



# Digitalna vezja UL, FRI



Vaja 1 Booleova algebra, logisim, breadboard

# Postulati Boolove algebre

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**Zaprtoost:**

**P1:**  $x \vee y \in X$

**P1\*:**  $x \cdot y \in X$

**Nevtralni element:**

**P2:**  $x \vee 0 = x$

**P2\*:**  $x \cdot 1 = x$

**Komutativnost:**

**P3:**  $x \vee y = y \vee x$

**P3\*:**  $x \cdot y = y \cdot x$

**Distributivnost:**

**P4:**  $x \vee (y \cdot z) = (x \vee y) \cdot (x \vee z)$

**P4\*:**  $x \cdot (y \vee z) = (x \cdot y) \vee (x \cdot z) = x \cdot y \vee x \cdot z$

**Inverzni element:**

**P5:**  $x \vee \bar{x} = 1$

**P5\*:**  $x \cdot \bar{x} = 0$

**Število elementov:**

**P6:**  $x \neq y$

# Lastnosti Boolove algebre

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**Idempotenca:**  $x \vee x \vee \dots \vee x = x$

$$x \cdot x \dots \cdot x = x$$

**Absorbicija:**  $x \vee (x \cdot y) = x$

$$x \cdot (x \vee y) = x$$

**Asociativnost:**  $(x \vee y) \vee z = x \vee (y \vee z) = x \vee y \vee z$



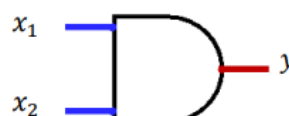

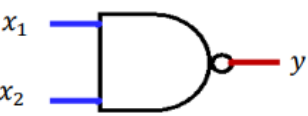
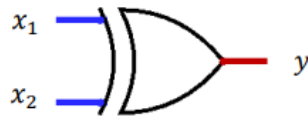

$$(x \cdot y) \cdot z = x \cdot (y \cdot z) = x \cdot y \cdot z$$

**DeMorganovo pravilo:**  $\overline{x_1 \vee x_2 \dots \vee x_n} = \overline{x_1} \cdot \overline{x_2} \cdot \dots \cdot \overline{x_n}$

$$\overline{x_1 \cdot x_2 \dots \cdot x_n} = \overline{x_1} \vee \overline{x_2} \vee \dots \vee \overline{x_n}$$



# Osnovne preklopne funkcije

Negacija (NE, NOT)	Disjunkcija (ALI, OR)	Konjunkcija (IN, AND)	Percipov operator (NE ALI, NOR)																																																												
$y = \bar{x}$	$y = x_1 \vee x_2$	$y = x_1 \cdot x_2$	$y = x_1 \downarrow x_2 = \overline{x_1 \vee x_2}$																																																												
																																																															
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# Naloga 1: Poenostavljanje logičnih funkcij

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□ Primer:  $f(x, y, z) = \overline{(\bar{x} \cdot \bar{y} \vee y \cdot z) \vee (x \vee z)} =$

$= \overline{\bar{x} \cdot \bar{y} \vee y \cdot z} \cdot \overline{x \vee z} =$	DeMorganovo pravilo
$= \overline{\bar{x} \cdot \bar{y}} \cdot \overline{y \cdot z} \cdot \bar{x} \cdot \bar{z} =$	DeMorganovo pravilo
$= (x \vee y) \cdot (\bar{y} \vee \bar{z}) \cdot \bar{x} \cdot \bar{z} =$	DeMorganovo pravilo
$= (x \cdot \bar{x}) \vee (\bar{x} \cdot y) \cdot (\bar{y} \vee \bar{z}) \cdot \bar{z} =$	Distributivnost (P4*)
$= (0 \vee \bar{x} \cdot y) \cdot (\bar{y} \vee \bar{z}) \cdot \bar{z} =$	Inverzni element (P5*)
$= (\bar{x} \cdot y) \cdot (\bar{y} \vee \bar{z}) \cdot \bar{z}$	Nevtralni element (P2*)
$= \bar{x} \cdot y \cdot \bar{z}$	Absorbpcija

