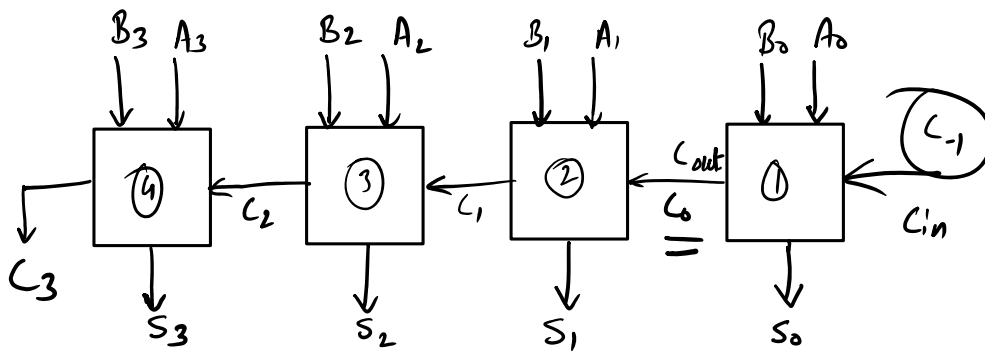


Carry Look Ahead Generator

22 September 2023 11:53

(4-Bit)



$$\text{Sum} = C_3 S_3 S_2 S_1 S_0$$

$$S_0 = A_0 \oplus B_0 \oplus C_{-1} \quad (C_{in})$$

$$S_1 = A_1 \oplus B_1 \oplus C_0$$

$$S_2 = A_2 \oplus B_2 \oplus C_1$$

$$S_3 = \underbrace{A_3 \oplus B_3}_{P_3} \oplus C_2$$

A	B	C_{in}	S	C_{out}
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

$$A \cdot B$$

$$C_0 = \underbrace{A \cdot B}_G + \underbrace{A \oplus B}_{P} \cdot C_{in}$$

Carry Generator

Carry Propagation

(Carry generated when $C_{in}=1$)

$$C_0 = G_0 + P_0 \cdot C_{in}$$

Generic eqn. \rightarrow $C_i = G_i + P_i \cdot C_{i-1}$

$$i = 0,$$

$$C_0 = G_0 + P_0 \cdot C_{-1} \quad \text{--- (1)}$$

$$i = 1,$$

$$C_1 = G_1 + P_1 \cdot C_0 \quad \text{--- (2)}$$

i.e. know the value of C_{in} then C_0

$$C_1 = G_1 + P_1 \cdot C_0$$

We know the value C_0 from (1),

$$\begin{aligned} C_1 &= G_1 + P_1 (G_0 + P_0 \cdot C_{-1}) \\ &= G_1 + P_1 G_0 + P_1 P_0 C_{-1} \end{aligned} \quad \text{--- (3)}$$

for $i=2$,

$$C_2 = G_2 + P_2 C_1 \quad (\text{from generic eqn.})$$

put value of C_1 from (3),

$$\begin{aligned} C_2 &= G_2 + P_2 (G_1 + P_1 G_0 + P_1 P_0 C_{-1}) \\ &= G_2 + P_2 G_1 + P_2 P_1 G_0 + P_2 P_1 P_0 C_{-1} \end{aligned} \quad \text{--- (4)}$$

