CORDIC Accuracy Serialize

20160122

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Serialized Addition

Carry Save Adder

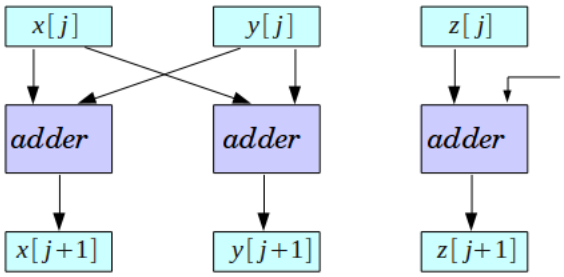
Peak Power

Serialized Addition

$$x[j+1] = x[j] - \sigma_j 2^{-j} y[j]$$

$$y[j+1] = y[j] + \sigma_j 2^{-j} x[j]$$

$$z[j+1] = z[j] - \sigma_j \tan^{-1}(2^{-j})$$



3 number addition

$$x[j+1] = x[j] - \sigma_j 2^{-j} y[j]$$

$$x[j] = x[j+1] + \sigma_j 2^{-j} y[j]$$

$$y[j+1] = y[j] + \sigma_j 2^{-j} x[j]$$

$$y[j+1] = y[j] + \sigma_j 2^{-j}(x[j+1] + \sigma_j 2^{-j} y[j])$$

$$y[j+1] = (1 + \sigma_j^2 2^{-2j}) y[j] + \sigma_j 2^{-j} x[j+1]$$

$$y[j+1] = (1 + 2^{-2j}) y[j] + \sigma_j 2^{-j} x[j+1]$$

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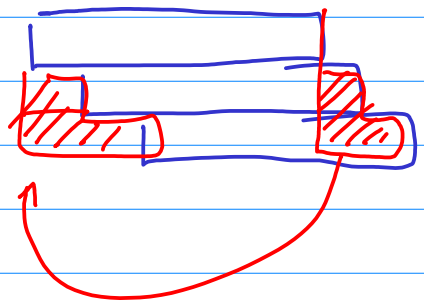

(2) RCA's → (1) 3-number adder

area nearly the same

power peak switching reduced

$$x[j+1] = x[j] - \sigma_j 2^{-j} y[j]$$

$$\Downarrow$$

$$x[j] = x[j+1] + \sigma_j 2^{-j} y[j]$$

$$y[j+1] = y[j] + \sigma_j 2^{-j} x[j]$$

$$y[j+1] = y[j] + \sigma_j 2^{-j}(x[j+1] + \sigma_j 2^{-j} y[j])$$

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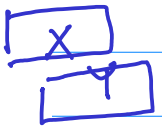
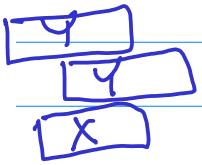
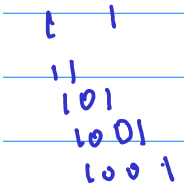


