

Ripple Carry Adder (1A)

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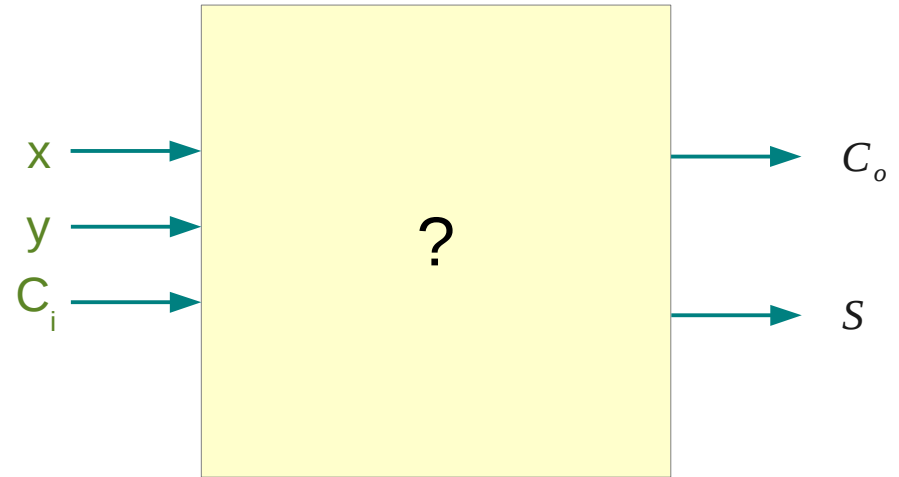
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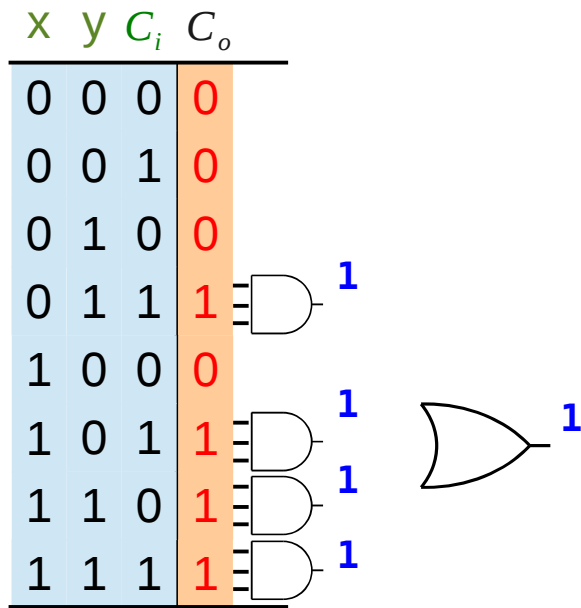
Truth Table

x	y	C_i	C_o	S
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

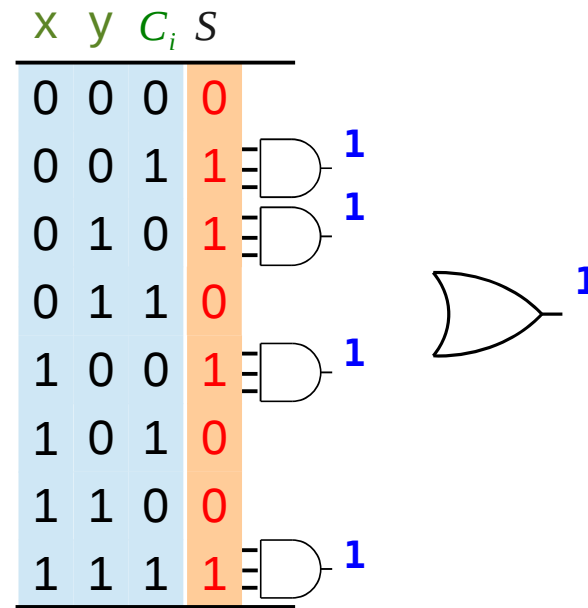
inputs output



SOP



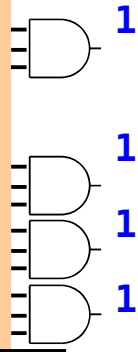
$$C_o = \bar{x}yC_i + x\bar{y}C_i + xy\bar{C}_i + xyC_i$$



