

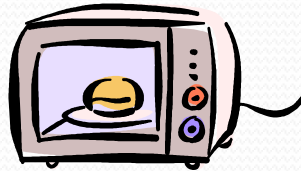
Logică computațională

Curs 13

Lector dr. Pop Andreea-Diana

Circuite logice

- circuite electronice simple

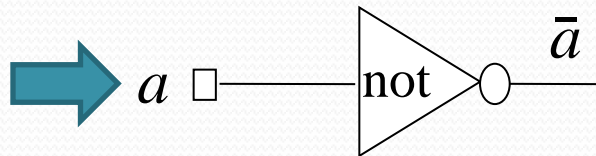
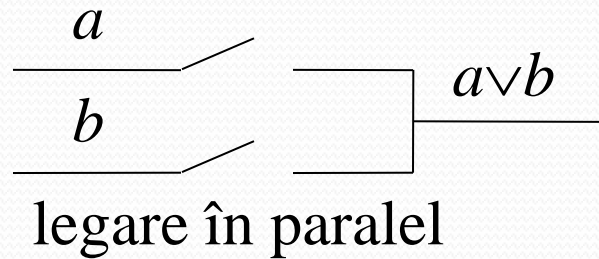
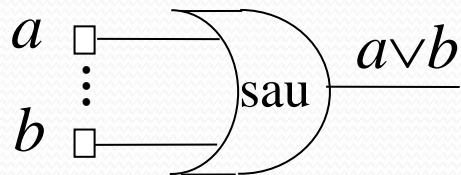
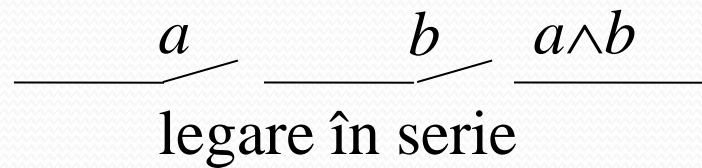
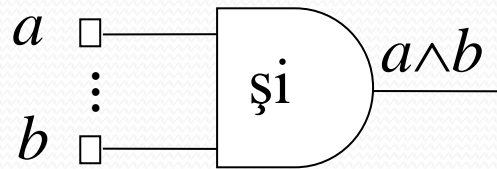


- modelarea – se face cu ajutorul *funcțiilor booleene* și a *circuitelor logice* care descriu algebric și grafic funcționarea acestora.

Porțile logice

- sunt elementele de bază ale unui circuit logic
- sunt utilizate pentru modelarea circuitelor
- **Definiție:** O *poartă* este un minicircuit logic care realizează una dintre operațiile logice de bază: \wedge , \vee , \neg .

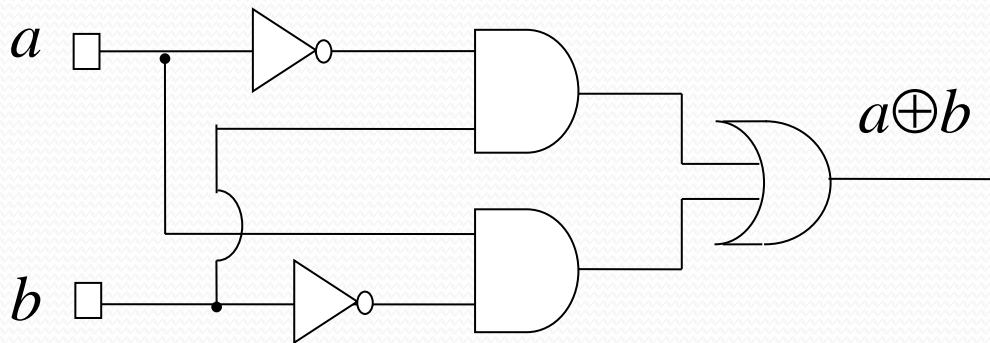
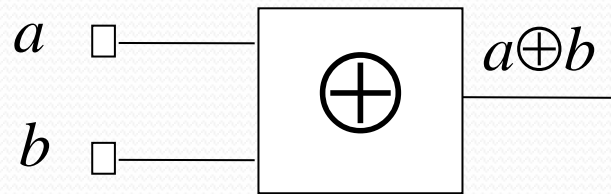
Porțile logice – conform standardelor IEEE



