

# DIT

- 2 testy, přílka, bonus, 50%
  - u témat
  - bodová logika, pravidlování bubulka, 7-segmentový displej
  - materiály: INOVACE VpV VOVL.R.CZ  
ELEKTRONIKA III  
ČÍSLICOVÁ TECHNIKA
- 

## INFORMACE

- data
- nehmotná věc
- má fyzické médium

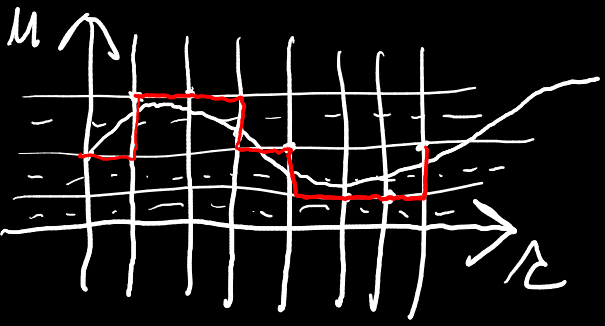
## SIGNÁL

- nositel informace

## DIGITÁLNÍ SIGNÁL

- hranatý, přesná hodnota

ANALOGOVÝ - věc může být jakoukoliv  
DISKRETNÍ věc pouze hodnoty <sup>parametrů</sup>  
DIGITALIZOVANÝ → data  
SPOJITÝ/NESPOJITÝ informace



BIT

- dvojkové číslo
- pro uložení nejmenší informace

DATA

- význam, lze uchovávat, cokoliv co zpracovává program

KÓDOVÁNÍ

- 2 množiny znaků a převádění mezi systémy

KÓD

- převiz pro znak

ČÍSELNÉ SOUSTAVY

DVOJKOVÁ, DESÍTKOVÁ, ŠESTNÁCTKOVÁ, ...

BCD KÓD

0-9 - 4 bity

7438 → 0111 | 0100 | 0011 | 1000

BUŇKA PAMĚTI

- 1 bit
- místo pro data

BYTE

$$1 \text{ B} = 8 \text{ b}$$

$$1 \text{ Kb} = 1024 \text{ b} = 2^{10}$$

...

## LOGICKÝ OBRVOD

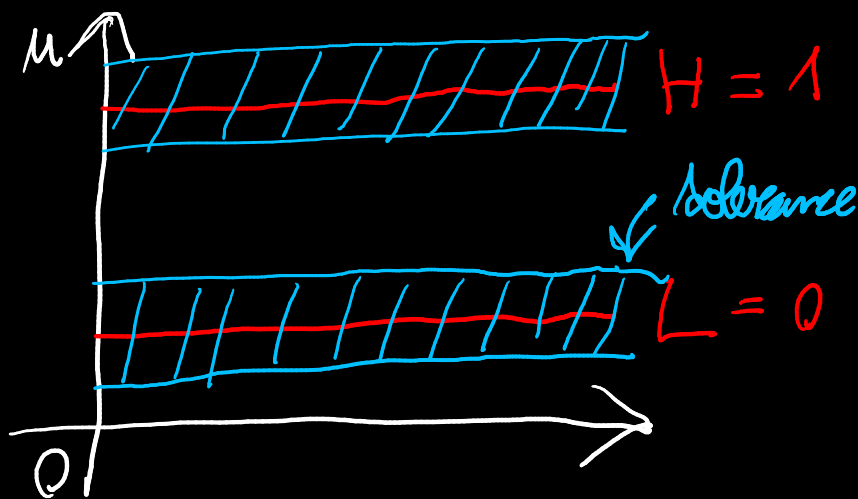
- systémem je hořá hodnota mabýrají pouze dva hodnot

1 zapnuto 0 vypnuto

1 vyšší 0 nižší napětí

## PRAVDIVOSTNÍ TABULKA

- všechny kombinace vstupů  $\Rightarrow$  výstupy



# BOOLEOVA ALGEBRA

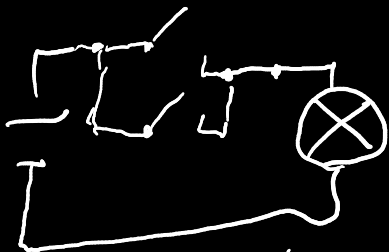
- 19. st., ruský matematik
- hodnoty mají být 1 a 0

## LOGICKÁ FUNKCE

- tři základní fce
- logický součet, logický součin,

OR ( $\vee$ )

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1



$$A + B = Y$$

**NOR**

AND ( $\wedge$ )

A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1



$$A \cdot B = Y$$

**NAND**

NOT  $\bar{A} = Y$

A	Y
0	1
1	0

XOR

$$A \oplus B = Y$$

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	0

Z

+

·

KOMUTATIVNÍ

$$A+B=B+A$$

$$A \cdot B = B \cdot A$$

ASOCIATIVNÍ

$$A+(B+C) = (A+B)+C$$

$$A \cdot (B \cdot C) = (A \cdot B) \cdot C$$

DISTRIBUTIVNÍ

$$(A+B) \cdot (A+C) = A + (B \cdot C)$$

$$A \cdot B + A \cdot C = A \cdot (B+C)$$

VYLOUČENÍ  
TŘETÍHO

$$A + \bar{A} = 1$$

$$A \cdot \bar{A} = 0$$

ZÁKON  
AGRESIVNOSTI  
0 a 1

$$A+1=1$$

$$A \cdot 0 = 0$$

NEUTRÁLNOST  
0 a 1

$$A+0=A$$

$$A \cdot 1 = A$$

ABSORBCE

$$A+A=A$$

$$A \cdot A = A$$

$$A+A \cdot B = A$$

$$A \cdot (A+B) = A$$



$$= \bar{a}b + a\bar{b}$$

---

$$\begin{aligned} f &= \bar{a}b\bar{c} + \bar{a}b\bar{c} + \underline{ab\bar{c}} + abc = \\ &= a(\bar{b}\bar{c} + b\bar{c}) + \bar{a}b\bar{c} + abc = \underbrace{a\bar{c} + \bar{a}b\bar{c}} + abc \\ &= a\bar{c}(b + b) \end{aligned}$$

