C}\bar{D} + \bar{A}B\bar{C}\bar{D} + A\bar{B}\bar{C}\bar{D} + A\bar{B}\bar{C}\bar{D} +$$

$$A\bar{B}\bar{C}\bar{D} + A\bar{B}C\bar{D} + A\bar{B}C\bar{D}$$

	$\bar{A}B$	$\bar{A}\bar{B}$	$A\bar{B}$	AB
$\bar{C}\bar{D}$	00	00	01	11
$\bar{C}D$	01	11	11	10
$C\bar{D}$	11	11	00	11
CD	10	01	10	10

$$FC\bar{D} = \bar{A}B + \bar{C} + A\bar{B} + \bar{B} \in \mathbb{D}$$

$$y = (A \oplus B) + \bar{C} + \bar{B}CD$$



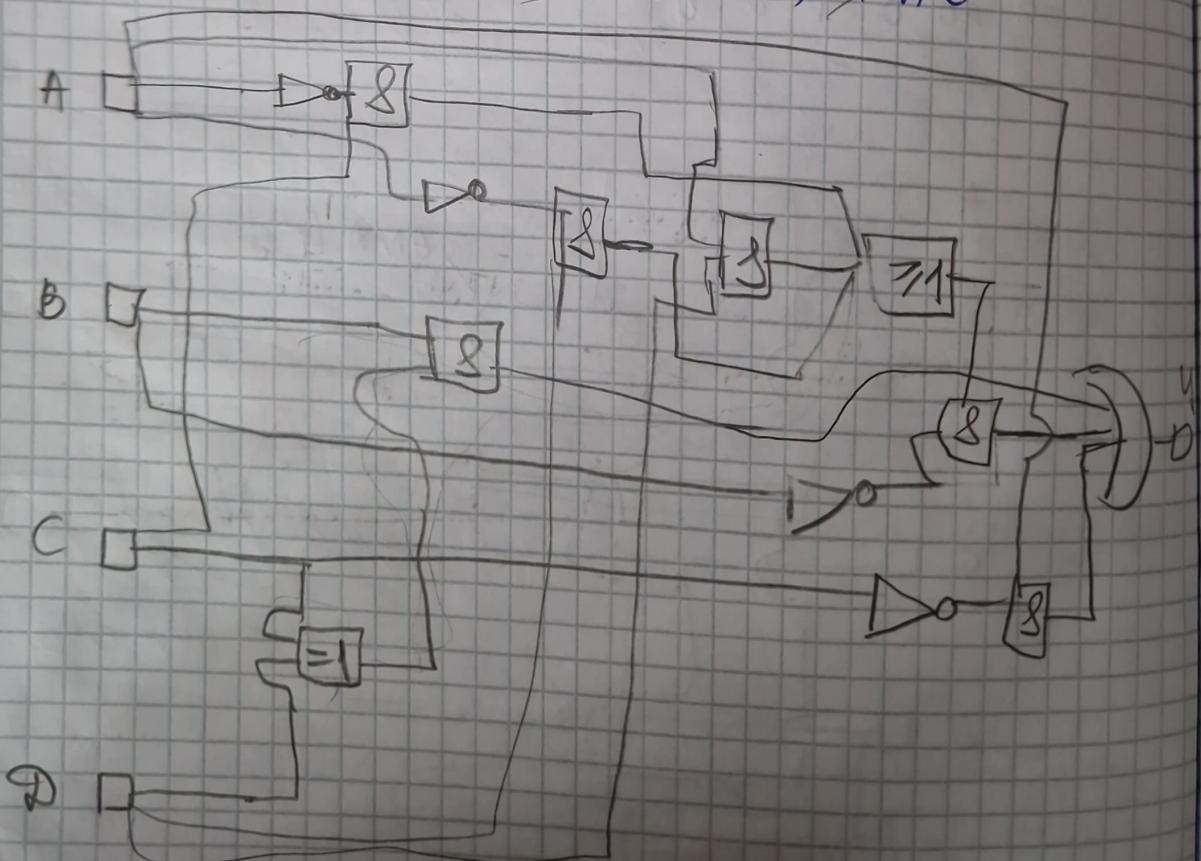
Pentru d:

$$FCC = \prod_{i=1}^4 (A + B + C + D) (A + \bar{B} + C + D) (A + \bar{B} + \bar{C} + D) \\ (A + B + \bar{C} + D) (\bar{A} + \bar{B} + \bar{C} + D)$$

$$FCD = \sum_{i=0}^{14} (0, 2, 3, 5, 6, 8, 9, 11, 12, 13, 14) = \\ m(0, 2, 3, 5, 6, 8, 9, 11, 12, 13, 14) = \\ \bar{A}\bar{B}\bar{C}\bar{D} + A\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}C\bar{D} + \bar{A}\bar{B}\bar{C}D + \bar{A}B\bar{C}\bar{D} + \\ + A\bar{B}\bar{C}\bar{D} + A\bar{B}\bar{C}D + A\bar{B}C\bar{D} + AB\bar{C}\bar{D} + A\bar{B}\bar{C}\bar{D} + ABC\bar{D}$$

$\bar{A}B$	$\bar{A}\bar{B}$	$A\bar{B}$	AB	$A\bar{B}$
00	0	0	1	1
$C\bar{D}$	0	0	1	2
$\bar{B}\bar{D}$	0	1	0	1
$\bar{C}\bar{D}$	1	0	1	1
CD	1	1	0	0
$C\bar{D}$	1	1	1	1
$\bar{C}\bar{D}$	0	1	1	0

$$FCD = \bar{A}\bar{C} + B\bar{C}\bar{D} + \bar{A}\bar{B}\bar{C} + \\ + A\bar{B}\bar{D} + B\bar{C}\bar{D} + \bar{A}\bar{B}\bar{D} \\ = \cancel{B}(\cancel{\bar{A}\bar{C}} + \cancel{\bar{A}\bar{D}} + \cancel{A\bar{D}}) + \\ + B(C\bar{D}) + \bar{A}\bar{C}$$



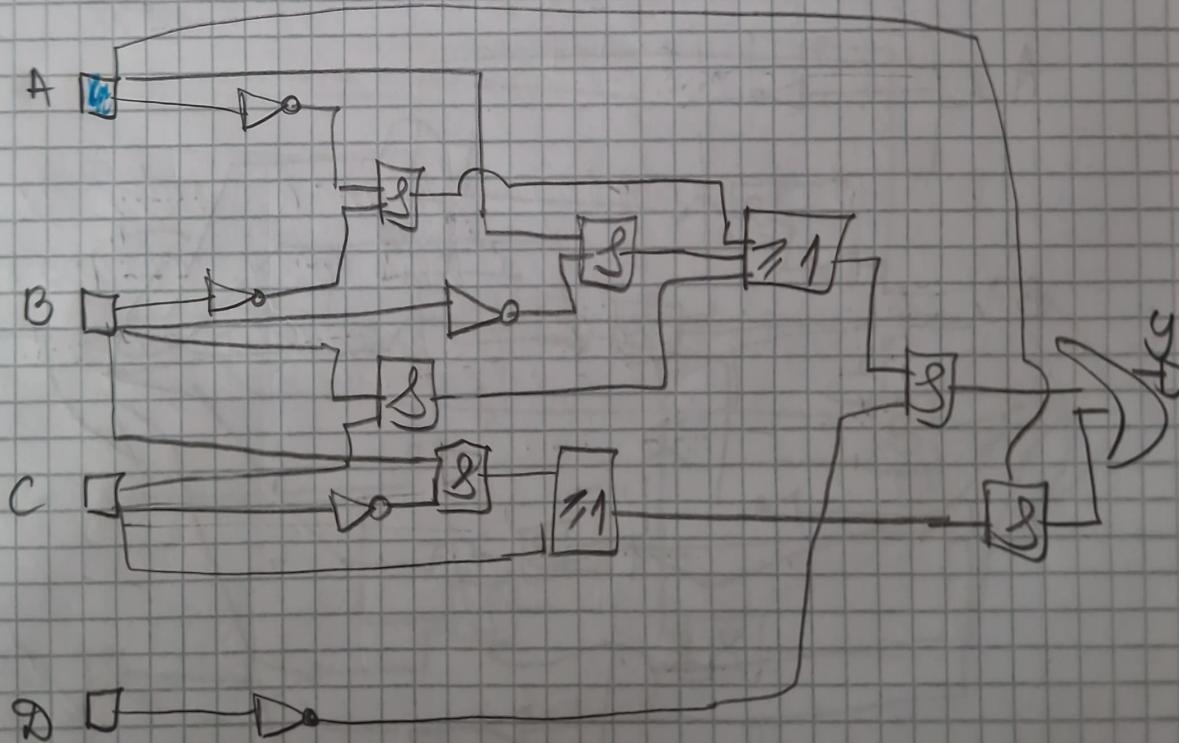
Pentru ϵ :