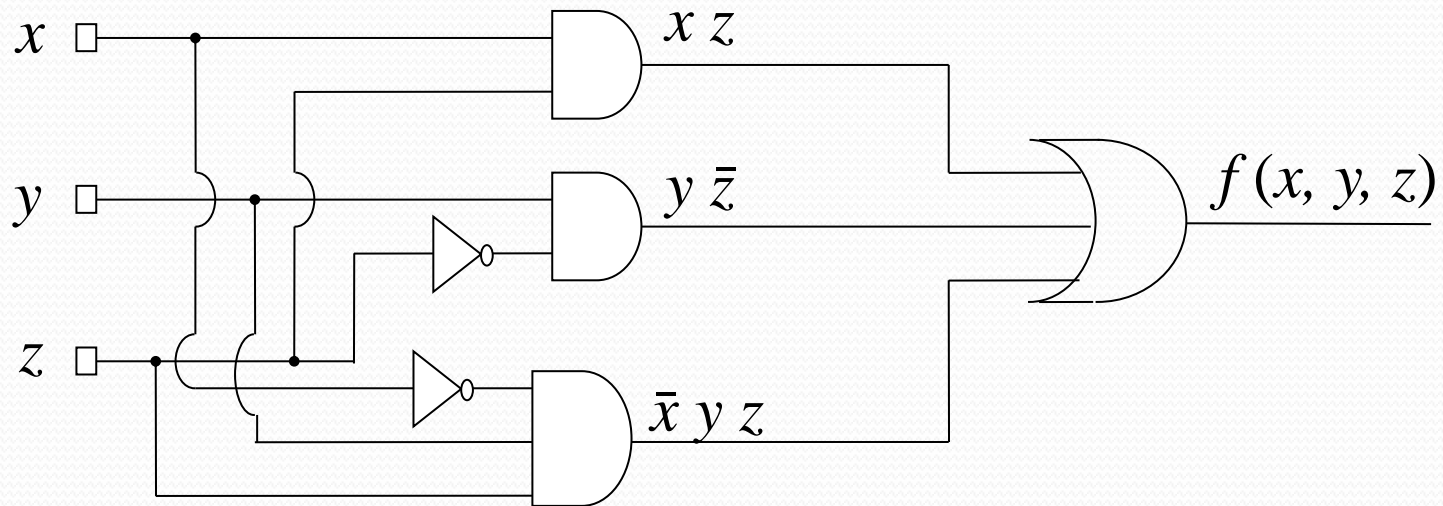
Circuite integrate

- 14-16 ”pini”
 - o parte porți de intrare
 - o parte sunt utilizate pentru conexiunea la curent
- Observație: forma disjunctivă este cel mai simplu de realizat

Exercițiu – desenați circuitul

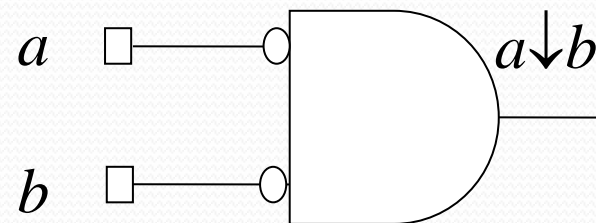
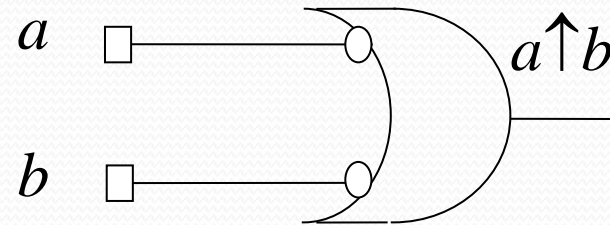
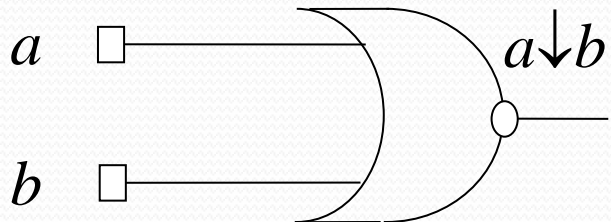
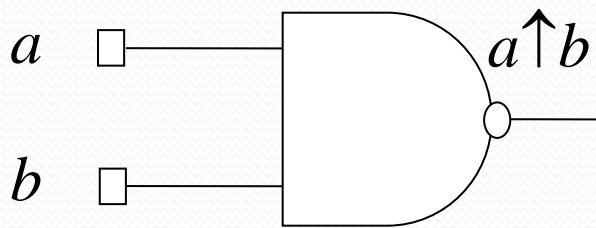
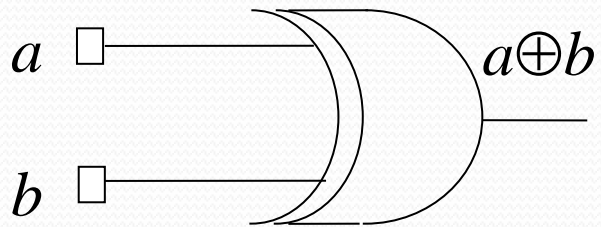


Exercițiu – $f(x, y, z) = ?$



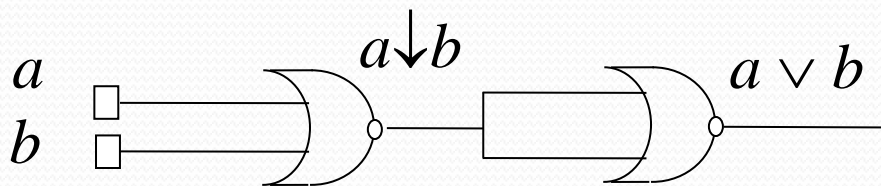
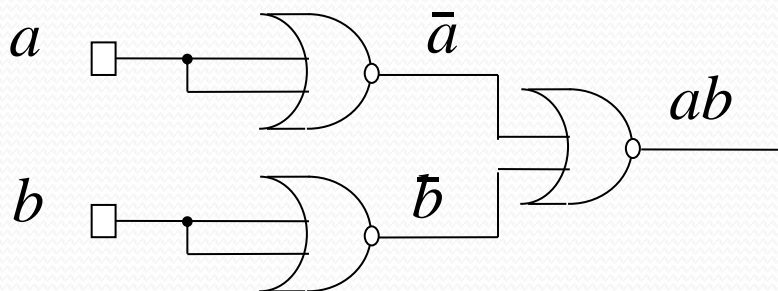
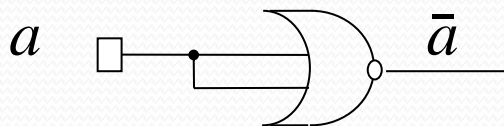
$$f(x, y, z) = xz \vee y\bar{z} \vee \bar{x}yz$$

Porți derivate



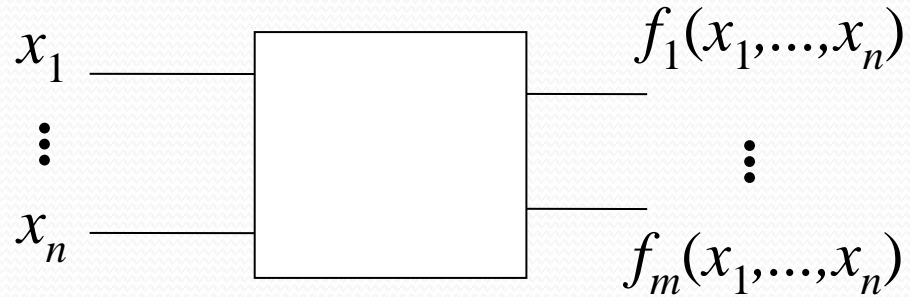
Exercițiu

- Desenați circuitele operațiilor logice „și”, „sau”, „not” folosind doar poartă „**nor**” / „nand”



Circuit combinațional

- Un circuit logic cu m ieșiri se numește ***circuit combinațional***.



Circuite logice combinaționale ∈ Hard-ul calculatorului

- decodorul
- circuitul comparator
- circuitul sumator

- detectorul de paritate
- ”shift”
- ...

Pașii principali pentru desenarea circuitelor

1. identificarea intrărilor (variabilelor) / ieșirilor (funcțiilor)
2. construirea tabelului de valori asociate
3. obținerea expresiilor funcțiilor
4. simplificarea funcțiilor
5. desenarea circuitului

Decodorul

1.