$$= \bar{c}(a + \bar{a}b) + abc =$$

$$= \bar{c}a + \bar{c}b + abc =$$

$$= a(\bar{c} + bc) + \bar{c}b =$$

$$= a\bar{c} + ab + \bar{c}b = a(\bar{c} + b) + \bar{c}b$$

---

$$f = a + \bar{a}b + b(c + d) =$$

$$= a + \bar{a}b + bc + bd =$$

$$= a + b + b(c + d) =$$

$$= a + b(c + d + 1) = a + b \cdot 1 = a + b$$

---

$$f = (a + b + \bar{c}) \cdot (\bar{a} + b + c) =$$

$$= \bar{a}a + ab + ac + \bar{a}b + bb + cb + \bar{a}\bar{c} + b\bar{c} + c\bar{c} =$$

$$= ab + ac + \bar{a}b + cb + \bar{a}\bar{c} + b\bar{c} =$$

ABSOLUTNĚ NEGACE	$A \cdot (\bar{A} + B) = A \cdot B$	$A + \bar{A} \cdot B = A + B$
	$\bar{A} \cdot (A + B) = \bar{A} \cdot B$	$\bar{A} + A \cdot B = \bar{A} + B$
DVOJITÁ NEGACE	$\bar{\bar{A}} = A$	$\bar{\bar{A}} = A$
DEMORGANOVY ZÁKONY	$\overline{A + B} = \bar{A} \cdot \bar{B}$	$\overline{A \cdot B} = \bar{A} + \bar{B}$

## Příklady

- co nejvíce zjednodušit

$$\overline{\bar{A} \cdot \bar{B}} \stackrel{\leq 4 \text{ bránda} \Rightarrow \text{zjednodušit}}{=} \bar{\bar{A}} + \bar{\bar{B}} = \underline{\underline{A + B}} \quad \underline{\underline{1 \text{ bránda}}}$$

$$\begin{aligned}
 f &= a \cdot \bar{b} \cdot c + \bar{a} \cdot b \cdot c + a \bar{b} \bar{c} + \bar{a} b c \\
 &= a (\bar{b} c + \bar{b} \bar{c}) + \bar{a} (b c + b \bar{c}) = \\
 &= \underbrace{a b}_{\text{rychlou}} (c + \bar{c}) + \bar{a} b \cdot \underbrace{(c + \bar{c})} =
 \end{aligned}$$

$$\begin{aligned}
&= a(b+c) + b(1+c) + \bar{c}(\bar{a}+b) = \\
&= b(a+\bar{a}) + ac + b + \bar{c}\bar{a} + \bar{c}b = \\
&= b + b + ac + \bar{c}\bar{a} + cb = b(1+\bar{c}) + ac + \bar{a}\bar{c} = \\
&= \underline{\underline{b + ac + \bar{a}\bar{c}}}
\end{aligned}$$


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$$\begin{aligned}
f &= a \cdot b \cdot \bar{c} + \bar{a}b\bar{c} + \bar{a}b\bar{c} + abc = \\
&= \bar{a}\bar{c}(b+b) + ab(\bar{c}+c) = \underline{\underline{\bar{a}\bar{c} + ab}}
\end{aligned}$$


---

$$\begin{aligned}
f &= (a+\bar{a}) \cdot (b+\bar{a}b) + \bar{a} \cdot \bar{b} = \\
&= 1 \cdot (b+ab) + \bar{a} \cdot \bar{b} = \\
&= (b+ab) + \bar{a} \cdot \bar{b} = \bar{b} \cdot a \cdot b + \bar{a} \cdot \bar{b} = \\
&= \bar{b}(\bar{a} + \bar{b}) + \bar{a} \cdot \bar{b} = \bar{a}\bar{b} + \bar{b}\bar{b} + \bar{a} \cdot \bar{b} = \\
&= \underline{\underline{\bar{a}\bar{b} + \bar{b}}}
\end{aligned}$$


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$$\begin{aligned}
f &= (a+\bar{b}+\bar{c}) \cdot (a+\bar{b}c) = \\
&= a + a\bar{b}c + a\bar{b} + \bar{b}\bar{b}c + a\bar{c} + \bar{b}\bar{c}c = \\
&= a(1+\bar{b}c + \bar{b} + \bar{c}) + \bar{b}\bar{b}c + \bar{b}\bar{c}c = \\
&= a + \bar{b}c + \bar{b}\bar{c}c = bc + a
\end{aligned}$$



$$\begin{aligned}
 f &= \bar{A} \cdot \bar{B} \cdot \bar{C} + \bar{A} \bar{B} C + \bar{A} B C + \bar{A} B \bar{C} = \\
 &= \bar{A} \bar{B} (\bar{C} + C) + \bar{A} B (C + \bar{C}) = \bar{A} \bar{B} + \bar{A} B = \\
 &= \bar{A} (\bar{B} + B) = \bar{A}
 \end{aligned}$$


