

Carry Save Adder (1A)

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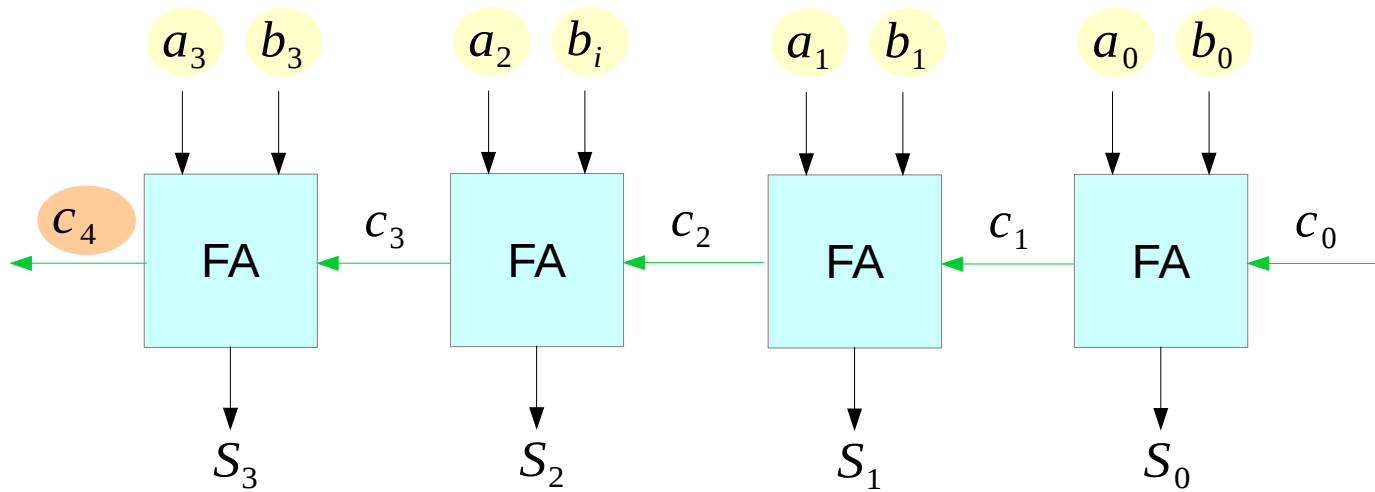
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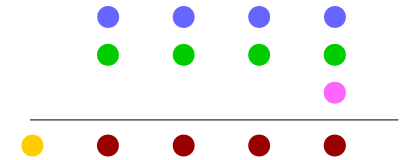
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Multi-operand Adders

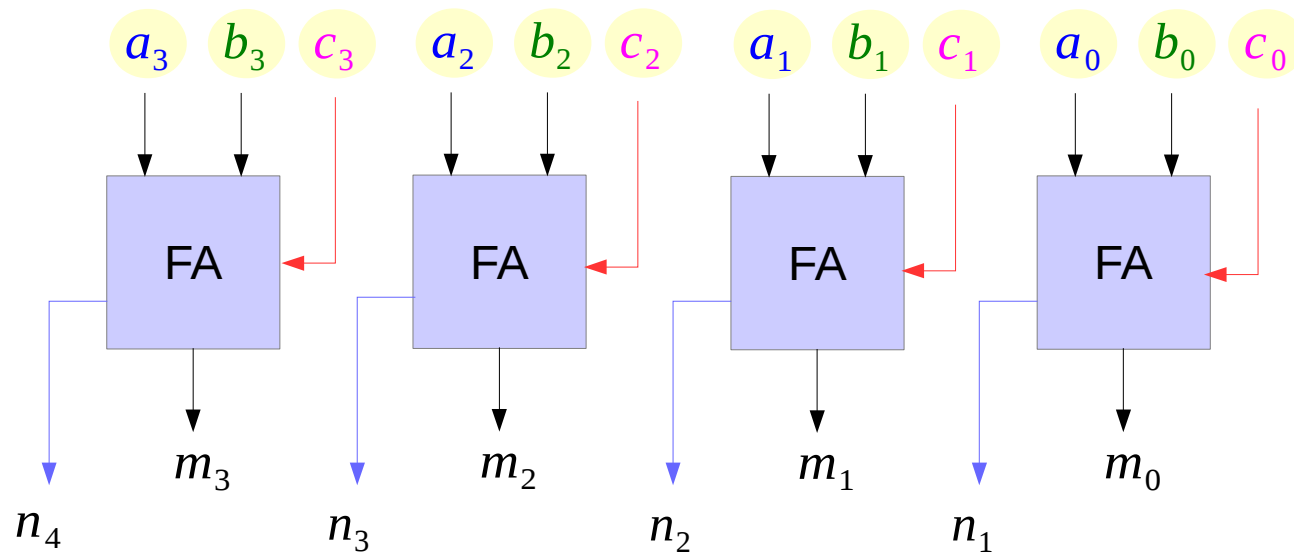
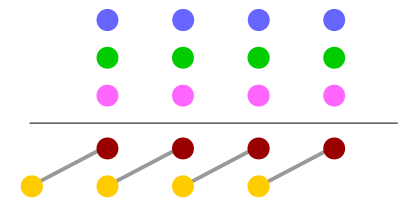


