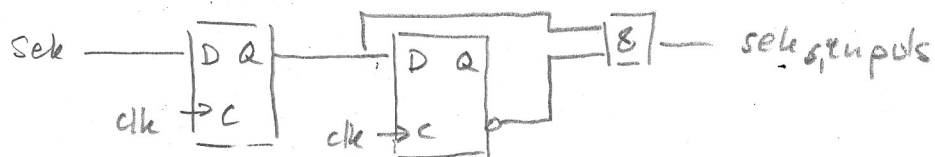
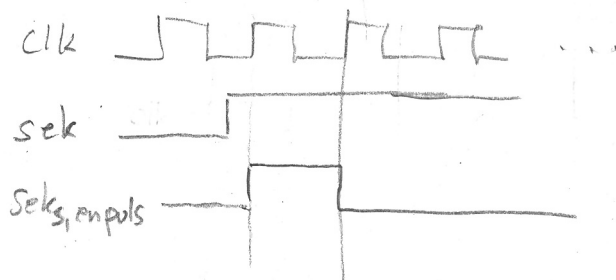
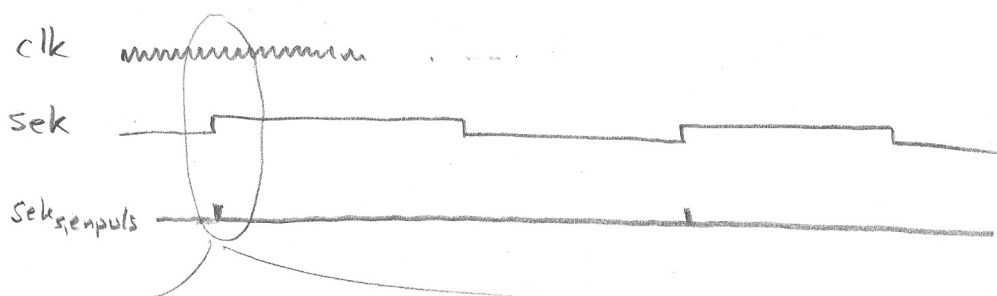
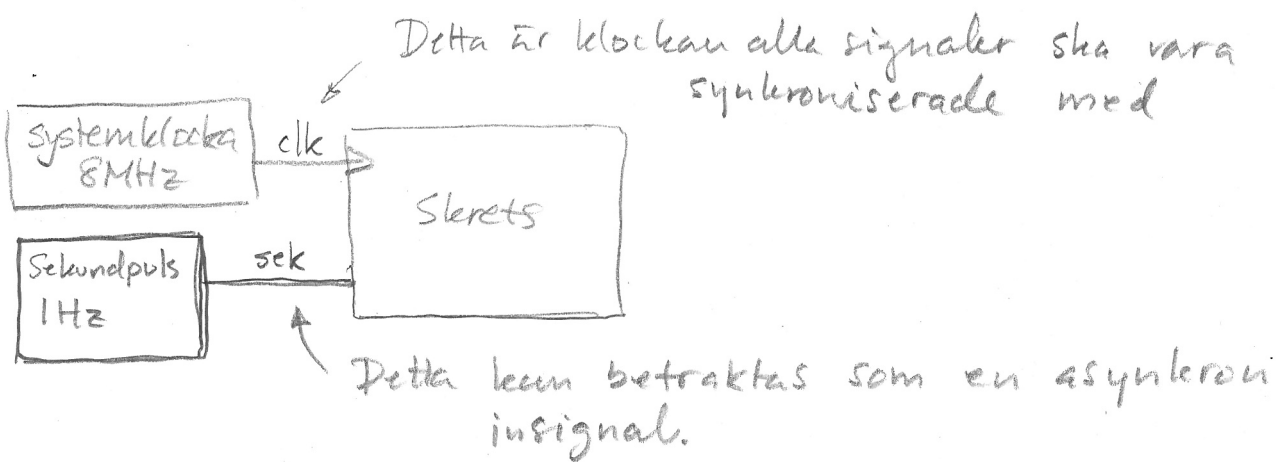


Klockor



Några klockpulshöjdröjningar gör inget!

