



# Digitalna tehnika

## 1. Vaja

Realizacija primerjalnika z logičnimi vrati

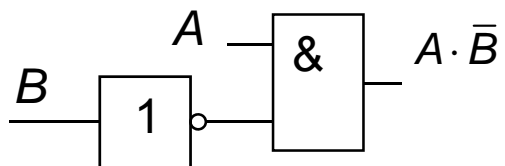


# 1a) Enobitni primerjalnik z vrati AND in NOT

A>B

A	B	f
0	0	0
0	1	0
1	0	1
1	1	0

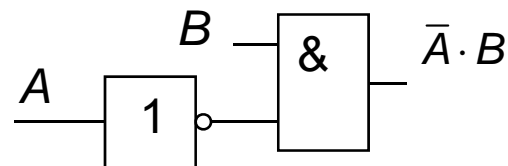
$$f(A,B) = A \cdot \bar{B}$$



A<B

A	B	f
0	0	0
0	1	0
1	0	1
1	1	0

$$f(A,B) = \bar{A} \cdot B$$

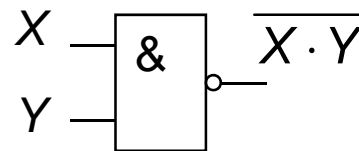




## 1b) Dvobitni primerjalnik z vrati NAND

A		B		A>B
A <sub>1</sub>	A <sub>0</sub>	B <sub>1</sub>	B <sub>0</sub>	
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	1
0	1	0	1	0
⋮	⋮	⋮	⋮	⋮
1	1	1	0	1
1	1	1	1	0

NAND:  $f(X, Y) = \overline{X \cdot Y}$



Poiščemo **MDNO** in funkcijo 2×negiramo

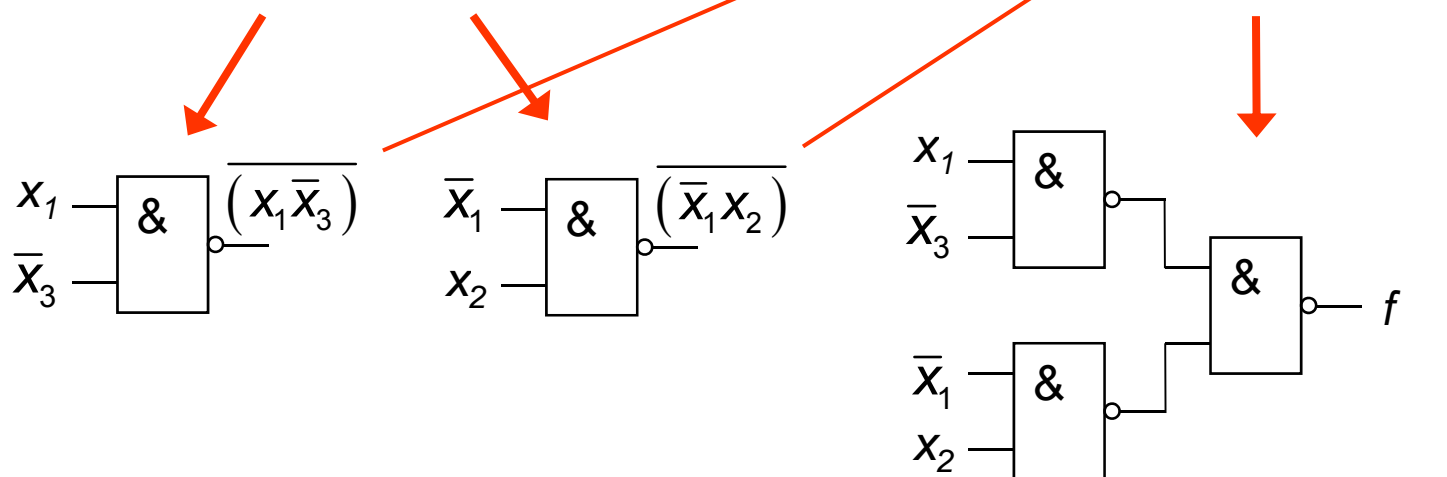


## 1b) Primer realizacije funkcije z NAND

$$f_{MDNO}(x_1, x_2, x_3) = x_1\bar{x}_3 + \bar{x}_1x_2$$

$$f = \overline{\overline{f_{MDNO}}} = \overline{(x_1\bar{x}_3 + \bar{x}_1x_2)}$$

