

# Digitale Schaltungen

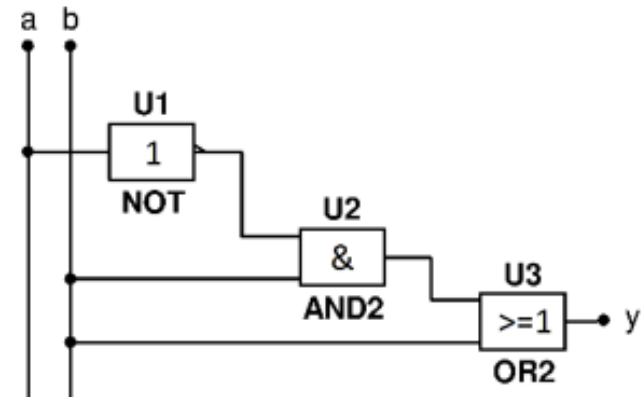
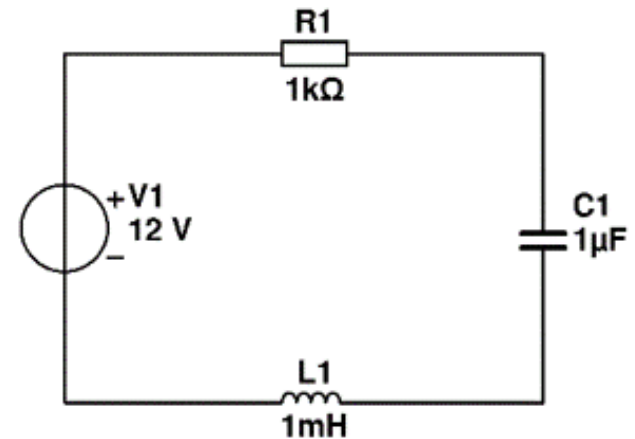
Netzwerke und Embedded Systems

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

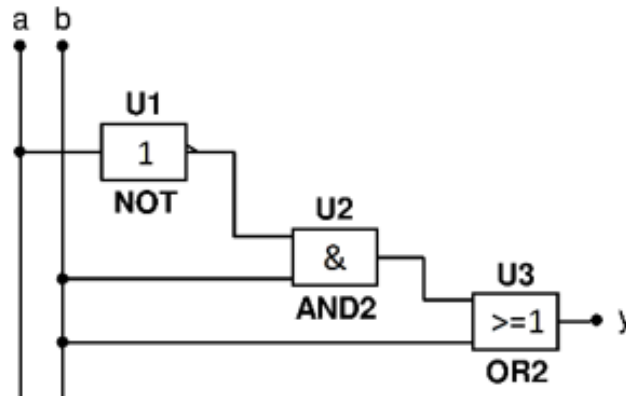


# Digitale Schaltungen (2)

- 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)

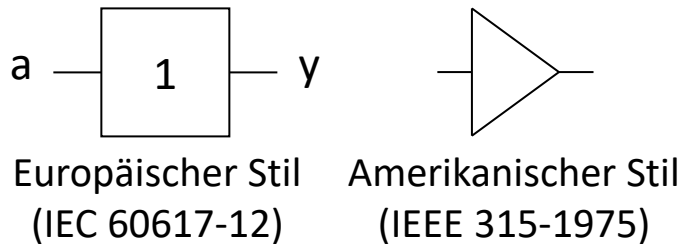
- Grundidee (Fortsetzung)
  - Wahrheitsfunktion ...
    - $\varphi(a,b) = (\neg a \wedge b) \vee b$
  - ... graphisch dargestellt



# Digitale Schaltungen (4)

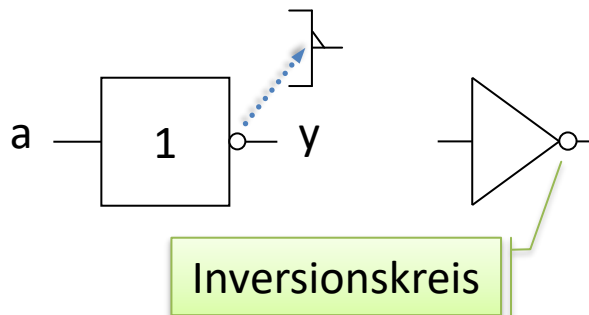
- Schaltzeichen

- Puffer



a	y=a
0	0
1	1

- Negation (NOT, ¬)