□ Poenostavite logične funkcije:

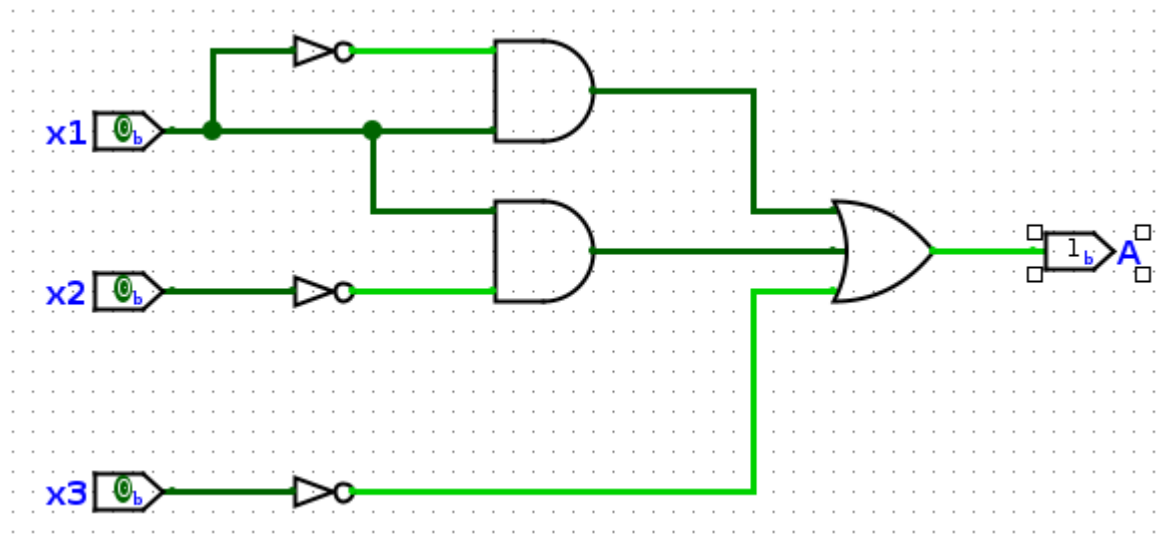
1.  $f(x, y, z) = \bar{x} \cdot \bar{y} \cdot z \vee x \cdot y \cdot z \vee x \cdot y \cdot \bar{z} \vee x \cdot \bar{y} \cdot z = ?$