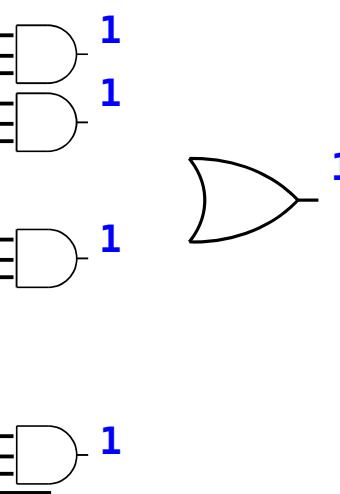
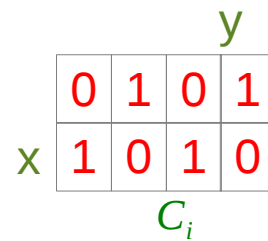
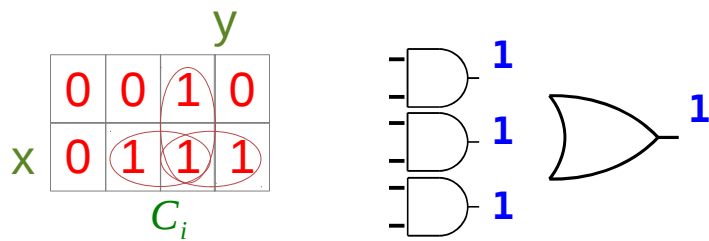
$$S = \bar{x}\bar{y}C_i + \bar{x}y\bar{C}_i + x\bar{y}\bar{C}_i + xyC_i$$

K-Map

x	y	C_i	C_o
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1



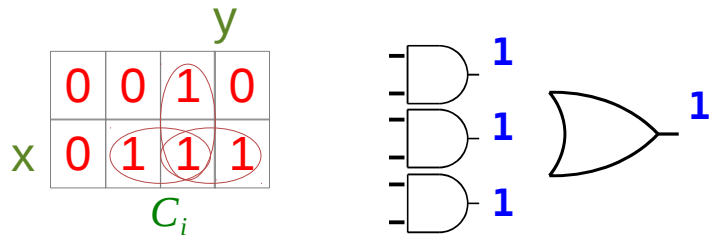
x	y	C_i	S
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	1

$$C_o = yC_i + xC_i + xy$$

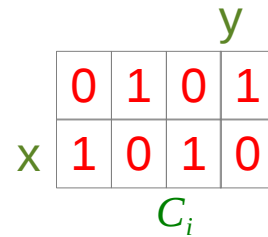
$$S = \bar{x}\bar{y}C_i + \bar{x}y\bar{C}_i + x\bar{y}\bar{C}_i + xyC_i$$

Boolean Algebra



$$C_o = yC_i + xC_i + xy$$

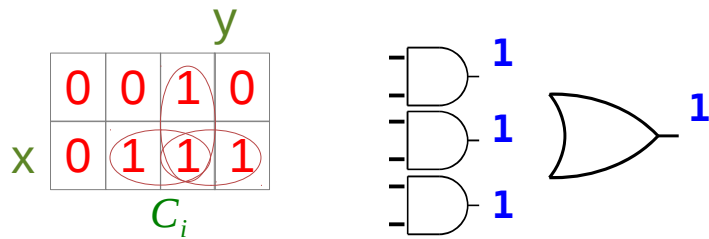
$$\begin{aligned} C_o &= (x + y)C_i + xy \\ &= (\bar{x}y + x\bar{y} + xy)C_i + xy \\ &= (\bar{x}y + x\bar{y})C_i + xy(C_i + 1) \\ &= (x \oplus y)C_i + xy \end{aligned}$$



