NAVRHOVÁNÍ LOGICKÝCH OBVODŮ

– logické obvody: – kombinační ... výstup závisí ("jen") na vstupu
– sekvenční ... –||– a na stavu

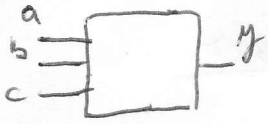
NAVRHOVÁNÍ KOMBINAČNÍCH OBVODŮ

a) POPIS K.O. TABULKOU

VSTUPY | VÝSTUP

a	b	c	y
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	1

8... 2^3



↑ OD OKA ... "STŘELBA"

b) POPIS K.O. VÝRAZEM

– K.O. JE PREZENTOVÁN LOGICKOU FCÍ ... $y = F(x)$; $x = x_1, x_2, x_3 \dots x_m$

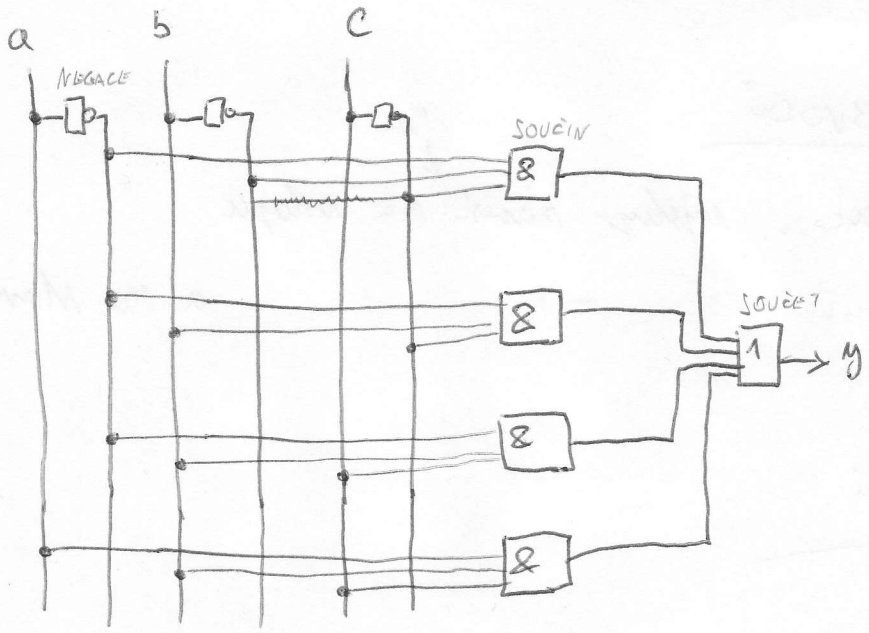
– KAŽDOU LOG. FCI LZE ZAPSAT VE TVARU "SOUČET SOUČINŮ":

$$y = b_1 x_1 x_2 \dots x_m + b_2 \bar{x}_1 x_2 \dots x_m + b_k \bar{x}_1 \bar{x}_2 \dots \bar{x}_m$$

NAPŘ:
$$y = x_1 x_2 \bar{x}_3 + x_1 \bar{x}_2 \bar{x}_3 + \bar{x}_1 x_2 x_3$$ (měly být 8 kombinací, ale jen tyhle měly nenulové b)

$$\dots y = b_1 x_1 x_2 x_3 + 1 \bar{x}_1 x_2 \bar{x}_3 + 0 \cdot x_1 \bar{x}_2 x_3 + 0 \bar{x}_1 \bar{x}_2 x_3 + (b_0 = 0)$$
$$+ 1 x_1 x_2 \bar{x}_3 + 0 \bar{x}_1 x_2 \bar{x}_3 + 1 x_1 \bar{x}_2 \bar{x}_3 + 0 \bar{x}_1 \bar{x}_2 \bar{x}_3$$

$y = \bar{a}\bar{b}\bar{c} + \bar{a}b\bar{c} + \bar{a}bc + abc$ – Z TABULKY NA PŘEDCHOZÍ STRANĚ



NĚKTERÁ PRAVIDLA BOOLEOVY ALGEBRY

$a \cdot b = b \cdot a$ $\qquad a + b = b + a$

$a \cdot (b + c) = a \cdot b + a \cdot c$ $\qquad a + (b \cdot c) = (a + b) \cdot (a + c)$

$(a \cdot b) \cdot c = a \cdot (b \cdot c)$ $\qquad (a + b) + c = a + (b + c)$

$\bar{\bar{a}} = a$

$a \cdot 0 = 0$

$a \cdot 1 = a$

$a + 0 = a$

$a + 1 = 1$

$a + \bar{a} = 1$

$a \cdot \bar{a} = 0$

DE MORGANOVO PRAVIDLO

$\overline{a \cdot b} = \bar{a} + \bar{b}$

negace součinu = negace + negace
zak negace

$\overline{a + b} = \bar{a} \cdot \bar{b}$

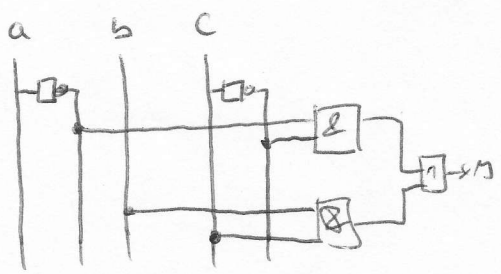
negace součtu = negace · negace
zak negace

$y = \bar{a}\bar{b}\bar{c} + \bar{a}b\bar{c} + \bar{a}bc + abc$

$y = \bar{a} \cdot \bar{c} \cdot (\bar{b} + b) + bc \cdot (\bar{a} + a)$

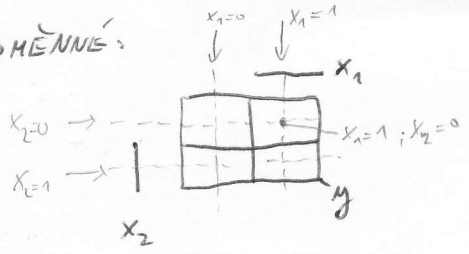
$(\bar{b} + b) = 1$ $\qquad (\bar{a} + a) = 1$

$y = \bar{a} \cdot \bar{c} + b \cdot c$ $\qquad$ MINIMALIZACE

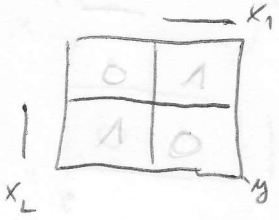


c) ZÁPIS K.O. KARNAUGHOVO MAPOU

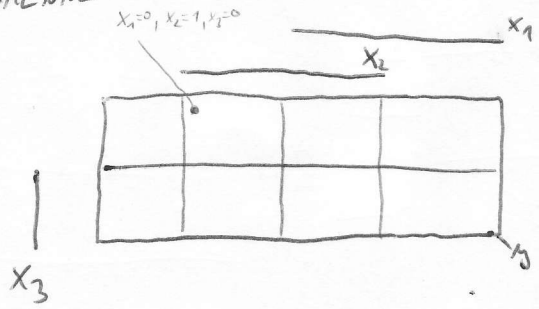
PRO 2 PROMĚNNÉ:



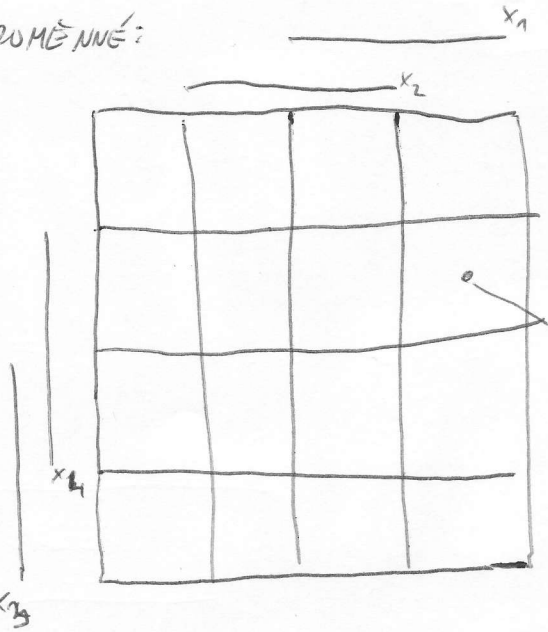
x_1	x_2	y
0	0	0
0	1	1
1	0	1
1	1	0



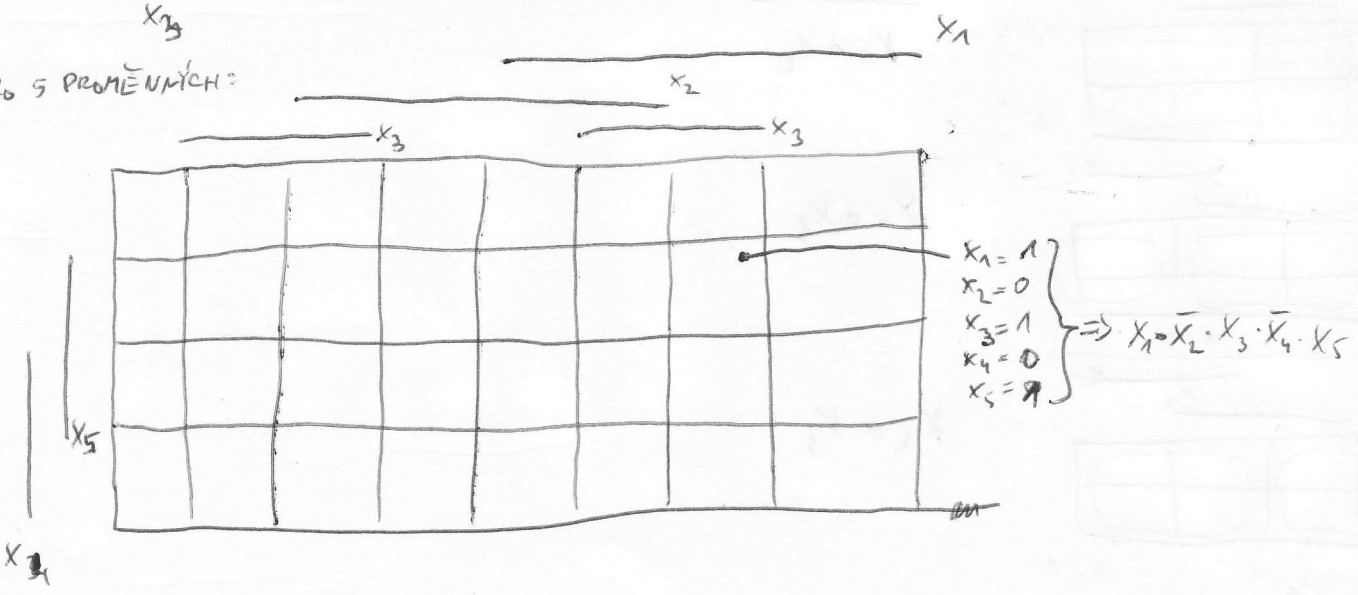
PRO 3 PROMĚNNÉ:

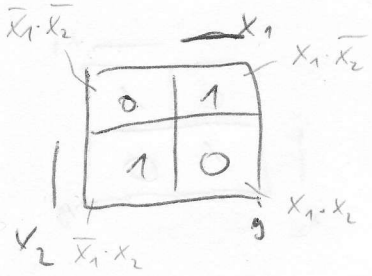


PRO 4 PROMĚNNÉ:



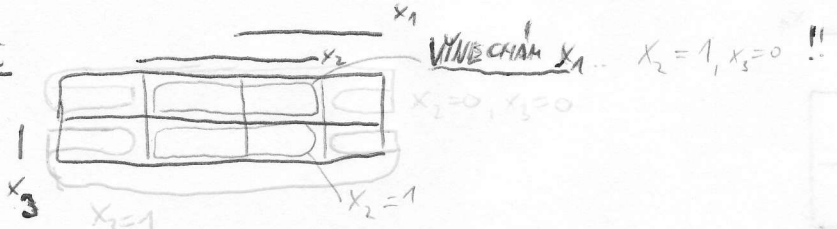
PRO 5 PROMĚNNÝCH:

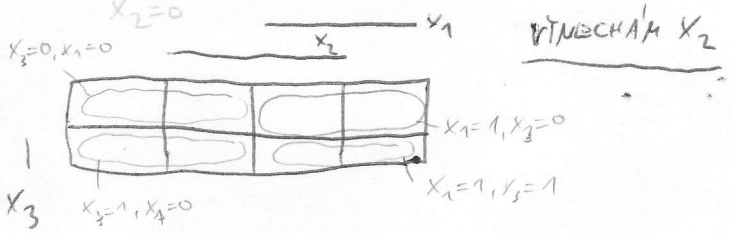


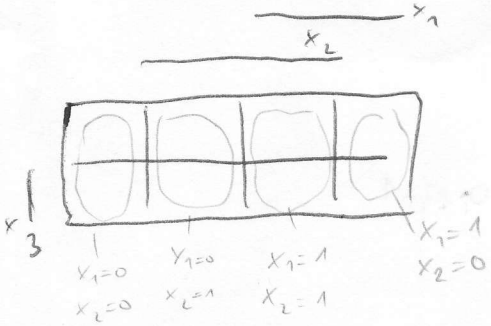


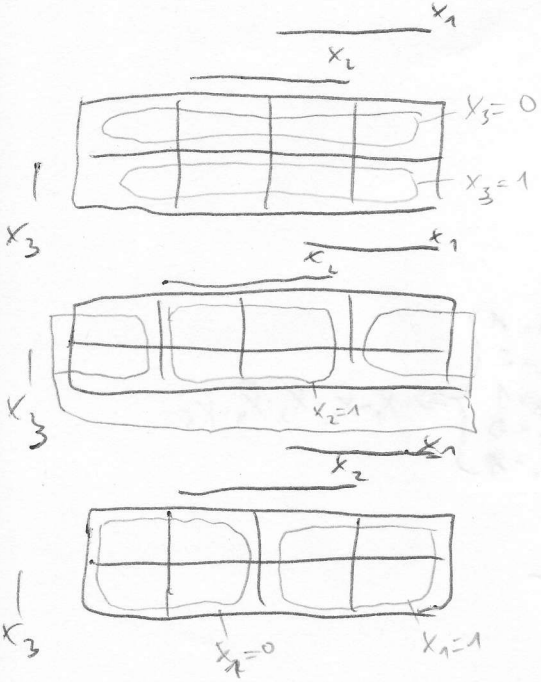
$$y = x_1 \cdot \bar{x}_2 + \bar{x}_1 \cdot x_2$$

PŘ:

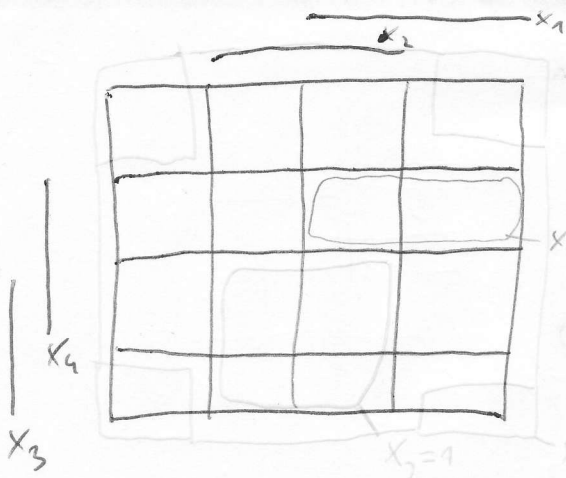








VYNECHÁM



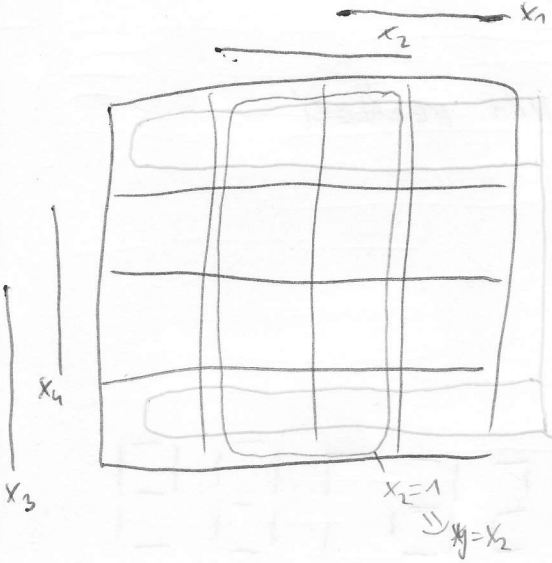
x_2 i $x_1 a x_4$

$x_1=1, x_3=0, x_4=1$

$x_2=1$
$x_3=1$

$x_2=0$

"DOPLŇKOVÁ"



