

# COL215L: Digital Logic & System Design

## Lecture 13: Binary Arithmetic (Cont.)



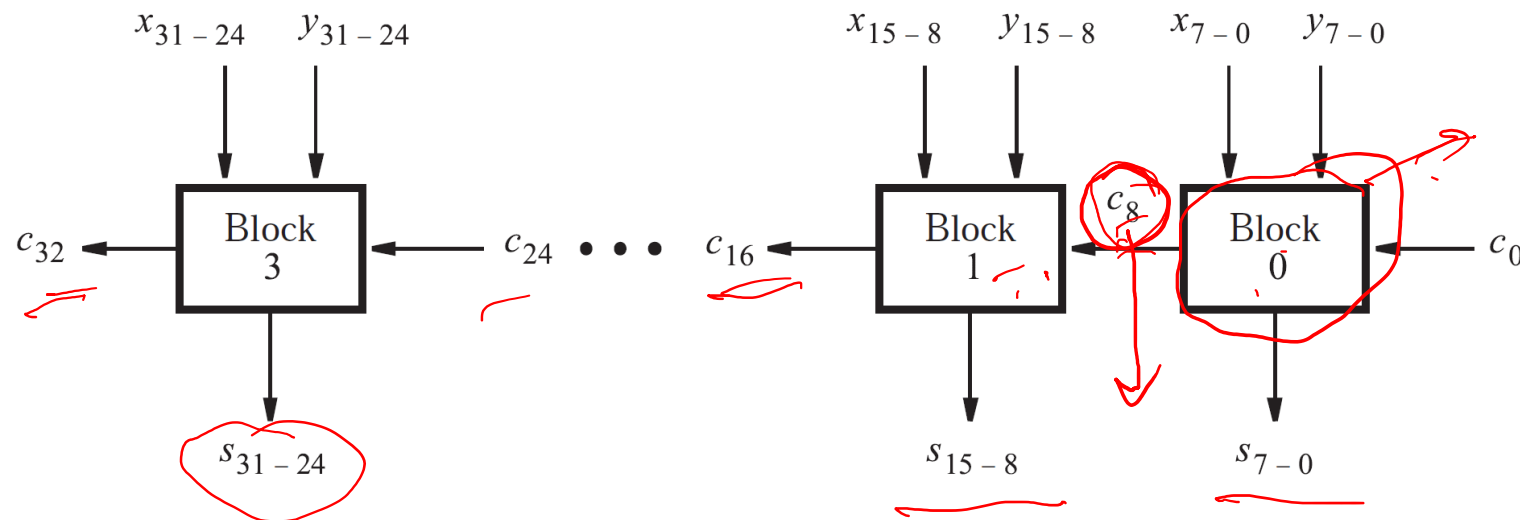
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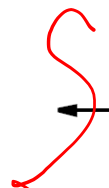
# Hierarchical Design

- 32-bit adder
  - 4 blocks of 8-bit adders with ripple-carry between blocks



$\rightarrow$

- 4 blocks of



$$C_2 = g_1 + p_1(g_0 + p_0 g) \\ = g_1 + p_1 g_0 + p_1 p_0 g$$

$$P_2 \cdot P_6 \dots P_{2k}$$

5 gates

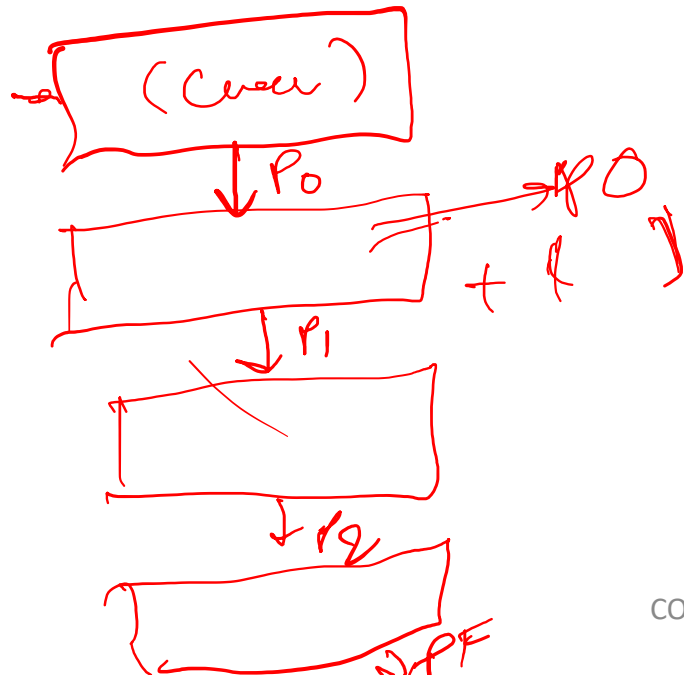
# Array Multiplication of Unsigned Numbers

- Example: Multiply a number B by 2

$$\begin{array}{r} 1110 \times 2 \\ \hline 14 \times 2 = 28 \end{array}$$

Handwritten notes show the binary multiplication of 1110 by 2, resulting in 11100. The multiplier 2 is circled, and the result 11100 is also circled. Arrows indicate the shift of the multiplicand to the left.

- Example: Multiply 11 and 14



Multiplicand M (11)  
Multiplier Q (14)

Partial product 0 → P0

Partial product 1 → P1

Partial product 2 → P2

Product PF (154)

$$\begin{array}{r} 1110 \\ + 1110 \\ \hline 101010 \\ + 0000 \\ \hline 01010 \\ + 1110 \\ \hline 10011010 \end{array}$$

Handwritten notes show the binary multiplication of 11 (11) and 14 (14). The multiplicand 1110 and multiplier 1011 are circled. The partial products are shown as 1110, 101010, and 01010. The final product is 10011010. Arrows indicate the shift of the partial products. The LSB is marked at the bottom right.