

Grundlagen der Rechnerarchitektur

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1 Zähler

(a)

Flanke midrule 0	$\text{state}_2[t]$	$\text{state}_1[t]$	$\text{state}_0[t]$	$\text{state}_2[t + 1]$	$\text{state}_1[t + 1]$	$\text{state}_0[t + 1]$
0	0	0	0	0	0	0
0	0	0	1	0	0	1
0	0	1	0	0	1	0
0	0	1	1	0	1	1
0	1	0	0	1	0	0
0	1	0	1	1	0	1
0	1	1	0	1	1	0
0	1	1	1	0	1	1
1	0	0	0	0	0	1
1	0	0	1	0	1	0
1	0	1	0	0	1	1
1	0	1	1	1	0	0
1	1	0	0	1	0	1
1	1	0	1	1	1	0
1	1	1	0	1	1	1
1	1	1	1	0	0	0

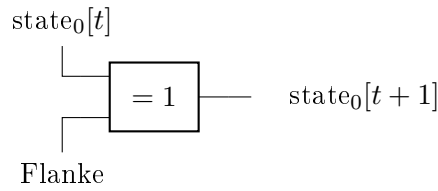
(b)

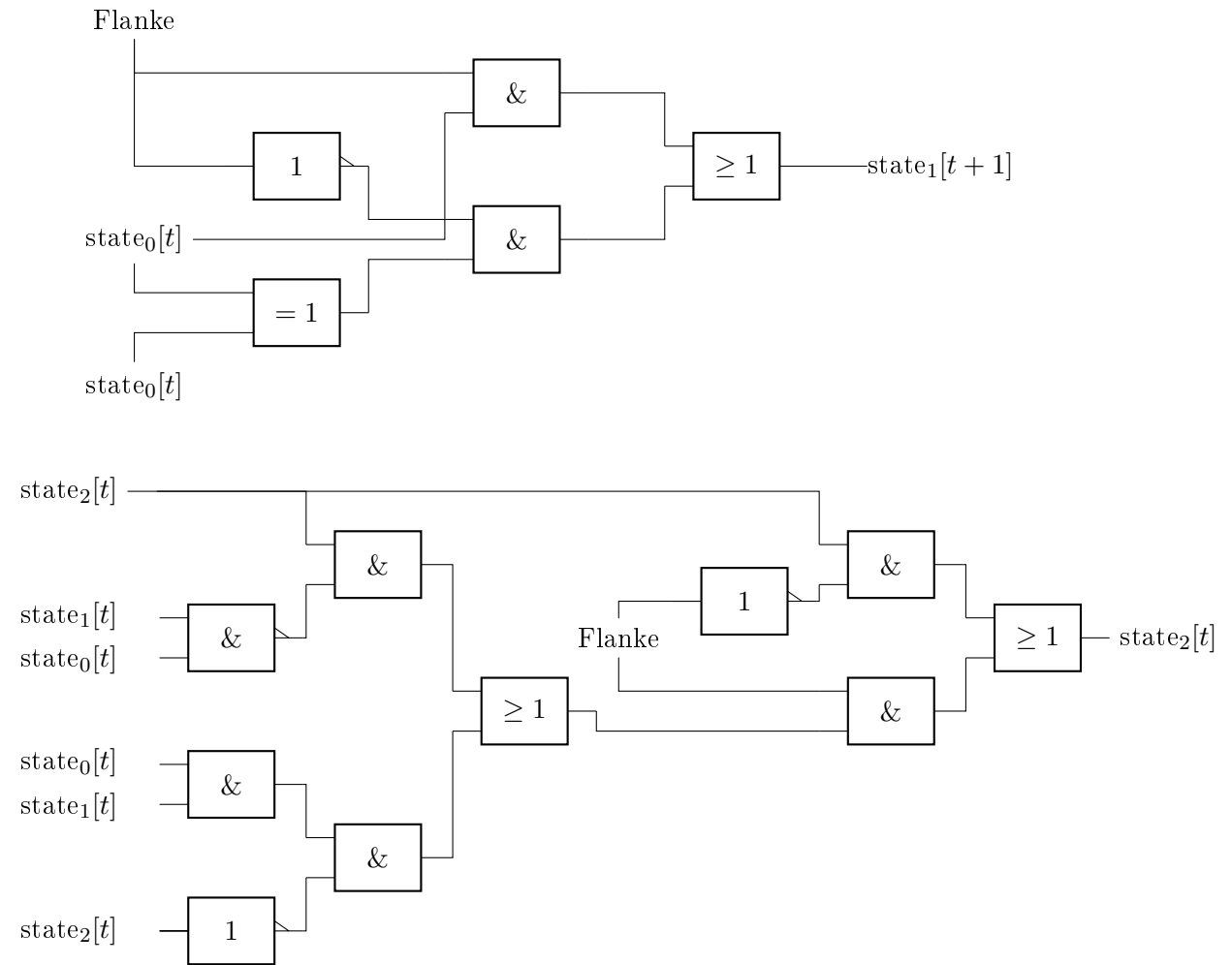
$$\begin{aligned}
\text{state}_0[t+1] &= \text{Flanke} \cdot (\overline{\text{state}_2[t]} \cdot \overline{\text{state}_1[t]} \cdot \overline{\text{state}_0[t]} + \\
&\quad \overline{\text{state}_2[t]} \cdot \overline{\text{state}_1[t]} \cdot \overline{\text{state}_0[t]} + \\
&\quad \text{state}_2[t] \cdot \overline{\text{state}_1[t]} \cdot \overline{\text{state}_0[t]} + \\
&\quad \text{state}_2[t] \cdot \text{state}_1[t] \cdot \overline{\text{state}_0[t]}) \\
&\quad + \overline{\text{Flanke}} \cdot \text{state}_0[t] \\
&= \text{Flanke} \cdot \overline{\text{state}_0[t]} + \overline{\text{Flanke}} \cdot \text{state}_0[t] \\
&= \text{Flanke} \oplus \text{state}_0[t]
\end{aligned}$$