$x_1 a x_3 a x_4$

$x_1 a x_2 a x_3$

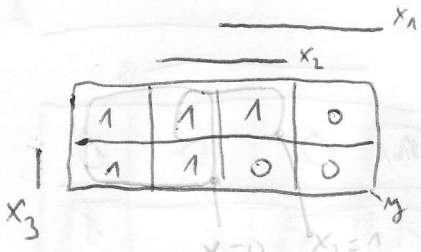
$x_4=0$

$x_2=1$

$\Rightarrow y=x_2$

B.10.

MINIMALIZACE V KARNAUGHOVO MAPĚ:



$x_1=0$ $x_2=1$

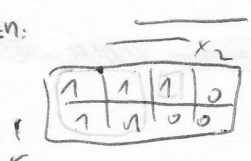
$\Rightarrow y=\overline{x_1}$

$x_3=0$

$\Rightarrow y=x_2 \overline{x_3}$

Tedy $y=\overline{x_1}+x_2 \cdot \overline{x_3}$

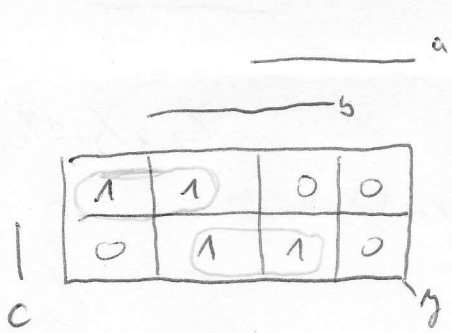
Pozn:



- vždy je maximálně 1 součin = 1

$y=\underbrace{\overline{x_1}}_{\wedge}+\underbrace{x_2 \cdot \overline{x_3}}_{\wedge}$ pro $x_1=0, x_2=1, x_3=0$ $\Rightarrow$ jsou oba součiny 1

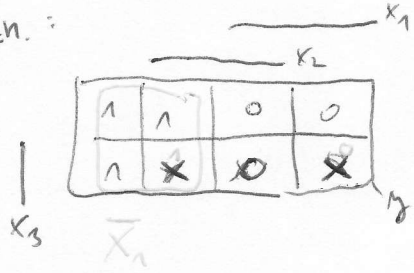
a	b	c	y
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	1



$\bar{a}\cdot\bar{c}$ $b\cdot c$

$y = \bar{a}\cdot\bar{c} + b\cdot c$

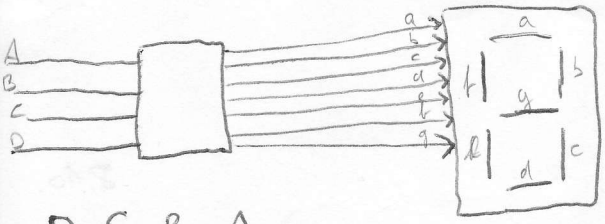
Pozn.:



$\bar{x}_1$

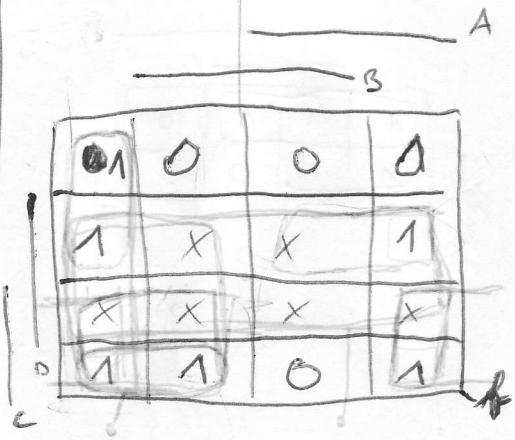
X... KŘÍŽEK ... NA VÝSTUPU NÁM NEZÁLEŽÍ

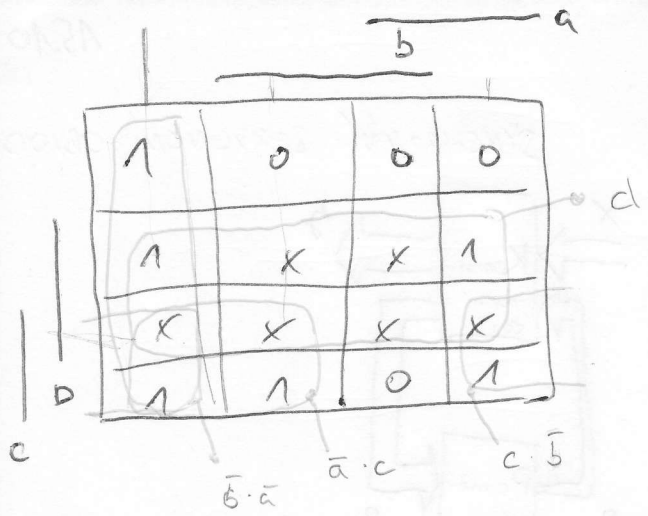
PŘ. převodník BCD → 7segmentů



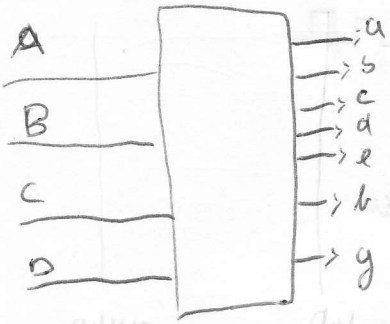
D	C	B	A	
0	0	0	0	...0
0	0	0	1	...1
0	0	1	0	...2
0	0	1	1	...3
:				
1	0	0	1	...9
1	0	1	0	...X - nezajímá
:				
1	1	1	1	...X
0	1	0	0	...4
0	1	0	1	...5
0	1	1	0	...6
0	1	1	1	...7
1	0	0	0	...8

a	b	c	d	e	f	g
					1	
					0	
					0	
					0	
					1	
					1	
					1	
					0	
					1	
					1	
					X	
					X	
					X	
					X	
					X	
					X	
	1					

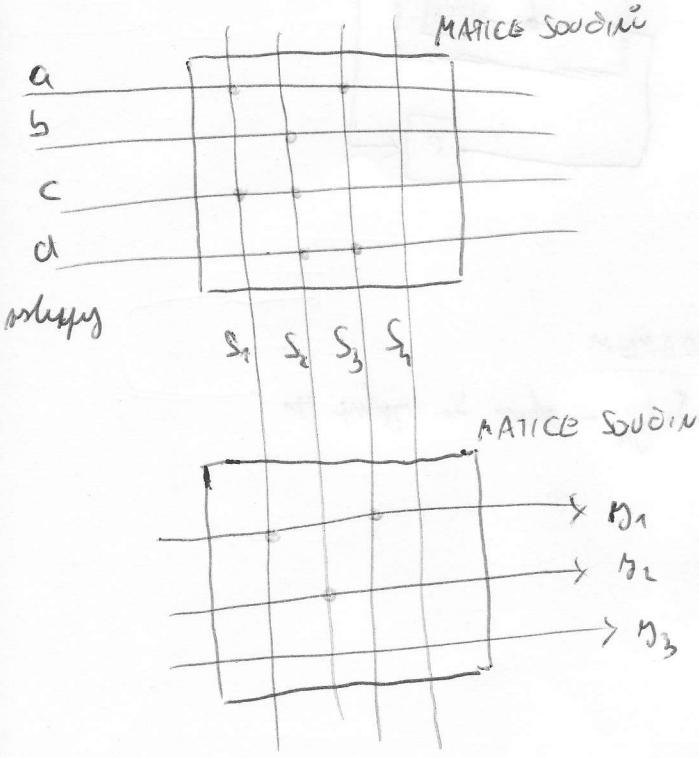




$$y = d + \bar{b}\cdot\bar{a} + \bar{a}\cdot c + c\cdot\bar{b}$$



PROGRAMOVATELNÁ LOGIKA:



$S_1 = a\cdot c$

$S_2 = b\cdot d\cdot c$

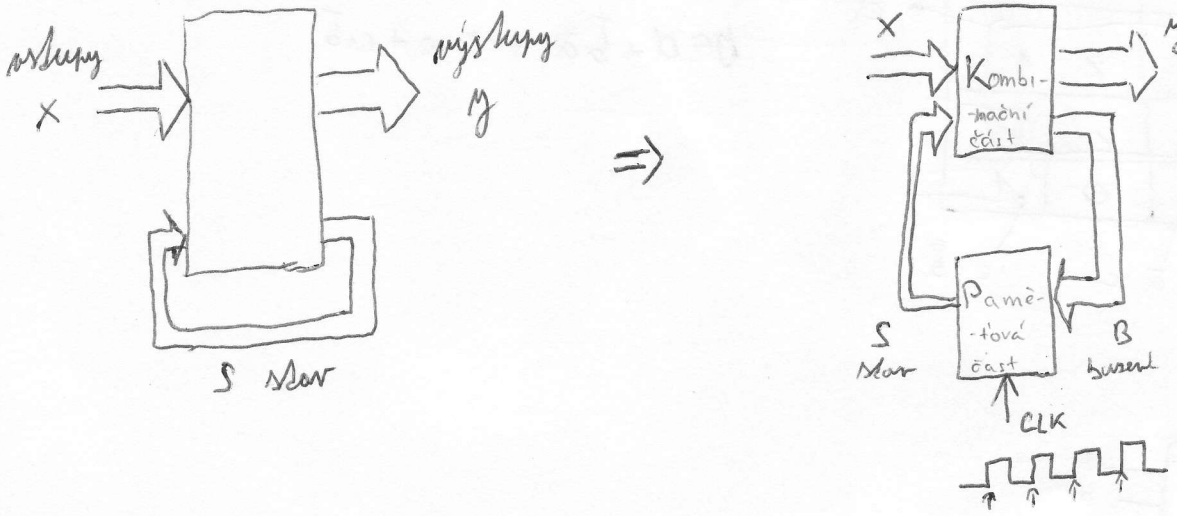
$S_3 = a\cdot d$

$y_1 = S_1 + S_3 = a\cdot c + a\cdot d$

$y_2 = S_2 = b\cdot d\cdot c$

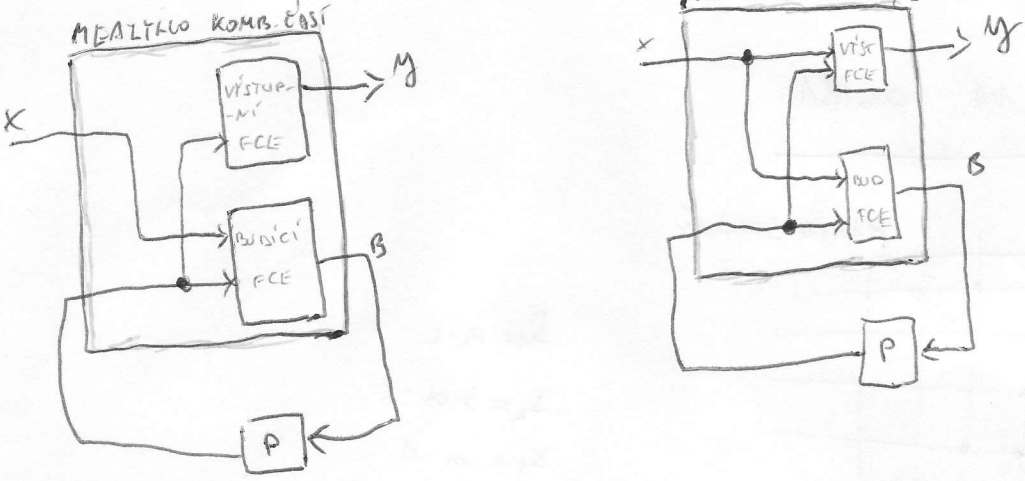
Navrhování sekvenčních obvodů

15.10



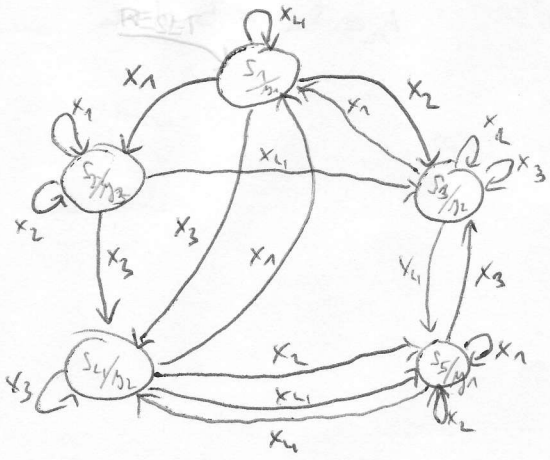
sekvenční obvod: Mealyho ... výstup závisí na stavu a vstupu

Mooreův ... -11- a vstupu



POPIS SEKVENČNÍHO OBVODU STAVOVÝM DIAGRAMEM

S_1/y_1 – stav S_1 výstup y_1



5.0

POPIS TABULKOU STAVŮ A VÝSTUPŮ

Stav	X_1	X_2	X_3	X_4	Y
S_1	S_2	S_3	S_4	S_1	Y_1
S_2	S_2	S_2	S_4	S_3	Y_3
S_3	S_1	S_3	S_3	S_5	Y_2
S_4	S_1	S_5	S_4	S_5	Y_2
S_5	S_5	S_5	S_3	S_4	Y_1