X+Y

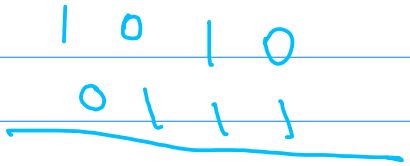


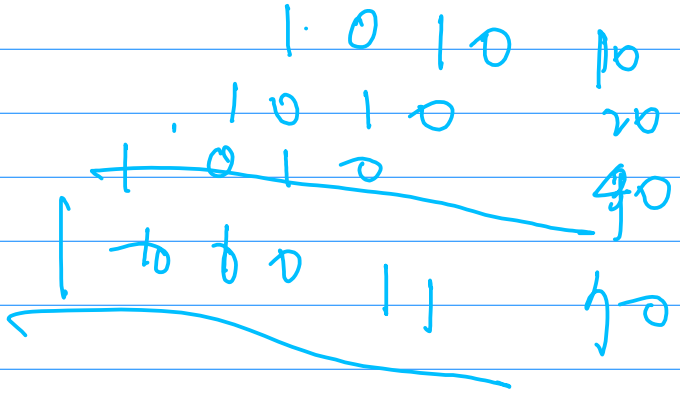


1101 (2 8+4

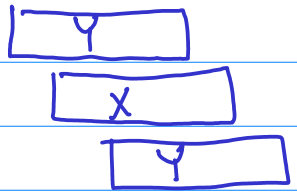
1010 10 8+2

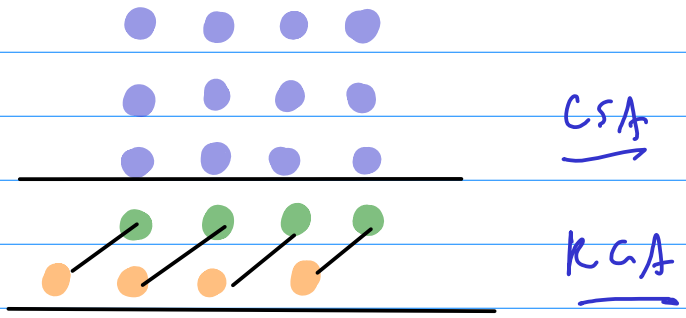
1001 9 8+1

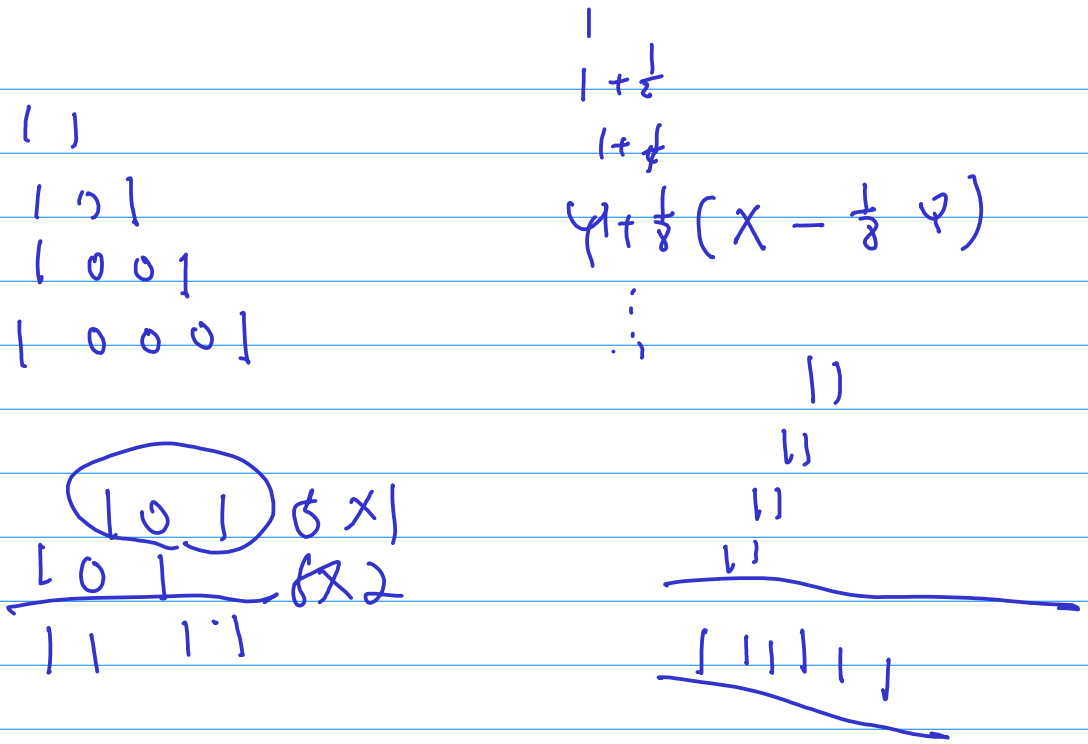


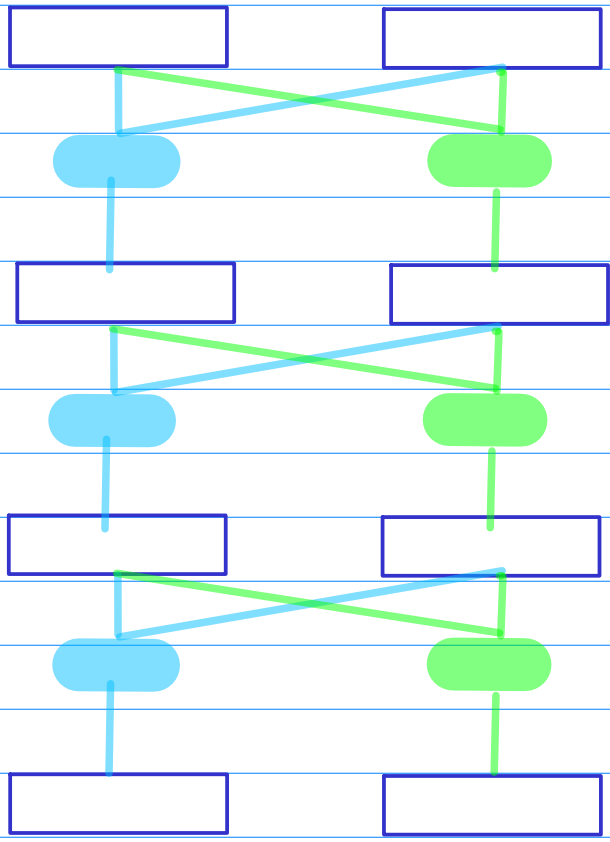