$$\begin{aligned}
\text{state}_1[t+1] &= \text{Flanke} \cdot (\overline{\text{state}_2[t]} \cdot \overline{\text{state}_1[t]} \cdot \text{state}_0[t] + \\
&\quad \overline{\text{state}_2[t]} \cdot \text{state}_1[t] \cdot \overline{\text{state}_0[t]} + \\
&\quad \text{state}_2[t] \cdot \overline{\text{state}_1[t]} \cdot \text{state}_0[t] + \\
&\quad \text{state}_2[t] \cdot \text{state}_1[t] \cdot \overline{\text{state}_0[t]}) \\
&\quad + \overline{\text{Flanke}} \cdot \text{state}_1[t] \\
&= \text{Flanke} \cdot (\text{state}_1[t] \oplus \text{state}_0[t]) + \overline{\text{Flanke}} \cdot \text{state}_1[t]
\end{aligned}$$

$$\begin{aligned}
\text{state}_2[t+1] &= \text{Flanke} \cdot (\overline{\text{state}_2[t]} \cdot \text{state}_1[t] \cdot \text{state}_0[t] + \\
&\quad \text{state}_2[t] \cdot \overline{\text{state}_1[t]} \cdot \overline{\text{state}_0[t]} + \\
&\quad \text{state}_2[t] \cdot \overline{\text{state}_1[t]} \cdot \text{state}_0[t] + \\
&\quad \text{state}_2[t] \cdot \text{state}_1[t] \cdot \overline{\text{state}_0[t]}) \\
&\quad + \overline{\text{Flanke}} \cdot \text{state}_2[t] \\
&= \text{Flanke} \cdot (\overline{\text{state}_2[t]} \cdot \text{state}_1[t] \cdot \text{state}_0[t] + \\
&\quad \text{state}_2[t] \cdot \overline{\text{state}_1[t]} \cdot \overline{\text{state}_0[t]}) + \\
&\quad \overline{\text{Flanke}} \cdot \text{state}_2[t]
\end{aligned}$$

(c)





2 Addierer und Subtrahierer

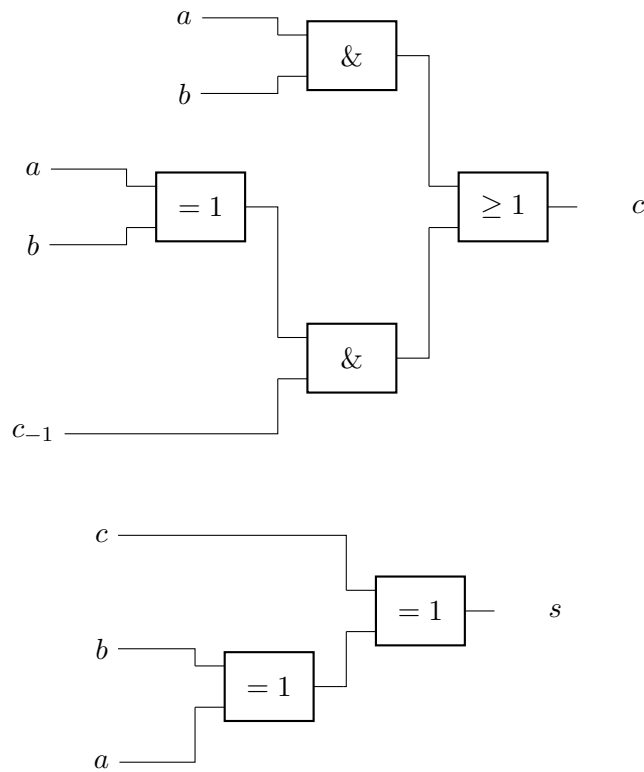
(a)