vstupy

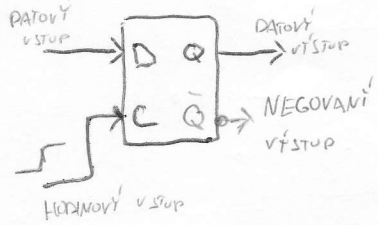
výstup

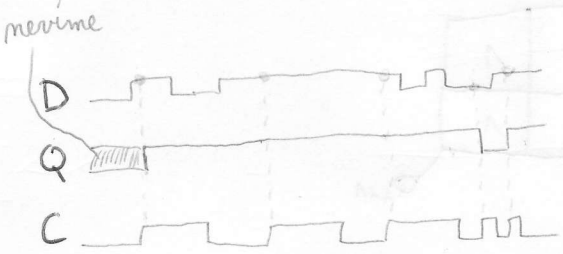
↑ SOUČASNÝ STAV - S_t

NÁSLEDUJÍCÍ STAV S_{t+1}

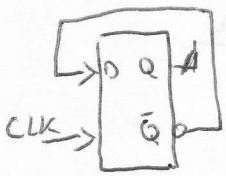
PAMĚŤOVÉ OBVODY

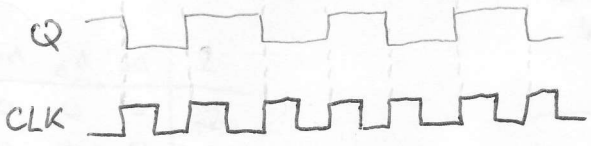
KLOPNÝ OBVOD D



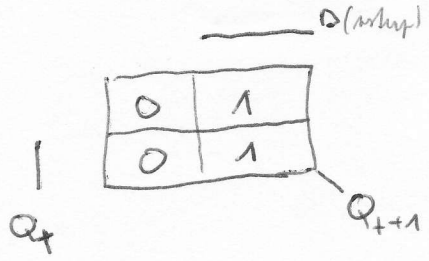


DĚLIČKA FREKVENCE

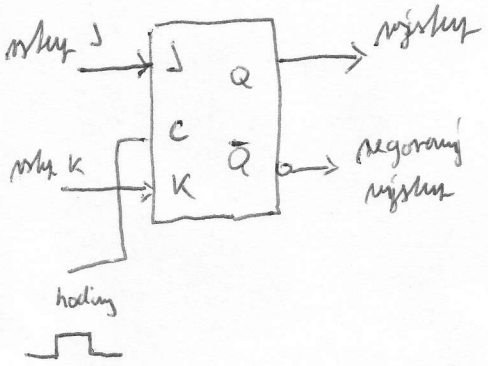




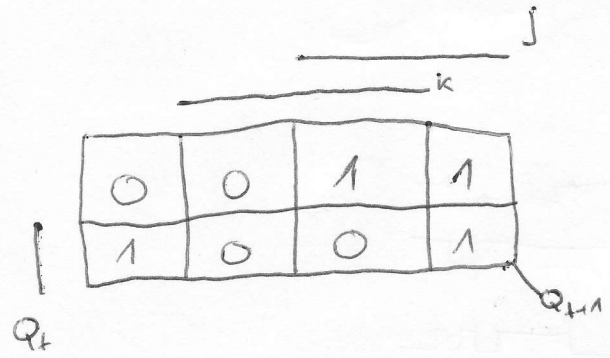
FORMÁLNÍ MODEL KL. OBVODU D



KLOPNÝ OBVOD JK



- PŘI HRANĚ ⎍ na C se ZAPAMATUJÍ HODNOTY J a K
- PŘI HRANĚ ⎍ SE ZMĚNÍ VÝSTUP PODLE J a K



POSTUP PŘI NÁVRHU SEKVENČNÍHO OBVODU

1) ZAKÓDOVÁNÍ STAVŮ, VSTUPŮ A VÝSTUPŮ

Stavové proměnné

stav S	A_2	A_1	A_0
S_1	0	0	0
S_2	0	0	1
S_3	0	1	0
S_4	0	1	1
S_5	1	0	0

NEBO

S	A_4	A_3	A_2	A_1	A_0
S_1	0	0	0	0	1
S_2	0	0	0	1	0
S_3	0	0	1	0	0
S_4	0	1	0	0	0
S_5	1	0	0	0	0

vstupy

X	x_1	x_0
X_1	0	0
X_2	0	1
X_3	1	0
X_4	1	1

výstupy

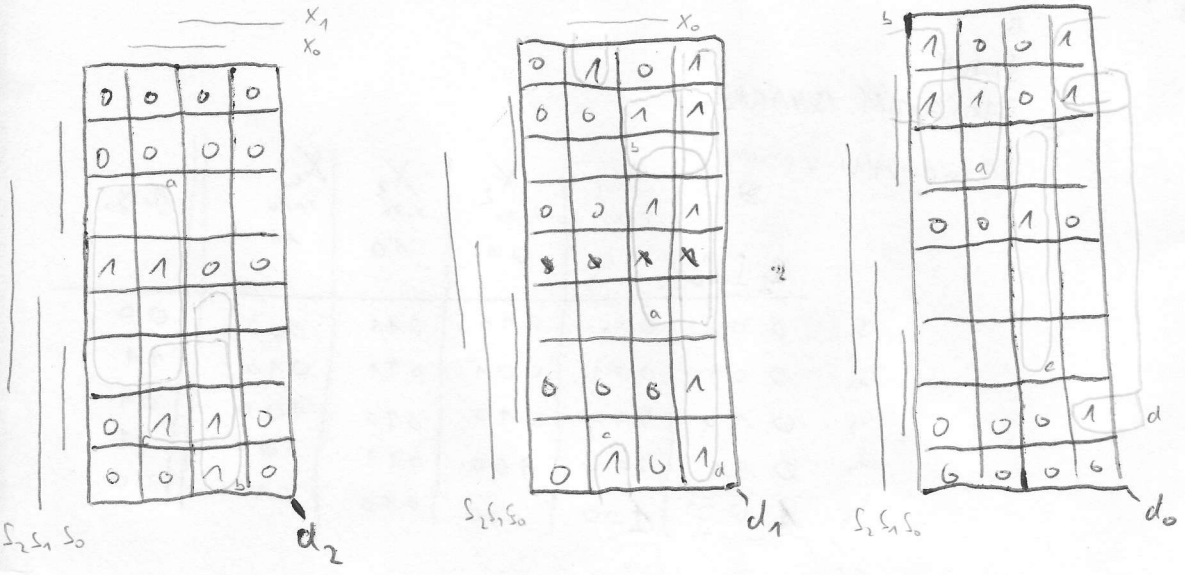
Y	y_1	y_0
Y_1	0	0
Y_2	1	0
Y_3	1	1

Tabulka pro d_1

$S_2S_1S_0$	x_1x_0 00	x_1x_0 01	x_1x_0 10	x_1x_0 11
000	0	1	1	0
001	0	0	1	1
010	0	1	1	0
011	0	0	1	0
100	0	0	1	1

Tabulka pro d_0

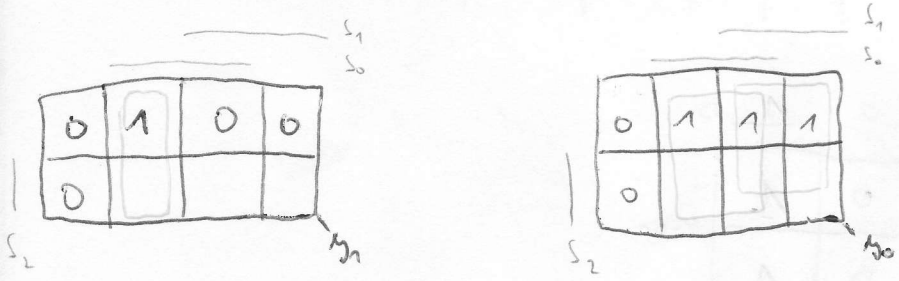
$S_2S_1S_0$	x_1x_0 00	x_1x_0 01	x_1x_0 10	x_1x_0 11
000	1	0	1	0
001	1	1	1	0
010	0	0	0	0
011	0	0	1	0
100	0	0	0	1



$$d_2 = S_2 \cdot \bar{x}_1 + S_0 \cdot S_1 \cdot x_0 + S_1 \cdot x_1 \cdot x_0$$

$$d_1 = S_2 \cdot x_1 + S_0 \cdot x_1 \cdot \bar{S}_0 + \bar{S}_2 \cdot \bar{S}_0 \cdot \bar{x}_1 \cdot x_0 + x_1 \cdot \bar{x}_0$$

$$d_0 = \bar{S}_1 \cdot S_0 \cdot \bar{x}_1 + \bar{S}_2 \cdot \bar{S}_1 \cdot \bar{x}_0 + S_2 \cdot \bar{x}_1 \cdot x_0 + \bar{S}_2 \cdot S_0 \cdot x_1 \cdot \bar{x}_0$$