Ripple Carry Adder



Carry Propagate Adder

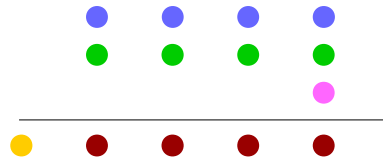
Carry Save Adder



Carry Save Adder

(3; 2) Counter

Ripple Carry Adder

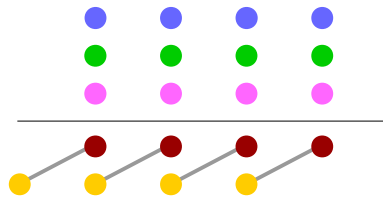


Add **two** numbers with carry in



One number with Carry out

Carry Save Adder

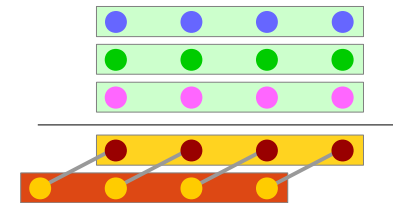


Add **three** numbers without carry in

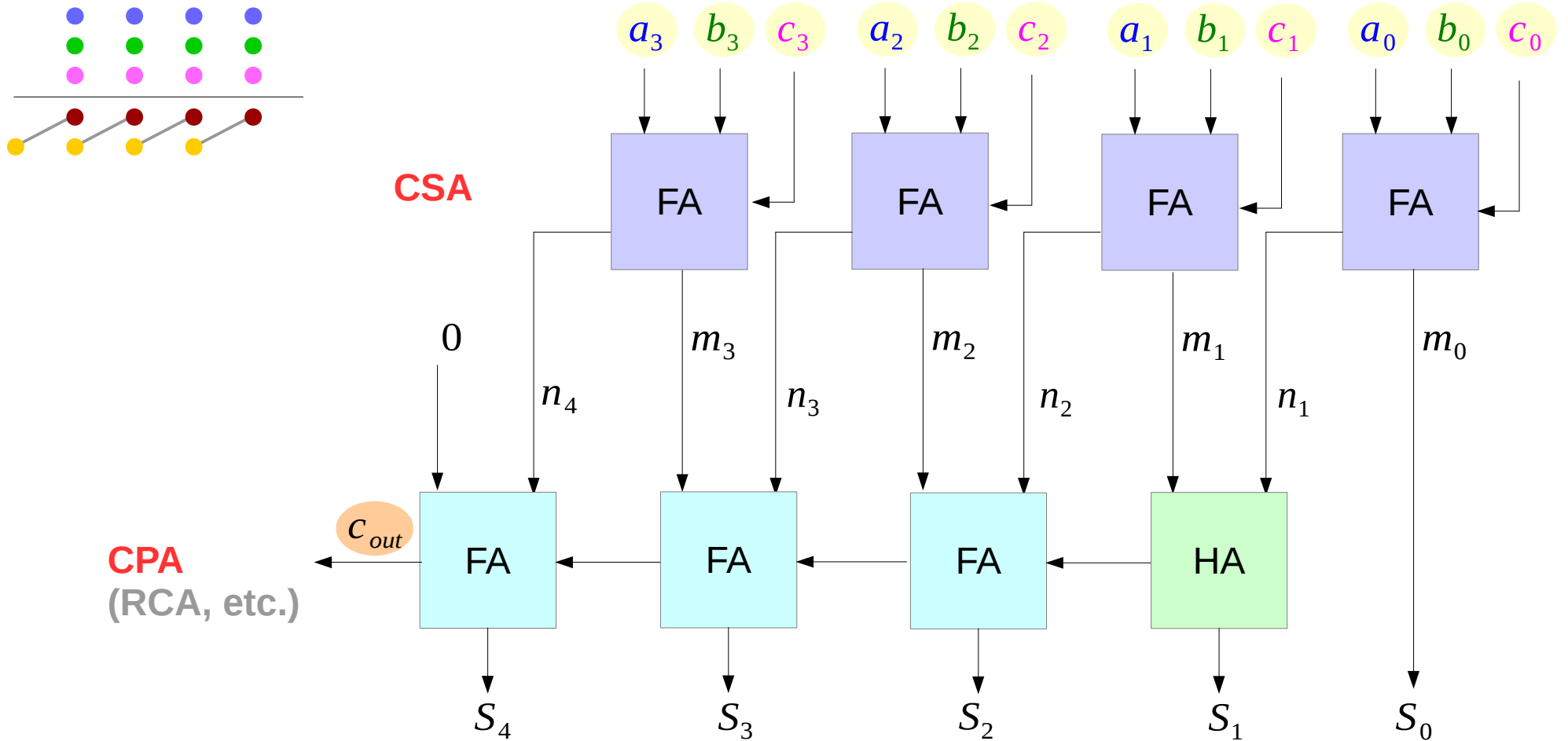


Two numbers

(3; 2) counter
3-to-2 reduction

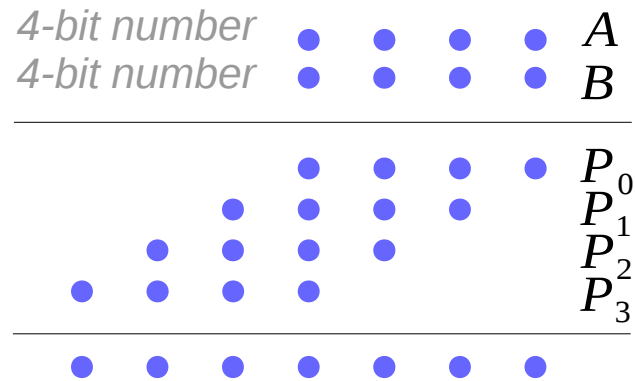


CSA + RCA

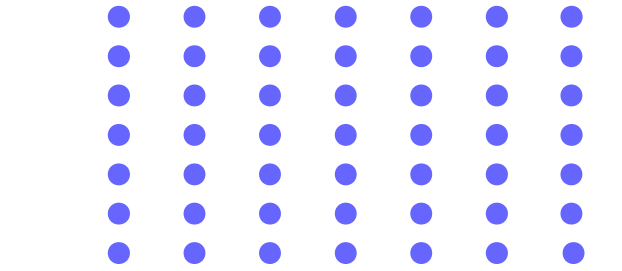


Multi-operand Addition Examples (1)