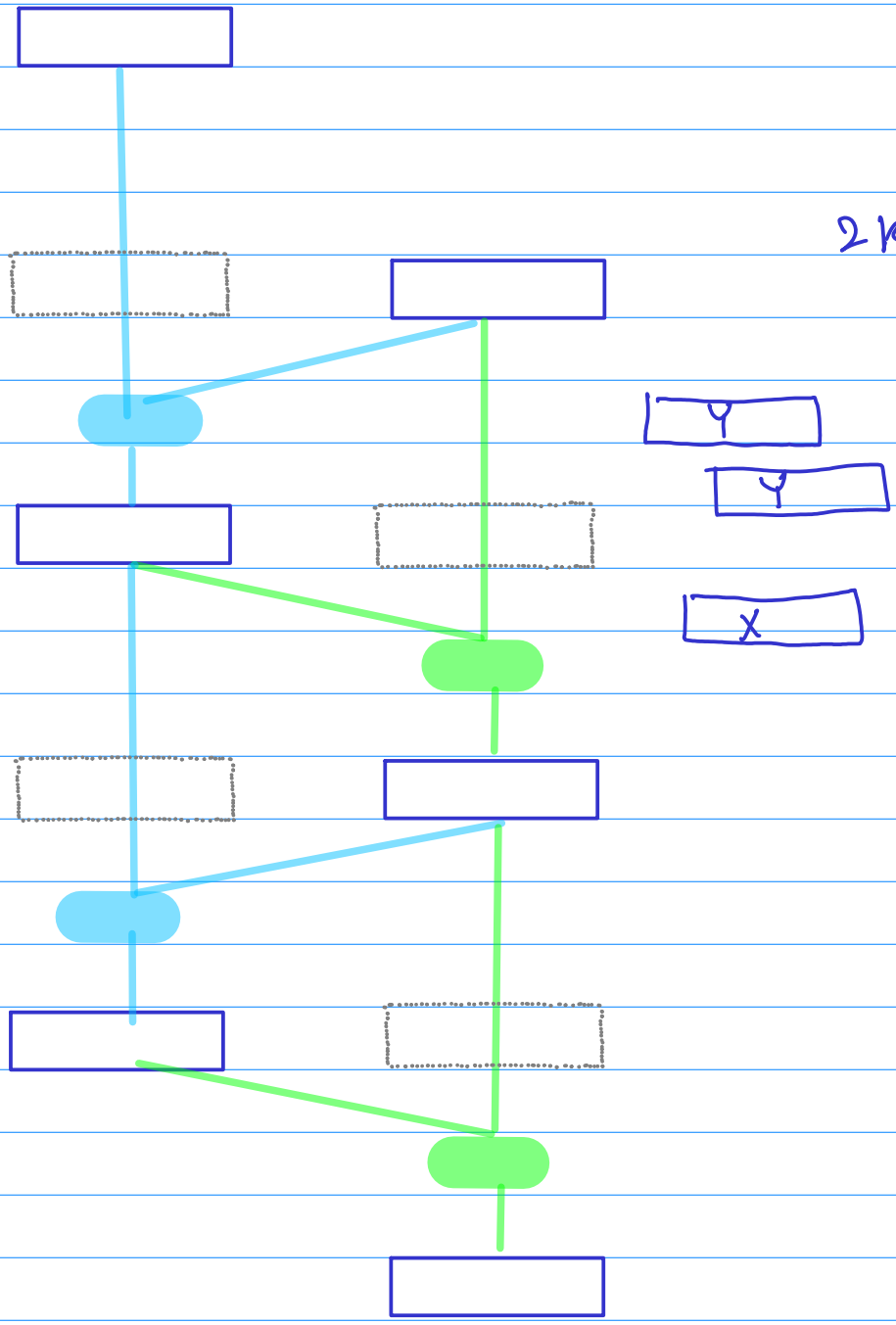
Carry Save Adder





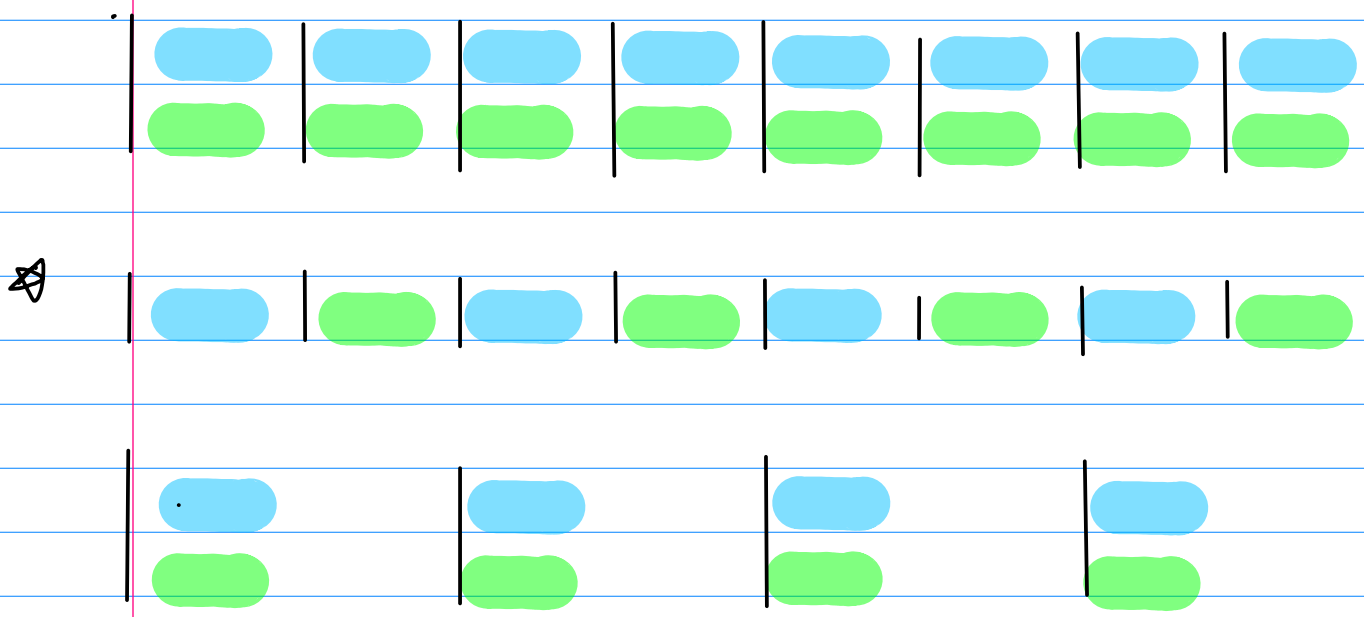





2 RCA's
Y
Y
X

Domino Logic - Pipeline w/o latch
Latch Design - Time borrowing (CSA)
CSA + RCA
Power v.s. Energy
Peak Power Consumption Rate

Peak Power