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$$\begin{aligned}
 f &= A \cdot B + \bar{A} \cdot B \cdot \bar{D} + \bar{A} B C D + \bar{A} B \bar{C} D = \\
 &= \bar{A} B D (C + \bar{C}) + B (A + \bar{A} \bar{D}) = \\
 &= \bar{A} B D + A B + \bar{A} B \bar{D} = \\
 &= B
 \end{aligned}$$

$$\begin{aligned}
 f &= (B + D) (\bar{A} + \bar{C}) (A + D) (\bar{B} + \bar{C}) (\bar{B} + A) (\bar{D} + C) = \\
 &= (B \bar{A} + B \bar{C} + D \bar{A} + D \bar{C}) (A \bar{B} + A \bar{C} + \bar{B} D + \bar{C} D) (\bar{B} \bar{D} + \bar{B} C \\
 &+ A \bar{D} + A C) = \cancel{A \bar{B} B \bar{A}} + A \bar{C} B \bar{A} + \bar{B} D B \bar{A} + \bar{C} D B \bar{A} + \\
 &A \bar{B} B \bar{C} + A \bar{C} B \bar{C} + \bar{B} D B \bar{C} + \bar{C} D B \bar{C} + \\
 &A \bar{B} D \bar{A} + A \bar{C} D \bar{A} + \bar{B} D D \bar{A} + \bar{C} D D \bar{A} + \\
 &A \bar{B} D \bar{C} + A \bar{C} D \bar{C} + \bar{B} D D \bar{C} + \bar{C} D D \bar{C}) \\
 &(\bar{B} \bar{D} + \bar{B} C + A \bar{D} + A C) = (\bar{B} \bar{A} D \bar{C} + B \bar{C} A + \\
 &+ \bar{B} \bar{C} D + D \bar{A} \bar{B} + D \bar{A} \bar{C} + D \bar{C} A \bar{B} + \\
 &+ D \bar{C} A + D \bar{C} \bar{B} + D \bar{C})
 \end{aligned}$$

$$(\bar{B}\bar{D} + \bar{B}C + A\bar{D} + AC) =$$

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

$$(\bar{B}\bar{D} + \bar{B}C + A\bar{D} + AC) = \underline{\underline{D\bar{A}\bar{B}C + A\bar{B}C\bar{D}}}$$

$$f = (A+C) (\bar{D} \cdot G) \cdot (\bar{A}\bar{B}) (\bar{D}+A) (F+G) \cdot \bar{C} \cdot (\bar{A}\bar{D}) (\bar{D}\bar{C}) =$$

$$(A+C) (\bar{D} + \bar{G}) \cdot (\bar{A} + \bar{B}) (\bar{D} \cdot \bar{A}) (F+G) \cdot \bar{C} \cdot (\bar{A} + \bar{D})$$

$$(\bar{D} + \bar{C}) = (\bar{A}\bar{D} + \bar{A}\bar{D}) \cdot (\bar{A}\bar{C}) \cdot (F\bar{D} + F\bar{G} + G\bar{D})$$

$$(\bar{A}\bar{D} + \bar{A}\bar{C} + \bar{B}\bar{D} + \bar{B}\bar{C}) = \bar{A}\bar{D}F + \bar{A}\bar{D}F\bar{G} + \bar{A}\bar{D}G +$$

$$\bar{A}\bar{C}F\bar{D} + \bar{A}\bar{C}F\bar{G} + \bar{A}\bar{C}G\bar{D} + \bar{B}\bar{D}F + \bar{B}\bar{D}F\bar{G} +$$

$$\bar{B}\bar{D}G + \bar{B}\bar{C}F\bar{D} + \bar{B}\bar{C}F\bar{G} + \bar{B}\bar{C}G\bar{D} =$$

$$= \bar{A}\bar{D}F + \bar{A}\bar{D}G + \bar{B}\bar{D}F + \bar{B}\bar{D}G + \bar{B}\bar{C}F(\bar{D} + \bar{G}) + \bar{A}\bar{C}F\bar{G}$$



$$\begin{aligned}
 & A\bar{E}C + \overline{[(\bar{D}A) + B]} + E\bar{C}A + \overline{(B + \bar{D})}A = \\
 & = AE + \overline{[B + (\bar{D} + \bar{A})]} + A(\bar{B} \cdot \bar{D}) = \\
 & = AE + \overline{[\bar{B} \cdot (\bar{D} + \bar{A})]} +
 \end{aligned}$$

$$A(E + \bar{B})$$

$$A\bar{B}\bar{C} + A\bar{B}C + \underbrace{AB\bar{C}} + \underbrace{ABC} = AB + A\bar{B} = \underline{\underline{A}}$$



A	B	C	Q	Č	Z	Π	Minderve	Maxderve
0	0	0	0	0	0	0		$A + B + C$
0	0	1	1	0	0	0	$\bar{A} \cdot \bar{B} \cdot C$	$\bar{A} + B + \bar{C}$
0	1	0	1	0	0	0	$\bar{A} \cdot B \cdot \bar{C}$	
0	1	1	0	1	0	0		$A + \bar{B} + C$
1	0	0	1	0	0	0	$A \cdot B \cdot \bar{C}$	
1	0	1	0	1	0	0		$\bar{A} + B + \bar{C}$
1	1	0	0	1	0	0		$\bar{A} + \bar{B} + C$
1	1	1	0	0	1	1		$\bar{A} + \bar{B} + \bar{C}$