$S_2S_1S_0$	y_1	y_0
000	0	0
001	1	1
010	0	1
011	0	1
111	0	0

$$y_1 = \bar{S}_1 \cdot S_0$$

$$y_0 = S_0 + S_1$$

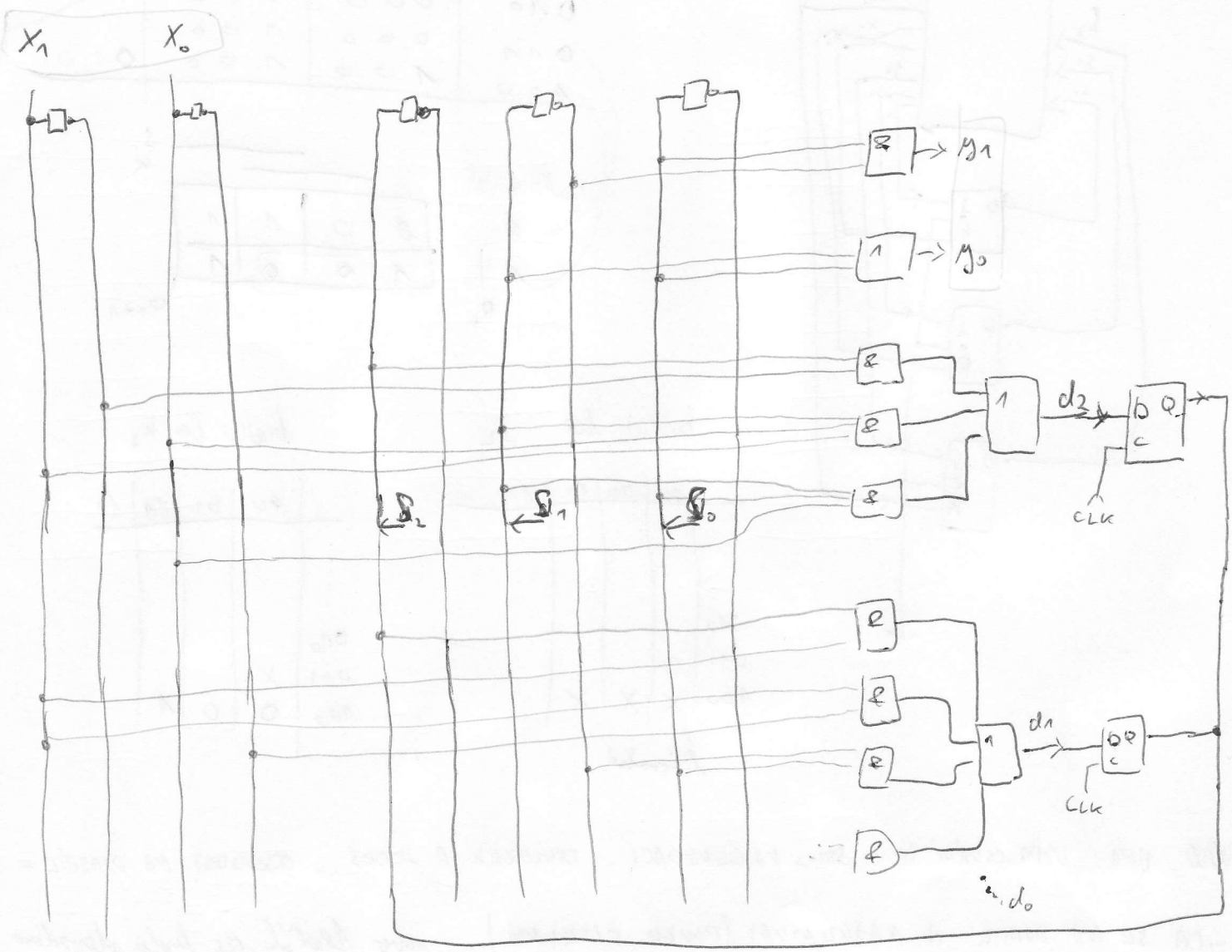
$y_1 = \bar{S}_1 \cdot \bar{x}_0$

$y_0 = S_0 + S_1$

$d_2 = S_2 \cdot \bar{x}_1 + S_0 \cdot S_1 \cdot x_0 + \bar{S}_1 \cdot x_1 \cdot x_0$

$d_1 = S_2 \cdot x_1 + S_0 \cdot x_1 \cdot \bar{x}_0 + \bar{S}_2 \cdot \bar{S}_0 \cdot \bar{x}_1 \cdot x_0 + \bar{S}_2 \cdot x_1 \cdot \bar{x}_0$

$d_0 = \ldots$



Pozn. Optimální hodnotu hledal Mavis

tab. viz. dříve

	POČET VÝSKYTŮ	$S_2 S_1 S_0$
S_1	3	1 0 0
S_2	3	0 1 1
S_3	5	0 0 0
S_4	4	0 1 0
S_5	5	0 0 1

S	X_1	X_2	X_3	X_4	Y
S_1	S_2	S_3	S_4	S_1	Y_1
S_2	S_2	S_2	S_4	S_3	Y_3
S_3	S_1	S_3	S_3	S_5	Y_2
S_4	S_1	S_5	S_4	S_6	Y_2
S_5	S_5	S_5	S_3	S_4	Y_1

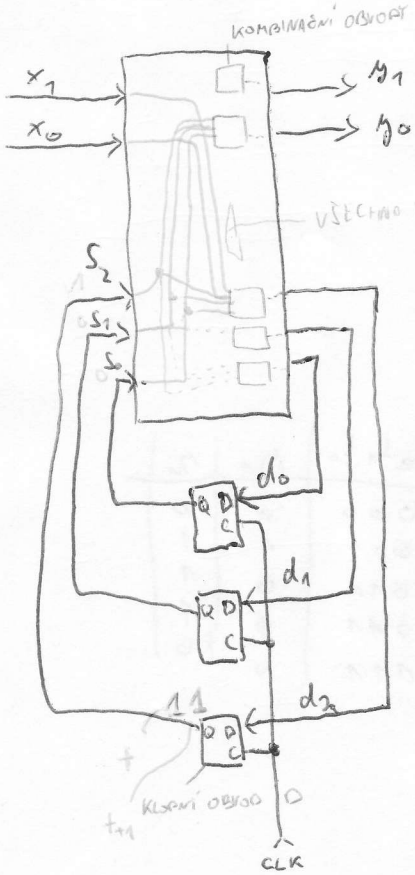
STAVY ZAKÓDOVÁNÍ BINÁRNĚ

ZAKÓDOVÁNÍ VSTUPU

S	S_2	S_1	S_0
S_1	0	0	0
S_2	0	0	1
S_3	0	1	0
S_4	0	1	1
S_5	1	0	0

	$S_2 S_1 S_0$	X_1 x_1x_0 00	X_2 x_1x_0 01	X_3 x_1x_0 10	X_4 x_1x_0 11	$y_1 y_0$
S_1	000	001	010	011	000	00
S_2	001	001	001	011	010	11
S_3	010	000	010	010	100	01
S_4	011	000	100	011	100	01
S_5	100	100	100	010	011	00

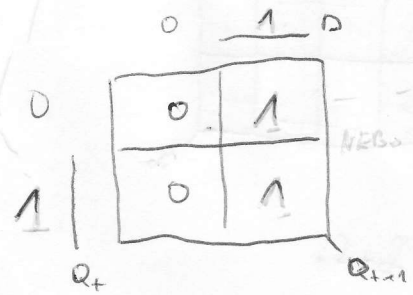
S_{2t} S_t S_{t+1} S_{2t+1}



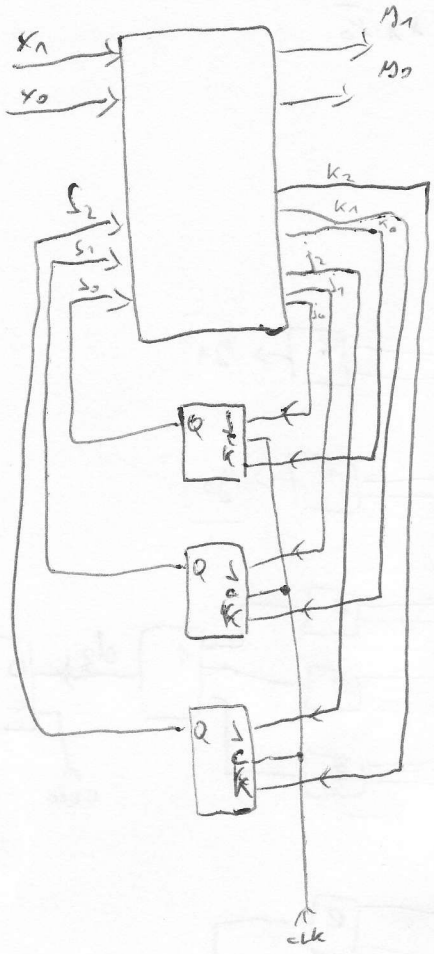
budicí fce d_2

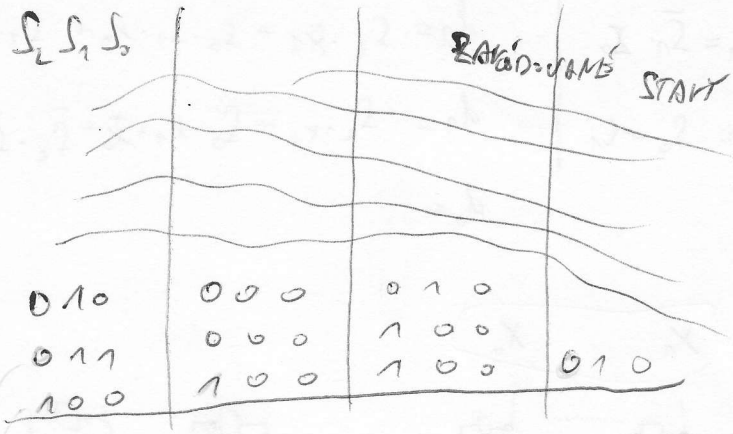
$S_2S_1S_0$	x_1x_0 00	x_1x_0 01	x_1x_0 10	x_1x_0 11
000	0	0	0	0
001	0	0	0	0
010	0	0	0	1
011	0	1	0	1
100	1	1	0	0

