



Digitalna vezja UL, FRI



Vaja 1 Booleova algebra, logisim, breadboard

Postulati Boolove algebre

Zaprtoost:

$$\mathbf{P1: } x \vee y \in X$$

$$\mathbf{P1*: } x \cdot y \in X$$

Nevtralni element:

$$\mathbf{P2: } x \vee 0 = x$$

$$\mathbf{P2*: } x \cdot 1 = x$$

Komutativnost:

$$\mathbf{P3: } x \vee y = y \vee x$$

$$\mathbf{P3*: } x \cdot y = y \cdot x$$

Distributivnost:

$$\mathbf{P4: } x \vee (y \cdot z) = (x \vee y) \cdot (x \vee z)$$

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

Inverzni element:

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

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

Število elementov:

$$\mathbf{P6: } x \neq y$$

Lastnosti Boolove algebre

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



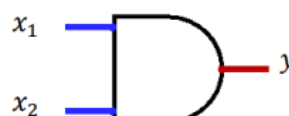

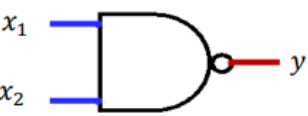
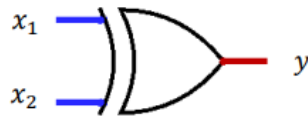

$$(x \cdot y) \cdot z = x \cdot (y \cdot z) = x \cdot y \cdot z$$

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

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

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

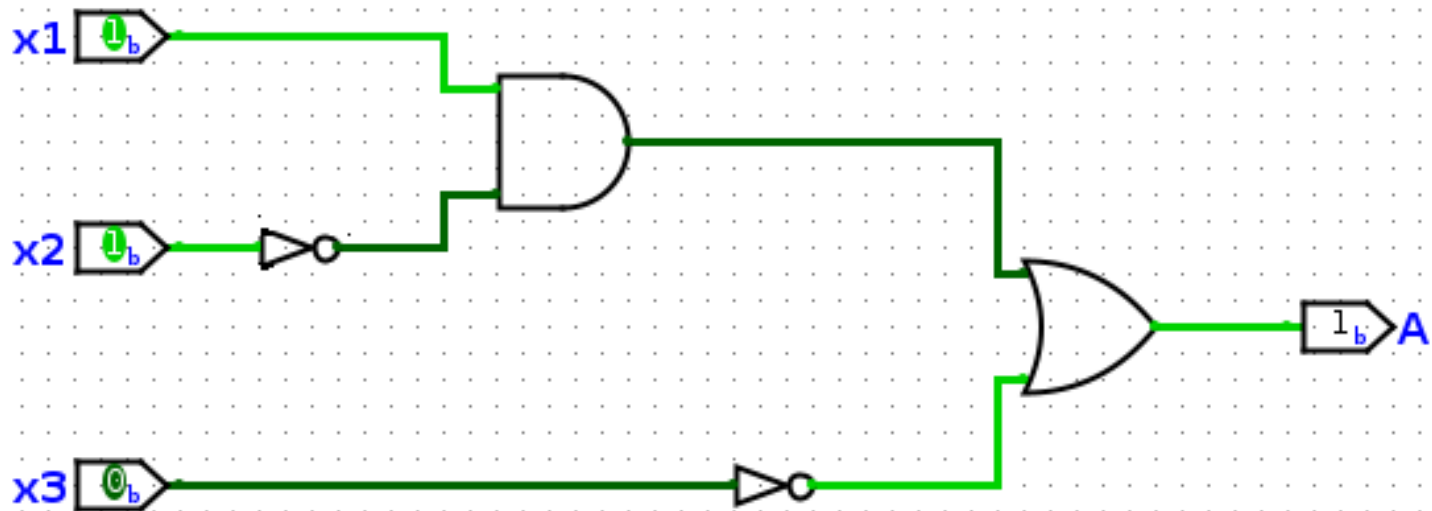
3. $f(A, B, C, D) = A \vee C \cdot \overline{(\bar{A} \cdot \bar{B} \vee B)} \vee \bar{C} \cdot \overline{B \vee \bar{D}} = ?$



