

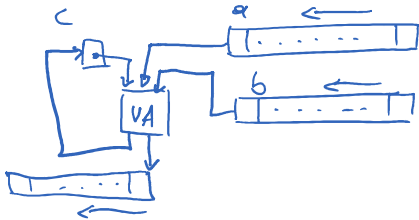
Gerichtete Schaltungen ohne Rückkopplung

Bsp.: Addition

1. Ansatz

1 Additionsstufe

Nimm 2 Ziffern und
Übertrag von rechts
berechne
Summe und Übertrag für linke Stelle



VA - Volladdierer

Volladdierer

a_i	b_i	c_i	c_{i+1}	s_i
0	0	0	0	0
0	0	1	0	1
0	1	0	0	1
0	1	1	1	0
1	0	0	0	1
1	0	1	1	0
1	1	0	1	0
1	1	1	1	1

c_{i+1}	a_i	b_i
0	0	0
0	0	1
0	1	0
1	1	1

$$c_{i+1} = a_i * b_i + a_i * c_i + b_i * c_i$$

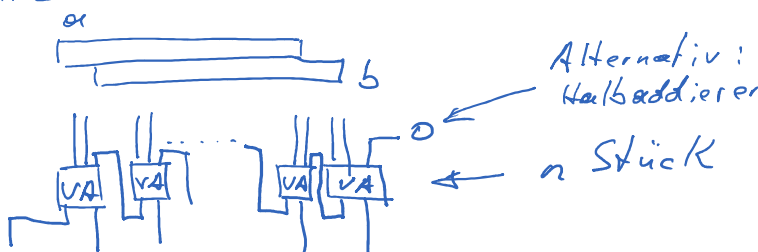
s_i	a_i	b_i
0	0	0
1	0	1
0	1	0
1	1	1

$$s_i = \overline{a_i} \cdot \overline{b_i} \cdot \overline{c_i} + \overline{a_i} \cdot \overline{b_i} \cdot c_i + a_i \cdot \overline{b_i} \cdot \overline{c_i} + a_i \cdot \overline{b_i} \cdot c_i$$

$$\begin{aligned} \text{Kosten} &= 3 \cdot 2^n + 2 \cdot 2^n \\ &+ 8 \cdot 2^n + 3 \cdot 2^n \\ &= 16 \text{ Gatter (2 Eingänge)} \end{aligned}$$

Laufzeit: n - Bit
→ n Schritte

2. Ansatz:



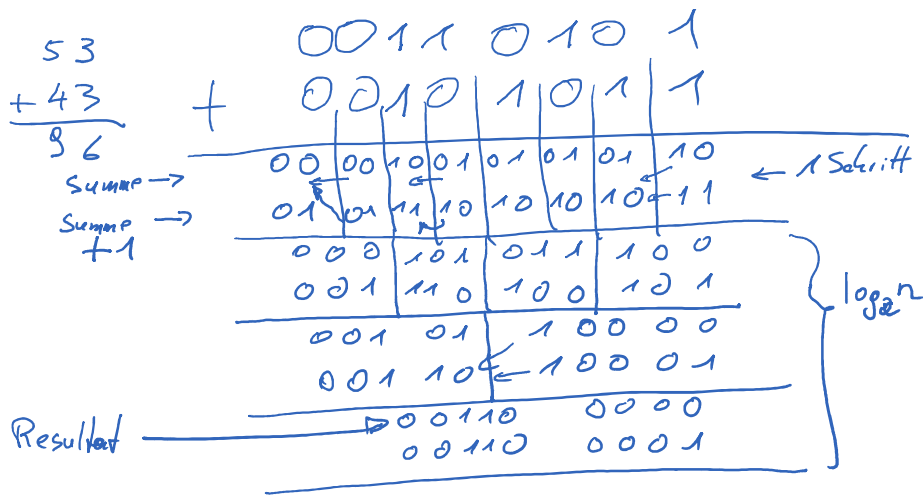
Kosten:

Platz - $16 \times n$ Gatter

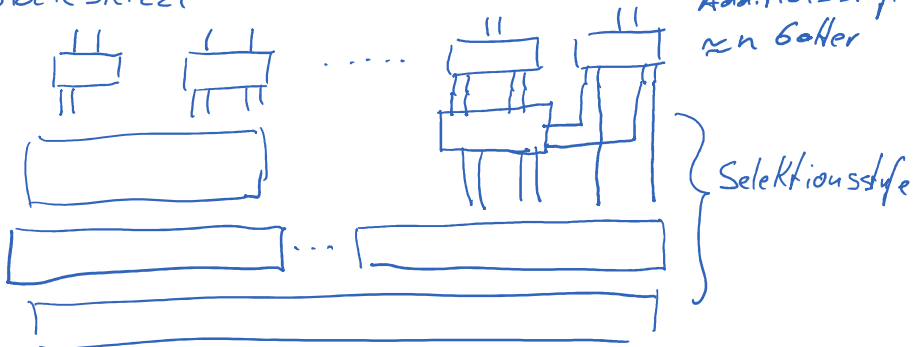
Laufzeit - $\approx n$

3. Ansatz:

$$\begin{array}{r} 53 \\ + 43 \\ \hline 1001101011 \end{array}$$



Blockskizze



Laufzeit: $1 + \log_2 n \approx \log n$

Fläche: $n * \log_2 n$

Additionsstufe

a_i	b_i	c_{i+1}	s_i	CP_{i+1}	SP_{i+1}
0	0	0	0	0	1
0	1	0	1	1	0
1	0	0	1	1	0
1	1	1	0	1	1

Selektionsstufe

SR	SR+1	CT	ST	CT+1	ST+1	NSR	NSR+1	SR	ST+1
3	3	3	4	4	7	12			
5	4	6	5	6	1	2			

$NSR \leftarrow SR * !CT$
 $NSR+1 \leftarrow SR+1 * CT$

08	07	08	08	10	08	03	11
08	08	10	10	11	08	04	12
0	7	08	8	10	8	04	1
08	8	10	0	10	8	04	2
08	7	8		10	8	4	1
08	8	00		10	8	4	2
08	8	00		08	4	1	Resultat
08	8	00		08	4	2	

3 Add. stufe
 Selektionsstufen

Bsp.:

The handwritten work shows the reduction of matrix A to row echelon form. The matrix is partitioned into four 4x4 blocks, each with a circled pivot element. Red arrows indicate the row operations performed to create zeros below each pivot.

Matrix A (4x16):

$$A = \begin{pmatrix} 1 & 0 & 1 & 0 & 1 & 0 & 1 & 0 \\ 0 & 1 & 1 & 0 & 0 & 1 & 1 & 0 \\ 0 & 1 & 0 & 1 & 1 & 0 & 0 & 0 \\ 1 & 0 & 1 & 0 & 1 & 1 & 0 & 1 \end{pmatrix}$$

Row Echelon Form (4x16):

$$\begin{pmatrix} 1 & 0 & 1 & 0 & 1 & 0 & 1 & 0 \\ 0 & 1 & 1 & 0 & 0 & 1 & 1 & 0 \\ 0 & 1 & 0 & 1 & 1 & 0 & 0 & 0 \\ 1 & 0 & 1 & 0 & 1 & 1 & 0 & 1 \end{pmatrix}$$

Red arrows indicate the following operations:

- Row 1 \leftarrow Row 1 - Row 4
- Row 2 \leftarrow Row 2 - Row 3
- Row 3 \leftarrow Row 3 - Row 2
- Row 4 \leftarrow Row 4 - Row 1

