Arithmetic Circuits

Multiplier

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CADSL

Binary Multiplication (Unsigned)

$1\,0\,0\,0_{two} = 8_{ten}$ — multiplicand

$1\,0\,0\,1_{two} = 9_{ten}$ — multiplier

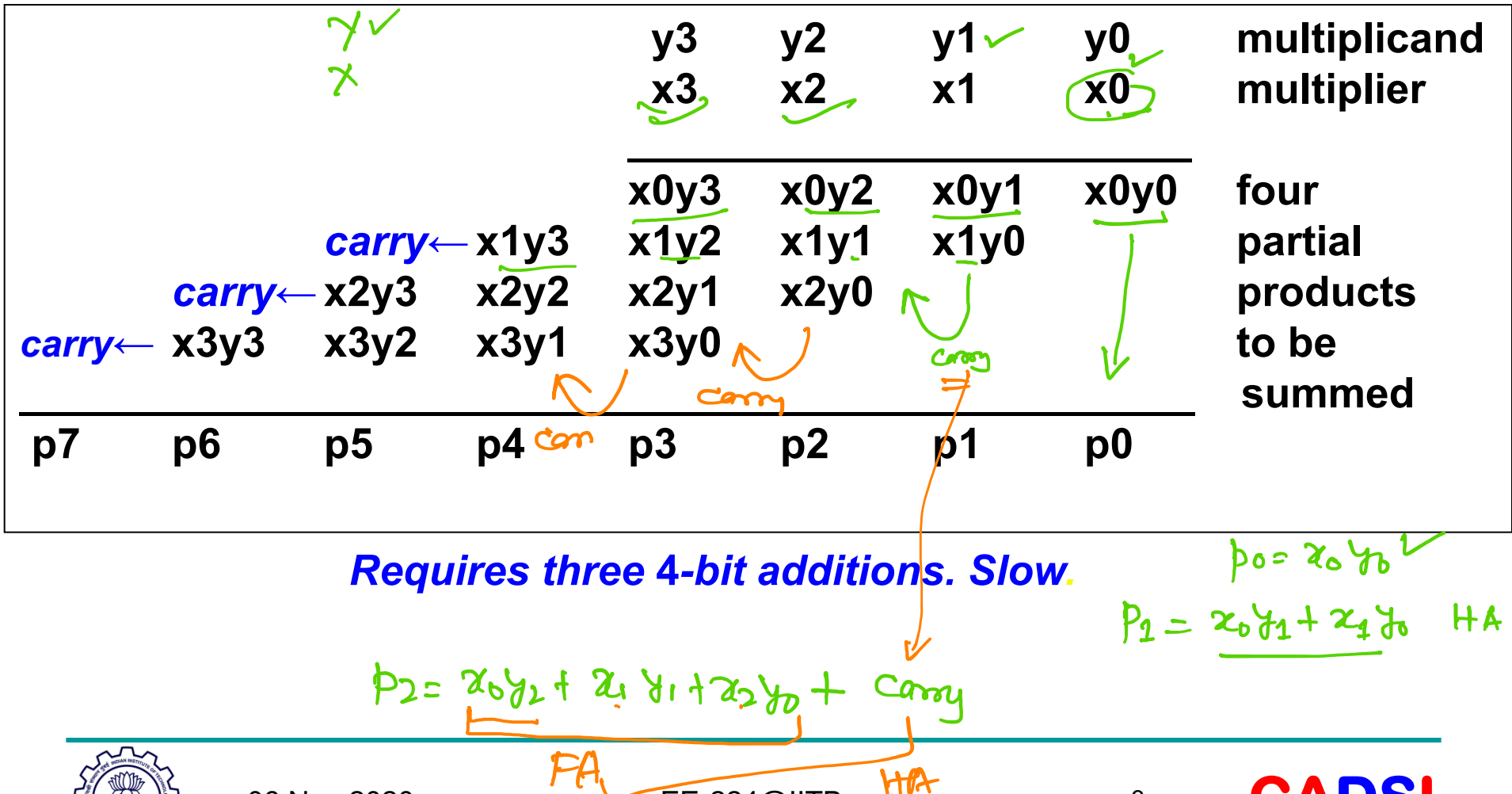
```
    1 0 0 0
  0 0 0 0
0 0 0 0
1 0 0 0
-----------
1 0 0 1 0 0 0
```

$= 72_{ten}$

partial products

Basic algorithm: For n = 1, 32, only If *n*th bit of multiplier is 1, then add multiplicand × 2^{n-1} to product

