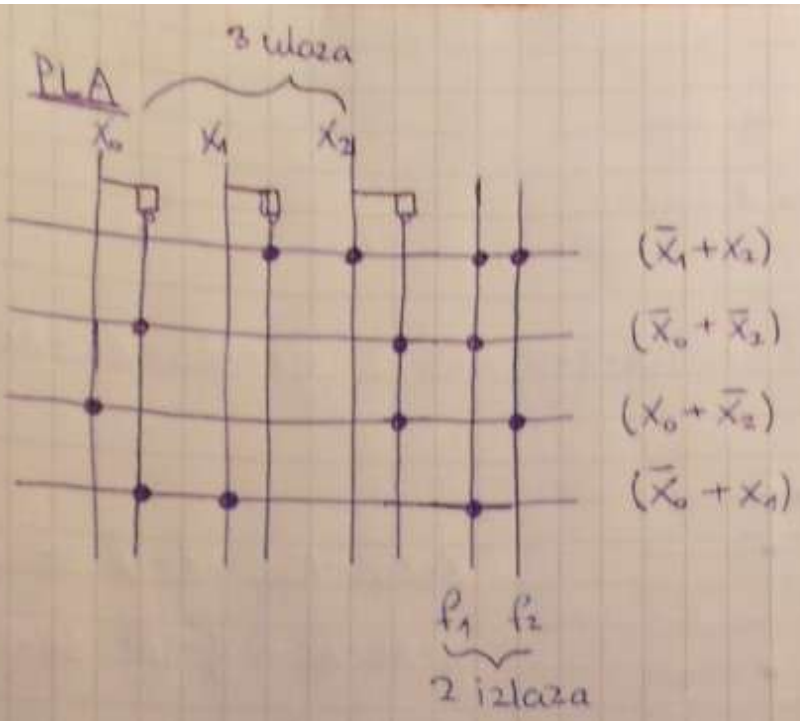
- **PLA**



$f_1 = (\bar{x}_1 + x_2)(\bar{x}_0 + \bar{x}_2)(\bar{x}_0 + x_1)$

$f_2 = (\bar{x}_1 + x_2)(x_0 + \bar{x}_1)$

f_1:

x_0 \ x_2x_1	00	01	11	10
0	1	0	1	1
1	0	0	0	0

$f_1 = \bar{x}_1\bar{x}_0 + x_2\bar{x}_0$

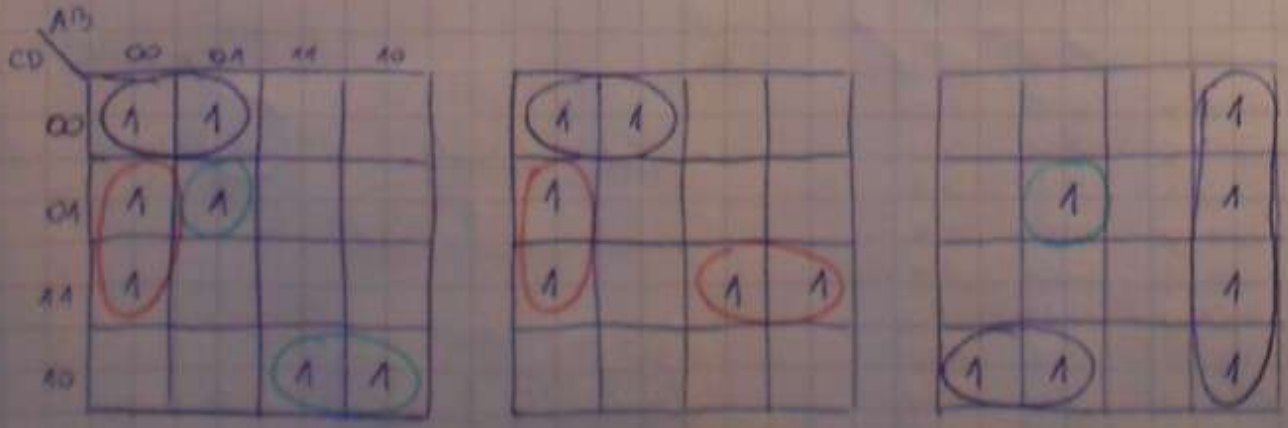
f_2:

x_0 \ x_2x_1	00	01	11	10
0	1	0	0	0
1	1	0	1	1

$f_2 = \bar{x}_1\bar{x}_2 + x_2x_0$

9. Uporabom PLA tipa NI-NI ostvari 3 f-je. Min. dimenzije PLA?

$f_1 = \bar{A}\bar{C} + \bar{A}\bar{B}CD + AC\bar{D}$ $f_2 = \sum m(0,1,3,4,11,15)$ $f_3 = \prod M(0,1,3,4,7,12,13,14,15)$

