COL215L: Digital Logic & System Design

Lecture 12: Binary Arithmetic (Cont.)

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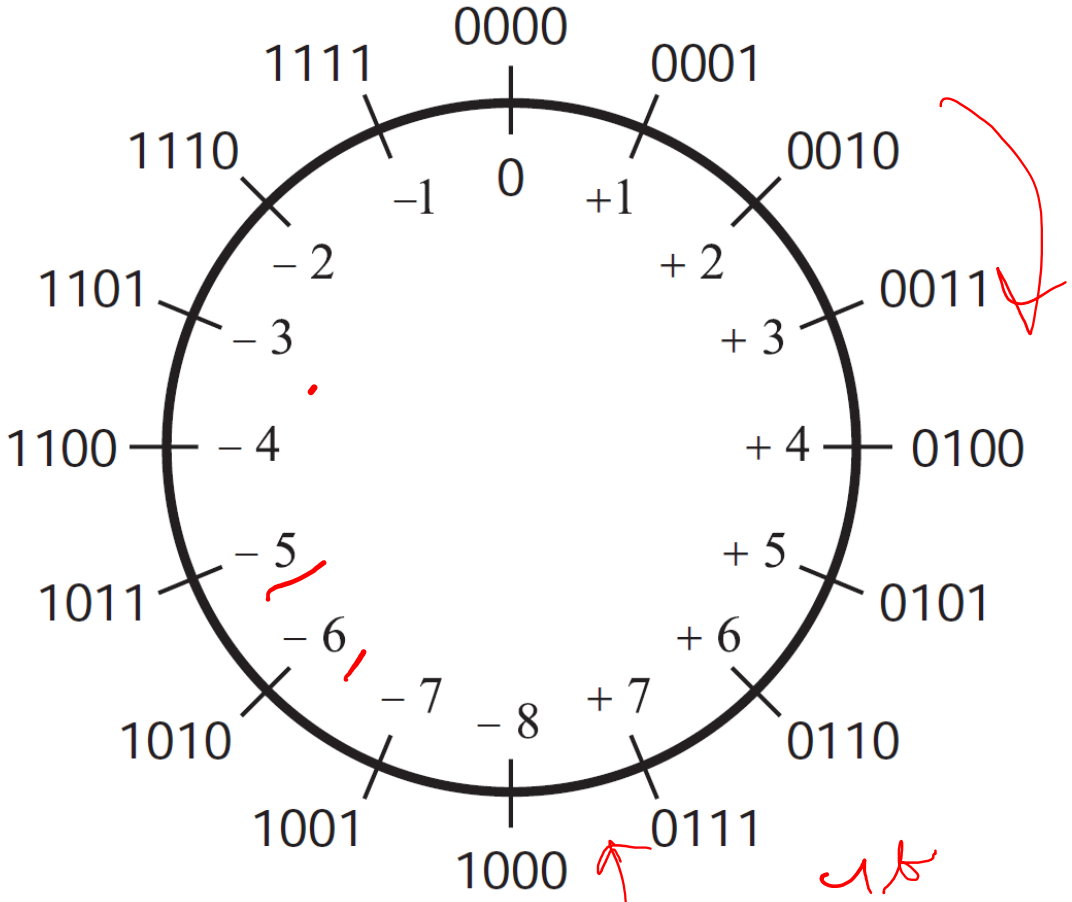
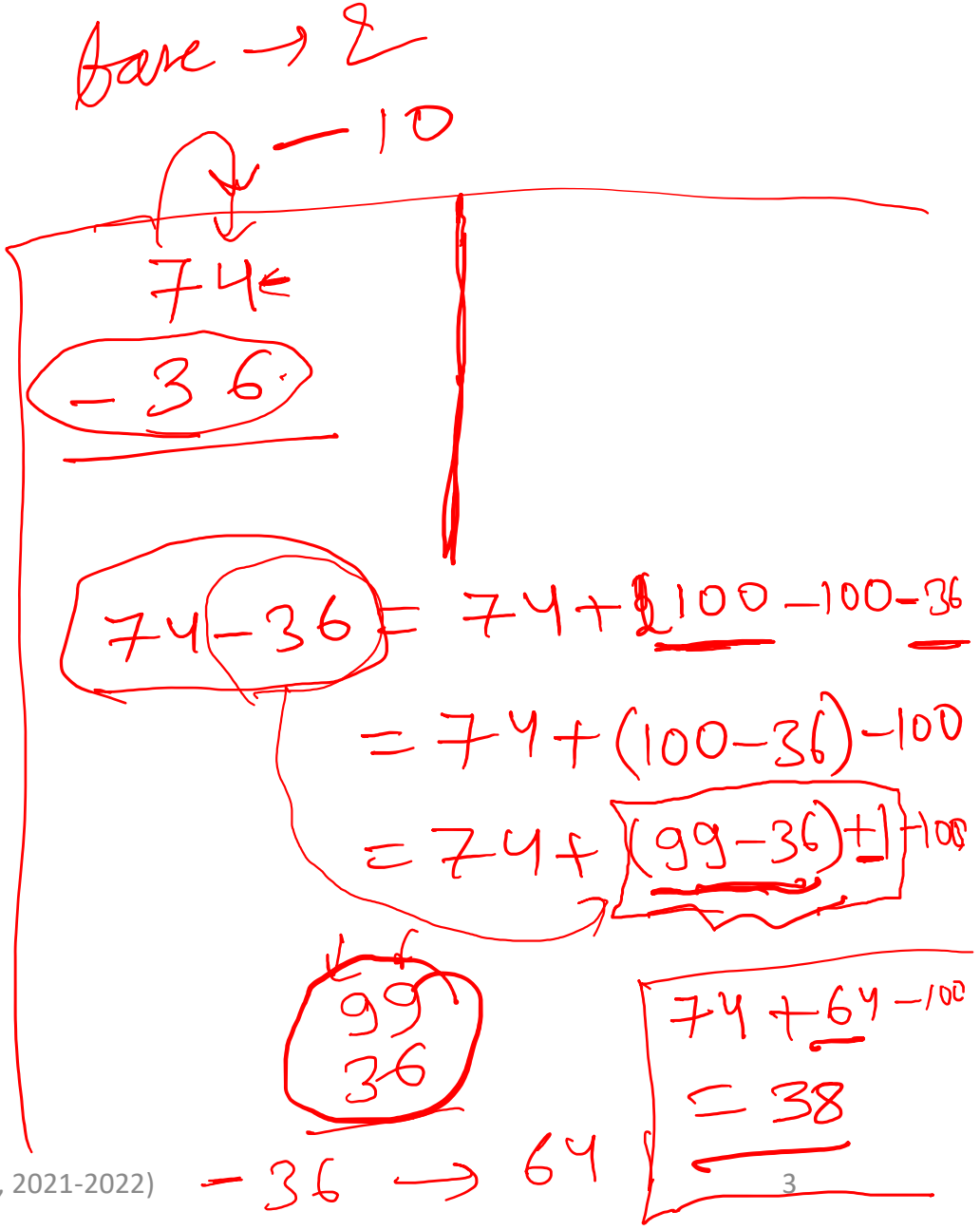
2's Complement Addition/Subtraction