Uppgift 1

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

$$\begin{array}{c} a \\ b \end{array} \rightarrow \boxed{G} \rightarrow y = a'b$$

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

NOT

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

$$\begin{array}{c} a \\ 1 \end{array} \rightarrow \boxed{G} \rightarrow a'$$

AND

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

$$\begin{array}{c} a \\ 1 \end{array} \rightarrow \boxed{G} \rightarrow \begin{array}{c} a' \\ b \end{array} \rightarrow \boxed{G} \rightarrow ab$$

OR

$$\begin{aligned} y &= (a+b)'' = (a'b')' = G(a'b', 1) = G(G(a, b'), 1) = \\ &= G(G(a, G(b, 1)), 1) \end{aligned}$$

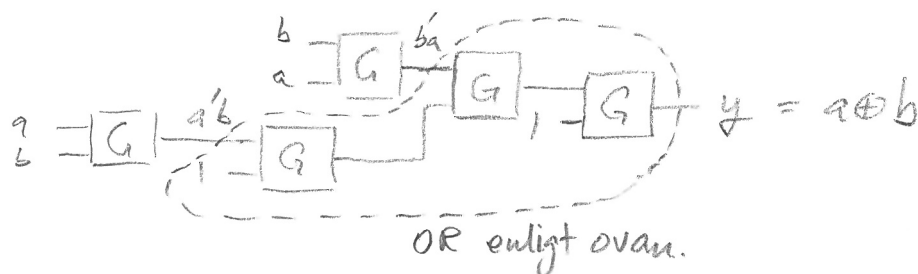
$$\begin{array}{c} b \\ 1 \end{array} \rightarrow \boxed{G} \rightarrow \begin{array}{c} b' \\ a \end{array} \rightarrow \boxed{G} \rightarrow \begin{array}{c} a'b' \\ 1 \end{array} \rightarrow \boxed{G} \rightarrow y = a+b = (a'b')'$$

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	<u>C</u> /0
<u>C</u>	<u>E</u> /1	D/0
D	A/0	B/1
<u>E</u>	F/0	<u>C</u> /0
F	D/0	<u>B</u> /1

1-ekv. klasser:

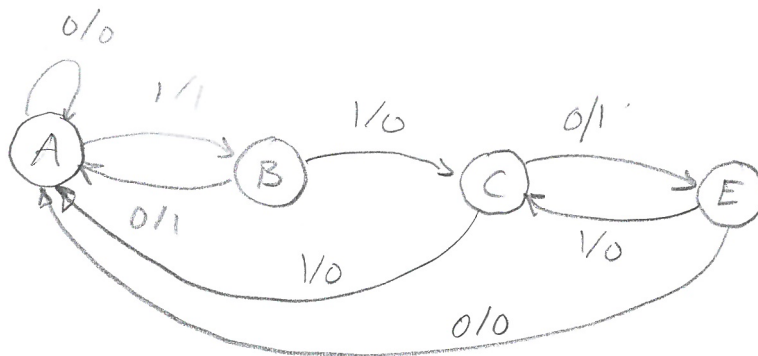
$$P_1 = \{\{A, D, F\}, \{B, C\}, \{E\}\}$$

2-ekv. klasser:

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

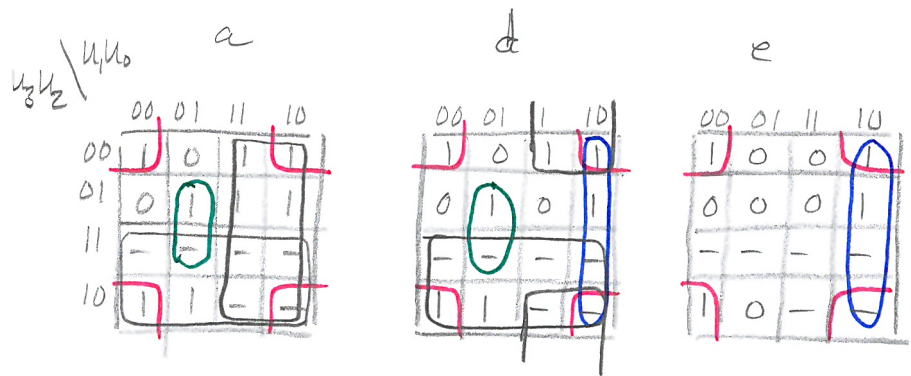
Ersätt $\{A, D, F\}$ med A

	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
0 0 0 0	1	1	1
0 0 0 1	0	0	0
0 0 1 0	1	1	1
0 0 1 1	1	1	0
0 1 0 0	0	0	0
0 1 0 1	1	1	0
0 1 1 0	1	1	1
0 1 1 1	1	0	0
1 0 0 0	1	1	1
1 0 0 1	1	1	0
z.o.	-	-	-

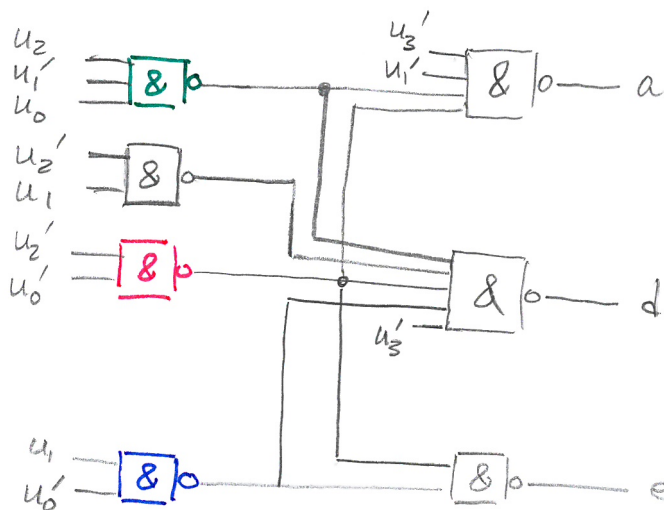


$$a = (u_3 + u_1 + u_2' u_0' + u_2 u_1' u_0)'' = (u_3' u_1' (u_2' u_0')' (u_2 u_1' u_0)')'$$

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

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

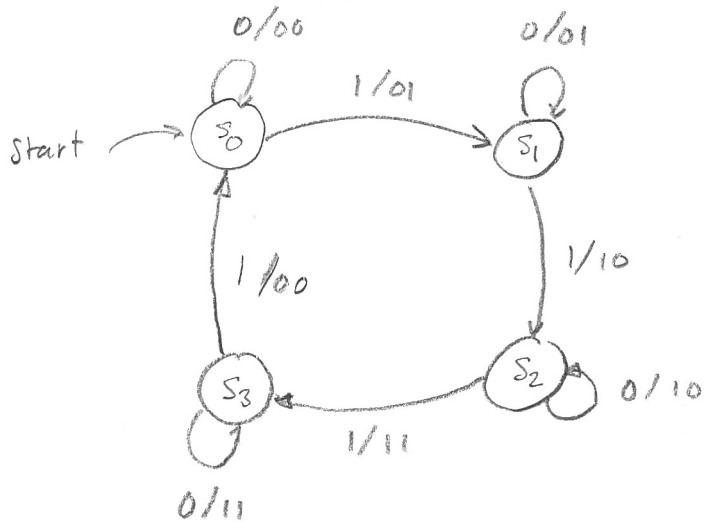
$$u_i \rightarrow \boxed{1} \rightarrow u_i' \quad \text{for } i \in \{0, 1, 2, 3\}$$



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

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

K-diagram

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

$q_1 q_0$	$x=0$	$x=1$
00	0	1
01	1	0
11	1	0
10	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)