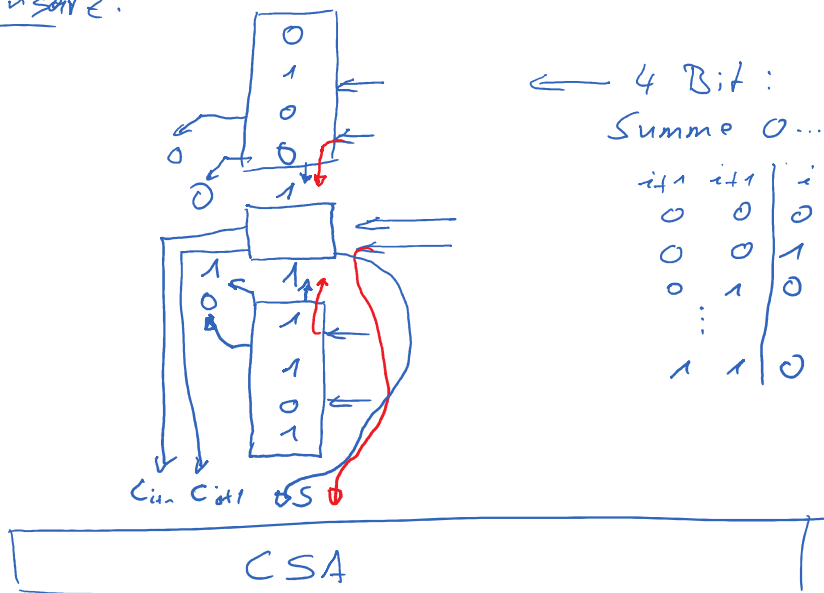
The final result is a matrix in row echelon form, with the first four rows forming the basis for the column space.

$$\begin{array}{r} \text{NR.:} \\ 1 \quad 0 \\ 0 \quad 1 \\ \hline 0 \\ 0 \quad 1 \quad 1 \end{array}$$

Multiplikation:

[illegible]

Ansatz:

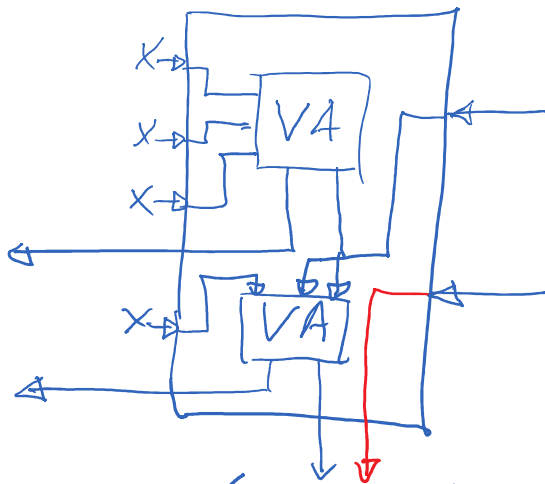


← 4 Bit:
Summe 0...4

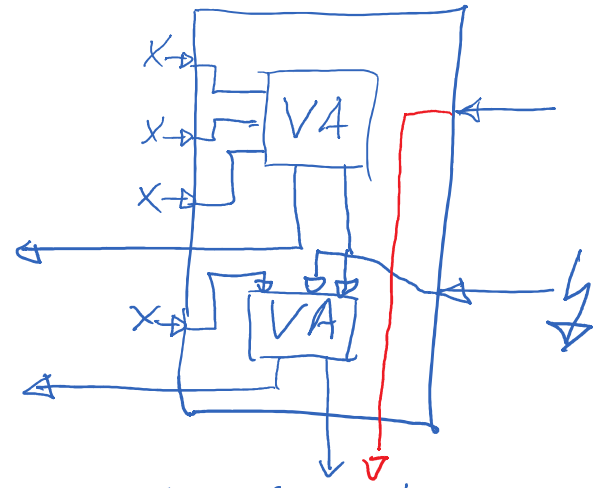
$$\begin{array}{cc|c} i+1 & i+1 & 1 \\ 0 & 0 & 0 \\ 0 & 0 & 1 \\ 0 & 1 & 0 \\ \vdots & & \\ 1 & 1 & 0 \end{array}$$

$$\log_2 n + \log_2 n$$

Innenleben blaue Box:



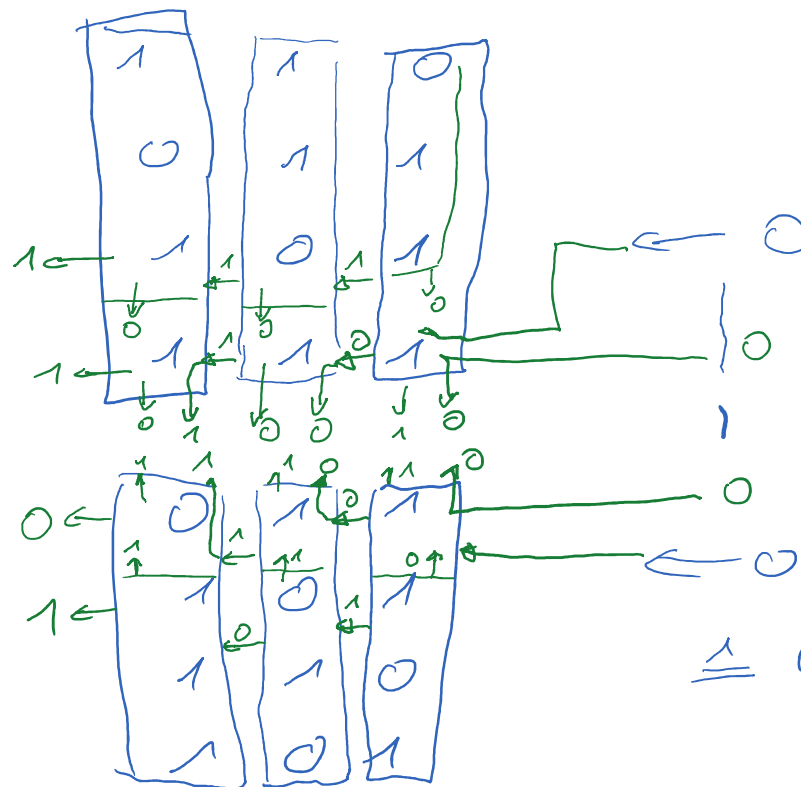
✓ Laufzeit
 $\sim \log n$



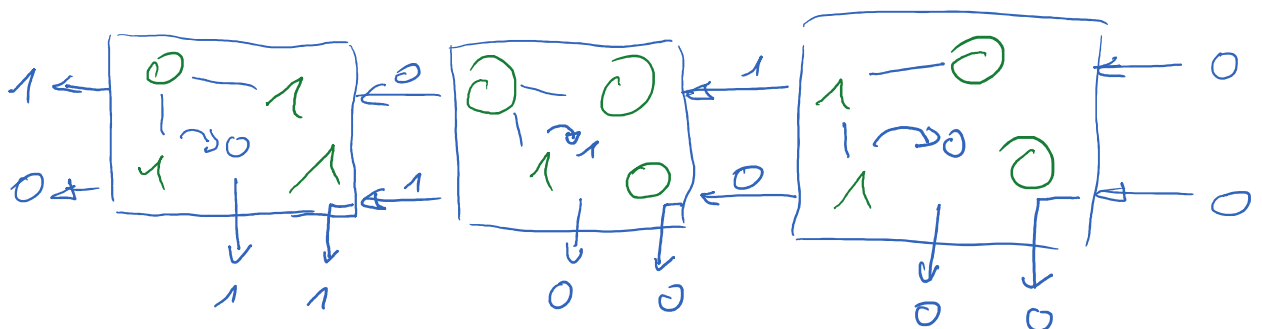
Laufzeit
 $\sim n$

Wallace Tree Multiplier

Bsp



In der Mitte



Addition

1	1	0	0	
0	1	0	0	
0 1	1 0	0 0	0 0	
1 0	1 1	0 1	0 1	
1	0	0	0	0
1	0	1	0	1
	1	0	0	0
	1	0	0	1

1 0 0 0 0

1 0 0 0 0

0

0

0

1

←

16