- Circular
- Overflow



Radix Representation

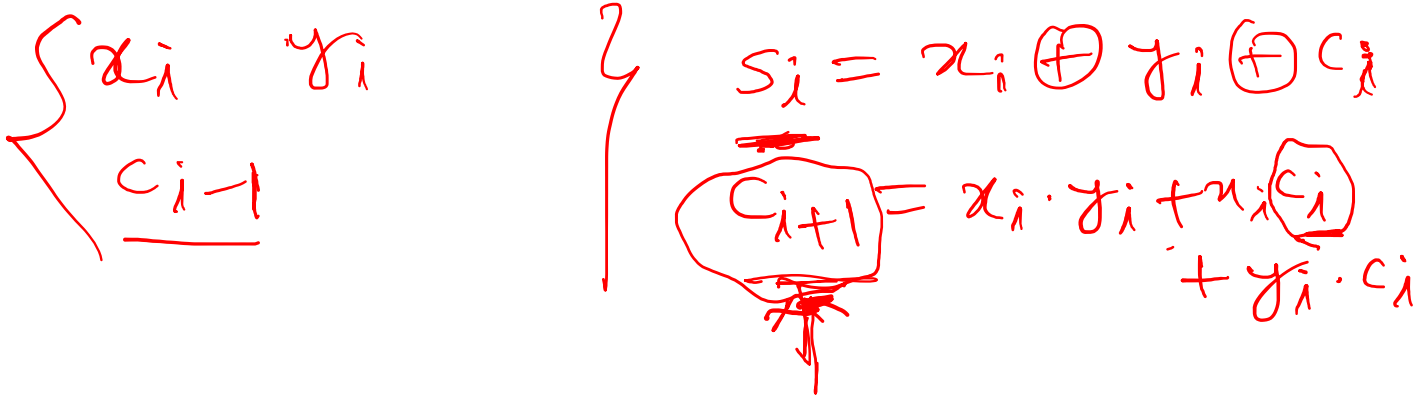
- Radix/base – R
- (R-1)' complement
  - $N = R^n - 1 - P$
- R' complement
  - $N = R^n - P$