- intrare: 4 cifre binare - x_1, x_2, x_3, x_4
- ieșire: $f_i(x_1, x_2, x_3, x_4) = 1$ pentru $x_1x_2x_3x_4_{(2)} = i_{(10)}$, $i = \overline{0, 9}$

Decodorul (2)

2.

3.

x_1	x_2	x_3	x_4	f_0	f_1	f_2	f_3	f_4	f_5	f_6	f_7	f_8	f_9	FCD (cu un singur element)
0	0	0	0	1	0	0	0	0	0	0	0	0	0	$f_0(x_1, x_2, x_3, x_4) = \bar{x}_1 \bar{x}_2 \bar{x}_3 \bar{x}_4$
0	0	0	1	0	1	0	0	0	0	0	0	0	0	$f_1(x_1, x_2, x_3, x_4) = \bar{x}_1 \bar{x}_2 \bar{x}_3 x_4$
0	0	1	0	0	0	1	0	0	0	0	0	0	0	$f_2(x_1, x_2, x_3, x_4) = \bar{x}_1 \bar{x}_2 x_3 \bar{x}_4$
0	0	1	1	0	0	0	1	0	0	0	0	0	0	$f_3(x_1, x_2, x_3, x_4) = \bar{x}_1 \bar{x}_2 x_3 x_4$
0	1	0	0	0	0	0	0	1	0	0	0	0	0	$f_4(x_1, x_2, x_3, x_4) = \bar{x}_1 x_2 \bar{x}_3 \bar{x}_4$
0	1	0	1	0	0	0	0	0	1	0	0	0	0	$f_5(x_1, x_2, x_3, x_4) = \bar{x}_1 x_2 \bar{x}_3 x_4$
0	1	1	0	0	0	0	0	0	0	1	0	0	0	$f_6(x_1, x_2, x_3, x_4) = \bar{x}_1 x_2 x_3 \bar{x}_4$
0	1	1	1	0	0	0	0	0	0	0	1	0	0	$f_7(x_1, x_2, x_3, x_4) = \bar{x}_1 x_2 x_3 x_4$
1	0	0	0	0	0	0	0	0	0	0	0	1	0	$f_8(x_1, x_2, x_3, x_4) = x_1 \bar{x}_2 \bar{x}_3 \bar{x}_4$
1	0	0	1	0	0	0	0	0	0	0	0	0	1	$f_9(x_1, x_2, x_3, x_4) = x_1 \bar{x}_2 \bar{x}_3 x_4$

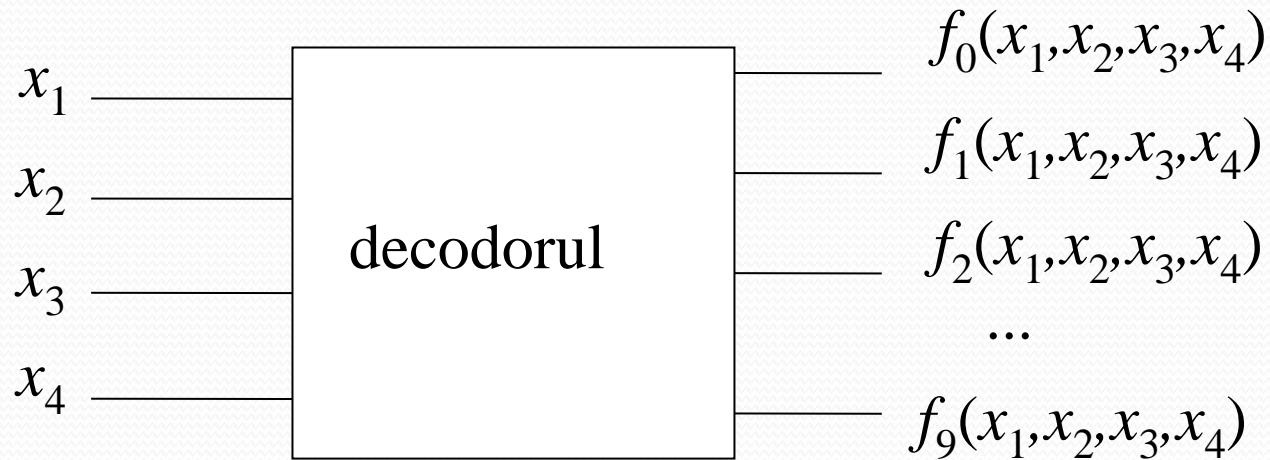
...

