Digitalna vezja
UL, FRI

Vaja 8 Naloge

Naloge:

- Določi MDNO in MKNO funkcije $f(x_1, x_2, x_3, x_4) = \vee^4 (4,5,6,7,9,11,12,14)$. Pri obeh oblikah ovrednoti število operatorjev (vrat) in operandov (vhodov) in na podlagi tega določi MNO.

- Funkcijo $f(x_1, x_2, x_3, x_4) = \&^4(2,3,5,7,9,10,11,13,14,15)$ pretvori v PDNO in jo realiziraj z enim MUX 4/1 in dvema MUX 2/1.

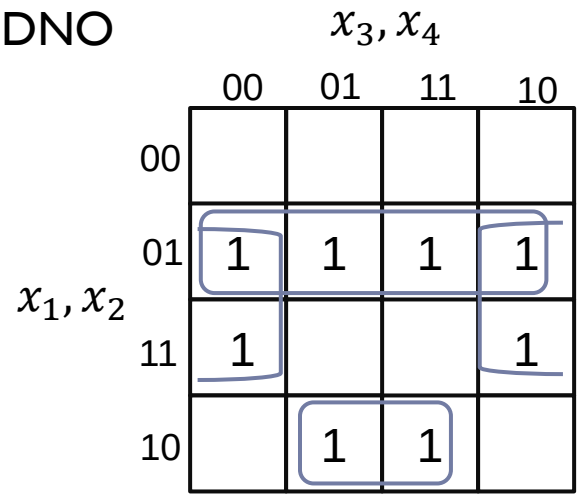
- Pariteta (XOR):

  Za 4-bitni podatek D = (d3, d2, d1, d0) izračunajte izhod za generiranje paritetnega bita PL, ki je določen z liho pariteto (izhod je 1, če na vhodu ni nobene ali je sodo število enic) in ga realizirajte z XOR operatorji.

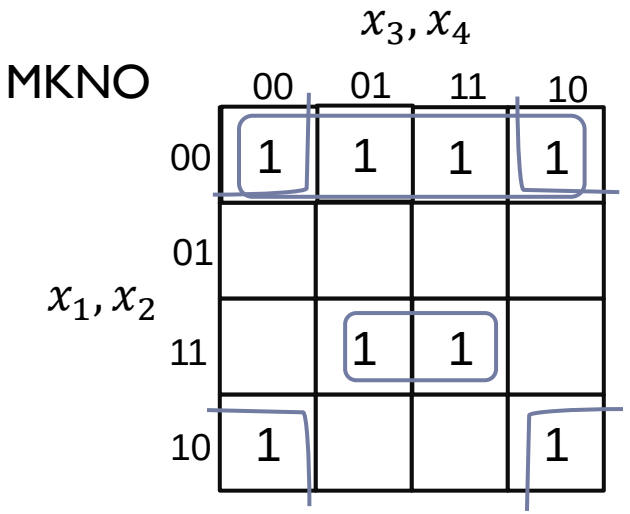
- Podana je logična funkcija $F(A, B, C, D) = \vee^4 (0,1,6,9,14) \vee^4_? (3,4,5,7,8,11,15)$.
  - Zapišite MDNO in MKNO ter določite MNO tako, da zapišete število operatorjev in število vhodov za MDNO in MKNO.
  - V Karnaugh-jevem diagramu pokažite, da je funkcija, ki ste jo zapisali v MDNO, linearna.
  - Zapišite splošno enačbo za linearni polinom, izračunajte koeficiente in jo zapišite z XOR operatorji.

Naloga 1: Rešitev

MDNO



MKNO



$$f(x_1, x_2, x_3, x_4) = \overline{x_1}x_2 \vee x_2\overline{x_4} \vee x_1\overline{x_2}x_4$$

[4,10]

$$\bar{f}(x_1, x_2, x_3, x_4) = \overline{x_1} \cdot \overline{x_2} \vee x_1x_2x_4 \vee \overline{x_2} \cdot \overline{x_4}$$

$$f(x_1, x_2, x_3, x_4) = \overline{\overline{x_1} \cdot \overline{x_2} \vee x_1x_2x_4 \vee \overline{x_2} \cdot \overline{x_4}} =$$

$$= (x_1 \vee x_2)(\overline{x_1} \vee \overline{x_2} \vee \overline{x_4})(x_2 \vee x_4)$$

[4,10]