$$f = \overline{(x_1\bar{x}_3)} \cdot \overline{(\bar{x}_1x_2)} = \overline{X \cdot Y}$$

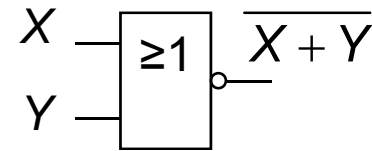




## 1b) Dvobitni primerjalnik z NOR

A		B		A>B
A <sub>1</sub>	A <sub>0</sub>	B <sub>1</sub>	B <sub>0</sub>	
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	1
0	1	0	1	0
⋮	⋮	⋮	⋮	⋮
1	1	1	0	1
1	1	1	1	0

NOR:  $f(X, Y) = \overline{X + Y}$



Poiščemo **MKNO** in funkcijo 2×negiramo

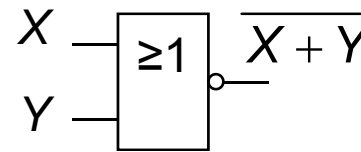
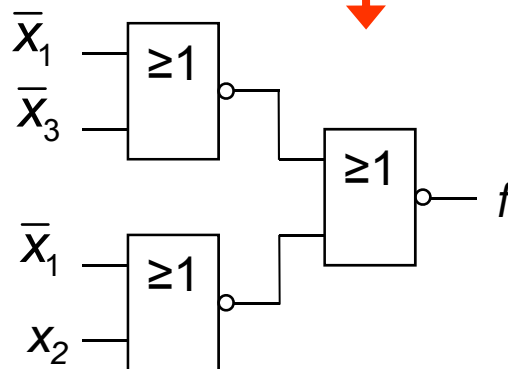
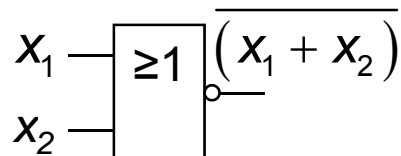
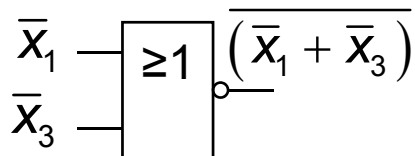