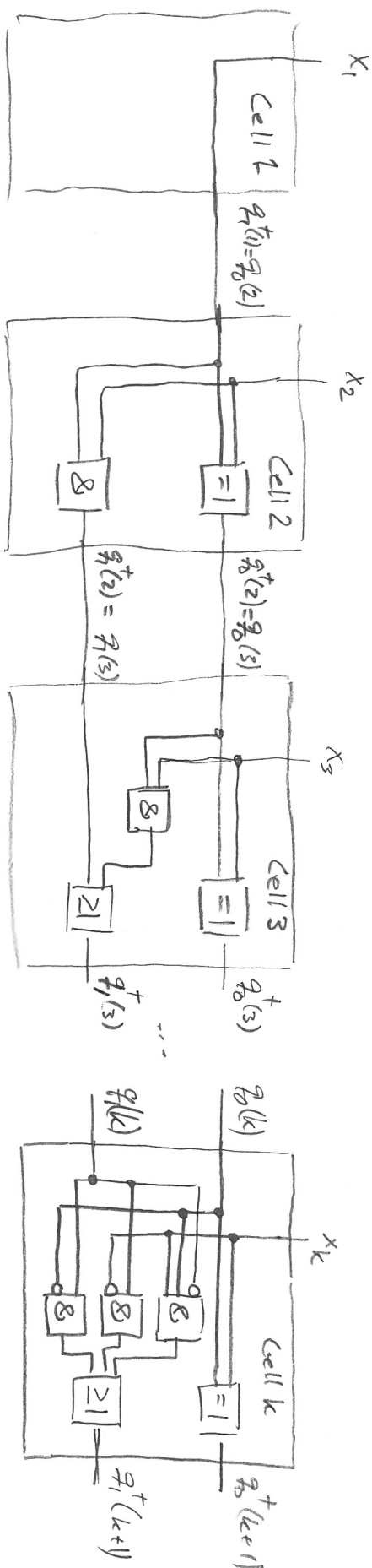
$$q_1^+ = q_1' q_0 x + q_1 x' + q_1 q_0' \quad q_0^+ = q_0 \oplus x$$

Cell n

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

$$u_0 = q_0 \oplus x$$

Oppgift 4 forts.



f r $k \in \{4, \dots, n\}$ d r

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

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

Uppgift 5

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

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

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: $x_1 x_2 x_3 = 000 \rightarrow 100 \rightarrow 000$