MNO = MDNO=MKNO

Naloga 2: Rešitev

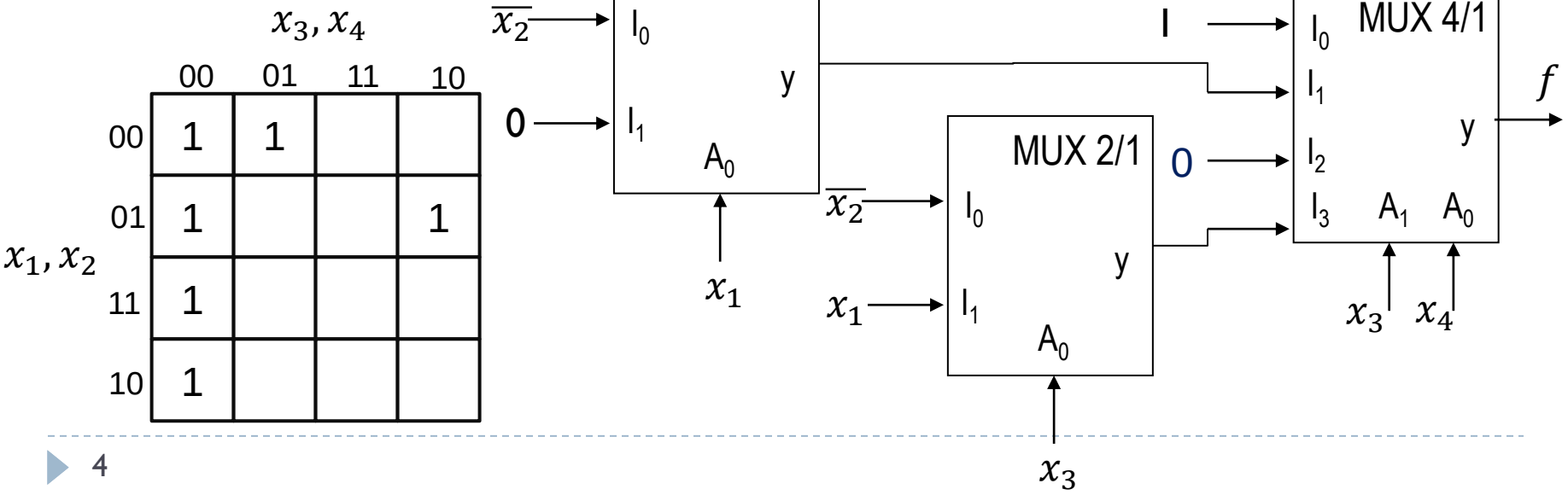
- PDNO:
- Indeksi manjkajči makstermov: 0,1,4,6,8,12
- Skrajšana PDNO:

$$f(x_1, x_2, x_3, x_4) = \bigvee^4 (0,1,4,6,8,12)$$

- Eksplicitna PDNO:

$$f(x_1, x_2, x_3, x_4) = \overline{x_1}\,\overline{x_2}\,\overline{x_3}\,\overline{x_4} \vee \overline{x_1}\,\overline{x_2}\,\overline{x_3}x_4 \vee \overline{x_1}x_2\overline{x_3}\,\overline{x_4} \vee \overline{x_1}x_2x_3\overline{x_4} \vee x_1\overline{x_2}\,\overline{x_3}\,\overline{x_4} \vee x_1\overline{x_2}\,\overline{x_3}x_4 \vee x_1x_2\overline{x_3}\,\overline{x_4}$$