<i>a</i>	<i>b</i>	<i>c₋₁</i>	<i>c</i>	<i>s</i>
0	0	0	0	0
0	1	0	0	1
1	0	0	0	1
1	1	0	1	0
0	0	1	0	1
0	1	1	1	0
1	0	1	1	0
1	1	1	1	1

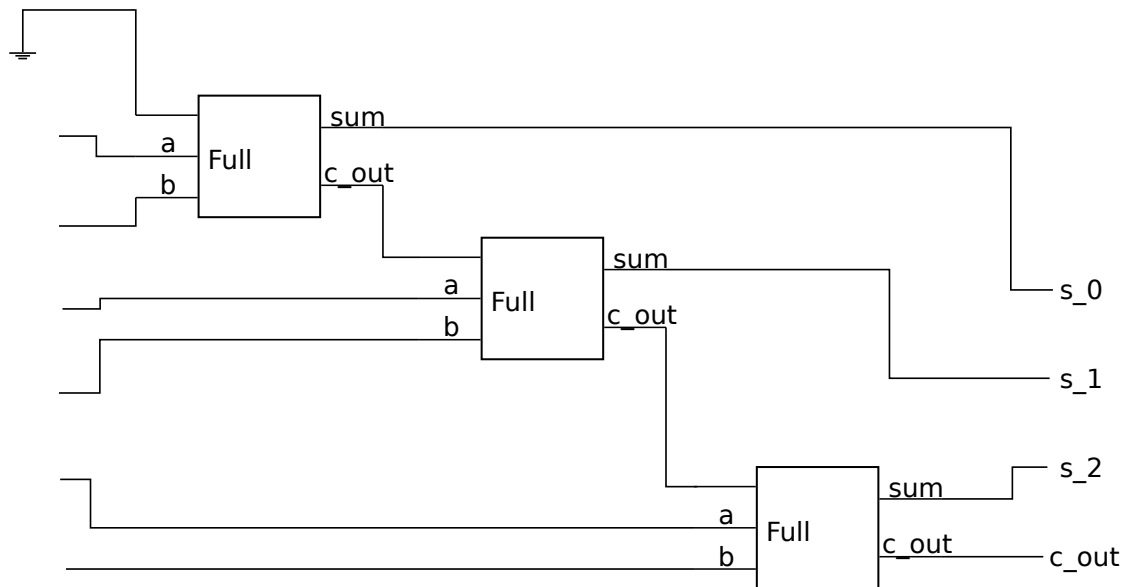
$$\begin{aligned}
c &= a \cdot b \cdot \overline{c_{-1}} + \bar{a} \cdot b \cdot c_{-1} + a \cdot \bar{b} \cdot c_{-1} + a \cdot b \cdot c_{-1} \\
&= a \cdot b + c_{-1} \cdot (\bar{a} \cdot b + a \cdot \bar{b}) \\
&= a \cdot b + c_{-1} \cdot (a \oplus b)
\end{aligned}$$

$$\begin{aligned}
s &= \bar{a} \cdot b \cdot \overline{c_{-1}} + a \cdot \bar{b} \cdot \overline{c_{-1}} + \bar{a} \cdot \bar{b} \cdot c_{-1} + a \cdot b \cdot c \\
&= \bar{a} \cdot (b \cdot \overline{c_{-1}} + \bar{b} \cdot c_{-1}) + a \cdot (\bar{b} \cdot \overline{c_{-1}} + b \cdot c) \\
&= \bar{a} \cdot (b \oplus c_{-1}) + a \cdot \overline{(b \oplus c_{-1})} \\
&= a \oplus b \oplus c
\end{aligned}$$

(b)



(c) Schaltbild des 3-Bit-Addierers:



(d) Schaltbild des 3-Bit-Addierers mit Subtraktionsfunktion:

