

Digitale Schaltungen

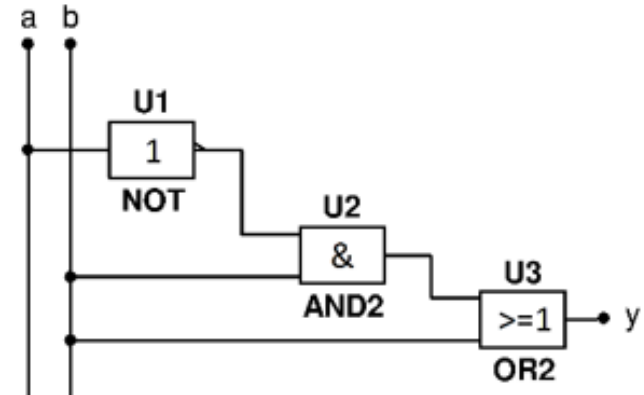
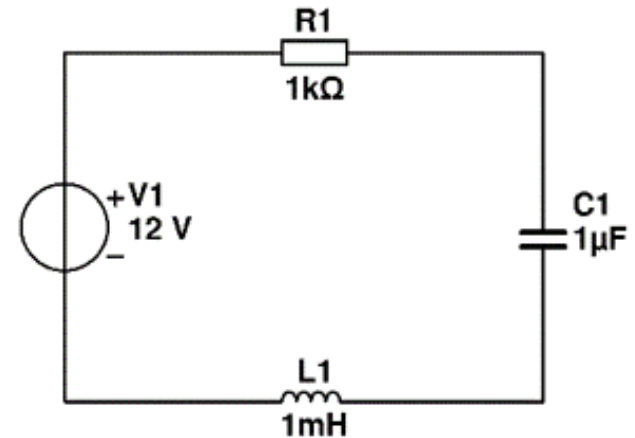
Netzwerke und Embedded Systems

1. Jahrgang

Wolfgang Neff

Digitale Schaltungen (1)

- Analog und Digital
 - Analoge Schaltungen
 - Jeder Spannungspegel erlaubt
 - Digital Circuits
 - Nur zwei Pegel erlaubt
 - + und –
 - 1 und 0
 - H und L

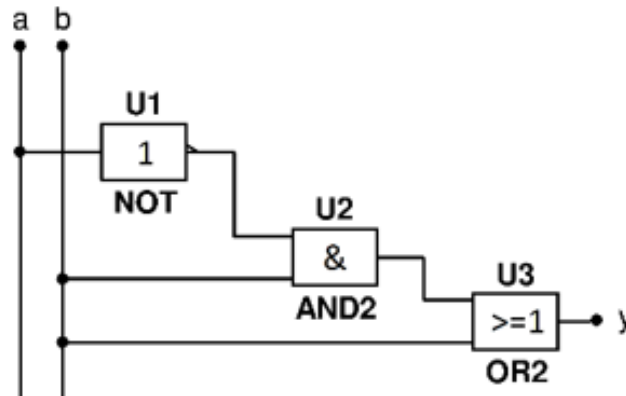


Digitale Schaltungen (2)

- Grundidee
 - Basiert auf Boolesche Algebra
 - 0 → Low Voltage (niederer Spannungspegel)
 - 1 → High Voltage (hoher Spannungspegel)
 - Operator → Symbol
 - Funktion → Schaltung
 - Terms
 - Wahrheitsfunktion → Schaltfunktion
 - Wahrheitstabelle → Schalttabelle

Digitale Schaltungen (3)

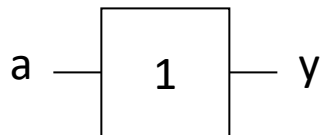
- Grundidee (Fortsetzung)
 - Wahrheitsfunktion ...
 - $\varphi(a,b) = (\neg a \wedge b) \vee b$
 - ... graphisch dargestellt



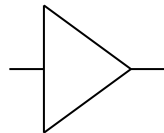
Digitale Schaltungen (4)

- Schaltzeichen

- Puffer



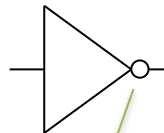
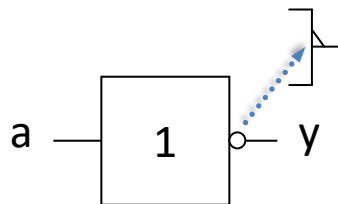
Europäischer Stil
(IEC 60617-12)



Amerikanischer Stil
(IEEE 315-1975)

a	y=a
0	0
1	1

- Negation (NOT, ¬)



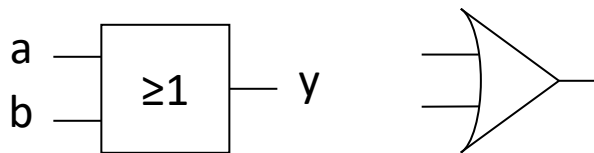
Inversionskreis

a	y=¬a
0	1
1	0

Digitale Schaltungen (5)

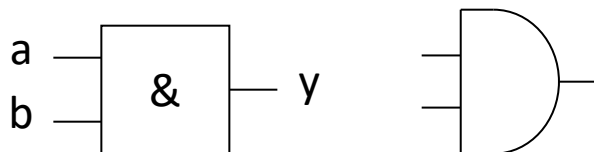
- Schaltzeichen (Fortsetzung)

- Disjunktion (OR, \vee)



a	b	$y=a\vee b$
0	0	0
0	1	1
1	0	1
1	1	1

- Konjunktion (AND, \wedge)

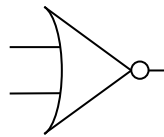
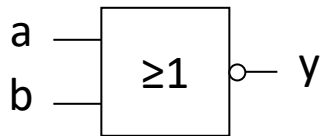


a	b	$y=a\wedge b$
0	0	0
0	1	0
1	0	0
1	1	1

Digitale Schaltungen (6)

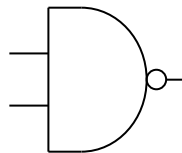
- Schaltzeichen (Fortsetzung)

– NOR (\downarrow)



a	b	$y=a\downarrow b$
0	0	1
0	1	0
1	0	0
1	1	0

– NAND (\uparrow)

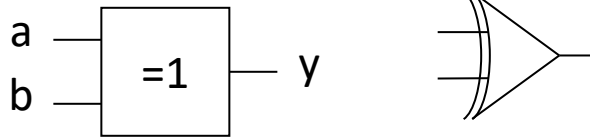


a	b	$y=a b$
0	0	1
0	1	1
1	0	1
1	1	0

Digitale Schaltungen (7)

- Schaltzeichen (Fortsetzung)

- XOR (\oplus)



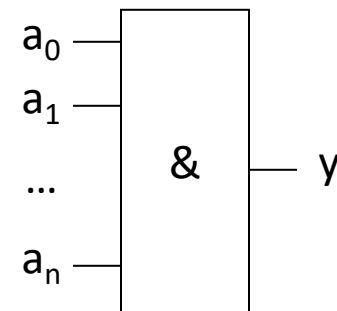
a	b	$y=a\oplus b$
0	0	0
0	1	1
1	0	1
1	1	0

- Zusammengesetzte Gatter

- UND-Gatter

- $y = a_0 \wedge a_1 \wedge a_2 \dots$

- $(a_0, a_1, \dots) \mapsto \begin{cases} 1 & \text{wenn alle } a_i = 1 \\ 0 & \text{sonst} \end{cases}$



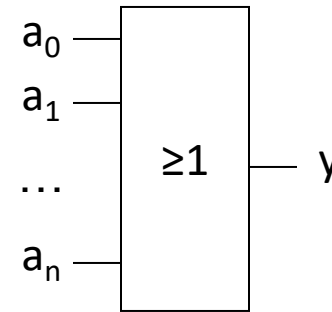
Digitale Schaltungen (8)

- Zusammengesetzte Gatter (Fortsetzung)

- ODER-Gatter

- $y = a_0 \vee a_1 \vee a_2 \dots$

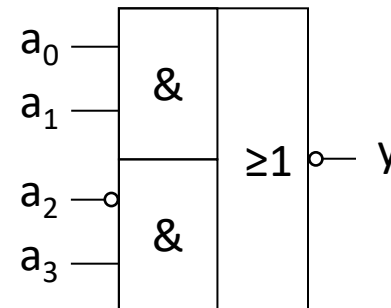
- $(a_0, a_1, \dots) \mapsto \begin{cases} 0 & \text{wenn alle } a_i = 0 \\ 1 & \text{sonst} \end{cases}$



- Zusammengesetzte Schaltungen

- Beispiel

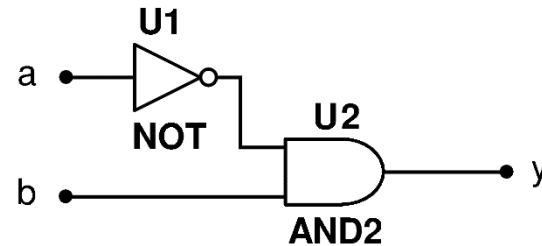
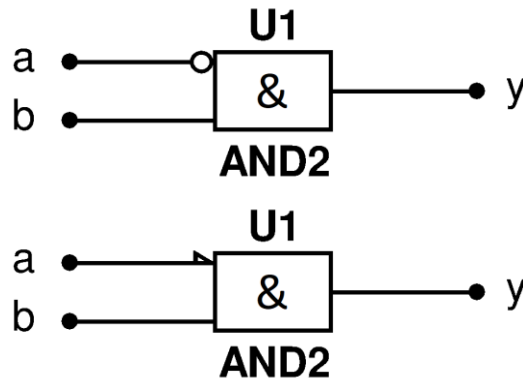
- $\neg((a_0 \wedge a_1) \vee (\neg a_2 \wedge a_3))$



Digitale Schaltungen (9)

- Funktionsbausteine

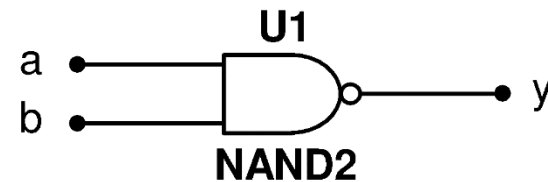
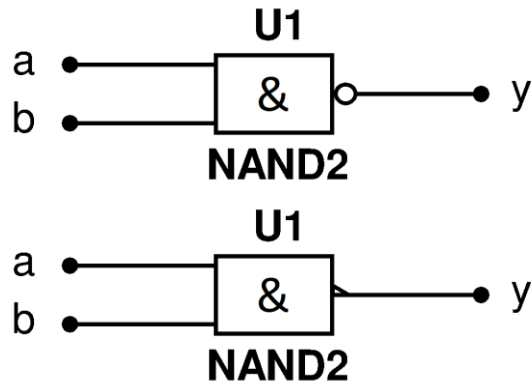
$$y = \neg a \wedge b$$



Digitale Schaltungen (10)

- Funktionsbausteine (Fortsetzung)

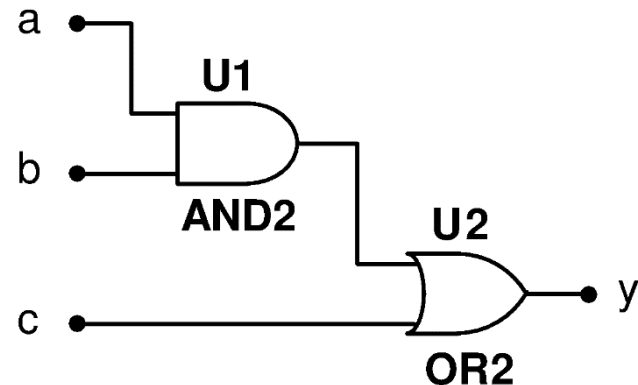
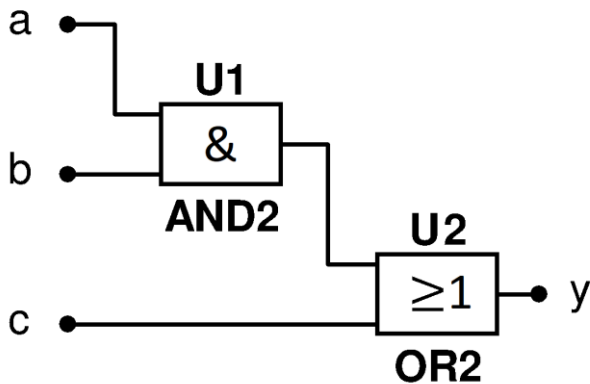
$$- y = \neg(a \wedge b)$$



Digitale Schaltungen (11)

- Funktionsbausteine (Fortsetzung)

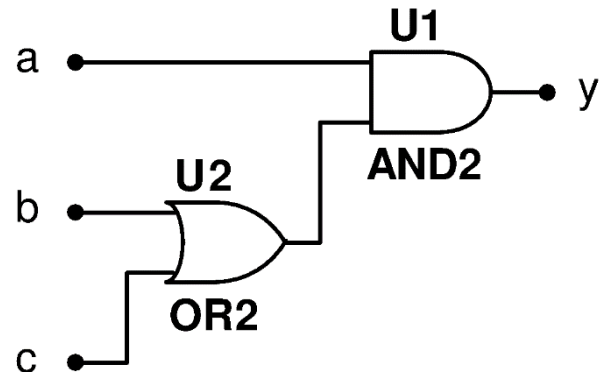
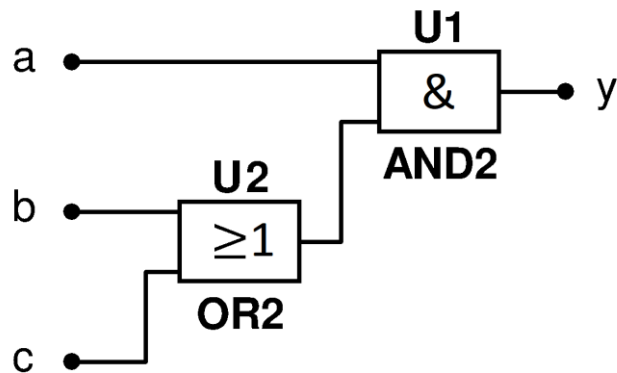
– $y = (a \wedge b) \vee c$



Digitale Schaltungen (12)

- Funktionsbausteine (Fortsetzung)

– $y = a \wedge (b \vee c)$



Digitale Schaltungen (13)

- Beispiel

$$y = (a \wedge \neg b) \vee \neg(c \wedge a) \vee c$$