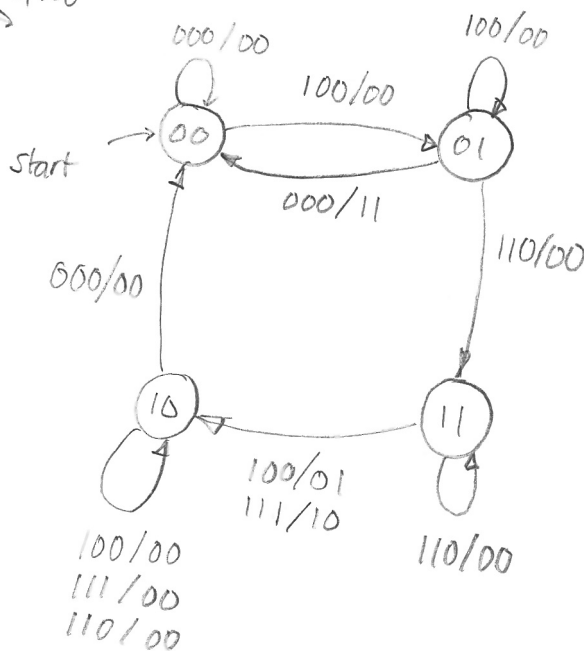
1 krona, $u_1 u_0 = 01$

5 krona, $u_1 u_0 = 10$

10 krona, $u_1 u_0 = 11$

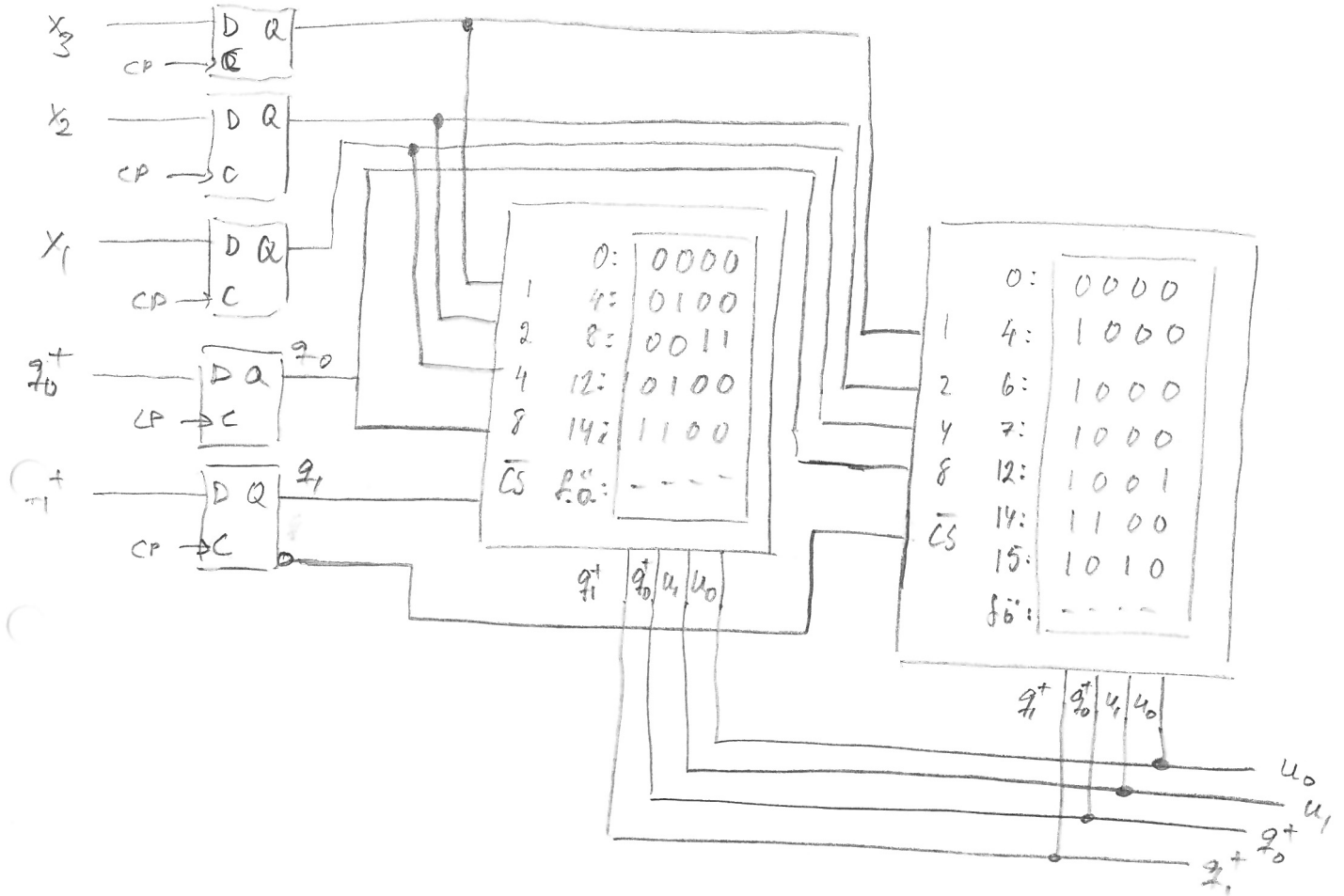
Tillståndsdigram

$x_1 x_2 x_3 / u_1 u_0$



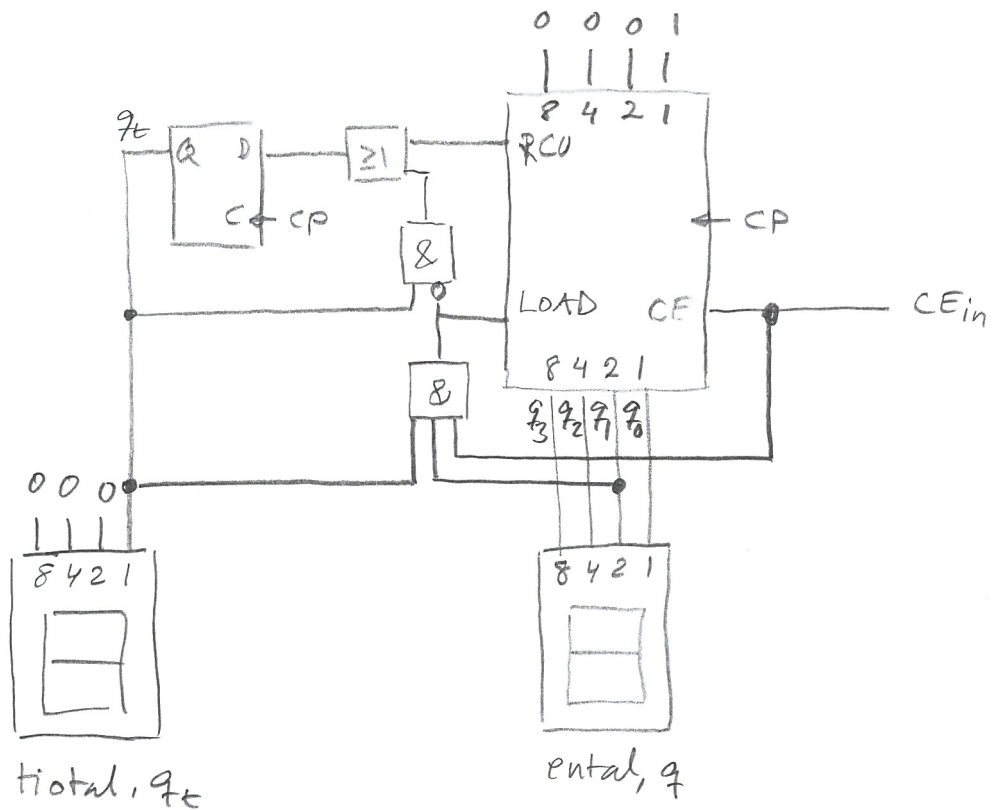
nr	8 4 2 1			$q_1^+ q_0^+ / u_1 u_0$
	$q_1 q_0$	$x_1 x_2 x_3$		
0	00	000		00 / 00
4	00	100		01 / 00
8	01	000		00 / 11
12	01	100		01 / 00
16	01	110		11 / 00
16	10	000		00 / 00
20	10	100		10 / 00
22	10	110		10 / 00
23	10	111		10 / 00
28	11	100		10 / 01
30	11	110		11 / 00
31	11	111		10 / 10
	f.ö.			-- / --

Uppgift 5 forts



Uppgift 6

1 2 3 ... 9 10 11 12



Scenario