$$S = \bar{x}\bar{y}C_i + \bar{x}y\bar{C}_i + x\bar{y}\bar{C}_i + xyC_i$$

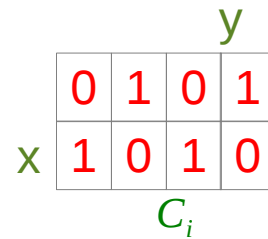
$$\begin{aligned} S &= (\bar{x}\bar{y} + xy)C_i + (\bar{x}y + x\bar{y})\bar{C}_i \\ &= \overline{(x \oplus y)}C_i + (x \oplus y)\bar{C}_i \\ &= (x \oplus y) \oplus C_i \end{aligned}$$

Boolean Algebra



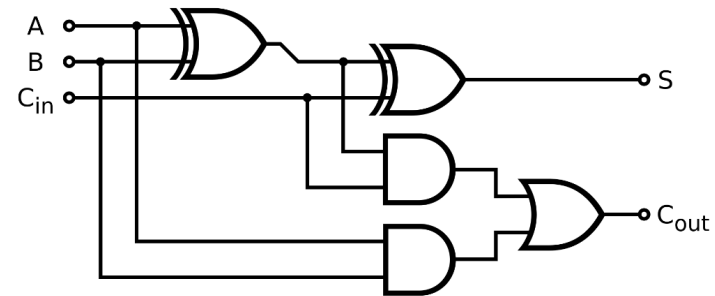
$$C_o = yC_i + xC_i + xy$$

$$\begin{aligned} C_o &= (x + y)C_i + xy \\ &= (\bar{x}y + x\bar{y} + xy)C_i + xy \\ &= (\bar{x}y + x\bar{y})C_i + xy(C_i + 1) \\ &= (x \oplus y)C_i + xy \end{aligned}$$