# PRAVDIVOSTNÍ TABULKA

Logická fce = vždy výsledek

**Univerzální fce**

- přesně určeno, kde 0 a 1

**Neuniverzální fce**

- je mi jedno co bude na výstupu

## 1) Úplná normální disjunktivní forma (UNDF)

Mintermy; součet mintermů, kdy výstup = Log 1

cesta přes 1  
(metoda)

součet součinů

(P<sub>3</sub>)

$$0 = \bar{A}\bar{B}C + \bar{A}B\bar{C} + A\bar{B}\bar{C}$$

$$\bar{C} = \bar{A} \cdot B \cdot C + A\bar{B}C + A \cdot B \cdot \bar{C}$$

## 2) Úplná normální konjunktivní forma (UNKF)

Maxtermy, součin maxtermů při výstupu logická 0

Přes 0, součin součtů

$$0 = (a + b + c)(a + b + \bar{c})(\bar{a} + b + \bar{c})(\bar{a} + \bar{b} + c)(\bar{a} + \bar{b} + \bar{c})$$

$$\bar{c} = (a+b+c)(a+b+\bar{c})(a+\bar{b}+c)(\bar{a}+b+c)(\bar{a}+\bar{b}+\bar{c})$$

$$\text{UNDF: } f_1(c, b, a) = \sum (1, 2, 5, 7)$$

$$\text{UNKF: } f_2(c, b, a) = \prod (0, 3, 4, 6)$$

### SEZNAM STAVOVÝCH INDEXŮ

#	C	B	A	$f_1$
0	0	0	0	0
1	0	0	1	1
2	0	1	0	1
3	0	1	1	0
4	1	0	0	0
5	1	0	1	1
6	1	1	0	0
7	1	1	1	1

$$\text{UNDF: } f_1(c, b, a) = \sum (1, 2, 5, 7)$$

$$\text{UNKF: } f_2(c, b, a) = \prod (0, 3, 4, 6)$$

$$f_1 = a \cdot b \bar{c} + \bar{a} b \bar{c} + \bar{a} b c + a b c$$

$$\tilde{f}_1 = (a+b+c) \cdot (\bar{a} + \bar{b} + \bar{c}) \cdot (a+b+\bar{c})$$

#	C	b	a	$f_2$
0	0	0	0	1
1	0	0	1	X
2	0	1	0	0
3	0	1	1	1
4	1	0	0	0
5	1	0	1	1
6	1	1	0	X
7	1	1	1	0

$$f(c, b, a) = \sum (0, 3, 5)$$

$$\tilde{f}(c, b, a) = \prod (2, 4, 7)$$

$$f = \bar{c} \cdot \bar{b} \cdot \bar{a} + a b \bar{c} + a b c$$

$$\tilde{f} = (a+b+c)(a+b+\bar{c})(\bar{a}+\bar{b}+\bar{c})$$

$$\begin{aligned}
 & (a+\bar{b}+c)(a+b+\bar{c})(\bar{a}+\bar{b}+\bar{c}) = \\
 & = (\underline{a} + \underline{a\bar{b}} + \underline{a\bar{c}} + \underline{a\bar{b}\bar{c}} + \underline{b\bar{c}} + \underline{ac} + \underline{bc})(\bar{a} + \bar{b} + \bar{c}) = \\
 & = (a + \bar{b}\bar{c} + bc)(\bar{a} + \bar{b} + \bar{c}) = \\
 & = \bar{a}\bar{b} + \bar{a}\bar{c} + \bar{a}\bar{b}\bar{c} + \bar{b}\bar{c} + b\bar{c} + \bar{a}bc = \\
 & = \bar{a}\bar{c} + \bar{b}\bar{c} + \bar{a}\bar{b} + \bar{a}bc = \\
 & = \bar{c}(a + \bar{b}) + \bar{a}\bar{b} + \bar{a}bc
 \end{aligned}$$

N	D	C	B	A	f	g	h
0	0	0	0	0	1	0	1
1	0	0	0	1	0	0	1
2	0	0	1	0	0	1	0
3	0	0	1	1	0	1	1
4	0	1	0	0	1	0	0
5	0	1	0	1	1	0	1
6	0	1	1	0	0	0	0
7	0	1	1	1	1	0	1
8	1	0	0	0	1	0	0
9	1	0	0	1	1	0	0
10	1	0	1	0	0	0	1
11	1	0	1	1	0	0	1
12	1	1	0	0	1	0	1
13	1	1	0	1	1	1	0

$$f = (A, B, C, D) = \Sigma(0, 4, 5, 7, 8, 9, 12, 13, 15)$$

$$\bar{f} = (A, B, C, D) = \Pi(1, 2, 3, 6, 10, 11, 14)$$

$$g = (A, B, C, D) = \Sigma(2, 3, 13, 14, 15)$$

$$G = (A, B, C, D) = \Pi(0, 1, 4, 5, 6, 7, 8, 9, 10, 11, 12)$$

14	1	1	1	0	0	1	1
15	1	1	1	1	1	1	1

$$\begin{aligned} \sum N \neq F = & \bar{D}\bar{C}\bar{B}\bar{A} + \bar{A}\bar{B}\bar{D}C + \bar{A}\bar{B}C\bar{D} + ABC\bar{D} + \\ & \bar{A}\bar{B}C\bar{D} + \bar{A}\bar{B}CD + ABCD \end{aligned}$$

$$\begin{aligned} \sum N \neq F = & (\bar{A} + B + C + D)(A + \bar{B} + C + D)(\bar{A} + \bar{B} + C + D) \\ & (A + \bar{B} + \bar{C} + D)(A + \bar{B} + C + \bar{D})(\bar{A} + \bar{B} + C + \bar{D}) \\ & (A + \bar{B} + \bar{C} + \bar{D}) \end{aligned}$$

$$\sum N \neq F = \bar{A}\bar{B}\bar{C}\bar{D} + A\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}CD + \bar{A}BCD + ABCD$$