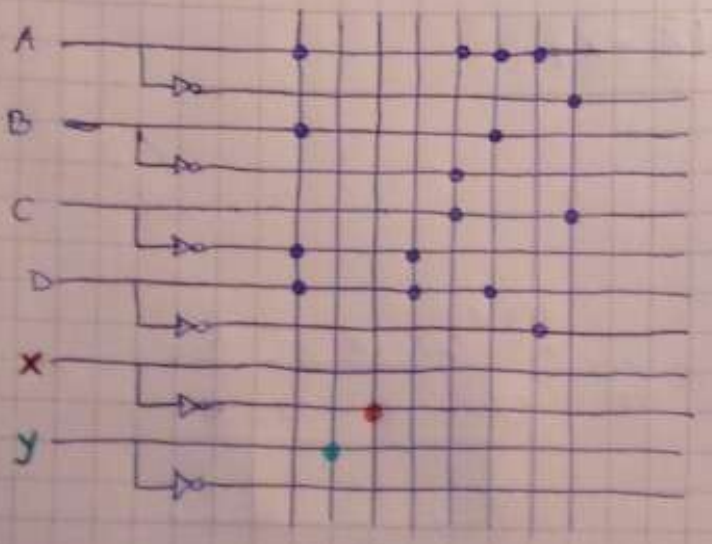


odg: 4 x 7 x 3 jer je 7 mogućih različitih zaokruženja

• **PAL**

- poluprogramirljivo log. polje
- programirljivo samo 1. polje

- Sklopom PAL ostvari $f = (\bar{A}+B+\bar{C})(\bar{A}+\bar{B}+\bar{D}) + \bar{C}D$ i $g = AB\bar{C}D + A\bar{D} + \bar{A}C$



$X = A\bar{B}C + ABD \Rightarrow \bar{x} = (\bar{A}+B+\bar{C})(\bar{A}+\bar{B}+\bar{D})$

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

$f = \bar{C}D + \bar{x}$

$y = AB\bar{C}D + y$

MOSFET - nili-nili
DIODE - ni-ni

- PAL $m \times k \cdot n \times n$

br. izlaza

br. izlaza

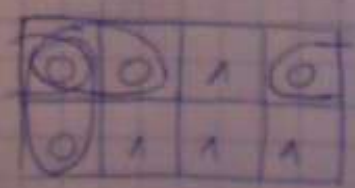
br. ulaza pojedini izlazni sklop NILI

zbrajalo, i oduzimalo

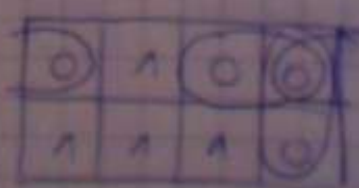
a	b	c	s	r	p	p
0	0	0	0	0	0	0
0	0	1	1	1	0	1
0	1	0	1	1	0	1
0	1	1	0	0	1	1
1	0	0	1	1	0	0
1	0	1	0	0	1	0
1	1	0	0	0	1	0
1	1	1	1	1	1	1

najviše! ⇒ $k=4$

4 zaokruženja



3 zaokr.



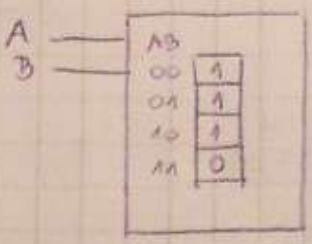
3 zaokr.