2.  $f(x, y) = \overline{\bar{x} \cdot \bar{y} \vee x \cdot y} = ?$

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



## Naloga 2: Realizacija vezja

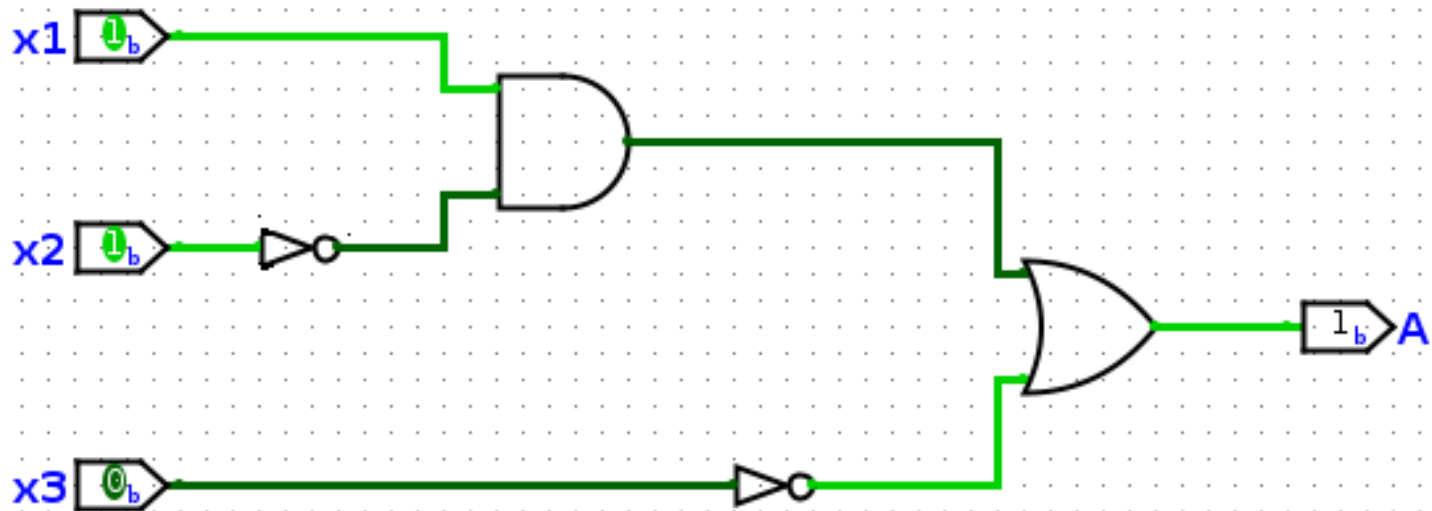


- Zapišite izhod logičnega vezja (A) z operatorji NOT, AND, OR in ga poenostavite
- Narišite vezje v Logisimu
- Vezje realizirajte na testni plošči

# Načrtovanje in simulacija digitalnih vezij

## □ Logisim-evolution

<https://github.com/logisim-evolution/logisim-evolution>



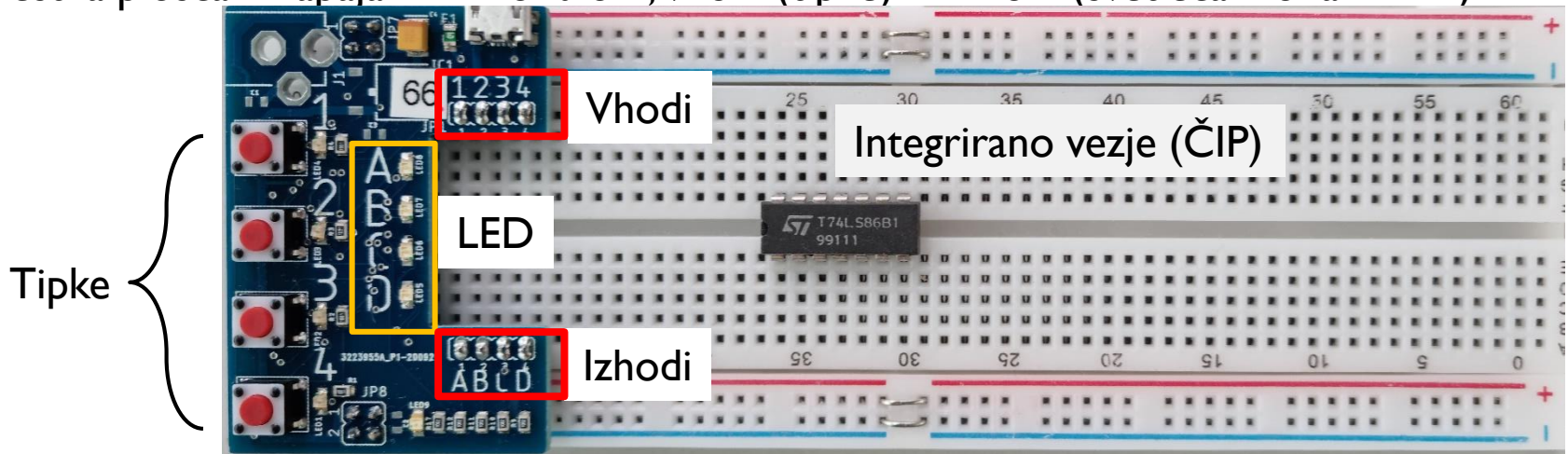
# Testna plošča (ang. breadboard)