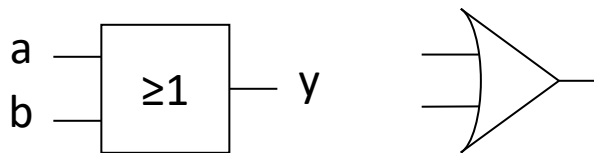


a	y=¬a
0	1
1	0

# Digitale Schaltungen (5)

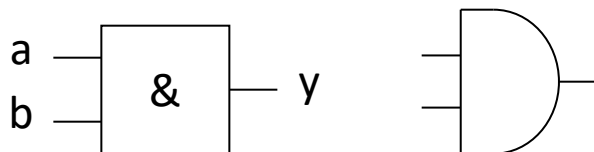
- Schaltzeichen (Fortsetzung)

- Disjunktion (OR,  $\vee$ )



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

- Konjunktion (AND,  $\wedge$ )

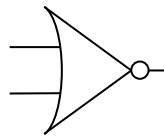
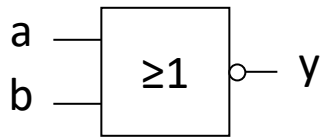


a	b	$y=a\wedge b$
0	0	0
0	1	0
1	0	0
1	1	1

# Digitale Schaltungen (6)

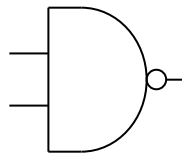
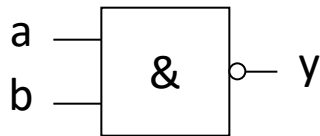
- Schaltzeichen (Fortsetzung)

– NOR ( $\downarrow$ )



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

– NAND ( $\uparrow$ )

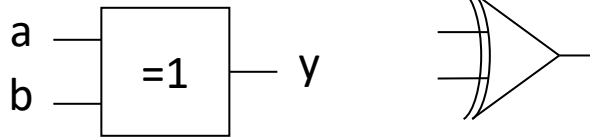


a	b	$y=a b$
0	0	1
0	1	1
1	0	1
1	1	0

# Digitale Schaltungen (7)

- Schaltzeichen (Fortsetzung)

- XOR ( $\oplus$ )



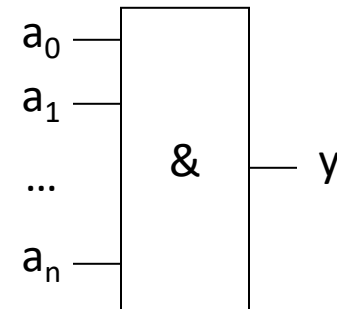
a	b	$y=a\oplus b$
0	0	0
0	1	1
1	0	1
1	1	0

- Zusammengesetzte Gatter

- UND-Gatter

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

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





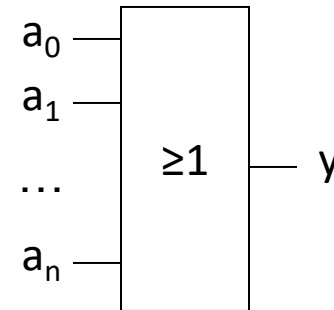
# Digitale Schaltungen (8)

- Zusammengesetzte Gatter (Fortsetzung)

- ODER-Gatter

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

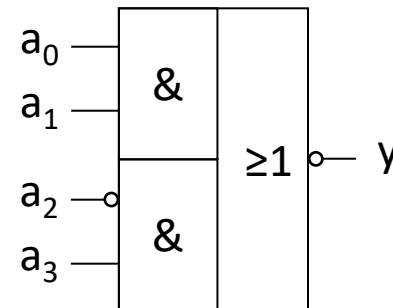
- $(a_0, a_1, \dots) \mapsto \begin{cases} 0 & \text{wenn alle } a_i = 0 \\ 1 & \text{sonst} \end{cases}$



- Zusammengesetzte Schaltungen

- Beispiel

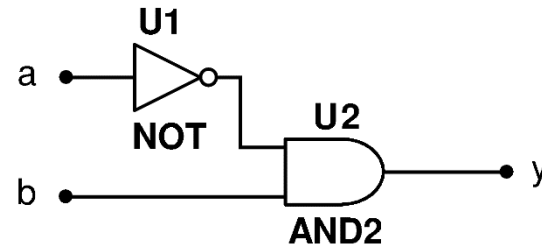
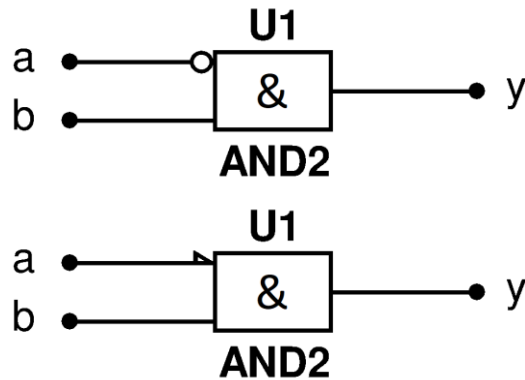
- $\neg((a_0 \wedge a_1) \vee (\neg a_2 \wedge a_3))$