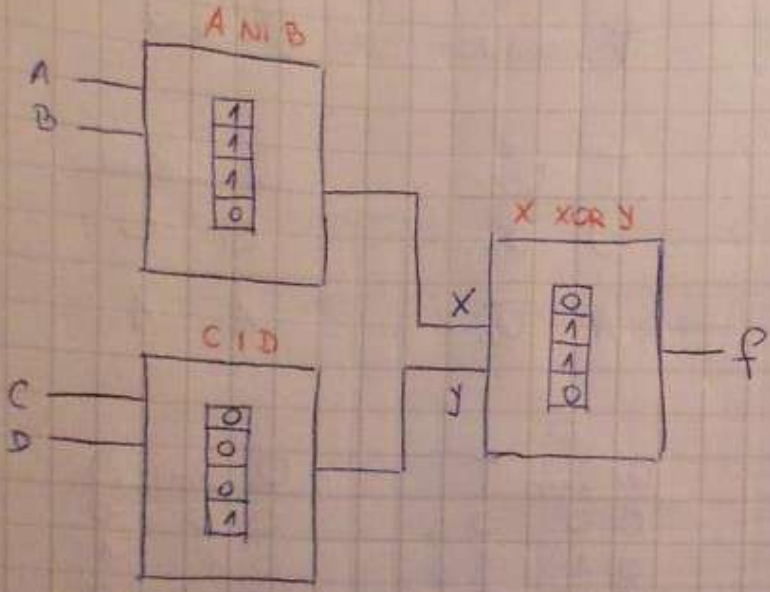
$m \times k \cdot n \times n$
$4 \cdot 3$

sdg: $3 \times 12 \times 3$

• FPGA

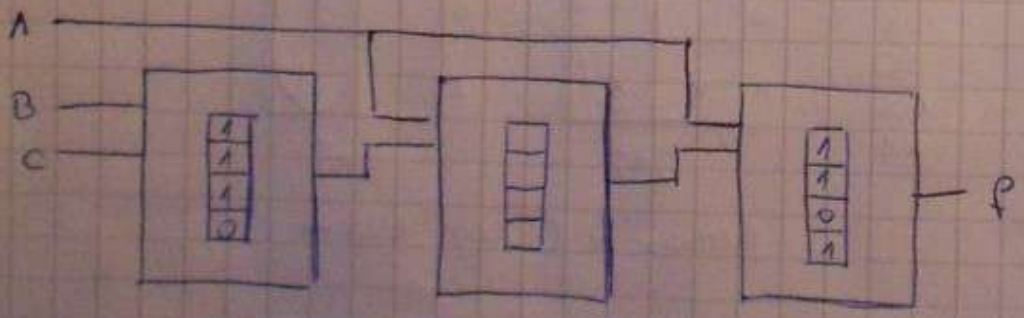
LUT





$f = \overline{AB} \oplus CD$

- FPGA. Što treba upisati u 2. log. sklop?



A B C	X Y	f
0 0 0	1 X	1
0 0 1	1 X	1
0 1 0	1 X	1
0 1 1	0 X	1
1 0 0	1 0	0
1 0 1	1 0	0
1 1 0	1 0	0
1 1 1	0 1	1

XX10

b) 0010

c) 0110

• BISTABILI

SR S-set R-reset

S	R	Q_{n+1}
0	0	Q_n
0	1	0
1	0	1
1	1	X

X - zabranjeno stanje

JK J-set K-reset

J	K	Q_{n+1}
0	0	Q_n
0	1	0
1	0	1
1	1	$\overline{Q_n}$

T-bistabil

T	Q_{n+1}
0	Q_n
1	$\overline{Q_n}$

D-bistabil

D	Q_{n+1}
0	0
1	1

pobudna tablica:

Q_n	Q_{n+1}	SR
0	0	0X
0	1	10
1	0	01
1	1	X0

Q_n	Q_{n+1}	JK
0	0	0X
0	1	1X
1	0	X1
1	1	X0

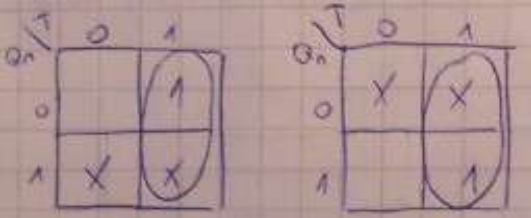
Q_n	Q_{n+1}	T
0	0	0
0	1	1
1	0	1
1	1	0

Q_n	Q_{n+1}	D
0	0	0
0	1	1
1	0	0
1	1	1

Zadaci:

Z1 08/01. ⑦

T	Q_n	Q_{n+1}	JK
0	0	0	0X
0	1	1	10
1	0	1	1X
1	1	0	X1

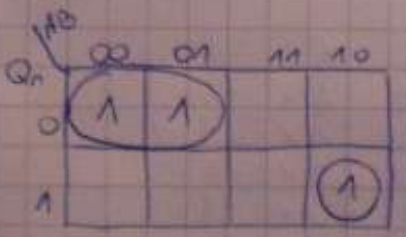


potrebno je 0 log. sklopova

11./12. ⑨

$Q_{n+1} = \overline{A} + Q_n B$

A	B	Q_n	Q_{n+1}	T
0	0	0	1	1
0	0	1	1	0
0	1	0	1	1
0	1	1	1	0
1	0	0	0	0
1	0	1	0	1
1	1	0	0	0
1	1	1	1	0



$T = \overline{A}\,\overline{Q_n} + A\overline{B}\,Q_n$

10/11 ⑦

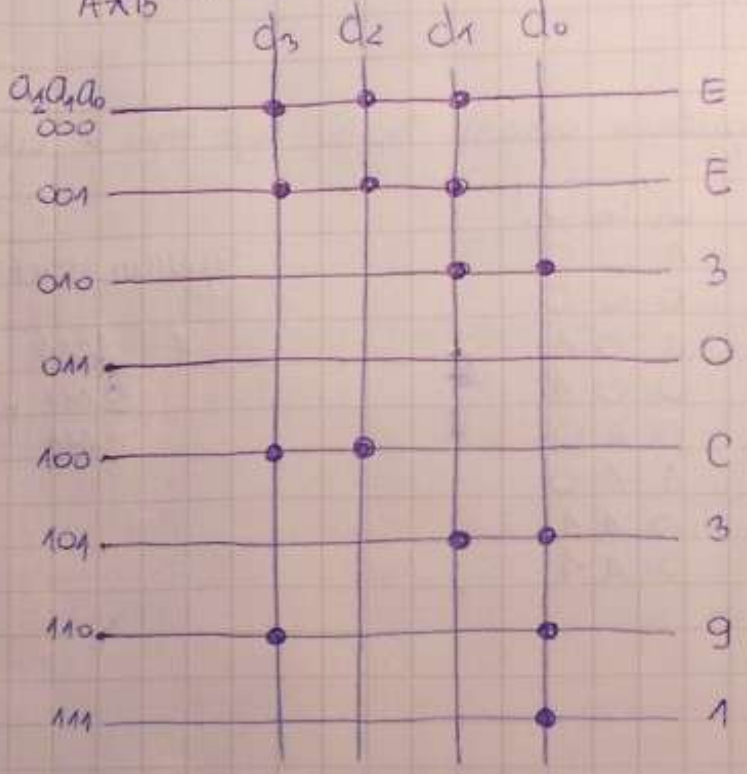
A	B	Q_n	Q_{n+1}	T
0	0	0	1	1
0	0	1	0	1
0	1	0	0	0
0	1	1	1	0
1	0	0	.	.

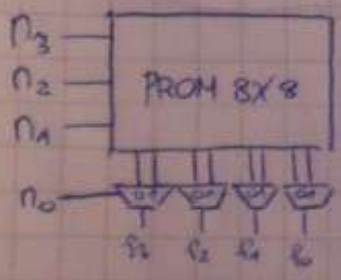
- nacrtati K-tablicu
- minimizirat

ROM, PROM, RAM

i_3	i_2	i_1	i_0	f	
0	0	0	0	3	11
0	0	0	1	3	11
0	0	1	0	1	01
0	0	1	1	0	00
0	1	0	0	2	10
0	1	0	1	1	01
0	1	1	0	0	00
0	1	1	1	0	00
1	0	0	0	2	10
1	0	0	1	2	10
1	0	1	0	1	01
1	0	1	1	0	00
1	1	0	0	2	10
1	1	0	1	1	01
1	1	1	0	3	11
1	1	1	1	1	01