4-bit number multiplication



seven 7-bit number addition



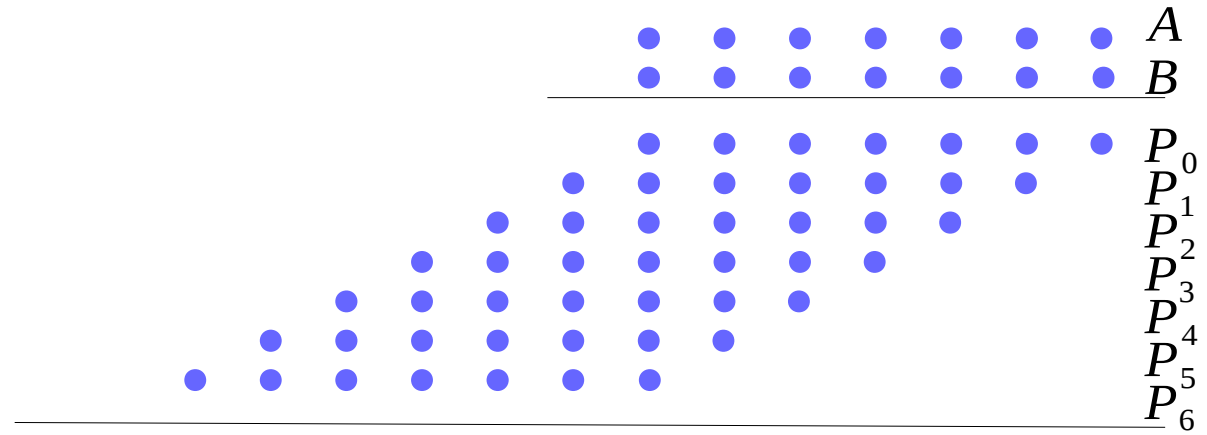
$$\vec{a} = (A_6, A_5, A_4, A_3, A_2, A_1, A_0)$$