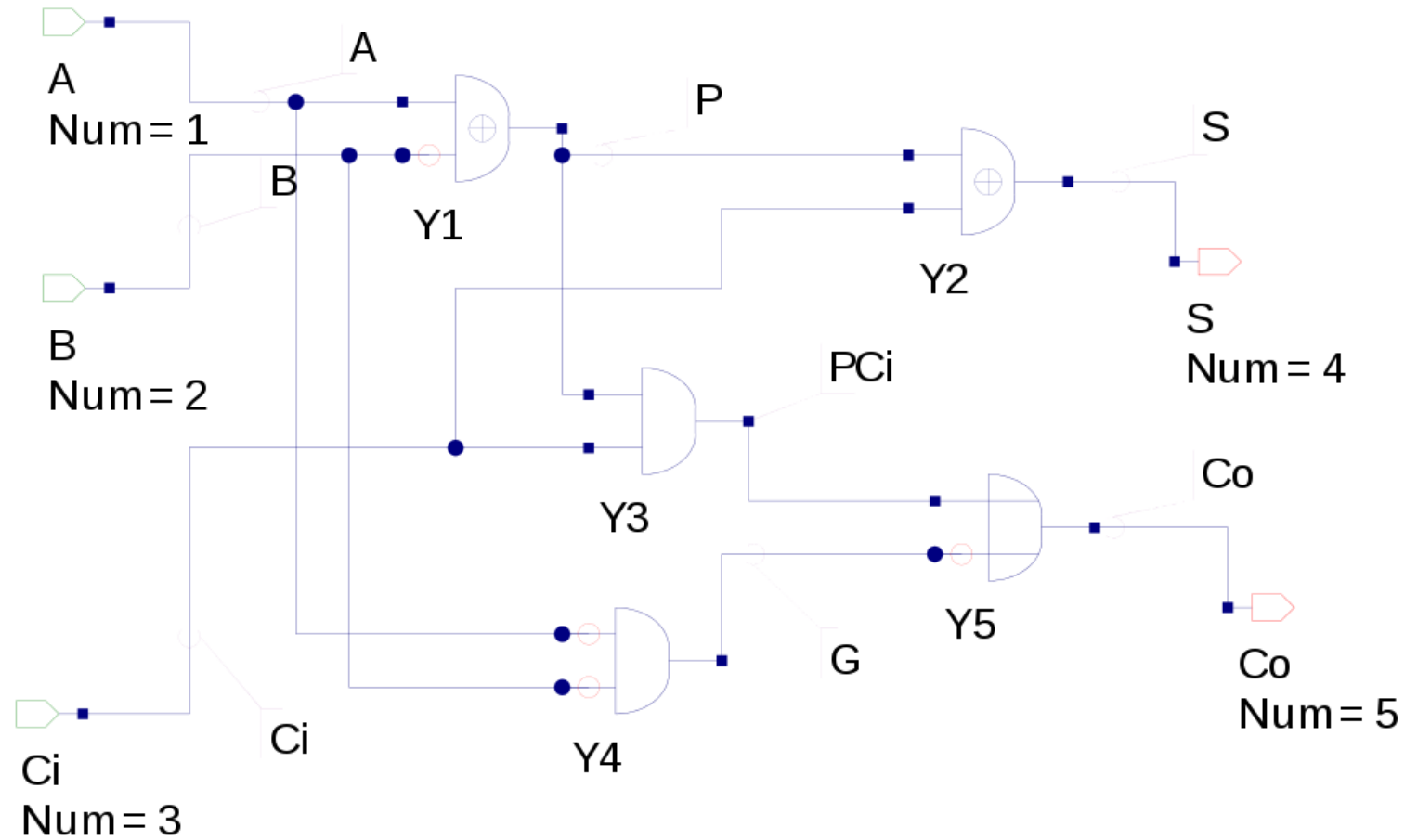


$$S = \bar{x}\bar{y}C_i + \bar{x}y\bar{C}_i + x\bar{y}\bar{C}_i + xyC_i$$

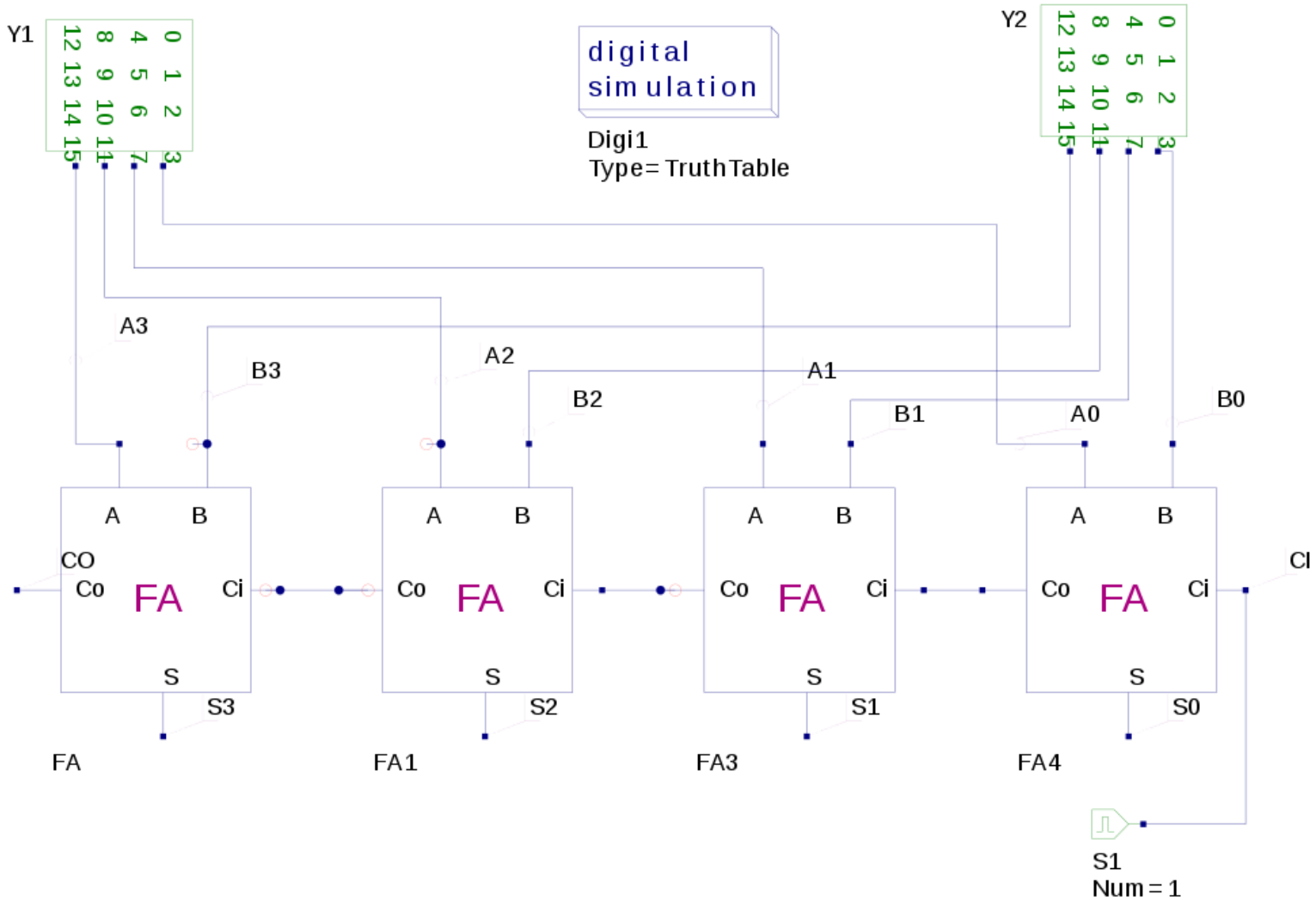
$$\begin{aligned} S &= (\bar{x}\bar{y} + xy)C_i + (\bar{x}y + x\bar{y})\bar{C}_i \\ &= \overline{(x \oplus y)}C_i + (x \oplus y)\bar{C}_i \\ &= (x \oplus y) \oplus C_i \end{aligned}$$