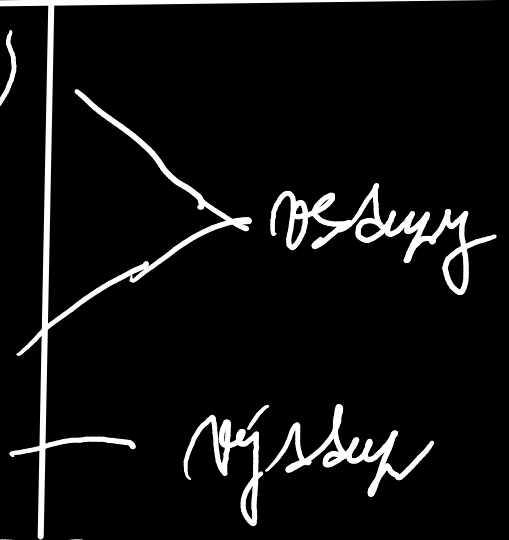
$$\begin{aligned} \sum N \neq F = & (A + B + C + D)(\bar{A} + B + C + D)(A + B + \bar{C} + \bar{D}) \\ & (\bar{A} + B + \bar{C} + \bar{D})(A + \bar{B} + \bar{C} + D)(\bar{A} + \bar{B} + \bar{C} + D) \\ & (A + B + C + \bar{D})(\bar{A} + B + C + \bar{D})(A + \bar{B} + C + \bar{D}) \\ & (\bar{A} + \bar{B} + C + \bar{D})(A + B + \bar{C} + \bar{D}) \end{aligned} \quad \text{D6}$$

$$\begin{aligned} h = (A, B, C, D) = \sum (0, 1, 3, 5, 7, 10, 11, 12, 14, 15) \\ H = (A, B, C, D) = \prod (2, 4, 6, 8, 9, 13) \end{aligned}$$

$$\begin{aligned} \text{UNDF} = & \bar{A}\bar{B}\bar{C}\bar{D} + A\bar{B}\bar{C}\bar{D} + AB\bar{C}\bar{D} + A\bar{B}C\bar{D} + ABC\bar{D} + \\ & \bar{A}B\bar{C}D + A\bar{B}C\bar{D} + \bar{A}\bar{B}CD + \bar{A}BCD + ABCD \end{aligned}$$

$$\begin{aligned} \text{UNKF} = & (A + \bar{B} + C + D)(A + B + \bar{C} + D)(A + \bar{B} + \bar{C} + D)(A + B + C + \bar{D}) \cdot \\ & (\bar{A} + B + C + \bar{D})(\bar{A} + \bar{B} + \bar{C} + \bar{D}) \end{aligned}$$

A - alarm (zap. nebo / vyprázdněno)  
 D1 - detektor pohybu  
 D2 - detektor pohybu  
 Z - zvonění



A	D1	D2	Z
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

$$\mathcal{L}(D2, D1, A) = \Sigma(5, 6, 7)$$

$$\mathcal{Z}(D2, D1, A) = \Pi(0, 1, 2, 3, 4)$$

$$\begin{aligned} \text{UNDF} = & D2 \cdot \bar{D1} \cdot A + \\ & \bar{D2} \cdot D1 \cdot A + \\ & D2 \cdot D1 \cdot A \end{aligned}$$

$$\begin{aligned} \text{UNKF} = & (D1 + D2 + A)(\bar{D2} + \bar{D1} + A) \\ & (D2 + \bar{D1} + A)(\bar{D2} + D1 + A) \\ & (D2 + D1 + A) \end{aligned}$$

Máme kancelář s dvěma místnostmi.

V každé místnosti je 1 detektor pohybu.



Jedná se o poslední zám. kápné alarm.  
 Pokud detektor detekuje pohyb <sup>v uzavřeném</sup> při alarmu, tak  
 se spustí hlídání na vnitřní alarm - zvonek.

---

el. A, B, C

- 1) všechny zapnuty
- 2) el. A je zapnuta a jedna z těch dvou
- 3) jen 1 bít
- 4) el. A a B zapnuty
- 5) alarm 1 je zapnuta

c	b	a	1	2	3	4	5
0	0	0	0	0	0	0	0
0	0	1	0	1	1	0	1
0	1	0	0	0	1	0	1
0	1	1	0	1	0	0	1
1	0	0	0	0	1	1	1
1	0	1	0	1	0	0	1
1	1	0	0	0	0	0	1
1	1	1	1	0	0	0	1

Domovní alarm = F

Glass break = a

detektor pohybu = b

klávková alarmu = c

=

závěna

- možná dveře - je spuštěn  
nemí spuštěn

- pohyb

#	c	b	a	F
0	0	0	0	0
1	0	0	1	1
2	0	1	0	0
3	0	1	1	1
4	1	0	0	0
5	1	0	1	1
6	1	1	0	1
7	1	1	1	1

$$F(a, b, c) = \Pi(0, 2, 4)$$

$$F = (a + b + c)(a + \bar{b} + c)(a + b + \bar{c})$$

$$= (\bar{a}\bar{b} + \underline{a}\underline{c} + \underline{a}\underline{b} + \underline{b}\underline{c} + \underline{a}\underline{c} + \underline{b}\underline{c} + \underline{c})$$

$$(a + b + \bar{c}) = (c + a)(a + b + \bar{c}) =$$

$$= \underline{a}\underline{c} + \underline{b}\underline{c} + \underline{a} + \underline{a}\underline{b} + \underline{a}\underline{c} =$$

$$= \underline{\underline{a + bc}}$$

#	C	B	A	P	Q
0	0	0	0	0	1
1	0	0	1	1	1
2	0	1	0	0	1
3	0	1	1	1	1
4	1	0	0	0	1
5	1	0	1	1	0
6	1	1	0	0	0
7	1	1	1	1	0

$$P(A,B,C) = \sum (1,3,5,7)$$

UNDF:  $P = A \cdot \bar{B} \bar{C} + A B \bar{C} + A \bar{B} C + A B C$

UNKF:  $Q(A,B,C) = \prod (5,6,7)$

$$Q = (\bar{A} + B + \bar{C})(A + \bar{B} + \bar{C})(\bar{A} + \bar{B} + \bar{C})$$

$$= (\bar{A}\bar{B} + \bar{A}\bar{C} + A\bar{B} + B\bar{C} + A\bar{C} + \bar{B}\bar{C} + \bar{C})$$