$$\vec{b} = (B_6, B_5, B_4, B_3, B_2, B_1, B_0)$$

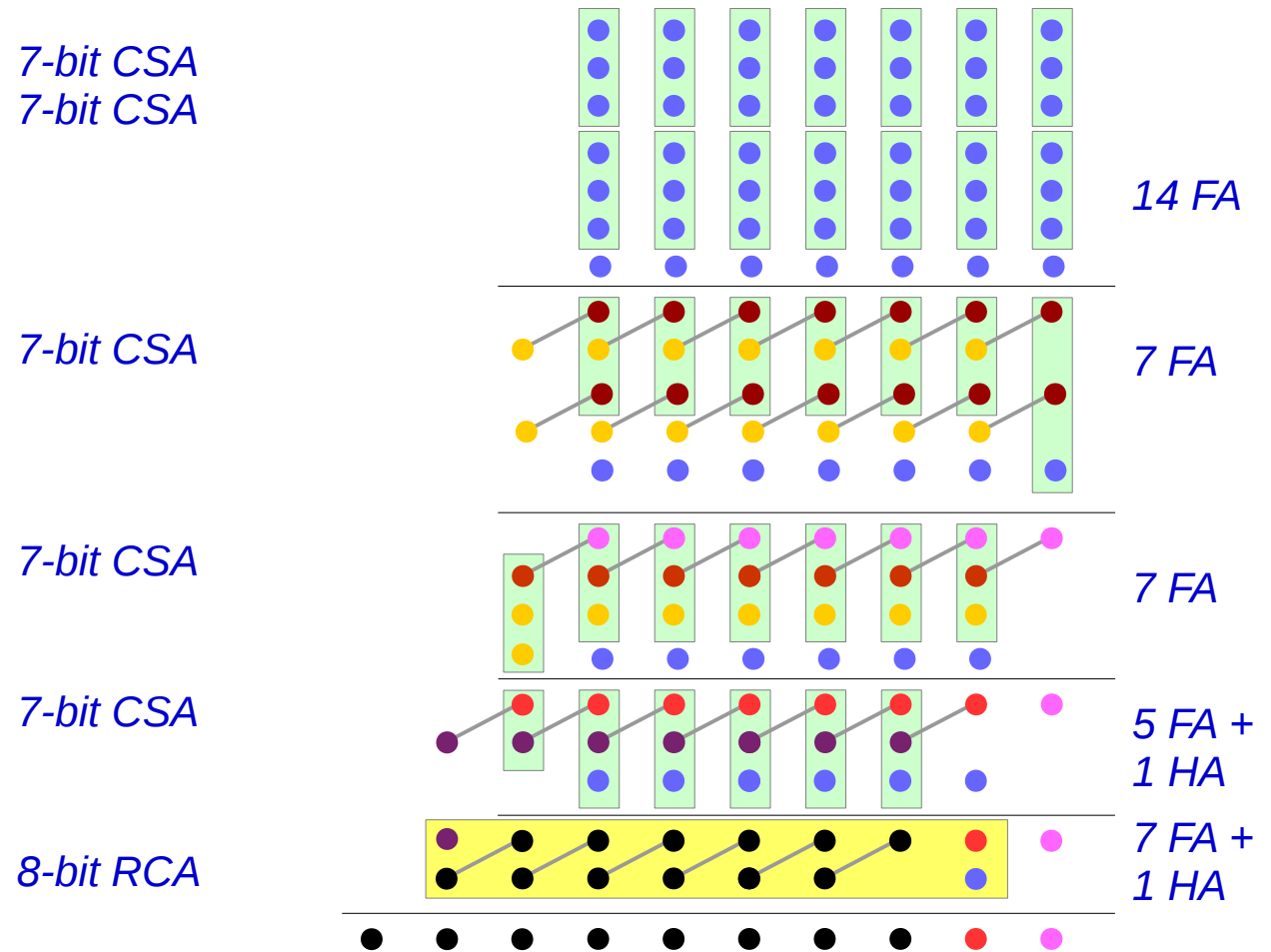
$$\vec{a} \cdot \vec{b} = \sum_{i=0}^6 A_i B_i$$

