

# Uppgift 1

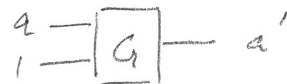
a	b	a+b	y
0	0	0	0
0	1	1	1
1	0	1	0
1	1	1	0

$$y = G(a, b) = a \oplus (a+b) = a'b$$



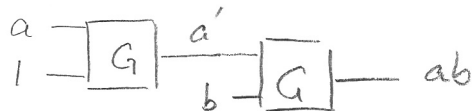
## NOT

$$y = G(a, 1) = a' \cdot 1 = a'$$



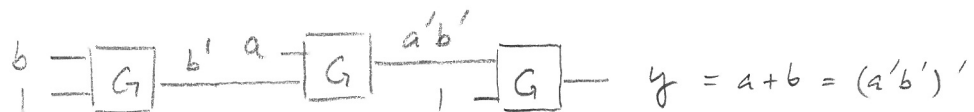
## AND

$$y = ab = G(a', b) = G(G(a, 1), b)$$



## OR

$$y = (a+b)'' = (a'b')' = G(a'b', 1) = G(G(a, b'), 1) = G(G(a, G(b, 1)), 1)$$

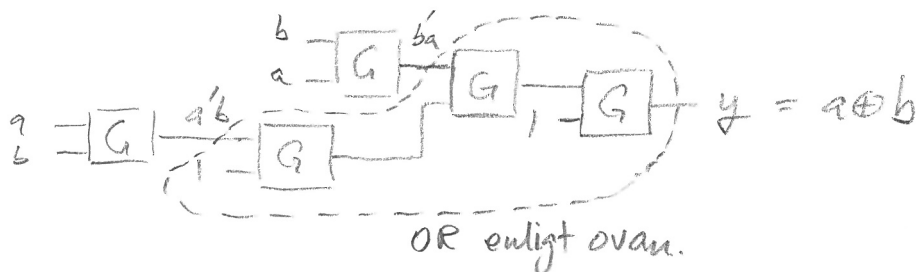


## XOR

$$y = a \oplus b = ab' + a'b = G(b, a) + G(a, b) =$$

$$= G(G(G(b, a), G(G(a, b), 1)), 1)$$

↑ OR implementeras som ovan



# Uppgift 2

	x=0	x=1
A	A/0	B/1
B	D/1	$\bar{C}$ /0
$\bar{C}$	$\bar{E}$ /1	D/0
D	A/0	B/1
$\bar{E}$	F/0	$\bar{C}$ /0
F	D/0	$\bar{B}$ /1

1-ekv. klasser:

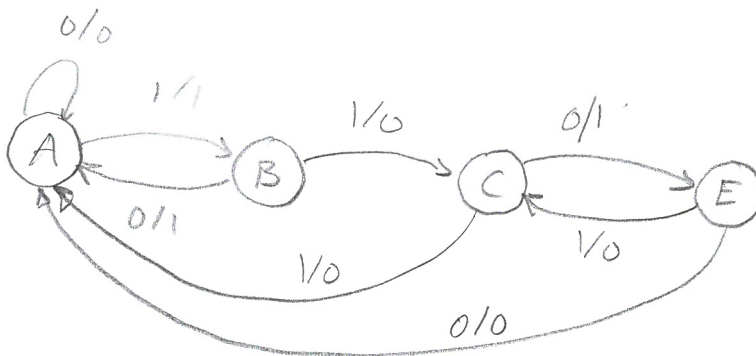
$$P_1 = \{\{A, D, F\}, \{B, C\}, \{E\}\}$$