Načrtovanje in simulacija digitalnih vezij

□ Logisim-evolution

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



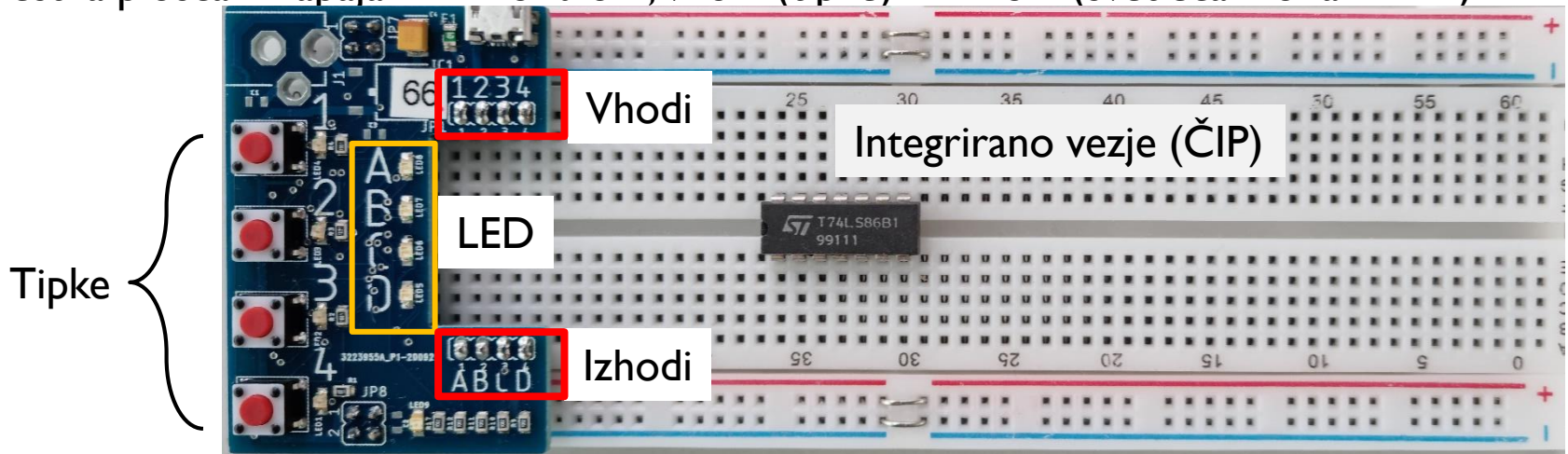
Testna plošča (ang. breadboard)

□ Oprema I

USB napajalnik (5V)

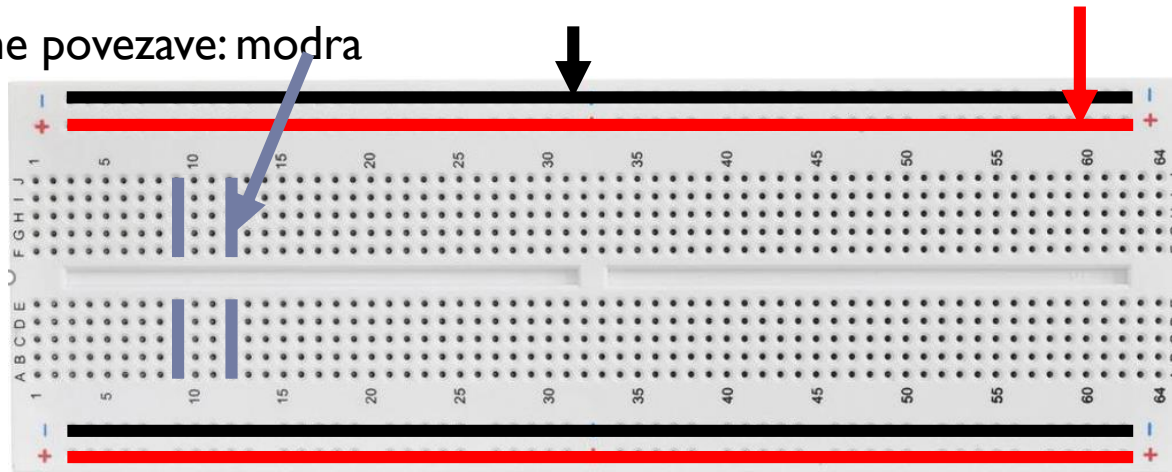


Testna plošča z napajalnim modulom, vhodi (tipke) in izhodi (svetleča dioda - LED)