$i=3$,

$$C_3 = G_3 + P_3 C_2$$

put value of C_2 from (4),

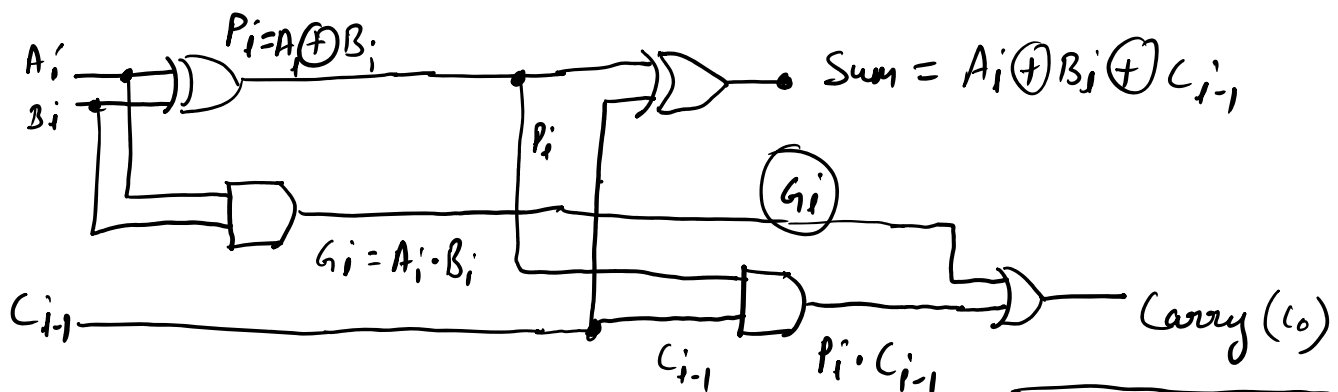
$$\begin{aligned} \text{(4)} \quad C_3 &= G_3 + P_3 (G_2 + P_2 G_1 + P_2 P_1 G_0 + P_2 P_1 P_0 C_{-1}) \\ &= G_3 + P_3 G_2 + P_3 P_2 G_1 + P_3 P_2 P_1 G_0 + P_3 P_2 P_1 P_0 C_{-1} \end{aligned} \quad \text{--- (5)}$$

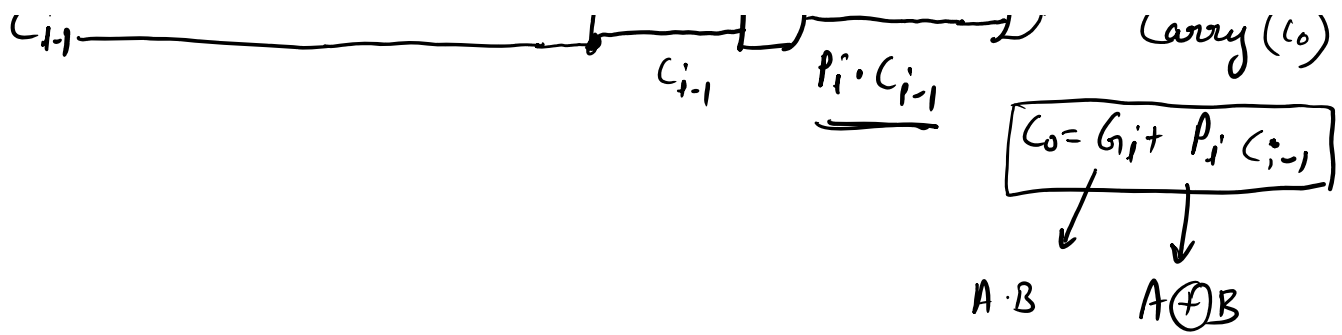
We know that $G = A \cdot B$

and $P = A \oplus B$

Final Expression

$$\begin{aligned} C = & A_3 \cdot B_3 + A_3 \oplus B_3 (A_2 \cdot B_2) + (A_3 \oplus B_3) (A_2 \oplus B_2) (A_1 \cdot B_1) + (A_3 \oplus B_3) \\ & (A_2 \oplus B_2) (A_1 \oplus B_1) (A_0 \cdot B_0) + (A_3 \oplus B_3) (A_2 \oplus B_2) (A_1 \oplus B_1) (A_0 \oplus B_0) C_{-1} \end{aligned}$$