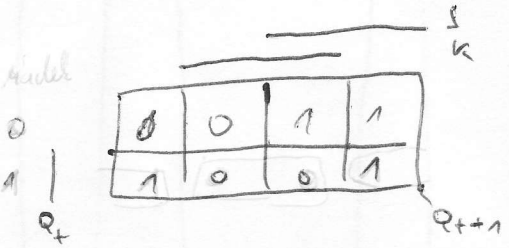
U D-KLOPÁKU, CO CHCI NA VÝSTUPU DÁT NA VSTUP (VŽDY PŘÍSLUŠNÝ SLOUPEC)



Pozn. Použití J-K







budící fce J_2

	00	01	10	11
010				
011	0			
100	X	X	X	

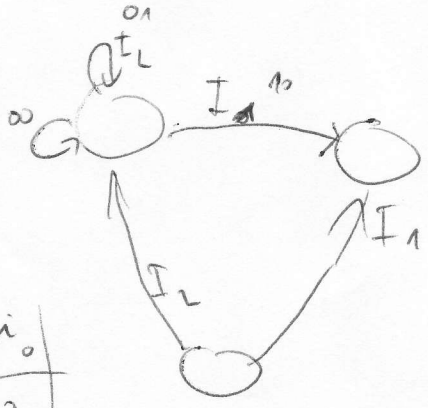
libovolná

budící fce K_2

	00	01	10	11
010				
011	X			
100	0	0	1	

WW.. UPA ... VYPRACOVÁNÍ SP.. STROJ NA GENERACI .. OBRÁZEK A JEDEŠ .. ODEVZDAT NA PORTÁLE - - DÁ SE NA PAPÍR A NASKENOVAT (POUZE ČITELNĚ) ... nebo fotit, že bylo odevzdáno ručně

II



II

	i_1	i_0
I_1	1	0
I_2	0	1

PCSPIM 5.11.

ADD $1, $2, $3 # $1 ← $2 + $3

MOVE $2 $1 # $2 ← $1 ⇒ přeloží se jako ADDU $2, $0, $1 # $2 ← $1

registr zero = 0

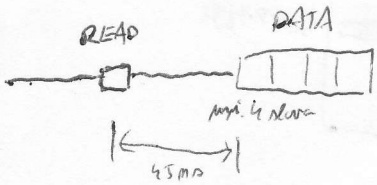
LW $1, [2-200] # $1 ← [2-200]

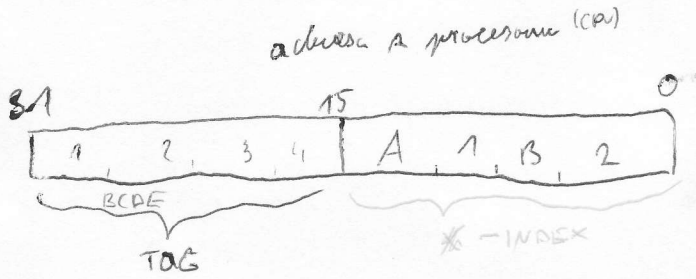
LW $10, var_1 # adresa var_1 se uloží do $10