Multi-operand Addition Examples (2)

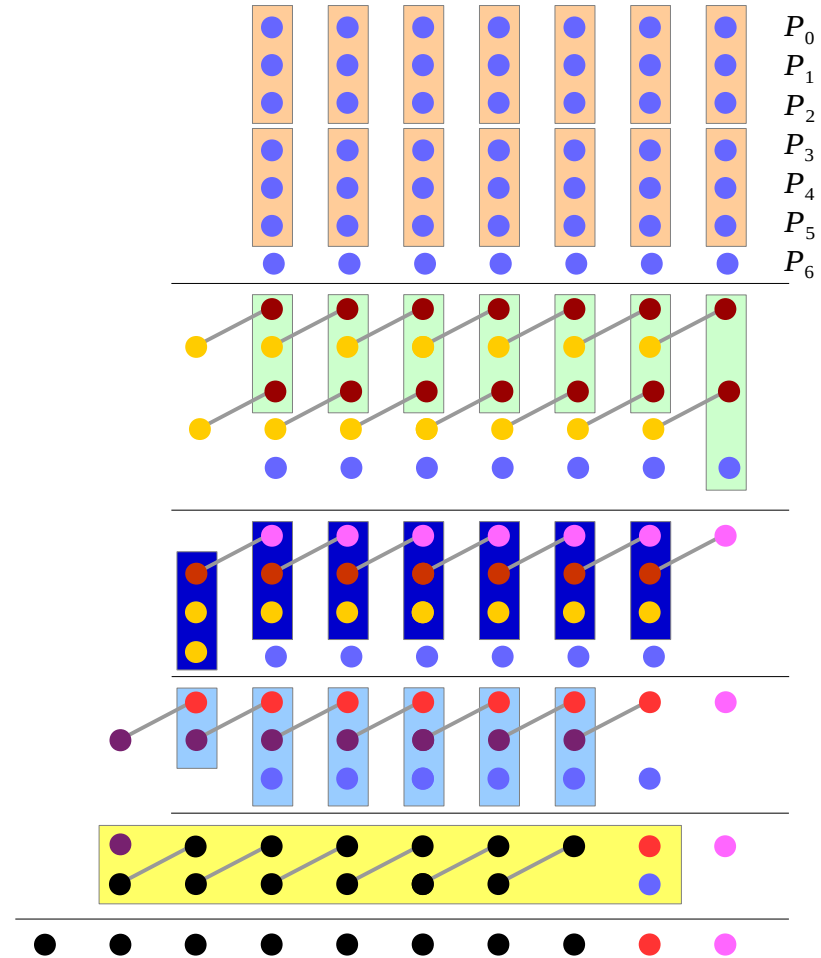
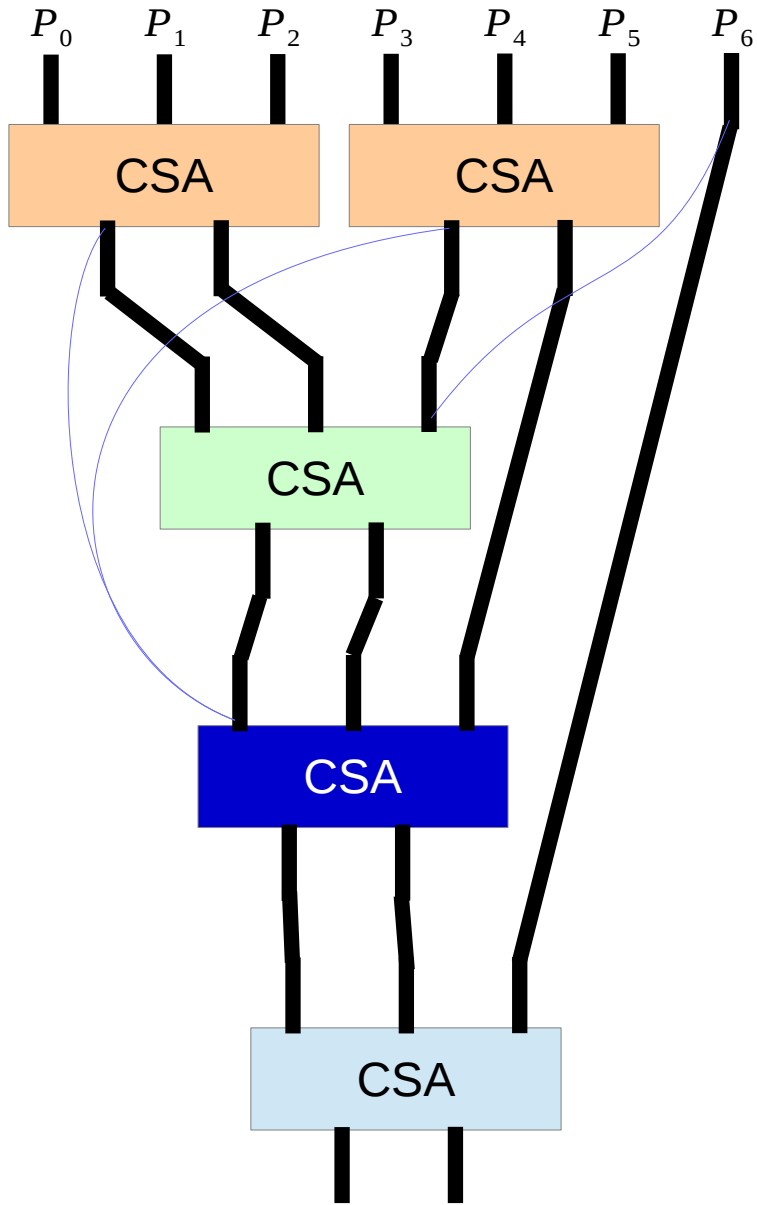
7-bit number multiplication