$$(\bar{A} + \bar{B} + \bar{C}) = (\bar{C} + A\bar{B} + \bar{A}\bar{B})(\bar{A} + \bar{B} + \bar{C})$$

$$= \bar{A}\bar{C} + \bar{B}\bar{C} + \bar{C} + A\bar{B}\bar{C} + \bar{A}\bar{B} + \bar{A}\bar{B} + \bar{A}\bar{B}\bar{C}$$

$$= \bar{C} + \bar{A}\bar{B}$$

N	D	C	B	A	Y	W
0	0	0	0	0	0	1
1	0	0	0	1	0	0
2	0	0	1	0	0	1
3	0	0	1	1	0	0
4	0	1	0	0	1	1
5	0	1	0	1	1	0
6	0	1	1	0	1	1
7	0	1	1	1	1	0
8	1	0	0	0	1	1
9	1	0	0	1	1	0
10	1	0	1	0	0	1
11	1	0	1	1	0	0
12	1	1	0	0	0	1
13	1	1	0	1	0	0
14	1	1	1	0	0	1
15	1	1	1	1	0	0

$Y \Rightarrow 10 > N > 3$   
 $W \Rightarrow N \text{ nodes}$

UNDF:  $Y(A,B,C,D) = \sum (4,5,6,7,8,9)$

$$Y = \bar{A}\bar{B}C\bar{D} + A\bar{B}C\bar{D} + \bar{A}B\bar{C}\bar{D} + A\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}\bar{C}D + A\bar{B}\bar{C}D$$

UNKF:  $W(A,B,C,D) = \prod (1,3,5,7,9,11,13,15)$

W =

$Y = 2$  a vna psluipi isou pravdivé  $W =$  přešve 2 psduuy isou pravdivé

N	D	C	B	A	Y	W
0	0	0	0	0	0	0
1	0	0	0	1	0	0
2	0	0	1	0	0	0
3	0	0	1	1	1	1
4	0	1	0	0	0	0
5	0	1	0	1	1	1
6	0	1	1	0	1	1
7	0	1	1	1	1	0
8	1	0	0	0	0	0
9	1	0	0	1	1	1
10	1	0	1	0	1	1
11	1	0	1	1	1	0
12	1	1	0	0	1	1
13	1	1	0	1	1	0
14	1	1	1	0	1	0
15	1	1	1	1	1	0

ÚNKF:

$$Y = (A, B, C, D) = \Pi(0, 1, 2, 4, 8)$$

$$Y = (A+B+C+D)(\bar{A}+B+C+D)(A+B+\bar{C}+D)(\bar{D}+A+B+C)(A\bar{B}C+D)$$

ÚNDF:

$$W = (A, B, C, D) = \Sigma(3, 5, 6, 9, 10, 12)$$

$$W = \bar{C}\bar{D}AB + A\bar{B}C\bar{D} + \bar{A}B\bar{C}\bar{D} + A\bar{B}\bar{C}D + \bar{A}B\bar{C}D + \bar{A}\bar{B}C\bar{D}$$

K ARNAUGHFOVA MAPA

GRAYOV KÓD

	a		b	
	0000 1	0001 1	0011 0	0010 1
c	0100 1	0101 0	0111 1	0110 0
d	1100 0	1101 1	1111 1	1110 0
	1000 0	1001 0	1011 0	1010 0

N	D	C	B	A	S
0	0	0	0	0	1
1	0	0	0	1	1
2	0	0	1	0	1
3	0	0	1	1	0
4	0	1	0	0	1
5	0	1	0	1	0
6	0	1	1	0	0
7	0	1	1	1	1
8	1	0	0	0	0
9	1	0	0	1	0
10	1	0	1	0	0
11	1	0	1	1	0
12	1	1	0	0	0
13	1	1	0	1	1
14	1	1	1	0	0
15	1	1	1	1	1

#	c	b	a	f
0	0	0	0	1
1	0	0	1	1
2	0	1	0	0
3	0	1	1	0
4	1	0	0	0
5	1	0	1	0
6	1	1	0	1
7	1	1	1	1

$\bar{b} \cdot \bar{c}$

	a		b	
c	000	001	011	010
0	1	1	0	0
1	0	0	1	1

smożemy

$$f = \bar{b}\bar{c} + bc$$

$$f = (\bar{b} + c) \cdot (b + \bar{c})$$

N	D	C	B	A	f
0	0	0	0	0	0
1	0	0	0	1	0
2	0	0	1	0	1
3	0	0	1	1	0
4	0	1	0	0	1
5	0	1	0	1	0
6	0	1	1	0	1
7	0	1	1	1	0
8	1	0	0	0	0
9	1	0	0	1	1
10	1	0	1	0	0
11	1	0	1	1	1
12	1	1	0	0	0
13	1	1	0	1	0
14	1	1	1	0	1
15	1	1	1	1	0

	a		b	
c	00	01	11	10
0	0	0	0	1
1	1	0	0	1
2	0	0	0	1
3	0	1	1	0

N	D	C	B	A	Y
0	0	0	0	0	0
1	0	0	0	1	0
2	0	0	1	0	1
3	0	0	1	1	1
4	0	1	0	0	0
5	0	1	0	1	0
6	0	1	1	0	0
7	0	1	1	1	1
8	1	0	0	0	0
9	1	0	0	1	0
10	1	0	1	0	1
11	1	0	1	1	X
12	1	1	0	0	1
13	1	1	0	1	X
14	1	1	1	0	0
15	1	1	1	1	X

	a		b	
c				
	0	0	1	1
	0	0	1	0
	1	X1	X1	0
	0	0	X1	1

$$Y = \bar{b}cd + ab + \bar{a}b\bar{c}$$

**DÚ**

#	C	b	a	f
0	0	0	0	1
1	0	0	1	1
2	0	1	0	0
3	0	1	1	0
4	1	0	0	0
5	1	0	1	0
6	1	1	0	1
7	1	1	1	1

	a		b	
c				
	1	1	0	0
	0	0	1	1

$$f = \bar{b}c\bar{c} + bc$$

$$f = (b + \bar{c}) \cdot (\bar{b} + c)$$

OPÁČKO

$$f = (\bar{a}b + c)(a + \bar{b})c = (\bar{a}bc + c)(a + \bar{b}) = \bar{a}bc + a\bar{b}c + ac + \bar{b}c = \bar{a}bc + ac + \bar{b}c = \underline{\underline{\bar{b}c + ac}}$$