(1) $x[j+1] = x[j] - \sigma_j 2^{-j} y[j]$

$$\Downarrow$$

$$x[j] = x[j+1] + \sigma_j 2^{-j} y[j]$$

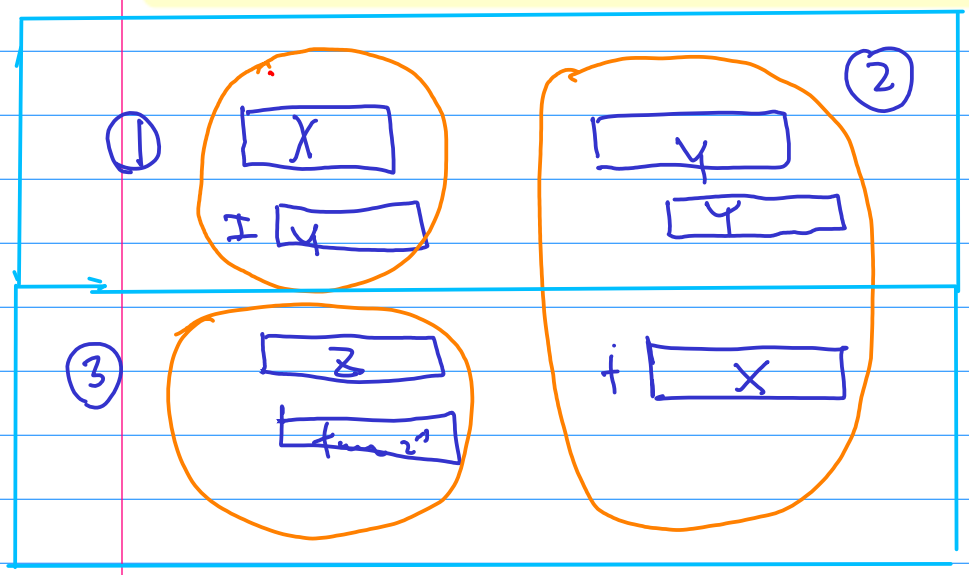
$$y[j+1] = y[j] + \sigma_j 2^{-j} x[j]$$

$$y[j+1] = y[j] + \sigma_j 2^{-j}(x[j+1] + \sigma_j 2^{-j} y[j])$$

$$y[j+1] = (1 + \sigma_j^2 2^{-2j}) y[j] + \sigma_j 2^{-j} x[j+1]$$

(2) $y[j+1] = (1 + 2^{-2j}) y[j] + \sigma_j 2^{-j} x[j+1]$

(3) $z[j+1] = z[j] - \sigma_j \tan^{-1}(2^{-j})$



Serialization requires only (2) adders

(3) adders → (2) adders

area-efficient

peak power - efficient.

re arranging works.