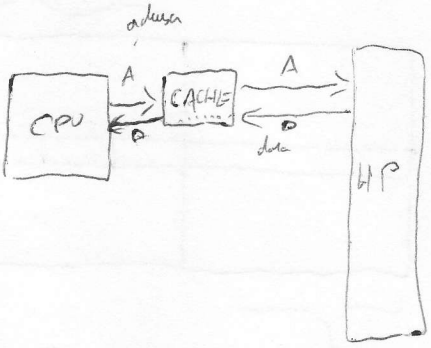
LOW WORD

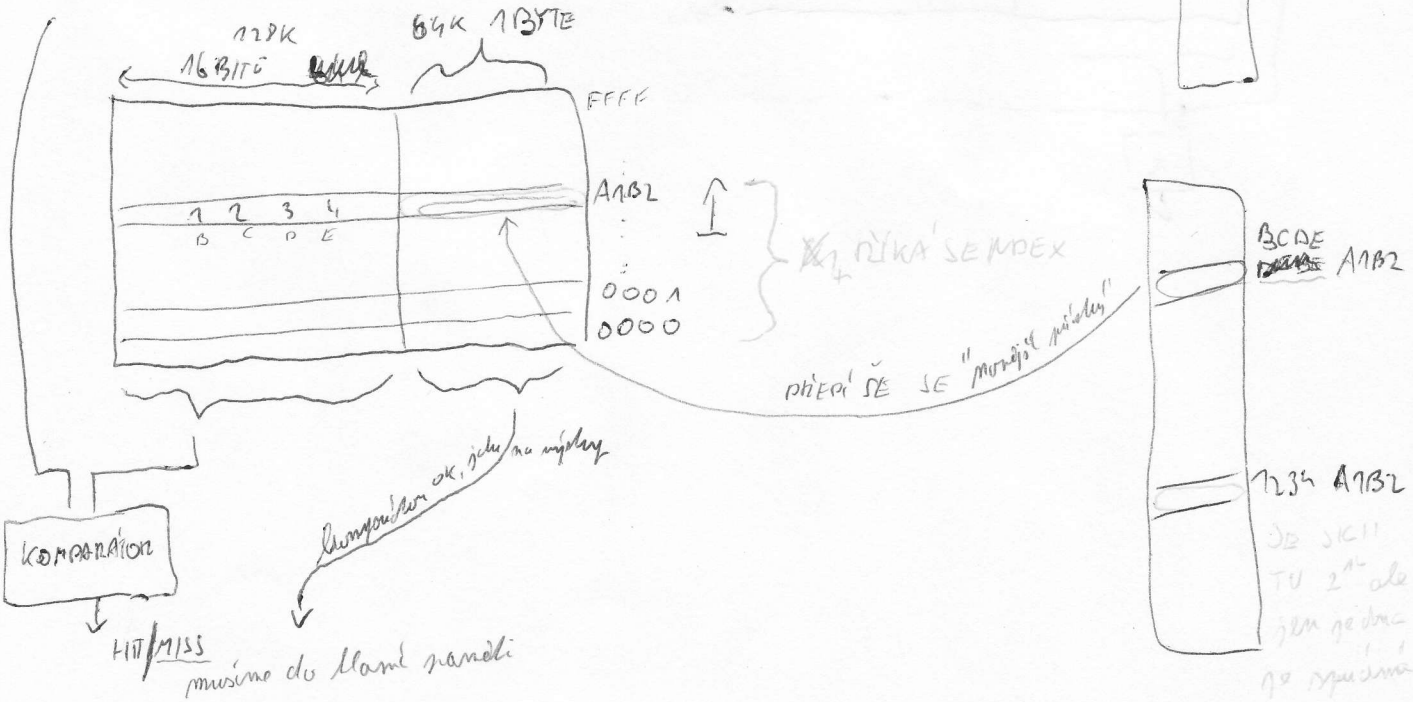
6.12

PAMĚTI CACHE

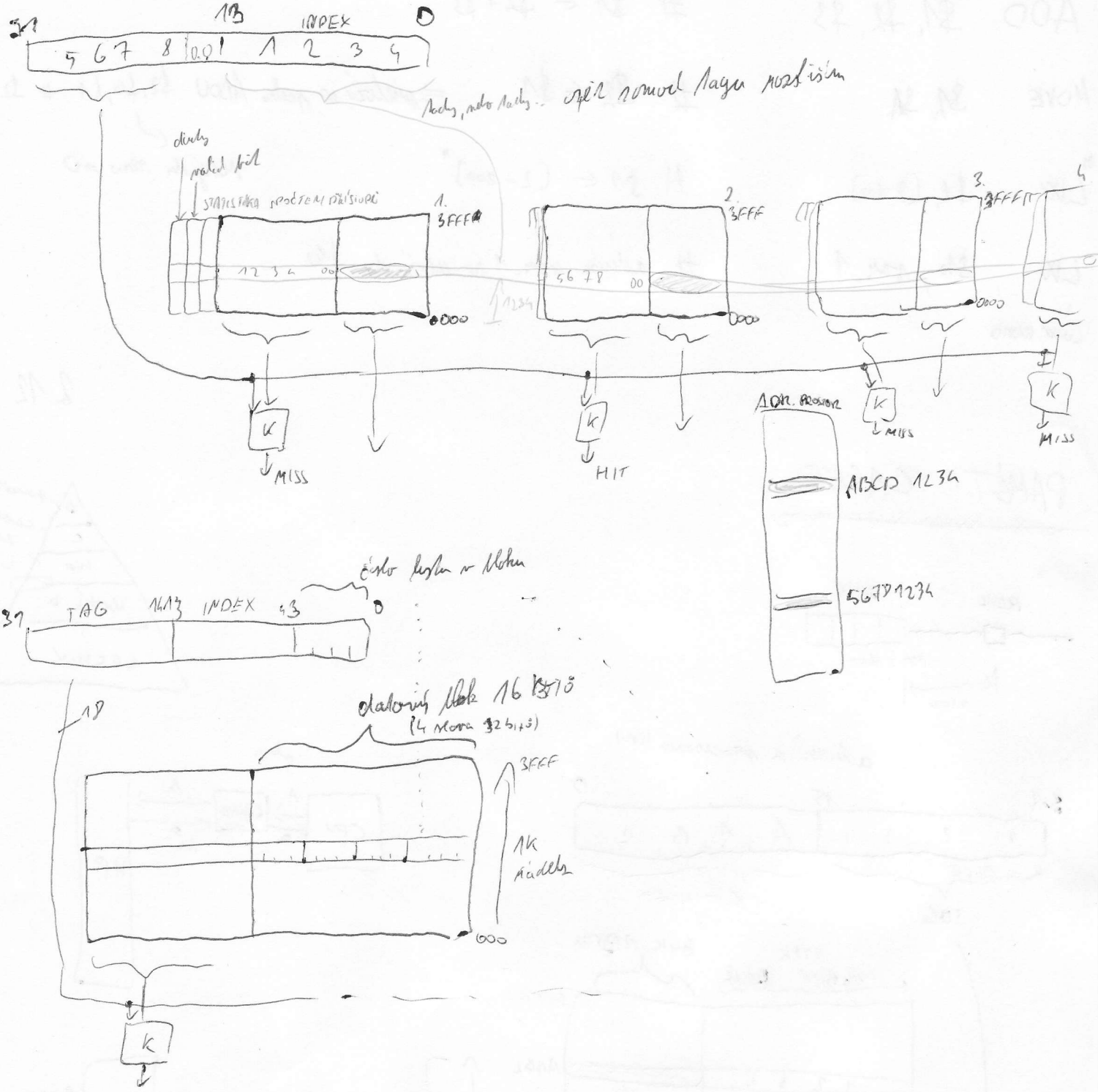




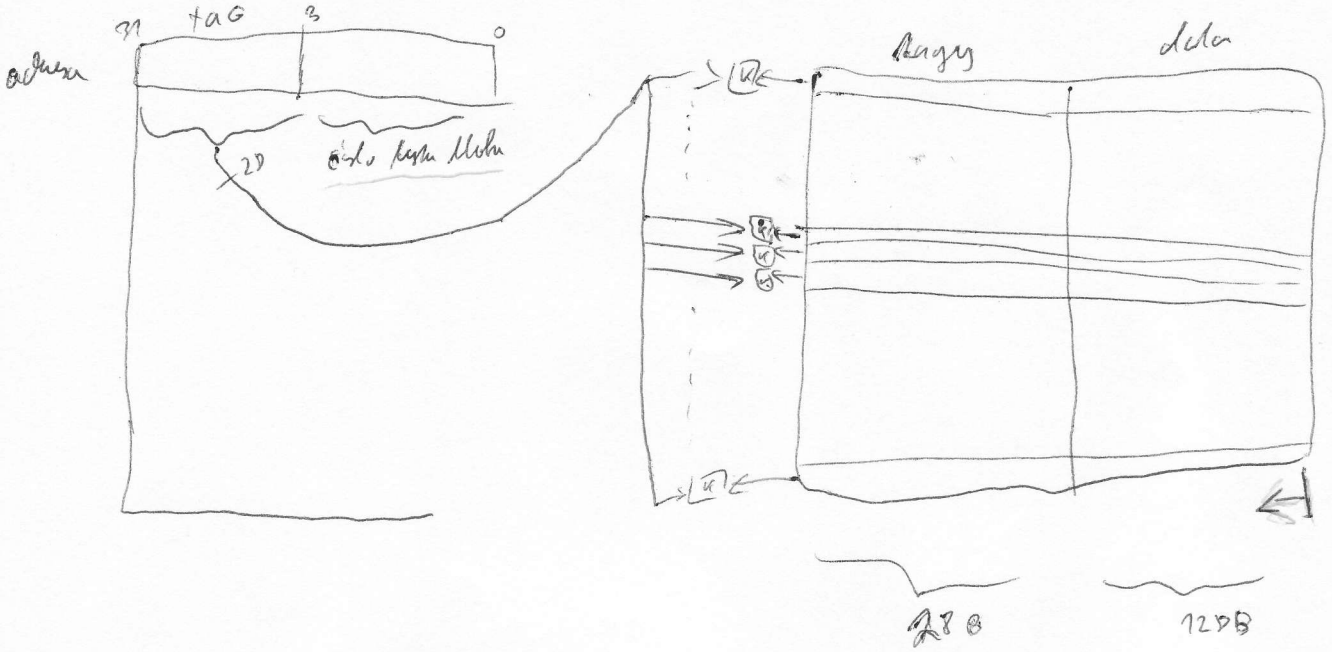




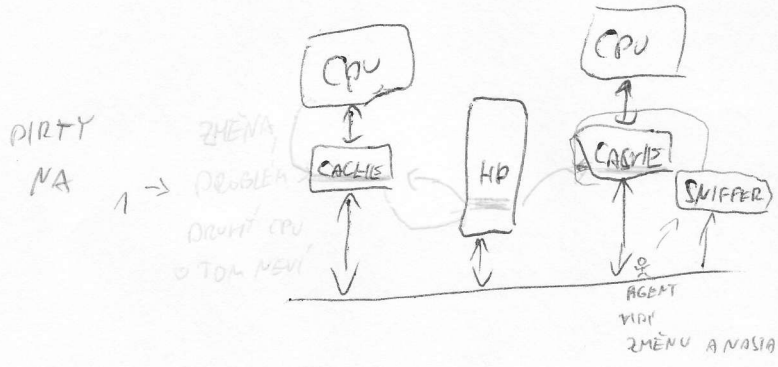
4 cestná CACHE



PLNĚ ASOCIATIVNÍ CACHE



poznámka k platnosti dat v CACHE



write back *
- zápis pouze do CACHE
- do HP až v případě přepisu jiným řádkem

write through
- zápis vždy také do HP

DIRTY
NA 1 ->

ZMĚNU ANALYZUJE VALID BIT

* 1) CACHE -> ZÁPISOVÝ BUFFER *
1) HP -> CACHE
3) ZÁPISOVÝ BUFFER -> HP