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Circuitul decodor – forma generală

4. ...

5. ...



Circuitul comparator

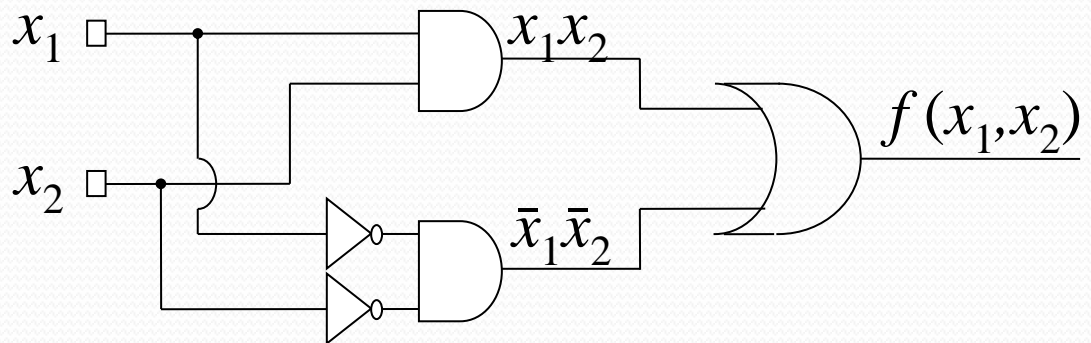
- verifică dacă două cifre binare sunt sau nu identice 1.

2.

x_1	x_2	$f(x_1, x_2)$
0	0	1
0	1	0
1	0	0
1	1	1

3. $f(x_1, x_2) = \bar{x}_1 \bar{x}_2 \vee x_1 x_2$ 4.

5.

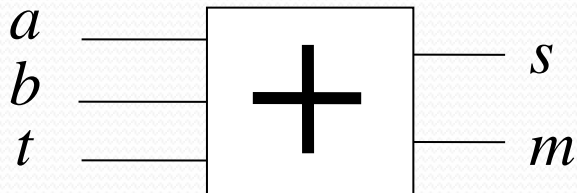


Sumatorul binar

- calculează suma a două cifre binare: a și b de pe aceeași poziție dintr-un număr binar

1.

- intrare: a , b , transportul t
- ieșire: s ($= a + b$), transportul m



2.

t	a	b	s	m
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

3.

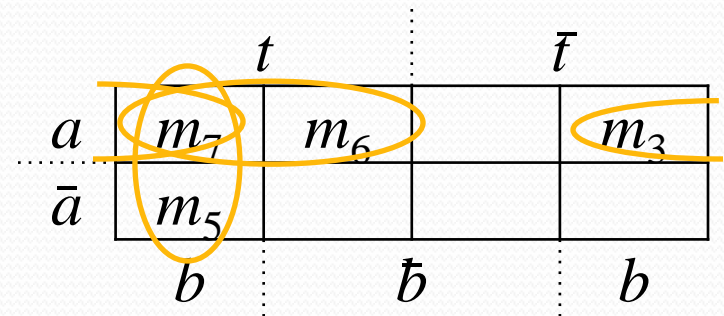
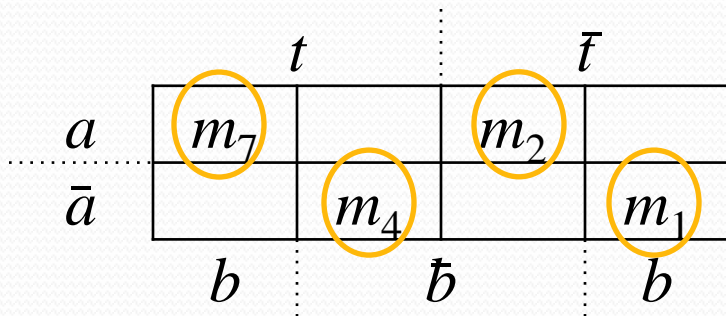
$$s(a,b,t) = \bar{t} \bar{a}b \vee \bar{t} a\bar{b} \vee t\bar{a}\bar{b} \vee tab$$