br. redaka / A×B – br. stupaca



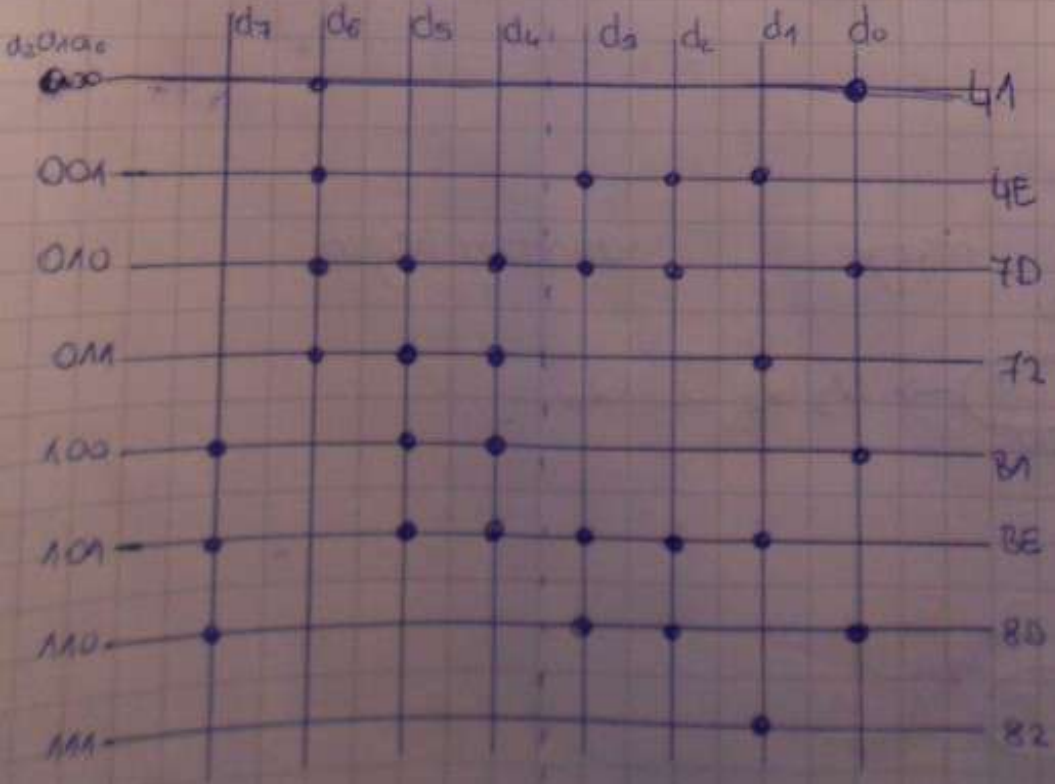


2011. (17) – sličan zadatak

$f = n \oplus \hat{n}$

n_3	n_2	n_1	n_0	$\hat{n}_3$	$\hat{n}_2$	$\hat{n}_1$	$\hat{n}_0$
0	0	0	0	0	0	0	0
0	0	0	1	1	0	0	0
0	0	1	0	0	0	0	1
0	0	1	1	1	0	0	1
0	1	0	0	0	0	1	0
0	1	0	1	1	0	1	0
0	1	1	0	0	0	1	1
0	1	1	1	1	0	1	1
1	0	0	0	0	1	0	0
1	0	0	1	1	1	0	0
1	0	1	0	0	1	0	1
1	0	1	1	1	1	0	1
1	1	0	0	0	1	1	0
1	1	0	1	1	1	1	0
1	1	1	0	0	1	1	1
1	1	1	1	1	1	1	1

0 - parni
1 - neparni



• POSMAČNI REGISTAR

$\underset{\xrightarrow{x}}{ABCD} \Rightarrow XABC\ D$

- Posmačnim registrom ostvariti brojilo koje broji u ciklusu 0, 4, 2, 5, 6, 3, 1

Q_2	Q_1	Q_0	Q_2'	Q_1'	Q_0'
0	0	0	1	0	0
0	0	1	0	0	0
0	1	0	1	0	1
0	1	1	0	0	1
1	0	0	0	1	0
1	0	1	1	1	0
1	1	0	0	1	1
1	1	1	0	1	1

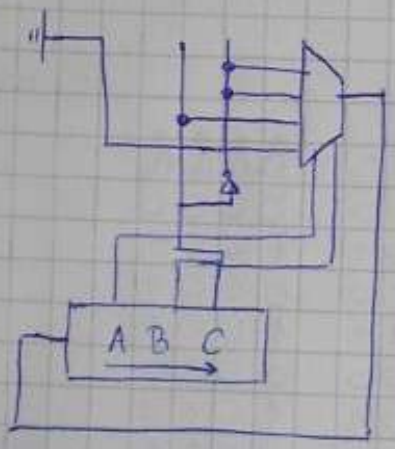
Siguran start:

7 = 1111   0 = 0000

0111 ✓   ~~0000~~

~~1111~~   1000 ✓

-



ABC	$\bar{A}\bar{B}\bar{C}$
000	100
001	000
010	101
011	001
100	010
101	110
110	011
111	011

0 → 4 → 2 → 5 → 6 → 3 → 1

- 2011. (11)   0 → 1 → 2 → ... 12 → 0 (1)   brisanje   • asinkrono brojilo

0 → 1 → 2 → ... 11 → 15 → 0 (2)

1101 → $Q_3\ Q_2\ \overline{Q_1}\ Q_0$

12 = 1100 → 0 = 0000

(8) $B_3\ B_2\ B_1\ B_0$ $B_3\ B_2\ B_1\ B_0$

12   1 1   0 0   11   1 0   1 1

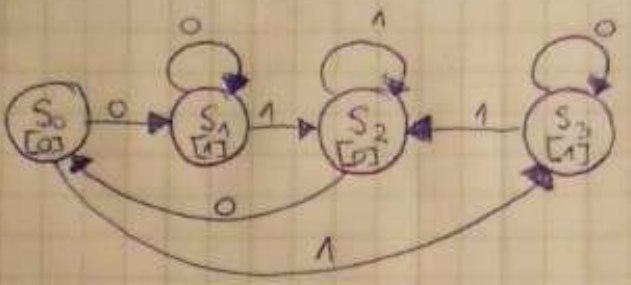
$B_3\ B_2\ B_1\ B_0$

1 0 0 0

$\overline{Q_3} + Q_2 + Q_1 + Q_0$

· AUTOMATI

Ž1 2010.



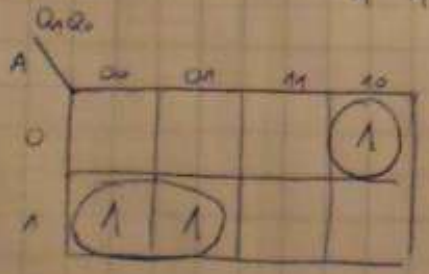
(13) S_1 i S_3 su ekvivalentni

(14) A-ulaz

Q_1Q_0	S_i
0 0	S_0
0 1	S_1
1 0	S_2
1 1	S_3

Q_1	Q_0	A	Q_1'	Q_0'	T_1	T_0
0	0	0	0	1	0	1
0	0	1	1	1	1	1
0	1	0	0	1	0	0
0	1	1	1	0	1	1
1	0	0	0	0	1	0
1	0	1	1	0	0	0
1	1	0	1	1	0	0
1	1	1	1	0	0	1

T	Q_{n+1}
0	Q_n
1	$\overline{Q_n}$

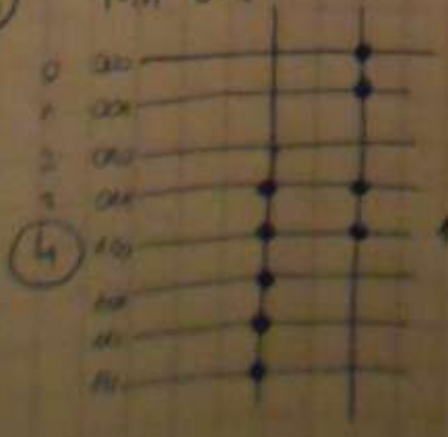


$$T_1 = \overline{Q_1}A + Q_1\overline{Q_0}\,\overline{A}$$

(15) S: 0,0,1,0,1

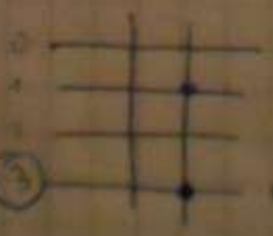
pobuda		0	0	1	0	1
stanje	S_0	S_1	S_1	S_2	S_0	S_3
izlaz	1	1	1	0	0	1