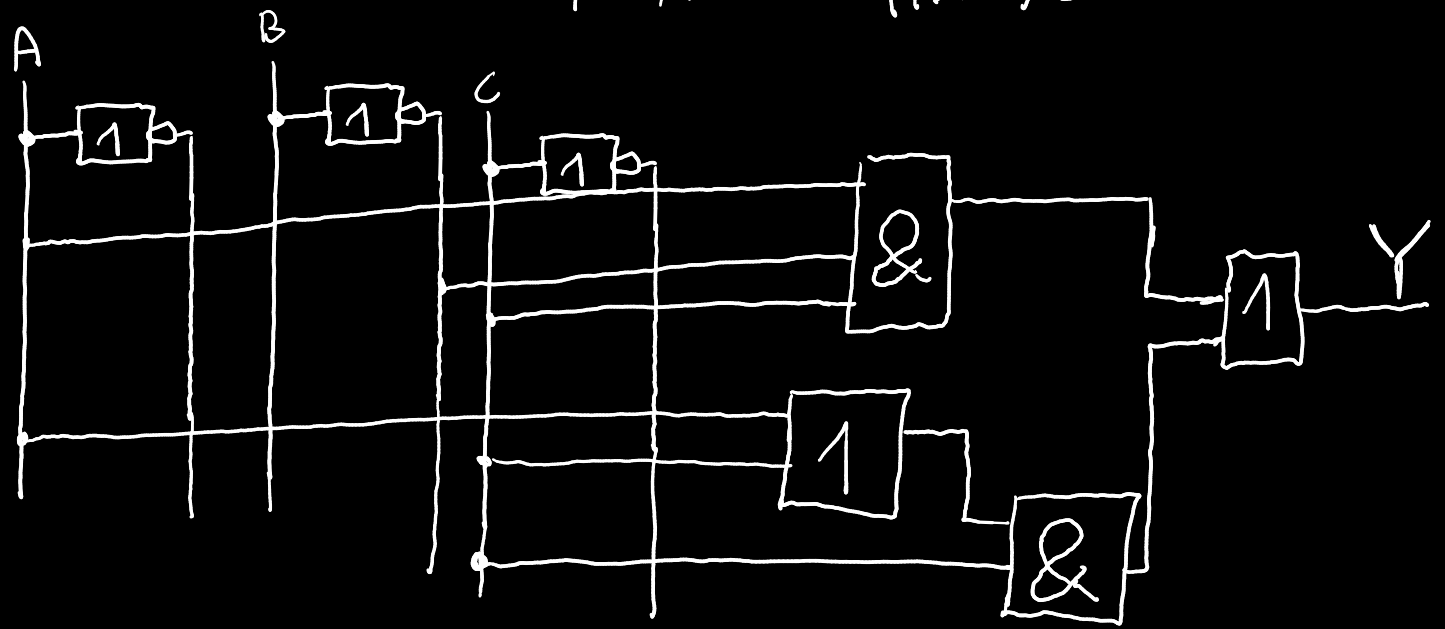
#	A	B	C	Y
0	0	0	0	0
1	0	0	1	1
2	0	1	0	0
3	0	1	1	0
4	1	0	0	0
5	1	0	1	1
6	1	1	0	0
7	1	1	1	1

①  $Y = A \cdot \bar{B} \cdot C + \bar{A}BC + A\bar{B}C$

②  $Y = (A+B+C) \cdot (\bar{A}+B+C) \cdot (A+\bar{B}+C) \cdot (\bar{A}+\bar{B}+C) \cdot (A+B+\bar{C})$