$$\begin{aligned} FCC &= \overline{\pi}(1, 3, 4, 5, 7, 9) = M(1, 3, 4, 5, 7, 9) \\ &= (A + B + C + \bar{D})(A + B + \bar{C} + \bar{D})(A + \bar{B} + C + D) \\ &\quad (A + \bar{B} + C + \bar{D})(A + \bar{B} + \bar{C} + \bar{D})(\bar{A} + B + C + \bar{D}) \end{aligned}$$

$$\begin{aligned} FCD &= \sum(0, 2, 6, 8, 10, 11, 12, 13, 14, 15) = \\ &= m(0, 2, 6, 8, 10, 11, 12, 13, 14, 15) = \\ &= \bar{A}\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}C\bar{D} + \bar{A}B\bar{C}\bar{D} + A\bar{B}\bar{C}\bar{D} + A\bar{B}C\bar{D} + \\ &\quad A\bar{B}C\bar{D} + ABC\bar{D} + AB\bar{C}\bar{D} + AB\bar{C}\bar{D} + ABC\bar{D}. \end{aligned}$$

	$\bar{A}B$	$\bar{A}\bar{B}$	AB	$A\bar{B}$
$\bar{C}\bar{D}$	00	01	11	10
$\bar{C}\bar{D}$ 00	1	0	1	1
$\bar{C}\bar{D}$ 01	0	0	1	0
$\bar{C}\bar{D}$ 11	0	0	1	1
$\bar{C}\bar{D}$ 10	1	1	1	0

$$\begin{aligned} FCD &= \bar{A}\bar{B}\bar{C}\bar{D} + B\bar{C}\bar{D} + \\ &\quad + AC + A\bar{B}\bar{D} + A\bar{B}\bar{C} \\ &= \bar{D}(\bar{A}\bar{B} + BC + A\bar{B}) + \\ &\quad + A(C + B\bar{C}) \end{aligned}$$



Pentru f:

$$FCC = \overline{A}(\overline{B}\overline{C}\overline{D}) + A(\overline{B}\overline{C}D) + \overline{A}B(\overline{C}\overline{D}) + A\overline{B}(\overline{C}D) + A\overline{B}C(\overline{D}) + A\overline{B}CD + ABC(\overline{D}) + ABCD$$

$$= M(0, 4, 5, 6, 8, 9, 10, 11, 12, 14, 15)$$

$$FCD = \sum(0, 4, 5, 6, 8, 9, 10, 11, 12, 14, 15) =$$

$$= m(0, 4, 5, 6, 8, 9, 10, 11, 12, 14, 15) =$$

$$= \overline{A}\overline{B}\overline{C}\overline{D} + \overline{A}\overline{B}\overline{C}D + \overline{A}B\overline{C}\overline{D} + \overline{A}BC\overline{D} + A\overline{B}\overline{C}\overline{D} +$$

$$+ A\overline{B}\overline{C}D + A\overline{B}C\overline{D} + A\overline{B}CD + ABC\overline{D} + ABCD$$