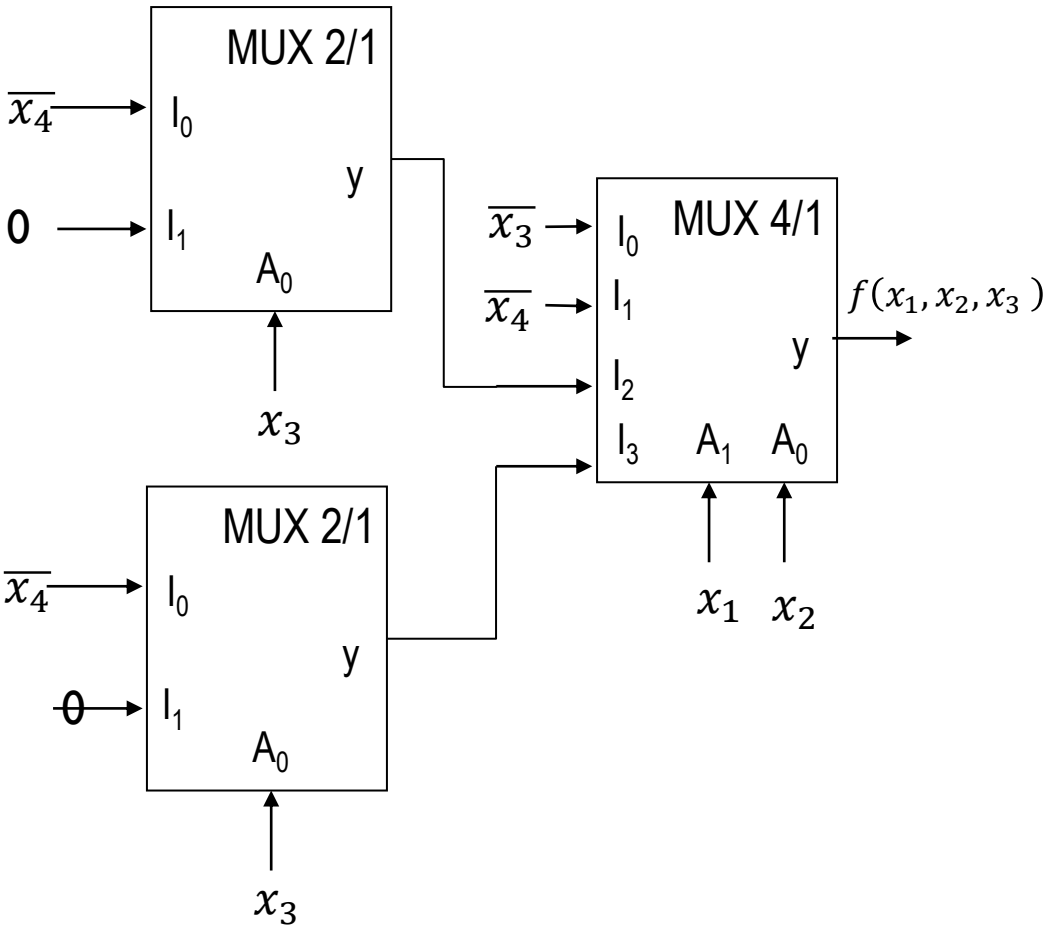
- Realizacija z MUXi:



Naloga 2: Rešitev

- Realizacija z MUXi – možnih je več rešitev:

x_1	x_2	x_3	x_4	f	
0	0	0	0	1	$\overline{x_3}$
0	0	0	1	1	
0	0	1	0	0	
0	0	1	1	0	
0	1	0	0	1	$\overline{x_4}$
0	1	0	1	0	
0	1	1	0	1	
0	1	1	1	0	
1	0	0	0	1	$\overline{x_4}$
1	0	0	1	0	
1	0	1	0	0	0
1	0	1	1	0	
1	1	0	0	1	$\overline{x_4}$
1	1	0	1	0	
1	1	1	0	0	0
1	1	1	1	0	



Naloga 3: Rešitev

d_3	d_2	d_1	d_0	P
0	0	0	0	1
0	0	0	1	0
0	0	1	0	0
0	0	1	1	1
0	1	0	0	0
0	1	0	1	1
0	1	1	0	1
0	1	1	1	0
1	0	0	0	0
1	0	0	1	1
1	0	1	0	1
1	0	1	1	0
1	1	0	0	1
1	1	0	1	0
1	1	1	0	0
1	1	1	1	1

	$\overline{d_1}\,\overline{d_0}$	$\overline{d_1}\,d_0$	$d_1 d_0$	$d_1\overline{d_0}$
$\overline{d_3}\,\overline{d_2}$	1		1	
$\overline{d_3}\,d_2$		1		1
$d_3 d_2$	1		1	
$d_3\overline{d_2}$		1		1

$$P = a_0 \nabla\, a_1 . d_3 \nabla\, a_2 . d_2 \nabla a_3 . d_1 \nabla a_4 . d_0$$

f(0,0,0,0)=1=a_0
f(0,0,0,1)=$0 = 1 \nabla\, a_4 \quad \Rightarrow\ a_4 = 1$
f(0,0,1,0)=$0 = 1 \nabla\, a_3 \quad \Rightarrow\ a_3 = 1$
f(0,1,0,0)=$0 = 1 \nabla\, a_2 \quad \Rightarrow\ a_2 = 1$
f(1,0,0,0)=$0 = 1 \nabla\, a_1 \quad \Rightarrow\ a_1 = 1$

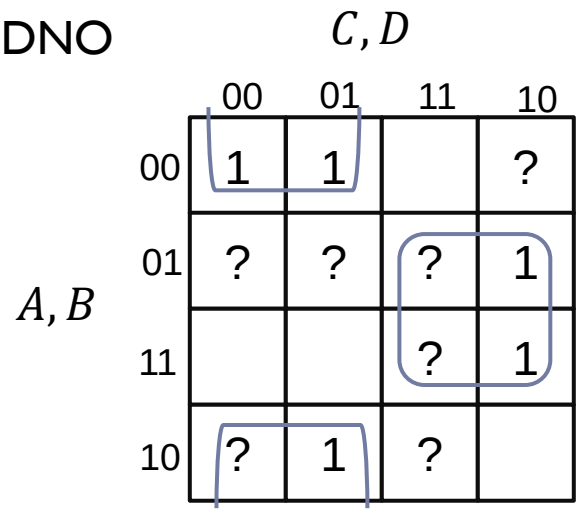
$$P = 1 \nabla 1 . d_3 \nabla 1 . d_2 \nabla 1 . d_1 \nabla 1 . d_0 = 1 \nabla d_3 \nabla d_2 \nabla d_1 \nabla d_0$$

Naloga 4: Rešitev

Podana je logična funkcija $F(A,B,C,D) = \vee^4 (0,1,6,9,14) \vee_?^{4^4} (3,4,5,7,8,11,15)$.

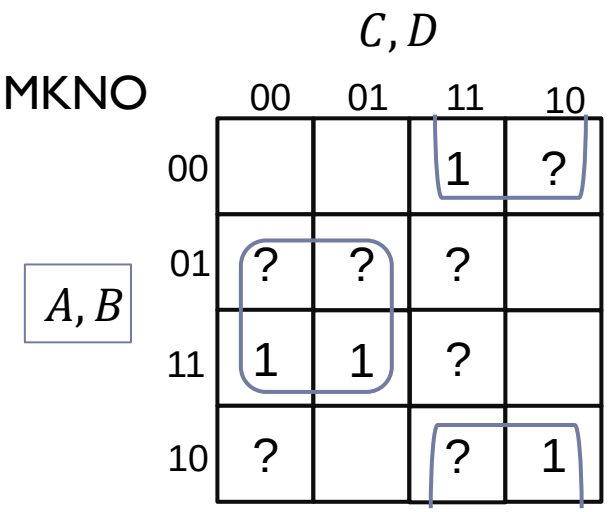
- MDNO, MKNO in MNO

MDNO



$f(A,B,C,D) = \bar{B}.\bar{C} \vee B.C$ [3,6]

MKNO



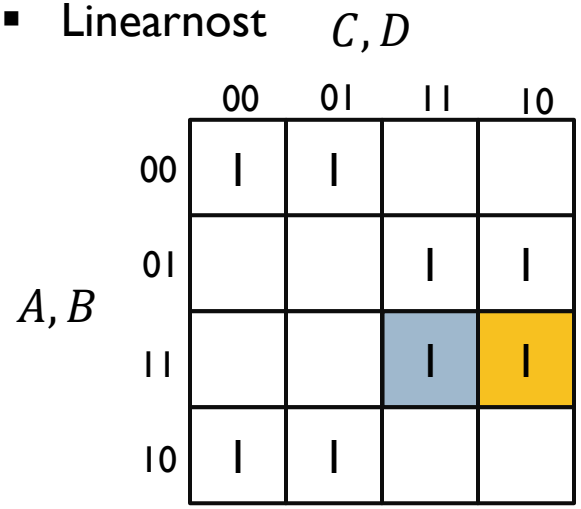
$\bar{f}(A,B,C,D) = B.\bar{C} \vee \bar{B}.C$

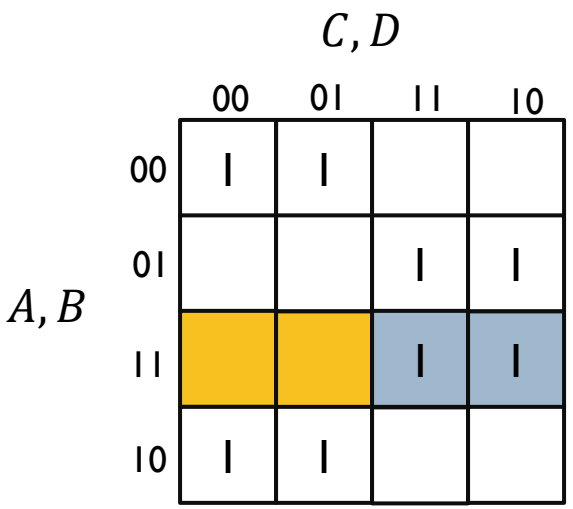
$f(A,B,C,D) = \overline{B.\bar{C} \vee \bar{B}.C} = (\bar{B} \vee C)(B \vee \bar{C})$