## 1b) Primer realizacije funkcije z vrati **NOR**

$$f_{MKNO}(x_1, x_2, x_3) = (\bar{x}_1 + \bar{x}_3) \cdot (x_1 + x_2)$$

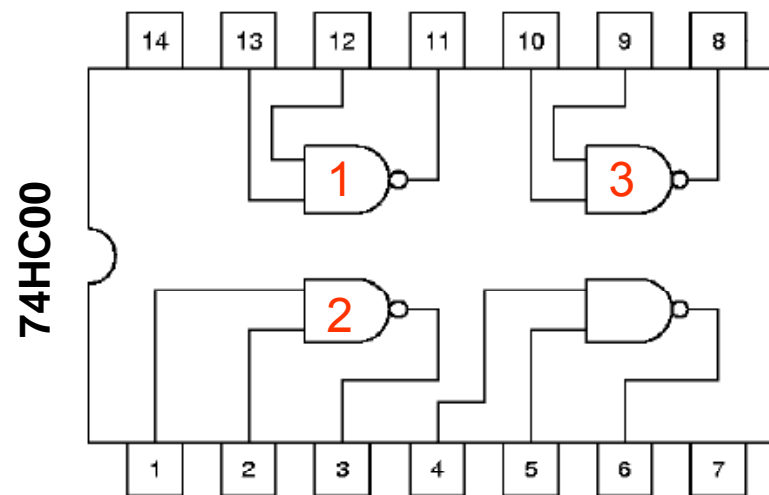
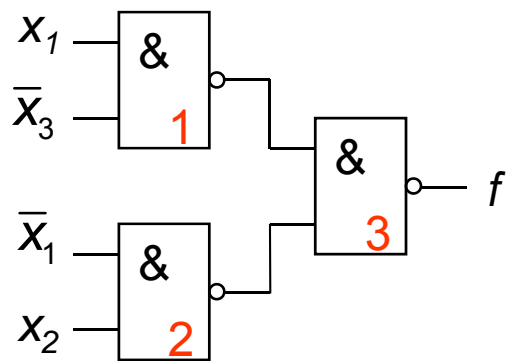
$$f = \overline{\overline{(\bar{x}_1 + \bar{x}_3) \cdot (x_1 + x_2)}}$$

$$f = \overline{(\bar{x}_1 + \bar{x}_3) + (x_1 + x_2)} = \overline{X + Y}$$



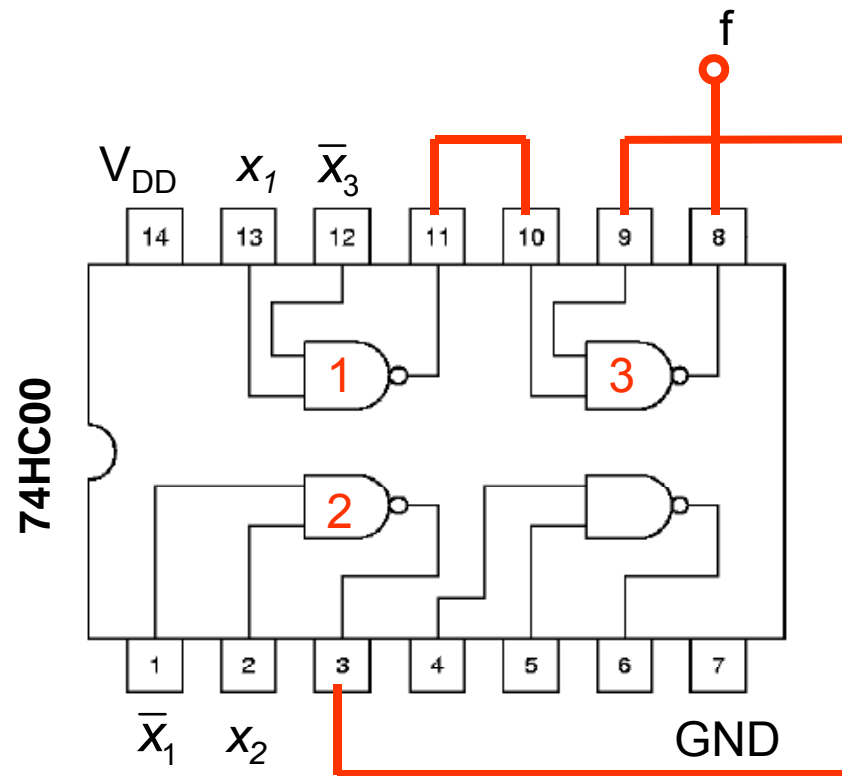
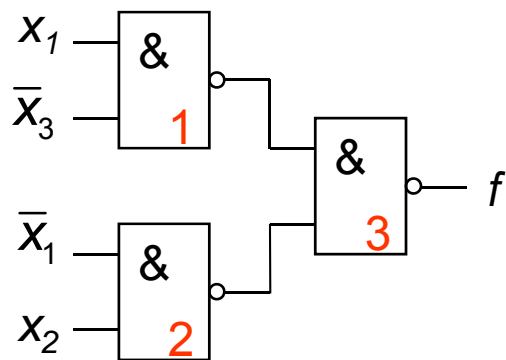