does redundant work

work load balanced

$$x[j+1] = x[j] - \sigma_j 2^{-j} y[j]$$

$$\Downarrow$$

$$x[j] = x[j+1] + \sigma_j 2^{-j} y[j]$$

$$y[j+1] = y[j] + \sigma_j 2^{-j} x[j]$$

$$y[j+1] = y[j] + \sigma_j 2^{-j}(x[j+1] + \sigma_j 2^{-j} y[j])$$

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$$z[j+1] = z[j] - \sigma_j \tan^{-1}(2^{-j})$$

$$(\theta_i > 0) \; ? \; \sigma_i = +1 \; : \; \sigma_i = -1$$

$$(\theta_0 = 75)^\circ > 0^\circ \Rightarrow$$

$$2^{-i} = 2^0 = 1 \Rightarrow$$

$$x'_{i+1} = (x'_i - y'_i \, \sigma_i 2^{-i})$$

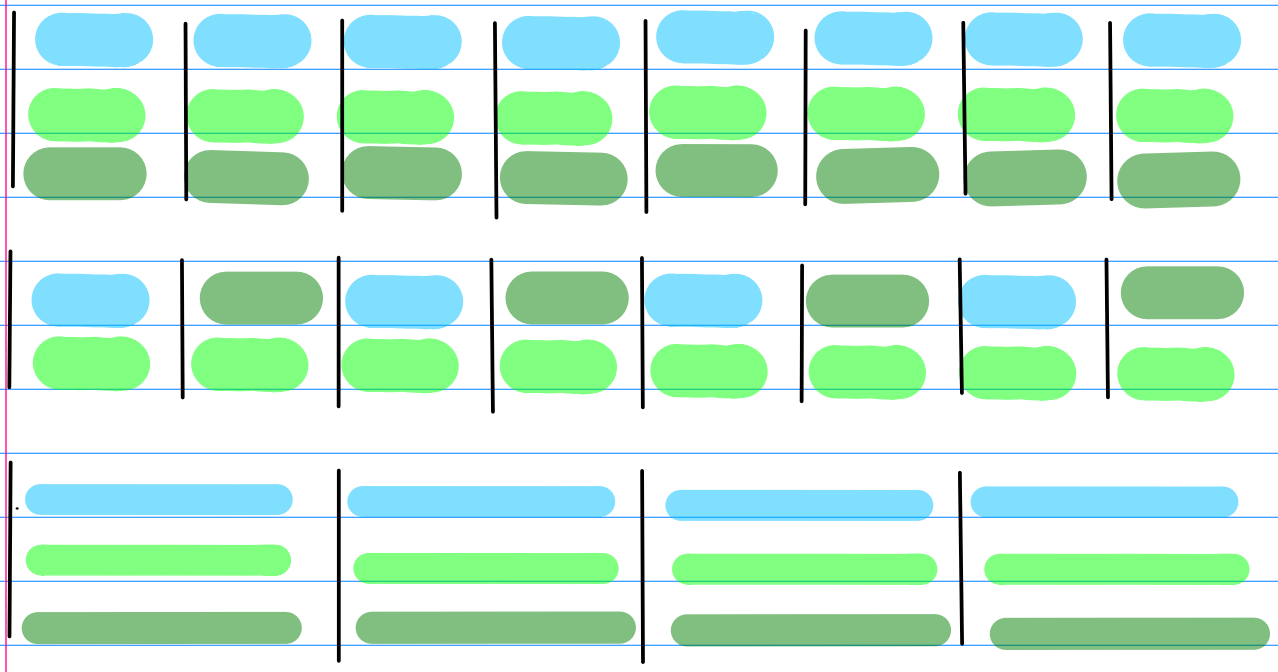
$$y'_{i+1} = (x'_i \, \sigma_i 2^{-i} + y'_i)$$

$$\theta_{i+1} = \theta_i - \tan^{-1}(\sigma_i 2^{-i})$$

* some kinds of metrics

think of man • month product.

* figure of index



Peak power / RMS power?