Adding seven 7-bit numbers using CSA



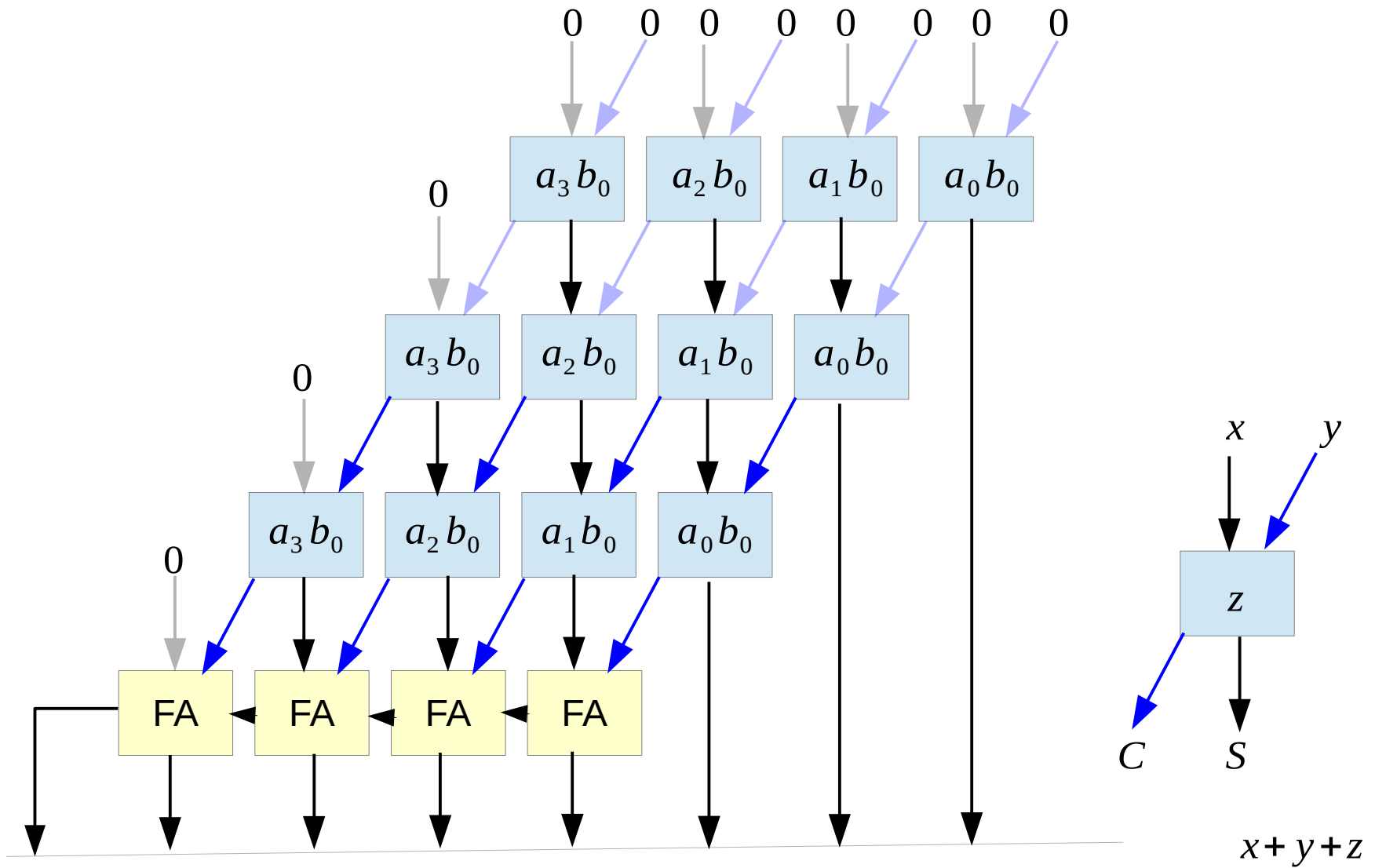
CSA Tree



4-bit Multiplication

$$\begin{array}{rcccc} & & a_3 & a_2 & a_1 & a_0 \\ & & b_3 & b_2 & b_1 & b_0 \\ \hline & & a_3 b_0 & a_2 b_0 & a_1 b_0 & a_0 b_0 \\ & a_3 b_0 & a_2 b_0 & a_1 b_0 & a_0 b_0 & \\ & a_3 b_0 & a_2 b_0 & a_1 b_0 & a_0 b_0 & \\ a_3 b_0 & a_2 b_0 & a_1 b_0 & a_0 b_0 & & \\ \hline \end{array}$$

Multiplier using CSA



References

- [1] en.wikipedia.org
- [2] Parhami, "Computer Arithmetic Algorithms and Hardware Designs"