2-ekv. klasser:

$$P_2 = \{\{A, D, F\}, \{B\}, \{C\}, \{E\}\} = P_3$$

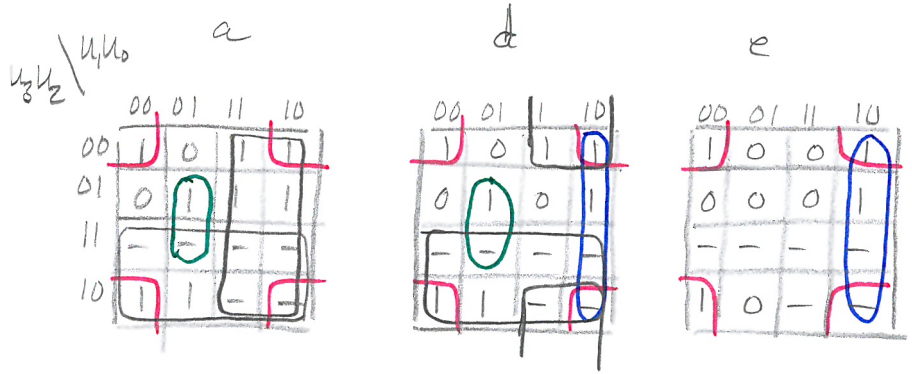
Ersätt  $\{A, D, F\}$  med A

	x=0	x=1
A	A/0	B/1
B	A/1	C/0
C	E/1	A/0
E	A/0	C/0



# Uppgift 3

$u_3 u_2 u_1 u_0$	a	d	e
0000	111		
0001	000		
0010	111		
0011	110		
0100	000		
0101	110		
0110	111		
0111	100		
1000	111		
1001	110		
z.o.	---		

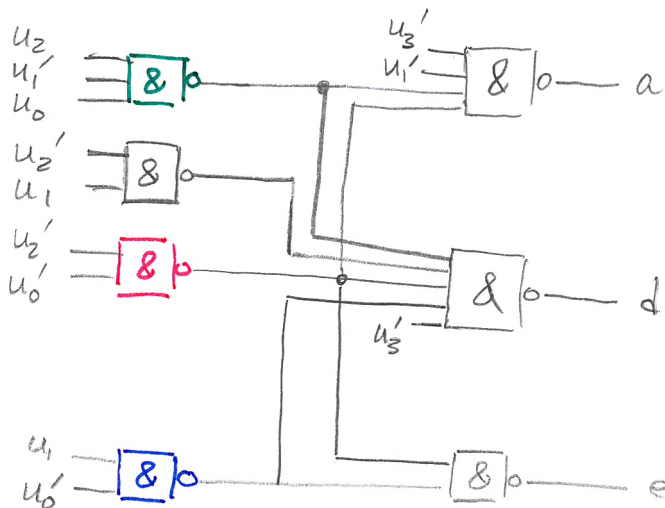


$$a = (u_3 + u_1 + u_2' u_0' + u_2 u_1' u_0)'' = (u_3' u_1' (u_2' u_0')' (u_2 u_1' u_0)')'$$

$$d = (u_3 + u_2' u_0' + u_2 u_1 + u_1 u_0' + u_2 u_1' u_0)'' = (u_3' (u_2' u_0')' (u_2 u_1)' (u_1 u_0')' (u_2 u_1' u_0)')'$$

$$e = (u_2' u_0' + u_1 u_0')'' = ((u_2' u_0')' (u_1 u_0')')'$$

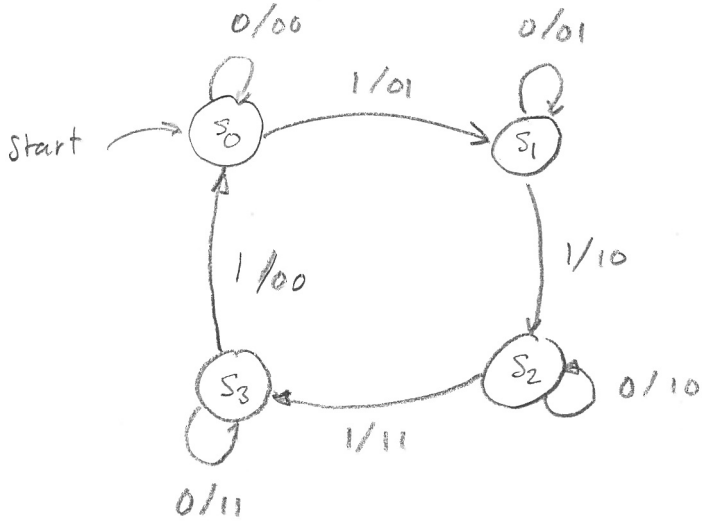
$u_i \rightarrow \boxed{1} \rightarrow u_i'$  for  $i \in \{0, 1, 2, 3\}$



Totalt krävs 7 NAND-grindar och 4 inverterare.

# Uppgift 4

## Diagram



Välj tillstånd så att  
nästa tillstånd = utsignal

$$q_1^+ = u_1$$

$$q_0^+ = u_0$$

$q_1 q_0$	
$s_0$	00
$s_1$	01
$s_2$	10
$s_3$	11

## Tabell

$q_1 q_0$	$q_1^+ q_0^+$	
	$x=0$	$x=1$
00	00	01
01	01	10
11	11	00
10	10	11

## K-diagram

$q_1 q_0$	$q_1^+ / u_1$		$q_0^+ / u_0$	
	$x$		$x$	
	0	1	0	1
00	0	0	0	1
01	0	1	1	0
11	1	0	1	0
10	1	1	0	1

Cell 1  $q_1 q_0 = 00$

$(q_1^+ = 0) \quad q_0^+ = x$

Cell 2  $q_1 q_0 = 00$  eller 01

$q_1^+ = q_0 x \quad q_0^+ = q_0 \oplus x$

Cell 3  $q_1 q_0 = 00$  eller 01 eller 10

$q_1^+ = q_1 + q_0 x \quad q_0^+ = q_0 \oplus x$

Cell 4 - (n-1)

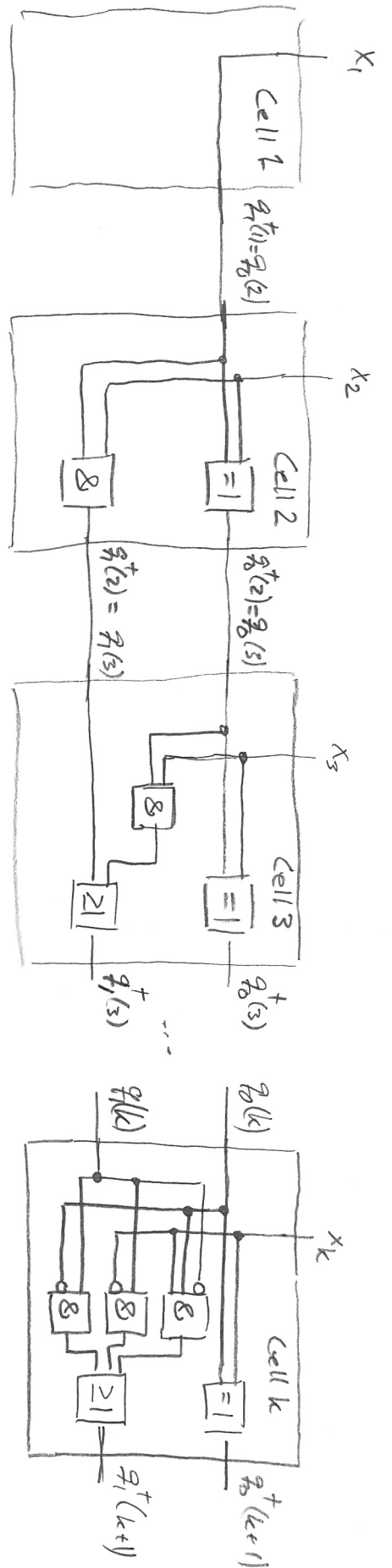
$q_1^+ = q_1' q_0 x + q_1 x' + q_1 q_0' \quad q_0^+ = q_0 \oplus x$

## Cell n

$u_1 = q_1' q_0 x + q_1 x' + q_1 q_0'$

$u_0 = q_0 \oplus x$

Uppgift 4 forts.



för  $k \in \{4, \dots, n\}$  där

$$q_1^+(n+1) = u_1 \text{ och}$$

$$q_0^+(n+1) = u_0$$

# Uppgift 5

$$x_i = \begin{cases} 1 & \text{täck} \\ 0 & \text{annars} \end{cases}$$

$$u_1 u_0 = \begin{cases} 01 & 1\text{-krona} \\ 10 & 5\text{-krona} \\ 11 & 10\text{-krona} \\ 00 & \text{f.ö.} \end{cases}$$

## Scenario

1-krona:  $x_1 x_2 x_3 = 000 \rightarrow 100 \rightarrow 110 \rightarrow 100 \rightarrow 000$

5-krona:  $x_1 x_2 x_3 = 000 \rightarrow 100 \rightarrow 110 \rightarrow 111 \rightarrow 110 \rightarrow 100 \rightarrow 000$

10-krona:  $x_1 x_2 x_3 = 000 \rightarrow 100 \rightarrow 000$

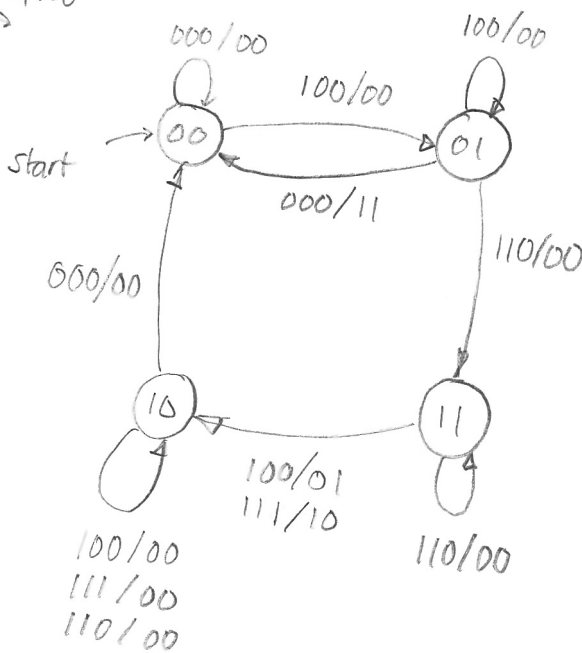
1 krona,  $u_1 u_0 = 01$

5 krona,  $u_1 u_0 = 10$

10 krona,  $u_1 u_0 = 11$

## Tillståndsdigram

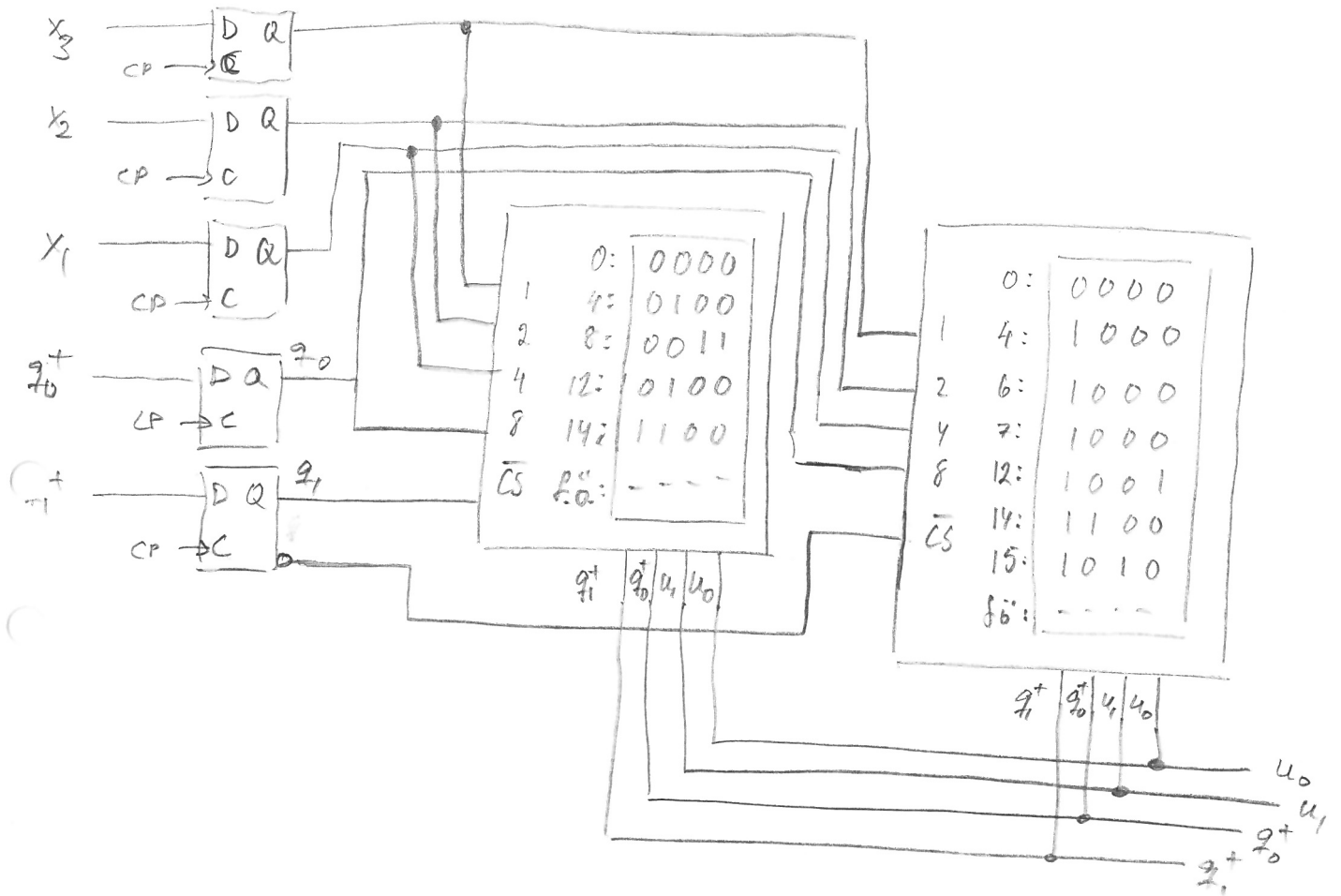
$x_1 x_2 x_3 / u_1 u_0$



99  
7170

nr	$q_1^+ q_0^+$	$x_1 x_2 x_3$	$q_1^+ q_0^+ / u_1 u_0$
0	00	000	00 / 00
4	00	100	01 / 00
8	01	000	00 / 11