# Digitale Schaltungen (9)

- Funktionsbausteine

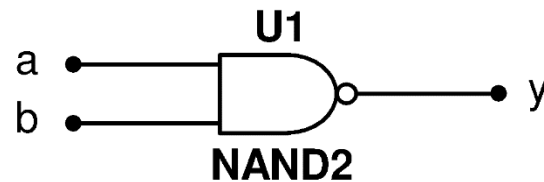
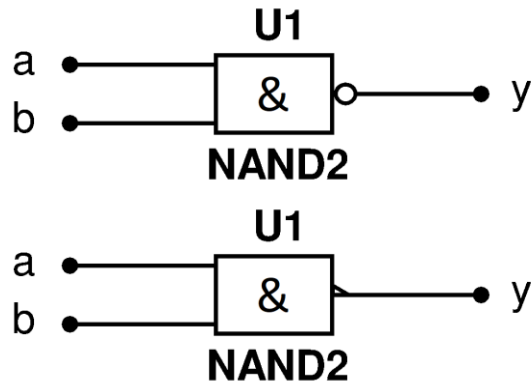
$$- y = \neg a \wedge b$$



# Digitale Schaltungen (10)

- Funktionsbausteine (Fortsetzung)

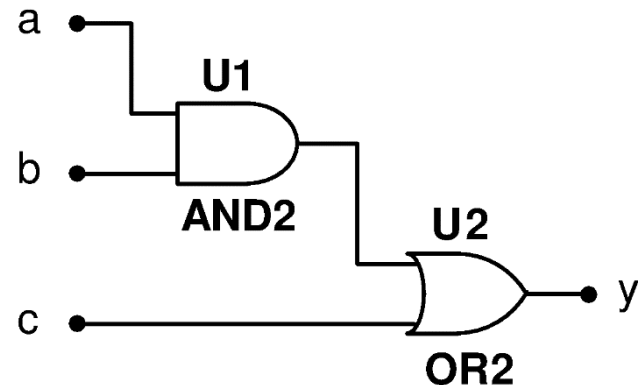
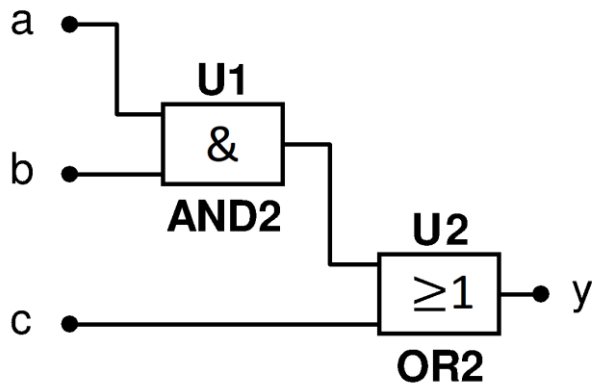
$$- y = \neg(a \wedge b)$$



# Digitale Schaltungen (11)

- Funktionsbausteine (Fortsetzung)

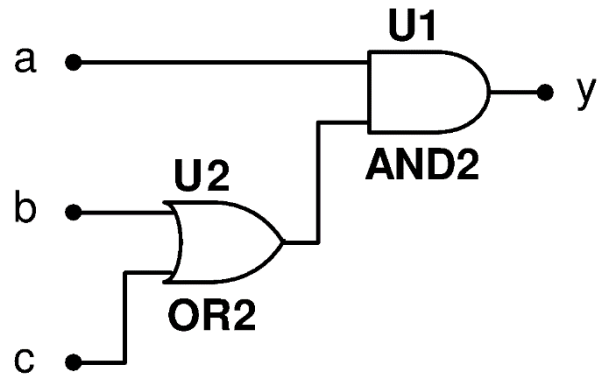
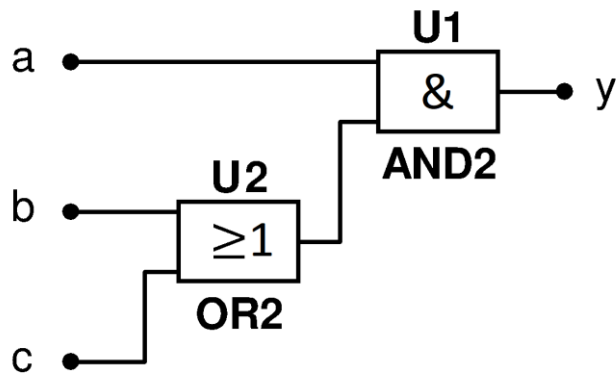
–  $y = (a \wedge b) \vee c$



# Digitale Schaltungen (12)

- Funktionsbausteine (Fortsetzung)

–  $y = a \wedge (b \vee c)$



# Digitale Schaltungen (13)

- Beispiel

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