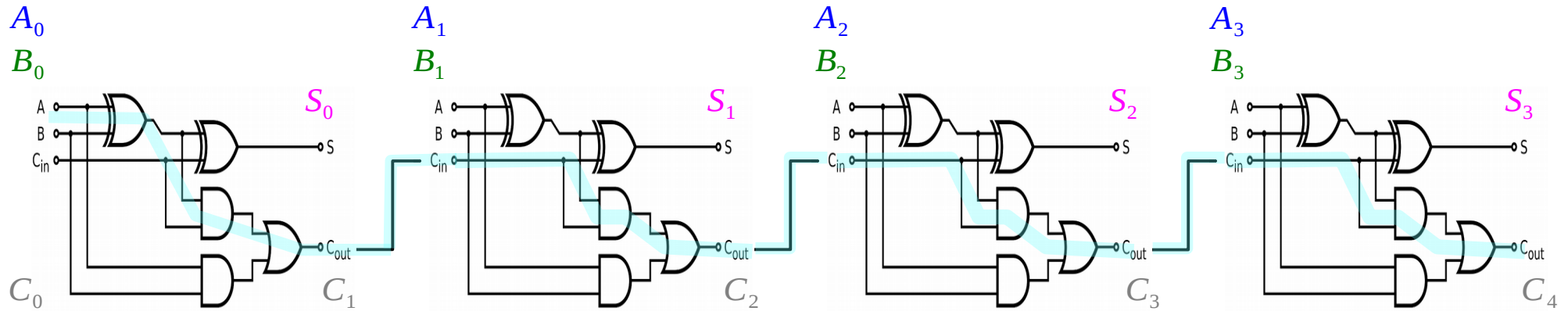
Full Adder in Qucs



4-Bit Adder in Qucs



Critical Path



References

- [1] en.wikipedia.org
- [2] D.M. Harris, S. L. Harris, "Digital Design and Computer Architecture"
- [3] <http://www.aoki.ecei.tohoku.ac.jp/arith/mg/algorithm.html>