12	01	100	01 / 00
14	01	110	11 / 00
16	10	000	00 / 00
20	10	100	10 / 00
22	10	110	10 / 00
23	10	111	10 / 00
28	11	100	10 / 01
30	11	110	11 / 00
31	11	111	10 / 10
	f.ö.		-- / --

# Uppgift 5 forts







## Entalet

Låt räknarens tillstånd  $q = (q_3, q_2, q_1, q_0)$  vara entalet.

## Räknarens styrsignaler

① :  $CE = CE_{in}$

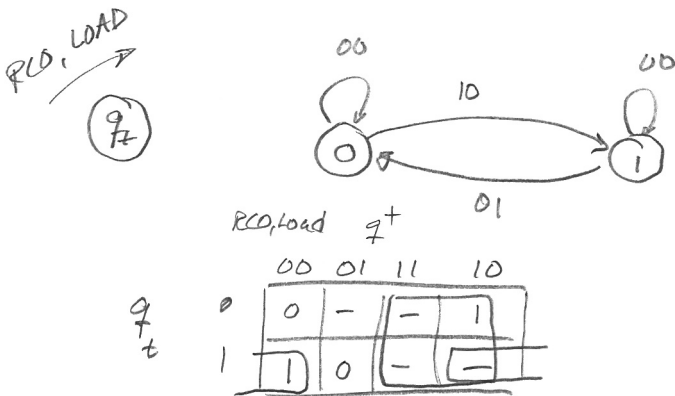
② :  $LOAD = (q_3 = 2) \text{ och } (q_1 = 1) \text{ och } (CE_{in} = 1) =$   
 $= q_1 q_3 CE_{in}$

Data in =  $1_{10} = (0001)_2$

## Tiotalet $q_t$

③ : SÄH  $q_t$  till 1 då  $RCO = 1$

④ : SÄH  $q_t$  till 0 då  $LOAD = 1$



$$q_t = RCO + q_t \cdot LOAD'$$