CS220A — Computer Organization

Group Number: 33   **Due Date:** February 6 2022, 23:59
Roll Number: 190616, 190773, 190714   **Assignment Number:** 2

1   8-Bit Carry Look-Ahead Adder (CLA Adder)

The propagation delay of each gate causes a delay between the output sum and carry corresponding to each bit. This delay needs to be rectified because the carry can be computed only after the sum has been computed. We thus use a CLA adder to "predict the carry" before its computation.

A	B	C_{in}	Cout
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

By observation, we conclude that

$$C_o = A.B + (A \oplus B).C_{in}$$

If G=A.B and P=A$\oplus B$,
$C_o = G + P.C_{in}$

Thus, for an eight bit adder with initial carry C_{-1}
$C_0 = G_0 + P_0.C_{-1}$
$C_1 = G_1 + P_1.(G_0 + P_0.C_{-1})$
$C_2 = G_2 + P_2.(G_1 + P_1.(G_0 + P_0.C_{-1}))$
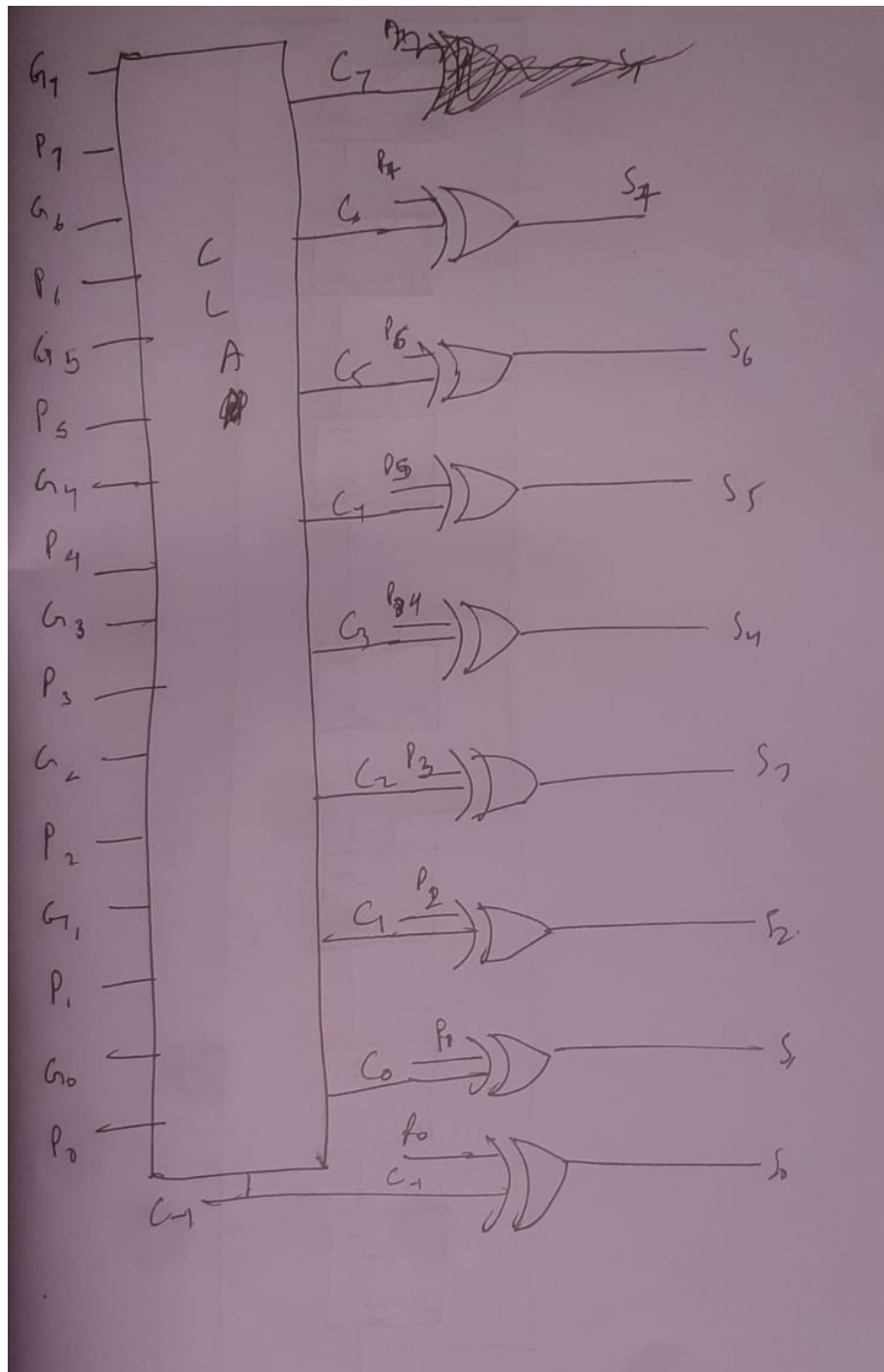$C_3 = G_3 + P_3.(G_2 + P_2.(G_1 + P_1.(G_0 + P_0.C_{-1})))$
$C_4 = G_4 + P_4.(G_3 + P_3.(G_2 + P_2.(G_1 + P_1.(G_0 + P_0.C_{-1}))))$
$C_5 = G_5 + P_5.(G_4 + P_4.(G_3 + P_3.(G_2 + P_2.(G_1 + P_1.(G_0 + P_0.C_{-1})))))$