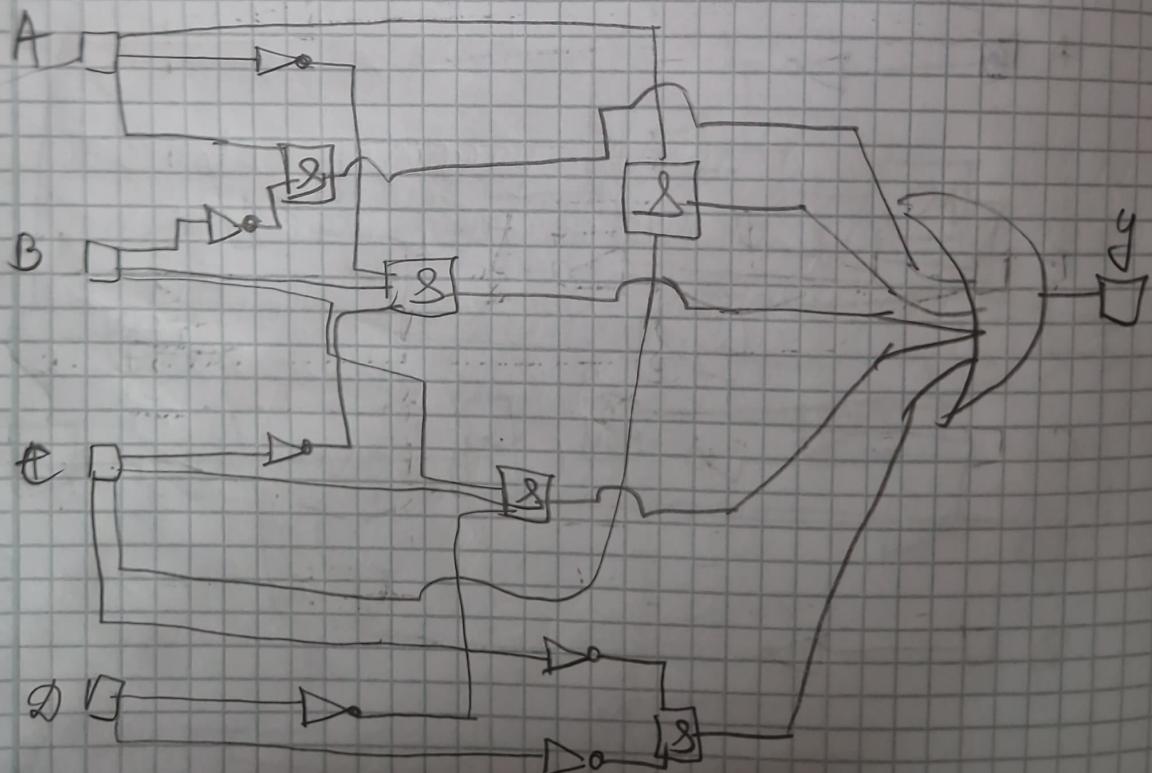
	$\overline{A}\overline{B}$	$\overline{A}B$	$A\overline{B}$	AB
$\overline{C}\overline{D}$	00	01	11	10
$\overline{C}D$	00	11	11	11
$C\overline{D}$	01	00	10	10
CD	11	00	11	11
$C\overline{D}$	10	01	11	10

$$FCD = \cancel{\overline{C}\overline{D}} + A\overline{B} +$$

$$+ AC + BC\overline{D} +$$

$$+ \cancel{A}\overline{B}\overline{C} = \overline{B}(B\overline{C} + \overline{C}) +$$

$$+ A(C + \overline{B}) + \overline{A}B\overline{C}$$



Pentru g :