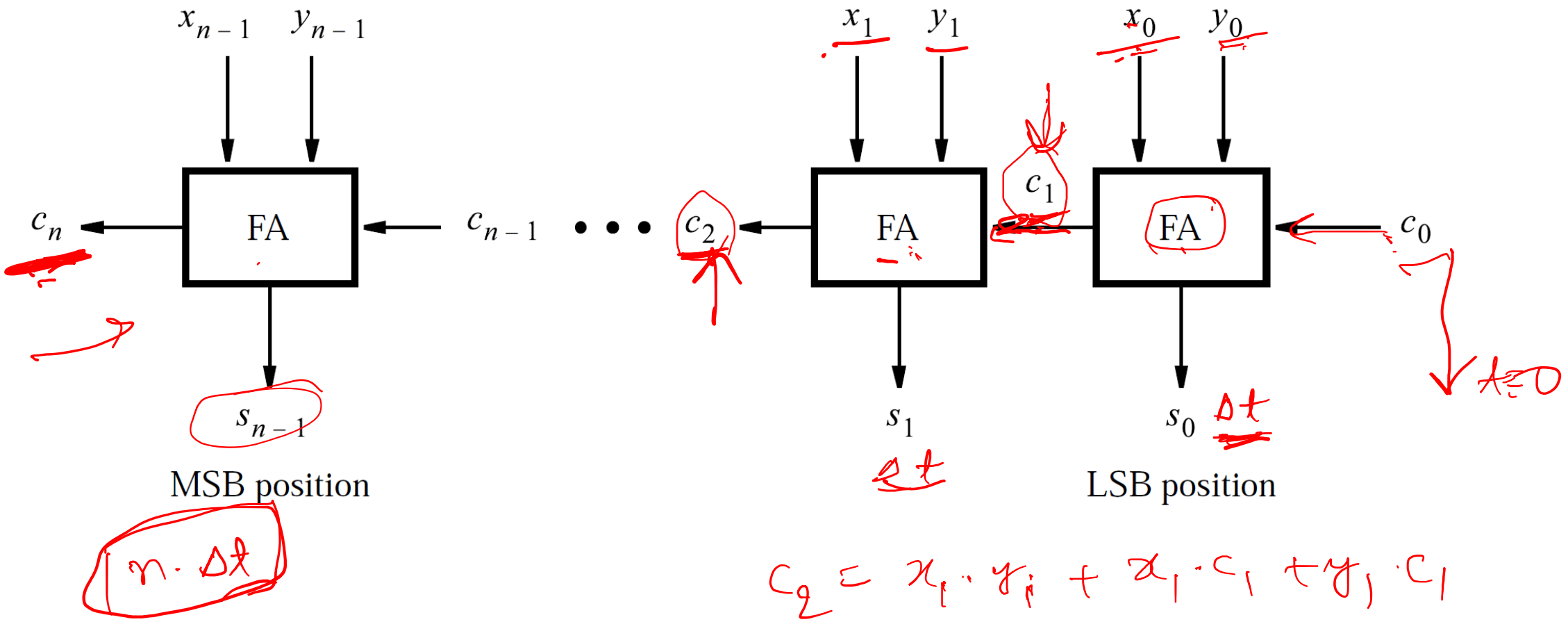
Binary Arithmetic

- Adding 1-bit numbers
  - Half adder
  - Full adder

- Adding N-bit numbers
  - Combination of full adders



Ripple Carry Adder



Carry-Lookahead Adder

- Generate function

$$g_i = x_i \cdot y_i$$

- Propagate function

$$p_i = x_i + y_i$$

$$c_{i+1} = x_i \cdot y_i + x_i c_i + y_i c_i$$