$$G_0 = A_0 B_0$$

$$G_1 = A_1 B_1$$

$$G_2 = A_2 B_2$$

$$G_3 = A_3 B_3$$

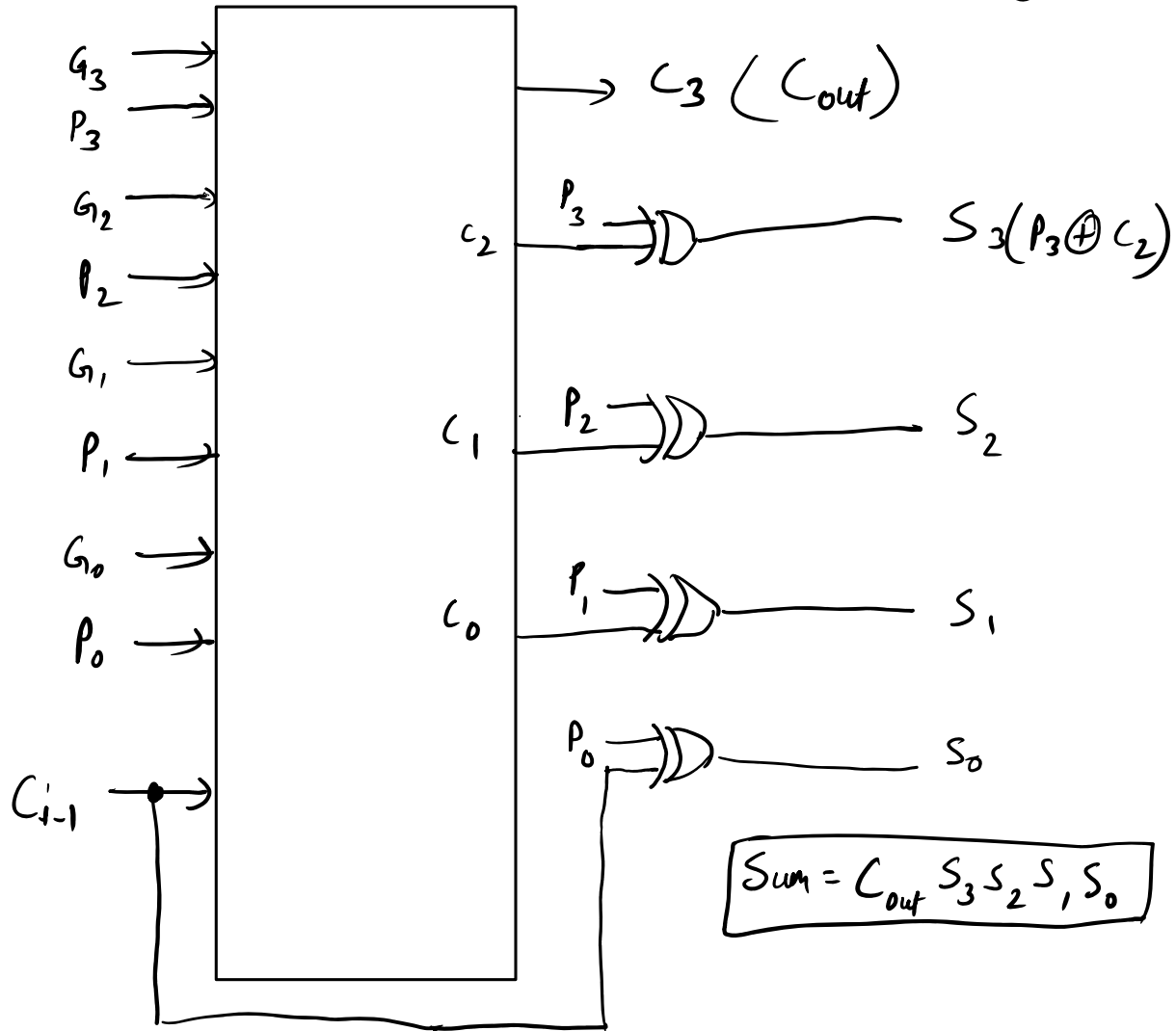
$$P_0 = A_0 \oplus B_0$$

$$P_1 = A_1 \oplus B_1$$

$$P_2 = A_2 \oplus B_2$$

$$P_3 = A_3 \oplus B_3$$

$$C_{i-1}$$



Carry Look Ahead Generator