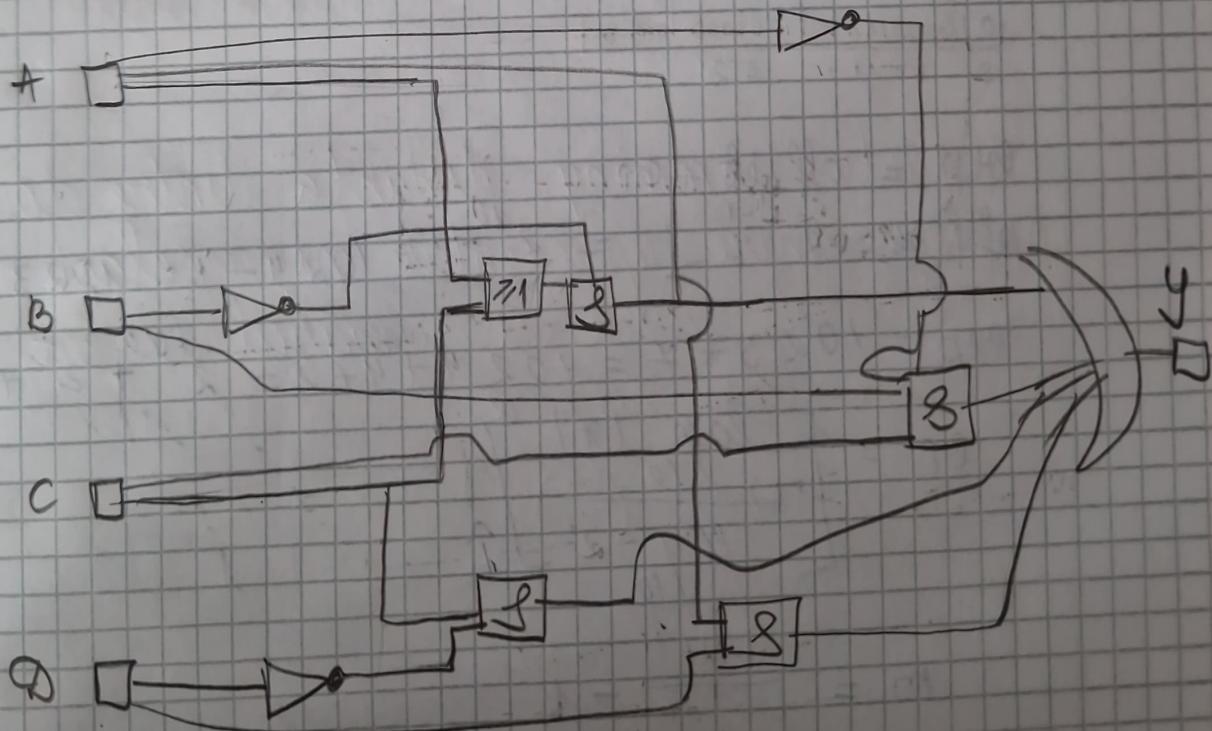
$$FCC = \prod (0, 1, 4, 12) = M(0, 1, 4, 12) = \\ = (A + B + C + D)(A + B + C + \bar{D})(A + \bar{B} + \bar{C} + \bar{D})(\bar{A} + \bar{B} + C + D)$$

$$FC\bar{D} = \sum (2, 3, 4, 5, 6, 8, 9, 10, 11, 13, 14, 15) \\ = m(2, 3, 4, 5, 6, 8, 9, 10, 11, 13, 14, 15)$$

$$= \bar{A}\bar{B}C\bar{D} + \bar{A}\bar{B}C\bar{D} + \bar{A}\bar{B}C\bar{D} + \bar{A}\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}C\bar{D} + A\bar{B}\bar{C}\bar{D} + \\ + A\bar{B}\bar{C}\bar{D} + A\bar{B}\bar{C}\bar{D} + A\bar{B}C\bar{D} + A\bar{B}\bar{C}D + AB\bar{C}\bar{D} + AB\bar{C}D$$

$\bar{A}\bar{B}$	$\bar{A}\bar{D}$	\bar{B}	AB	$A\bar{B}$
$\bar{C}\bar{D}$	0 0	0 1	1 1	1 0
$\bar{C}\bar{D}$	0 0	0 1	1 3	1 9
$\bar{C}\bar{D}$	0 1	1 0	1 15	1 11
$\bar{C}\bar{D}$	1 1	1 0	1 1	1 1
$\bar{C}\bar{D}$	1 0	1 6	1 14	1 10

$$FC\bar{D} = A\bar{B} + C\bar{D} + \bar{B}C + \\ + A\bar{D} + \bar{A}\bar{B}\bar{C} = \\ = \bar{B}(\underline{A} + C) + \underline{C\bar{D}} + \underline{A\bar{D}} + \\ + \underline{A\bar{B}\bar{C}}$$