Insignal CE _{in}	0	1	0	1	0	0	1	0	0	0	1	0
Tillstånd/ utsignal	q	1	2	2	3	7	9	0	0	2	2	1
	q _t	0	0	0	0	0	0	1	1	1	1	0
Räknare	CE	0	1	0	1	0	0	1	0	0	1	0
	LOAD	0	0	0	0	0	0	0	0	0	1	0
	RCU	0	0	0	0	0	1	0	0	0	0	0

Entalet

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

Räknarens styrsignaler

① : $CE = CE_{in}$

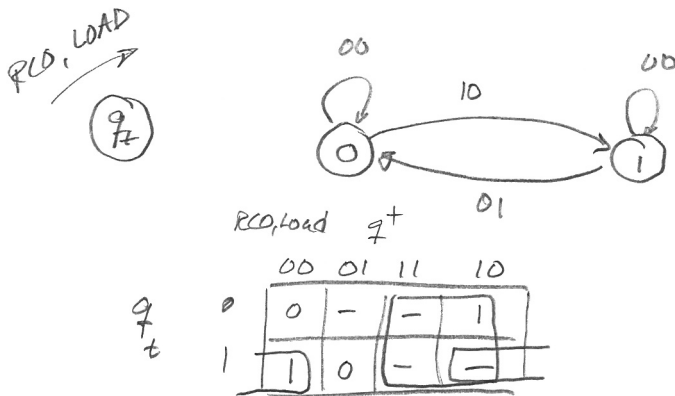
② : $LOAD = (q_2 = 2) \text{ och } (q_t = 1) \text{ och } (CE_{in} = 1) =$
 $= q_1 q_t CE_{in}$

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

Tiotalet q_t

③ : SÄH q_t till 1 då $RCO = 1$

④ : SÄH q_t till 0 då $LOAD = 1$



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