$$m(a,b,t) = \bar{t} ab \vee t\bar{a}b \vee ta\bar{b} \vee tab$$

4.Simplificarea

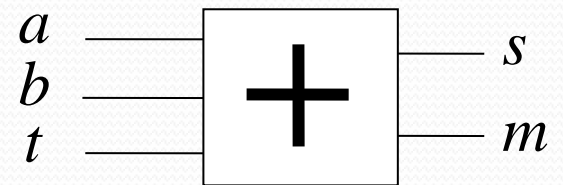
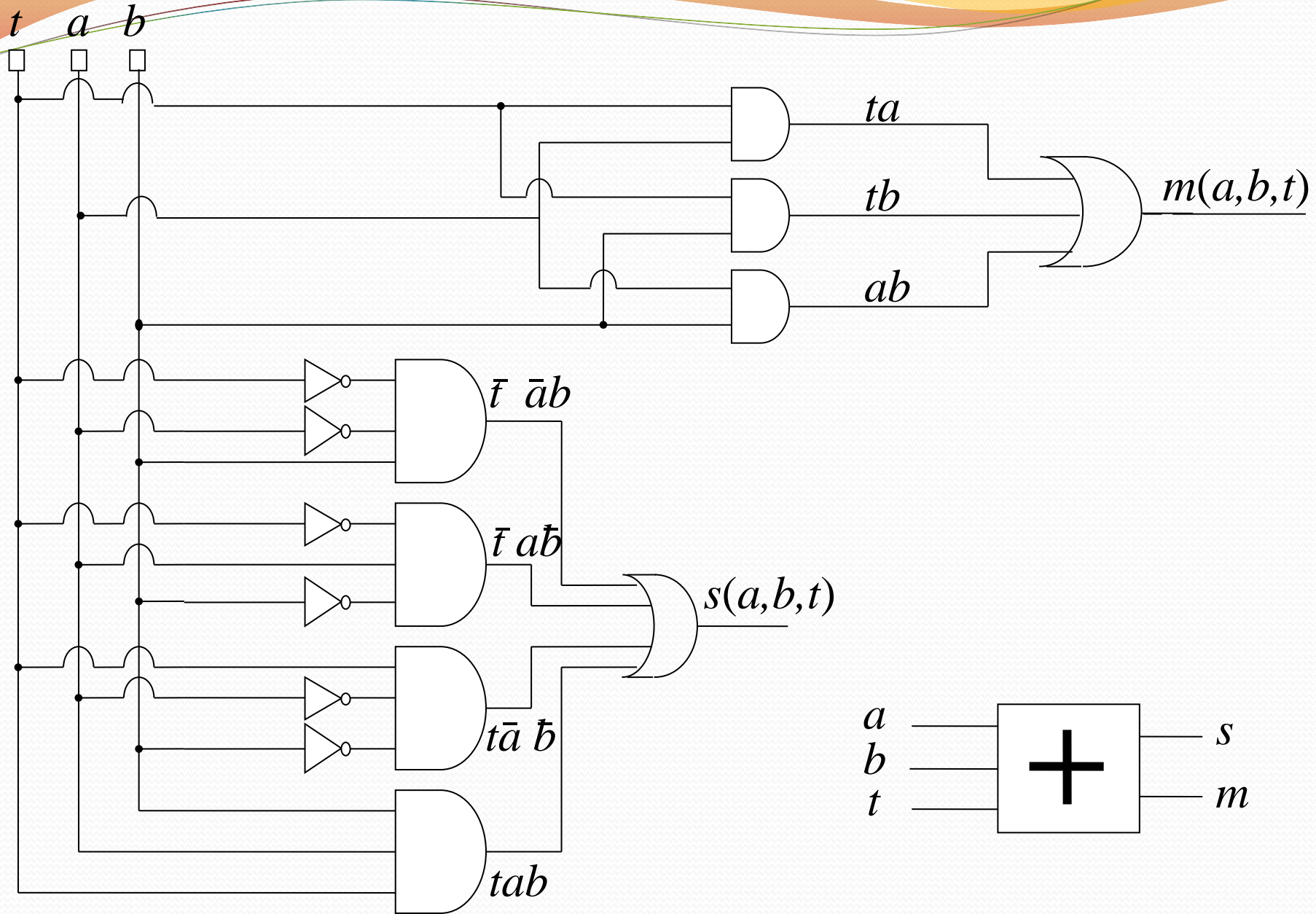
$$m(a,b,t) = \bar{t} ab \vee t\bar{a} b \vee ta\bar{b} \vee tab$$

$$s(a,b,t) = \bar{t} \bar{a} b \vee \bar{t} a\bar{b} \vee t\bar{a} \bar{b} \vee tab$$