## Primer vezave

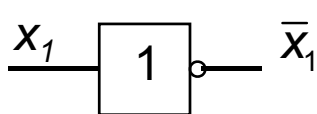




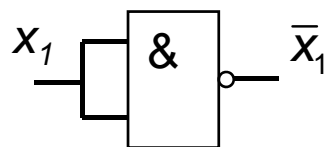
### Primer vezave



### Negacija spremenljivke



Negator  
(inverter)

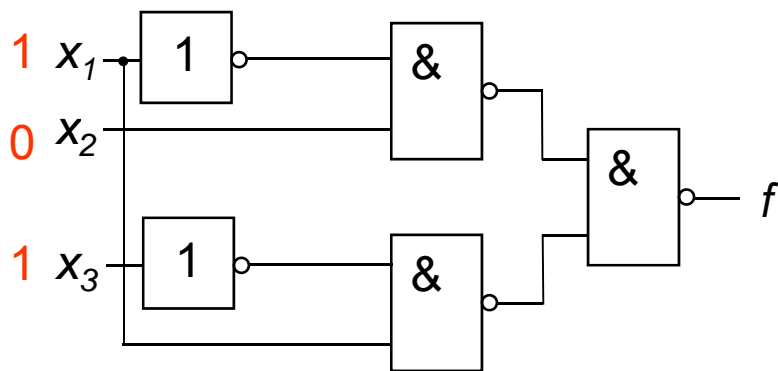


NAND





## Iskanje napak v vezjih (NAND)



Napaka: namesto 0  
dobimo 1

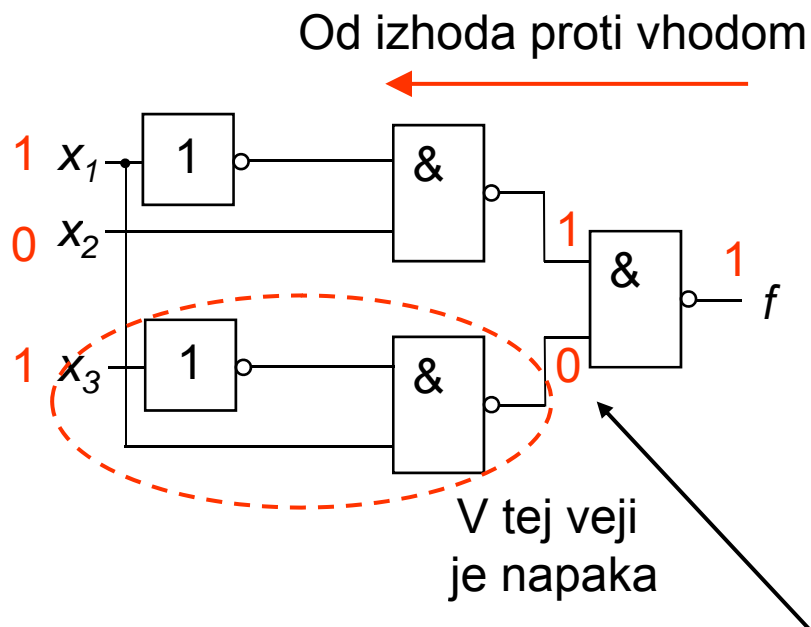
$x_1$	$x_2$	$x_3$	$f$
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	0 (1)
1	1	0	1
1	1	1	0

NAND

$x_1$	$x_2$	$f$
0	0	1
0	1	1
1	0	1
1	1	0



## Iskanje napak v vezjih (NAND)



Napaka: namesto 0  
dobimo 1

$x_1$	$x_2$	$x_3$	$f$
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	0 (1)
1	1	0	1
1	1	1	0