08.11.2023

Kabonator VI

(Binary 64)

$$128 + 32 + 4 = 2^7 + 2^5 + 2^4$$

1 0 1 0 0 1 0 0, 0 1 0 0 0 1 0 1

$$0,24 \times 2 = 0,54 \quad 0$$

$$0,54 \times 2 = 1,08 \quad 1$$

$$0,08 \times 2 = 0,16 \quad 0$$

$$0,16 \times 2 = 0,32 \quad 0$$

$$0,32 \times 2 = 0,64 \quad 0$$

$$0,64 \times 2 = 1,28 \quad 1$$

$$0,28 \times 2 = 0,56 \quad 0$$

$$0,56 \times 2 = 1,12 \quad 1$$

↓

$$\begin{aligned} & 2^7 + 2^5 + 2^2 + 2^{-2} + 2^{-6} + 2^{-8} = \\ & = 2^7 \left(1 + 2^{-2} + 2^{-5} + 2^{-9} + 2^{-13} + 2^{-15} \right) \\ & \underline{\underline{(0|1000000110|01\ 001000\ 1000\ 0)}} \\ & \qquad \qquad \qquad S \quad k=11 \quad 52 \end{aligned}$$

$$exp = offset + e^n$$

$$offset = 2^{k-1} - 1 = 2^{10} - 1 = 1024 - 1 = 1023$$

$$exp = 1023 + 7 = 1024 + 4 + 2 = 2^{10} + 2^2 + 2^1$$

$$e^n = \left\lceil \frac{\log_{10}(1+1)}{\log_{10}2} \right\rceil$$

$$m = \frac{17+1}{2^{e^n}} - 1$$

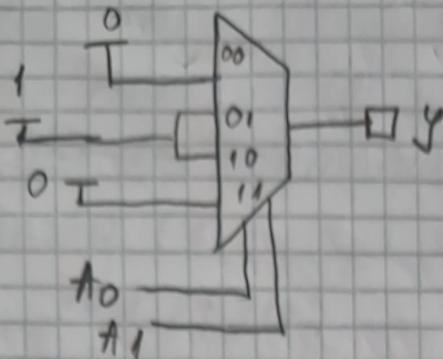
$$\begin{array}{ccc} A & B & y \\ 0 & 0 & 0 \end{array}$$

$$\begin{array}{ccc} 0 & 1 & 1 \end{array}$$

$$\begin{array}{ccc} 1 & 0 & 1 \\ 1 & 1 & 0 \end{array}$$

2^4

Bitii de adresă acoperă întreg spațiul de valori



$$Y = \bar{A}\bar{B}D_0 + \bar{A}BD_1 + A\bar{B}D_2 + AB\bar{D}_3$$

$$Y(0,0) = 0$$

$$Y(0,1) = 1$$

$$Y(1,0) = 1$$

$$Y(1,1) = 0$$

$$\begin{array}{r} 5 - 4 = \\ \hline 1 & 0 & 1 & - \\ & 1 & 1 & 1 \\ \hline & 1 & 1 & 0 \\ \hline \end{array}$$

$$\begin{array}{r} 0 & 1 & 0 & 1 & - & x \\ 0 & 1 & 1 & 1 & - & y \\ \hline & & & & & x - y = x + \bar{y} + 1 \\ & & & & & \bar{y} = 1000 \end{array}$$

$$\bar{y} + 1 = 1001$$

$$\begin{array}{r} 0 & 1 & 0 & 1 & + \\ 1 & 0 & 0 & 1 & \\ \hline 0 & 1 & 1 & 0 & \end{array}$$

Dacă nr. e negativ, o reprez. în complementul față de 2

$$25 \quad \bar{x} = 0001 \quad \bar{x} + 1 = 0010 \Rightarrow$$