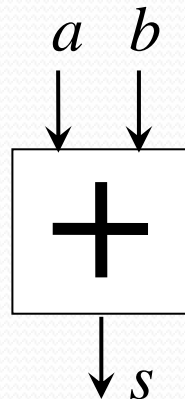
$$m(a,b,t) = ta \vee tb \vee ab$$

5. Circuitele

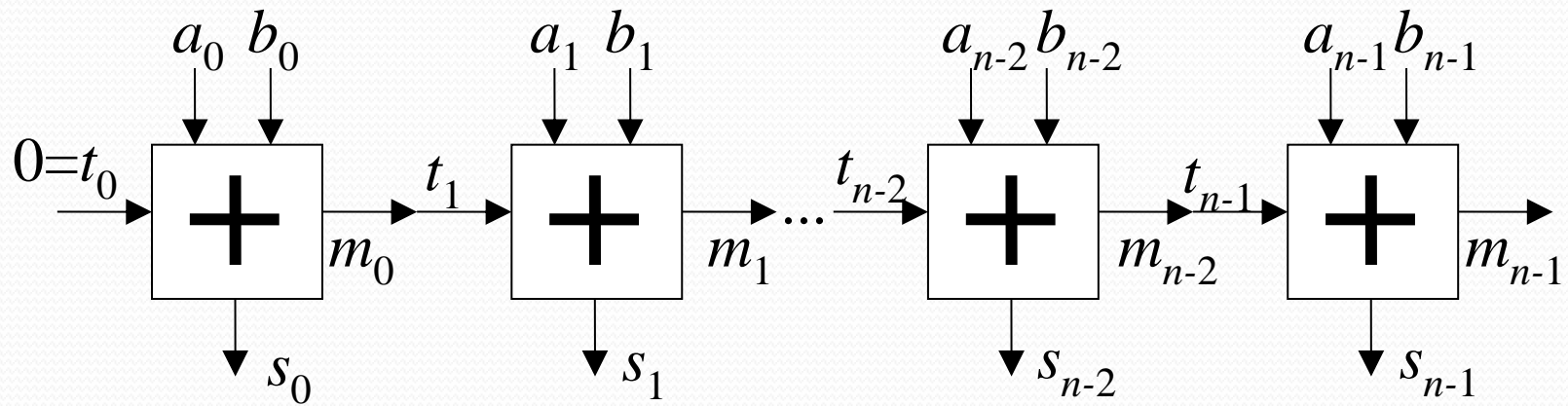


Sumatorul binar cu n poziții

- $a = a_{n-1} \dots a_0 (2)$ și $b = b_{n-1} \dots b_0 (2)$
- $s = s_{n-1} \dots s_0 (2)$

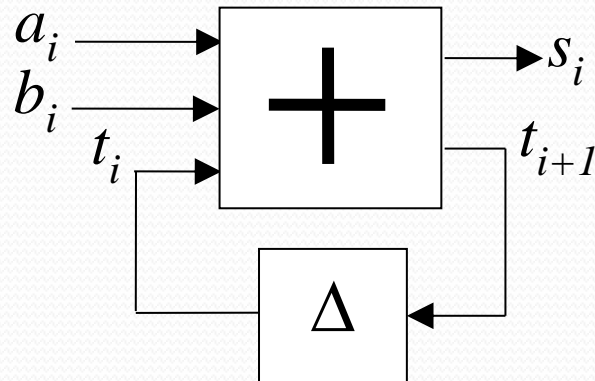


Compunere de sumatoare simple



Circuit cu întârziere

- cifra de transport obținută la un pas se folosește în pasul următor



Indicații "anti - încălcire"