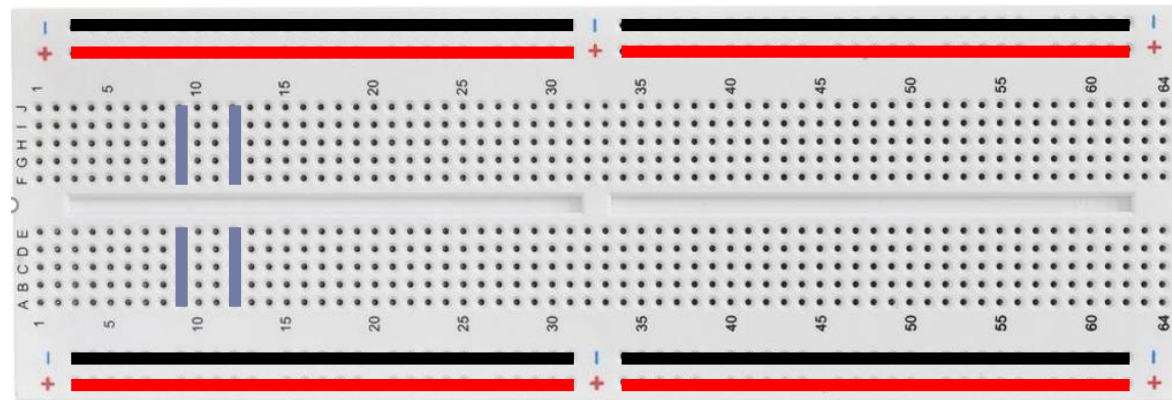


❑ Povezave na testni plošči:

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

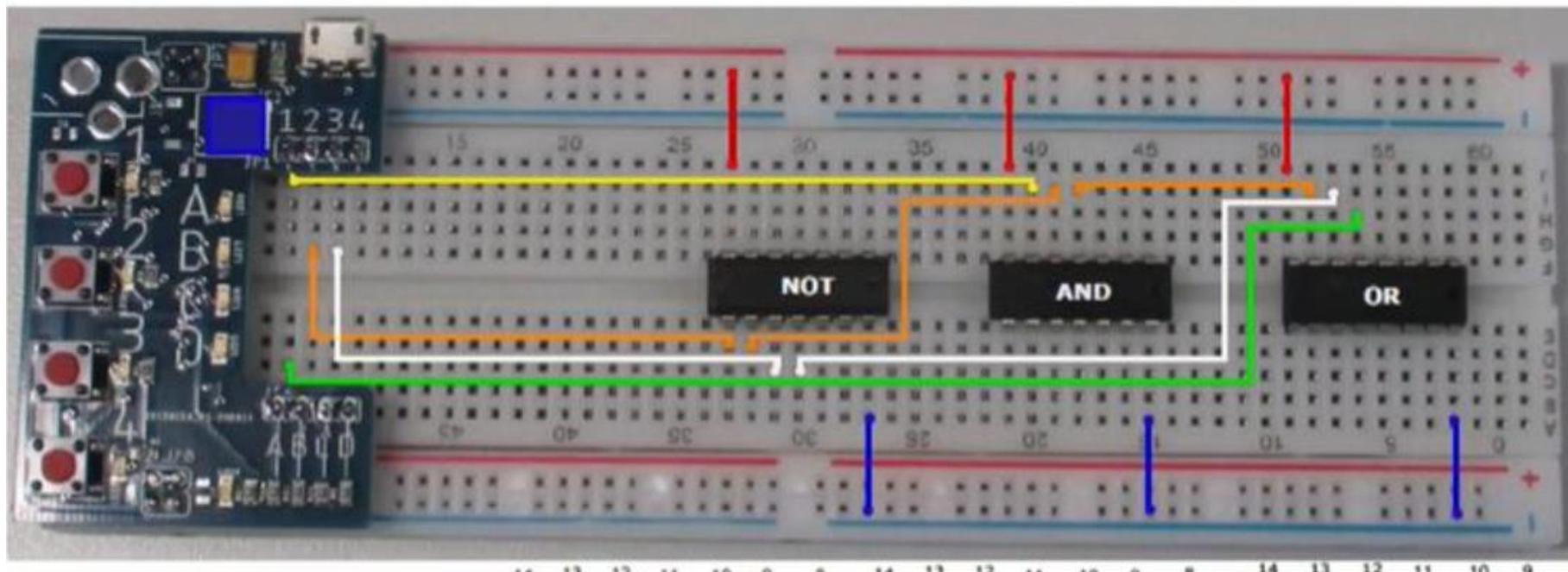
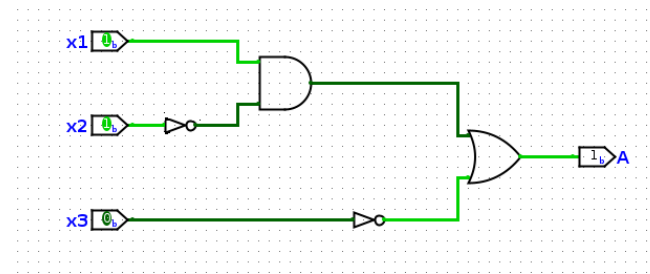
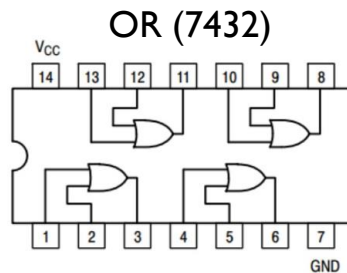
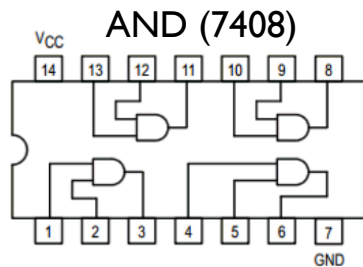
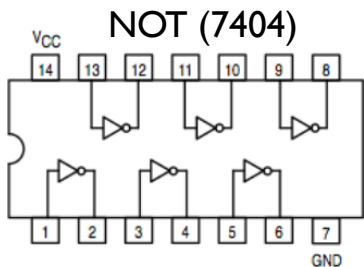