## □ Oprema I

USB napajalnik (5V)



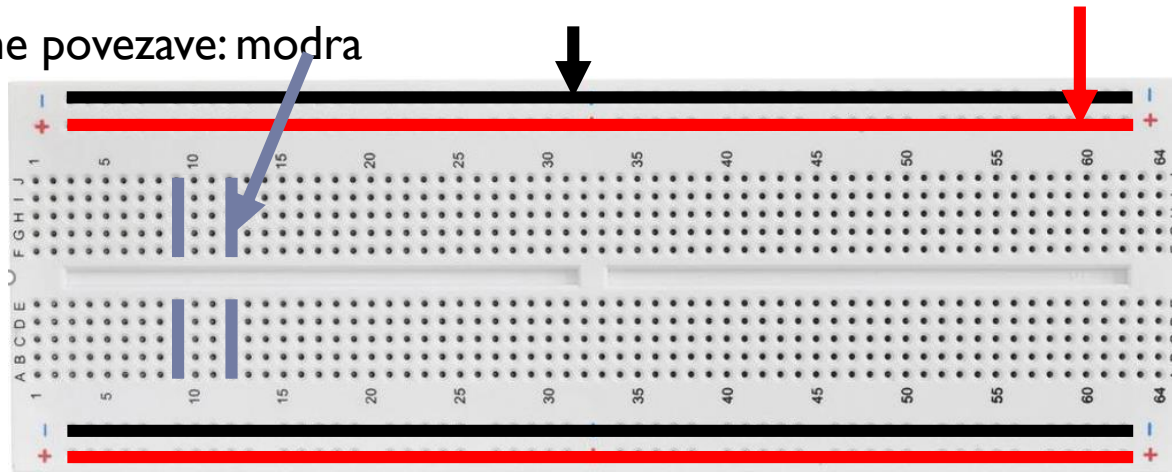
Testna plošča z napajalnim modulom, vhodi (tipke) in izhodi (svetleča dioda - LED)



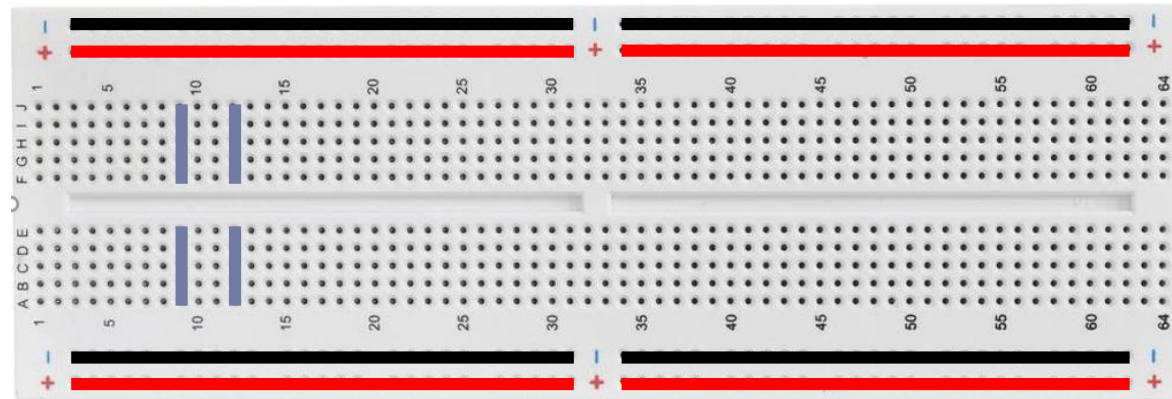


□ Povezave na testni plošči:

- Vzdolžne povezave: Gnd (masa) – črna (!), Vcc (napajanje) - rdeča (+)
- Prečne povezave: modra



ali



# Realizacija vezja

## Čipi iz družine 7400