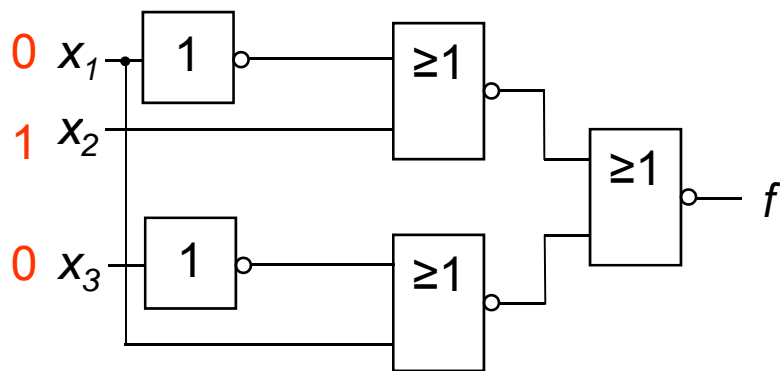
NAND

$x_1$	$x_2$	$f$
0	0	1
0	1	1
1	0	1
1	1	0

Na izhodu NAND lahko dobimo 1, kadar je vsaj eden od vhidov v ta vrata 0. Ta vhod je napačen.



## Iskanje napak v vezjih (NOR)



Napaka: namesto 1  
dobimo 0

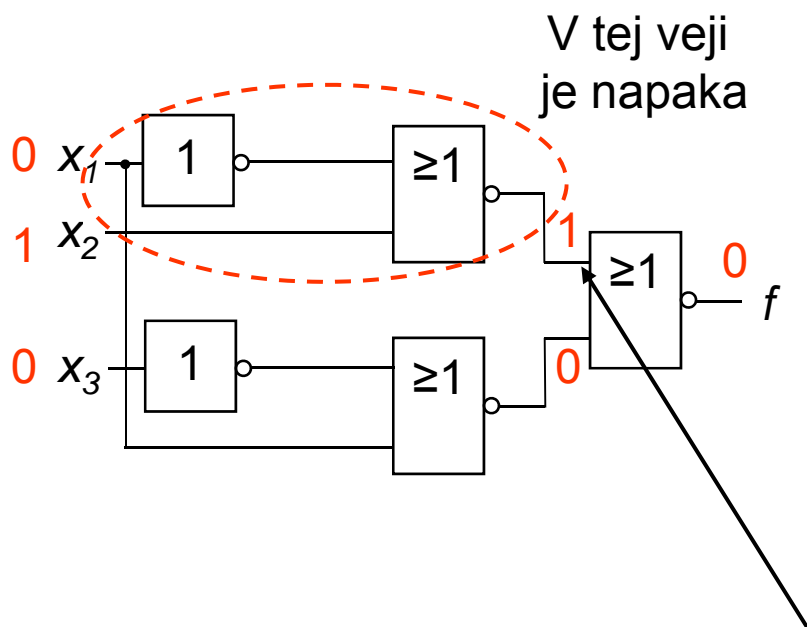
$x_1$	$x_2$	$x_3$	$f$
0	0	0	0
0	0	1	0
0	1	0	1 (0)
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0

NOR

$x_1$	$x_2$	$f$
0	0	1
0	1	0
1	0	0
1	1	0



## Iskanje napak v vezjih (NOR)



Napaka: namesto 1  
dobimo 0

$x_1$	$x_2$	$x_3$	$f$
0	0	0	0
0	0	1	0
0	1	0	1 (0)
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0

NOR

$x_1$	$x_2$	$f$
0	0	1
0	1	0
1	0	0
1	1	0

Na izhodu NOR lahko dobimo 0, kadar je vsaj eden od vhodov v ta vrata 1. Ta vhod je napačen.



## Poročilo

- ❑ Naslov vaje
- ❑ Analitična rešitev
  - PKNO, PDNO
  - MKNO, MDNO
  - K-diagram, tabela
- ❑ Simbolni diagram
- ❑ Vežalni načrt (npr. Eagle)