$C_6 = G_6 + P_6.(G_5 + P_5.(G_4 + P_4.(G_3 + P_3.(G_2 + P_2.(G_1 + P_1.(G_0 + P_0.C_{-1}))))))$
$C_7 = G_7 + P_7.(G_6 + P_6.(G_5 + P_5.(G_4 + P_4.(G_3 + P_3.(G_2 + P_2.(G_1 + P_1.(G_0 + P_0.C_{-1})))))))$
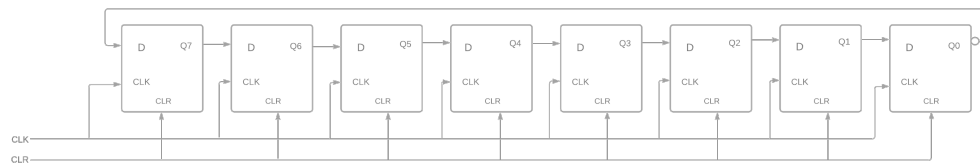
8-Bit Carry Look-Ahead Adder (CLA Adder)

2   8-bit Johnson counter

In Johnson counter, the complemented output of last flip flop is connected to input of first flip flop and to implement n-bit Johnson counter we require n flip-flop.

No. of states in Johnson counter = No. of flip-flop used Number of used states=2n Number of unused states=2n - 2*n

clear	clock pulse	Q_7	Q_6	Q_5	Q_4	Q_3	Q_2	Q_1	Q_0
1	0	0	0	0	0	0	0	0	0
0	1	1	0	0	0	0	0	0	0
0	2	1	1	0	0	0	0	0	0
0	3	1	1	1	0	0	0	0	0
0	4	1	1	1	1	0	0	0	0
0	5	1	1	1	1	1	0	0	0
0	6	1	1	1	1	1	1	0	0
0	7	1	1	1	1	1	1	1	0
0	8	1	1	1	1	1	1	1	1
0	9	0	1	1	1	1	1	1	1
0	10	0	0	1	1	1	1	1	1
0	11	0	0	0	1	1	1	1	1
0	12	0	0	0	0	1	1	1	1
0	13	0	0	0	0	0	1	1	1
0	14	0	0	0	0	0	0	1	1
0	15	0	0	0	0	0	0	0	1
0	16	0	0	0	0	0	0	0	0

8-bit Johnson Counter