Application 1:

Add the tow number 11 and 13 in decimal using Carry-Lookahead Adder

Step 1: Compute G_i and P_i

Using:

$$G_i = A_i \cdot B_i, \quad P_i = A_i \vee B_i$$

Bit (i)	A_i	B_i	$G_i = A_i \cdot B_i$	$P_i = A_i \vee B_i$
0	1	1	$1 \cdot 1 = 1$	$1 \vee 1 = 1$
1	1	0	$1 \cdot 0 = 0$	$1 \vee 0 = 1$
2	0	1	$0 \cdot 1 = 0$	$0 \vee 1 = 1$
3	1	1	$1 \cdot 1 = 1$	$1 \vee 1 = 1$

Step 2: Compute Group Generate ($G_{3:0}$)

Using:

$$G_{3:0} = G_3 \vee (P_3 \wedge (G_2 \vee (P_2 \wedge (G_1 \vee (P_1 \wedge G_0)))))$$

1. Compute $G_1 \vee (P_1 \wedge G_0)$:

$$G_1 \vee (P_1 \wedge G_0) = 0 \vee (1 \wedge 1) = 0 \vee 1 = 1$$

2. Compute $G_2 \vee (P_2 \wedge (G_1 \vee (P_1 \wedge G_0)))$:

$$G_2 \vee (P_2 \wedge (G_1 \vee (P_1 \wedge G_0))) = 0 \vee (1 \wedge 1) = 0 \vee 1 = 1$$

3. Compute $G_3 \vee (P_3 \wedge (G_2 \vee (P_2 \wedge (G_1 \vee (P_1 \wedge G_0)))))$:

$$G_3 \vee (P_3 \wedge (G_2 \vee (P_2 \wedge (G_1 \vee (P_1 \wedge G_0))))) = 1 \vee (1 \wedge 1) = 1 \vee 1 = 1$$

Thus:

$$G_{3:0} = 1$$

Step 3: Compute Group Propagate ($P_{3:0}$)

Using:

$$P_{3:0} = P_3 \wedge P_2 \wedge P_1 \wedge P_0$$

Substitute values:

$$P_{3:0} = 1 \wedge 1 \wedge 1 \wedge 1 = 1$$

Step 4: Compute Final Carry (C_4)

Using:

$$C_4 = G_{3:0} \vee (P_{3:0} \wedge C_0)$$

Substitute values:

$$C_4 = 1 \vee (1 \wedge 0) = 1 \vee 0 = 1$$

Step 5: Compute Intermediate Carries (C_1, C_2, C_3)

Using:

$$C_i = G_{i-1} \vee (P_{i-1} \wedge C_{i-1})$$

1. $C_1 = G_0 \vee (P_0 \wedge C_0) = 1 \vee (1 \wedge 0) = 1 \vee 0 = 1$
2. $C_2 = G_1 \vee (P_1 \wedge C_1) = 0 \vee (1 \wedge 1) = 0 \vee 1 = 1$
3. $C_3 = G_2 \vee (P_2 \wedge C_2) = 0 \vee (1 \wedge 1) = 0 \vee 1 = 1$

Step 6: Compute Sum Bits (S_i)

Using:

$$S_i = A_i \oplus B_i \oplus C_i$$

Bit (i)	A_i	B_i	C_i	$S_i = A_i \oplus B_i \oplus C_i$
0	1	1	0	$1 \oplus 1 \oplus 0 = 0$
1	1	0	1	$1 \oplus 0 \oplus 1 = 0$
2	0	1	1	$0 \oplus 1 \oplus 1 = 0$
3	1	1	1	$1 \oplus 1 \oplus 1 = 1$
4 (C_4)	-	-	1	1

Thus, the final sum in **binary** is:

$$S = 11000$$

S=24 in decimal