(16) MA 8×2



MA ⇒ 4

MB 4×2

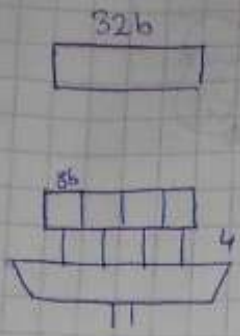


MB ⇒ 3

A	Q_1	Q_0	Q_1'	Q_0'
0	0	0	0	1
0	0	1	0	1
0	1	0	0	0
0	1	1	1	1
1	0	0	1	1
1	0	1	1	0
1	1	0	1	0
1	1	1	1	0

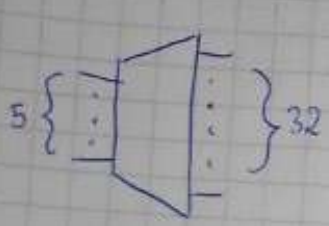
· MEMORIJE

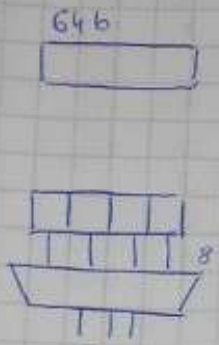
64 x 32



256 x 8b

2 adresna bita



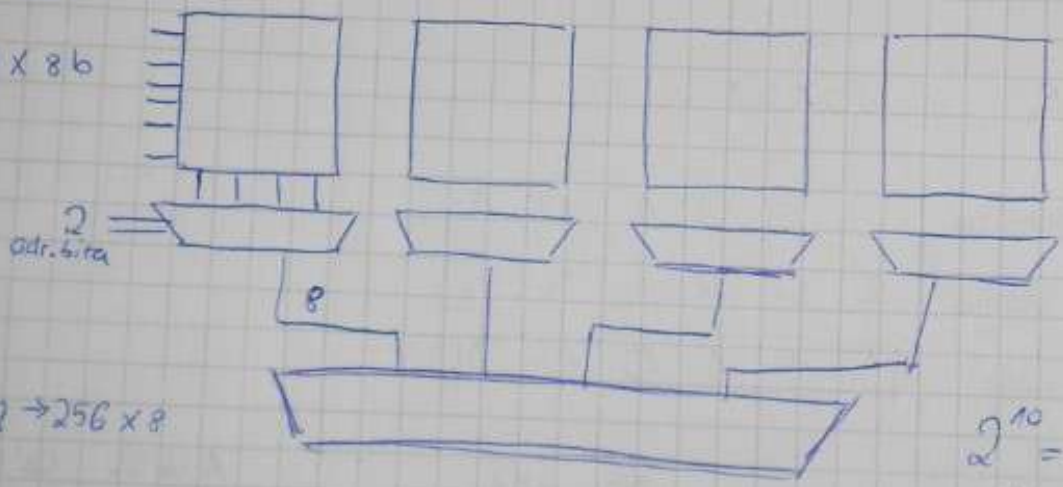


3 adr. b.

---

64 x 32b

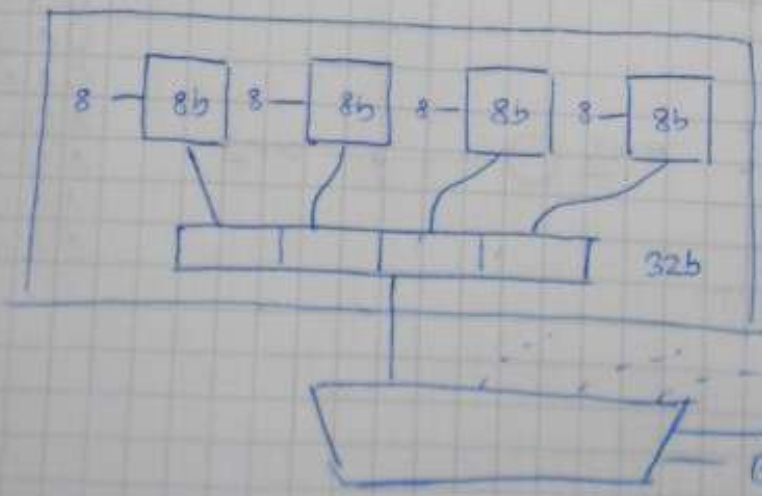
→ 1024 x 8b



64x32 → 256 x 8

$2^{10} = 1024$

→ 1024 x 32b



$2^{10} = 1024$

1024 x 32 b