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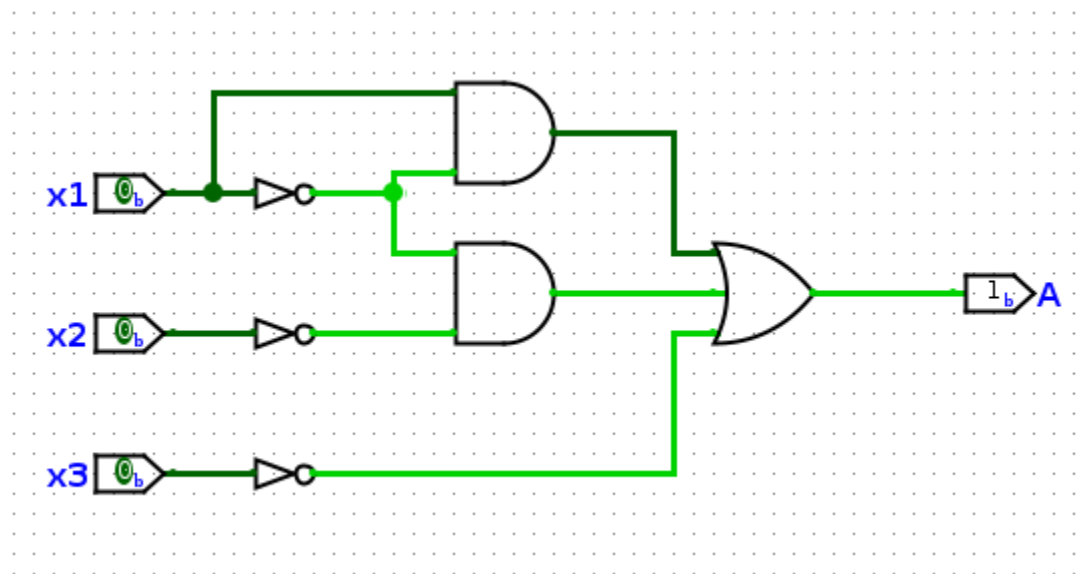


Realizacija vezja

Čipi iz družine 7400



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