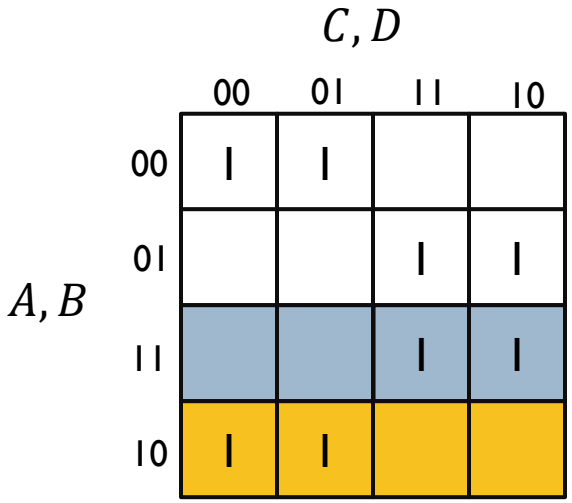
[3,6]

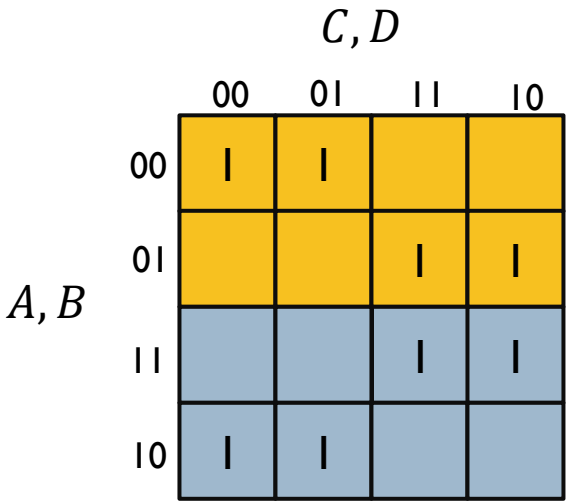
MNO = MDNO=MKNO

- Linearnost





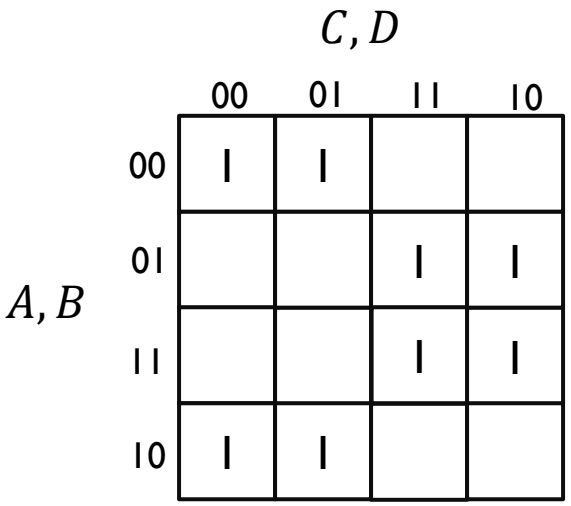




Funkcija je linearna. Pri vseh preverjanjih je popolnoma enaka ali popolnoma različna.

- Linearni polinom:

$$f(A,B,C,D) = a_0 \nabla a_1.A \nabla a_2.B \nabla a_3.C \nabla a_4.D$$



Izračun koeficientov:

$$f(0,0,0,0) = 1 = a_0$$
$$f(0,0,0,1) = 1 = 1 \nabla a_4 \quad \Rightarrow \quad a_4 = 0$$
$$f(0,0,1,0) = 0 = 1 \nabla a_3 \quad \Rightarrow \quad a_3 = 1$$
$$f(0,1,0,0) = 0 = 1 \nabla a_2 \quad \Rightarrow \quad a_2 = 1$$
$$f(1,0,0,0) = 1 = 1 \nabla a_1 \quad \Rightarrow \quad a_1 = 0$$

$$f(A,B,C,D) = 1 \nabla 0.A \nabla 1.B \nabla 1.C \nabla 0.D = 1 \nabla B \nabla C$$