A	B	OR	AND	XOR
0	0	0	0	0
0	1	1	0	1
1	0	1	0	1
1	1	1	1	0

$Y = A\bar{B}C + (A+B)C$

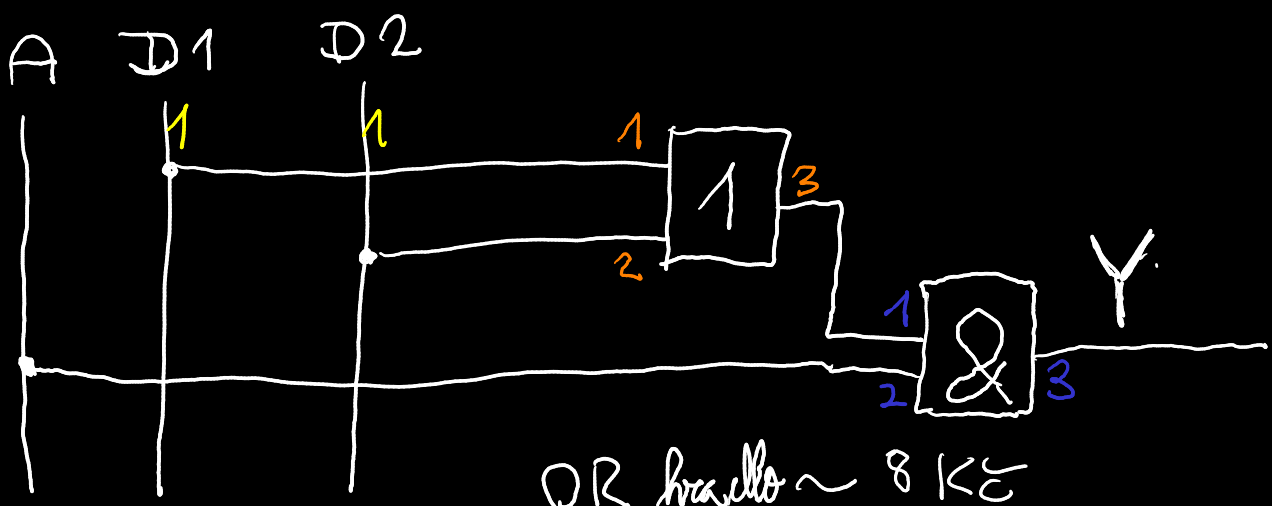


$$\overline{U}NDF = \overline{D2} \cdot \overline{D1} \cdot A + \overline{D2} \cdot D1 \cdot A +$$

$$D2 \cdot D1 \cdot A = A D2 + A D1 \overline{D2}$$

$$= A (D2 + D1 \overline{D2})$$

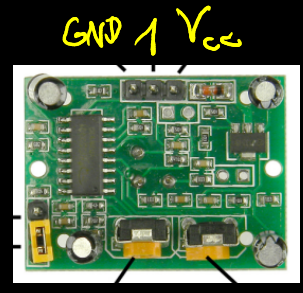
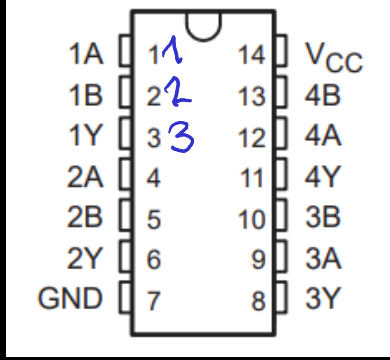
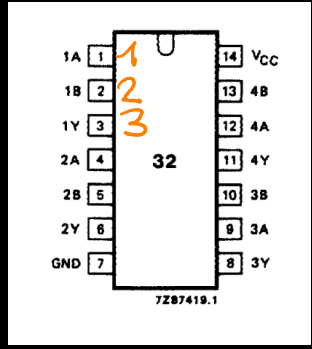
$$= \underline{A (D1 + D2)}$$



OR brovella ~ 8 K $\Omega$   
 AND brovella ~ 13 K $\Omega$   
 spina ~ 10 K $\Omega$   
 kontakt ~ 20 K $\Omega$   
 2x PIR modul ~ 130 K $\Omega$

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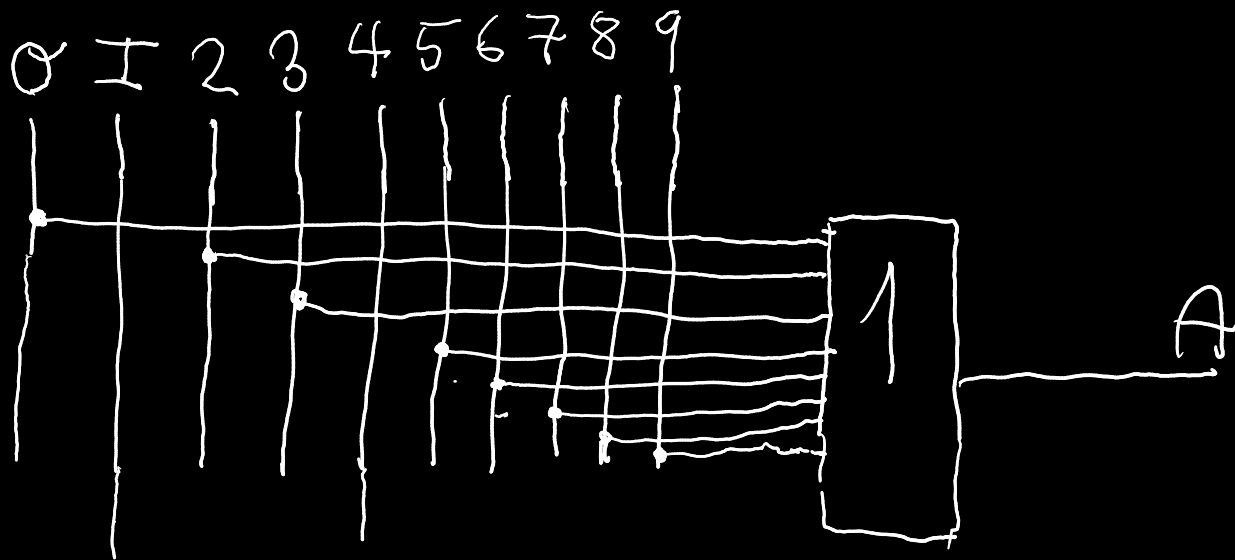
180 K $\Omega$







$$\begin{aligned}
 &= \underline{0} + \underline{2} + \underline{3} + \underline{5} + \underline{6} + \underline{7} + \underline{8} + \underline{9} + 4(\underline{0} + \underline{1} + \underline{2} + \underline{3} + \underline{5} + \underline{6} + \underline{7} + \underline{8} + \underline{9}) \\
 &+ \overline{1}(\underline{0} + \underline{2} + \underline{3} + \underline{4} + \underline{5} + \underline{6} + \underline{7} + \underline{8} + \underline{9}) = \\
 &= 0 + 2 + 3 + 5 + 6 + 7 + 8 + 9 + \underline{1}4 + \overline{1}4 \\
 &= 0 + 2 + 3 + 5 + 6 + 7 + 8 + 9
 \end{aligned}$$



0	1	2	3			A	B
1	0	0	0			0	0
0	1	0	0			0	1
0	0	1	0			1	0
0	0	0	1			1	1