$$= x_i \cdot y_i + (x_i + y_i) \cdot c_i$$

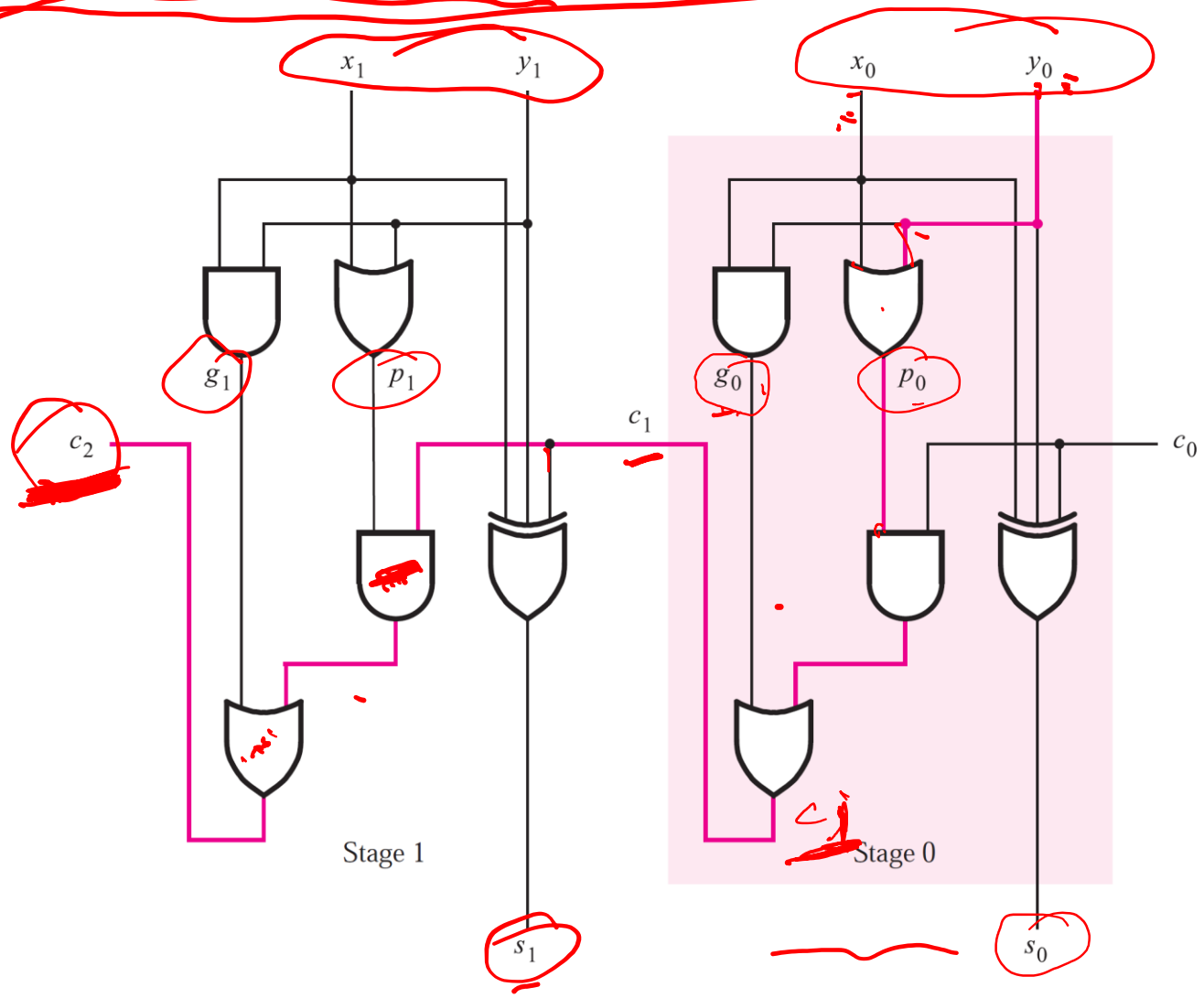
$$\Rightarrow c_{i+1} = g_i + p_i \cdot c_i$$

$$= g_i + p_i (g_{i-1} + p_{i-1} \cdot c_{i-1})$$

$$\Rightarrow c_{i+1} = g_i + p_i \cdot g_{i-1} + p_i \cdot p_{i-1} \cdot g_{i-2}$$

$$- - - - p_1 \cdot p_0 \cdot c_0$$

Ripple Carry Adder Circuit



n - bit

$2n+1$

Carry-Lookahead Adder Circuit