Adding Partial Products



$$p_3 = x_0 y_3 + x_1 y_2 + x_2 y_1 + x_3 y_0 + \text{Carry}$$

FA

FA

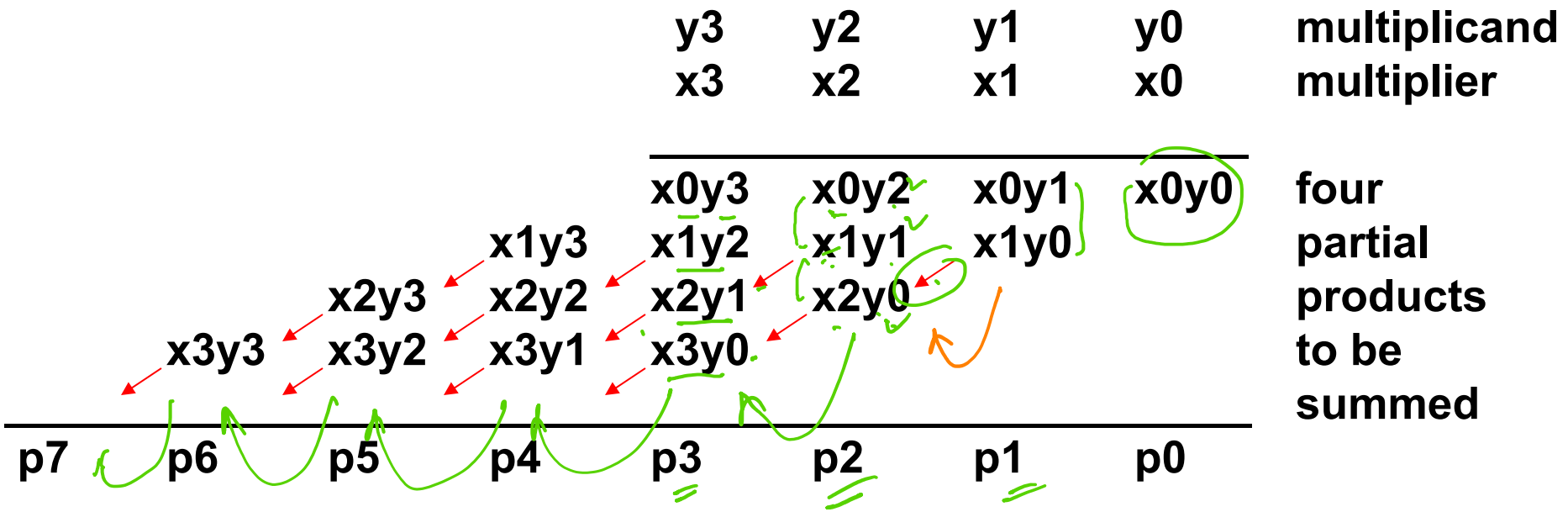
$$p_4 = x_1 y_3 + x_2 y_2 + x_3 y_1 + \text{Carry}$$

FA

HA

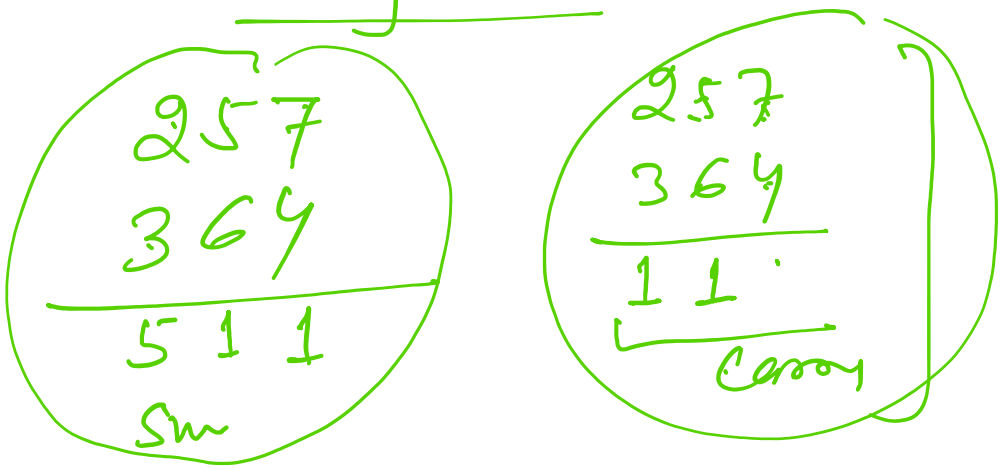
Gates

Array Multiplier: Carry Forward



Note: Carry is added to the next partial product (carry-save addition). Adding the carry from the final stage needs an extra (ripple-carry stage. These additions are faster but we need four stages.

Carry Save Adder



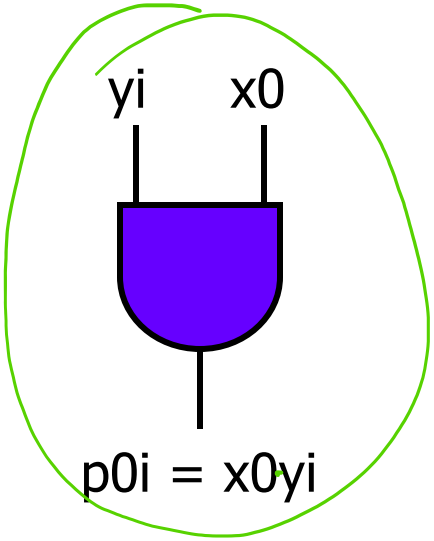
511

110

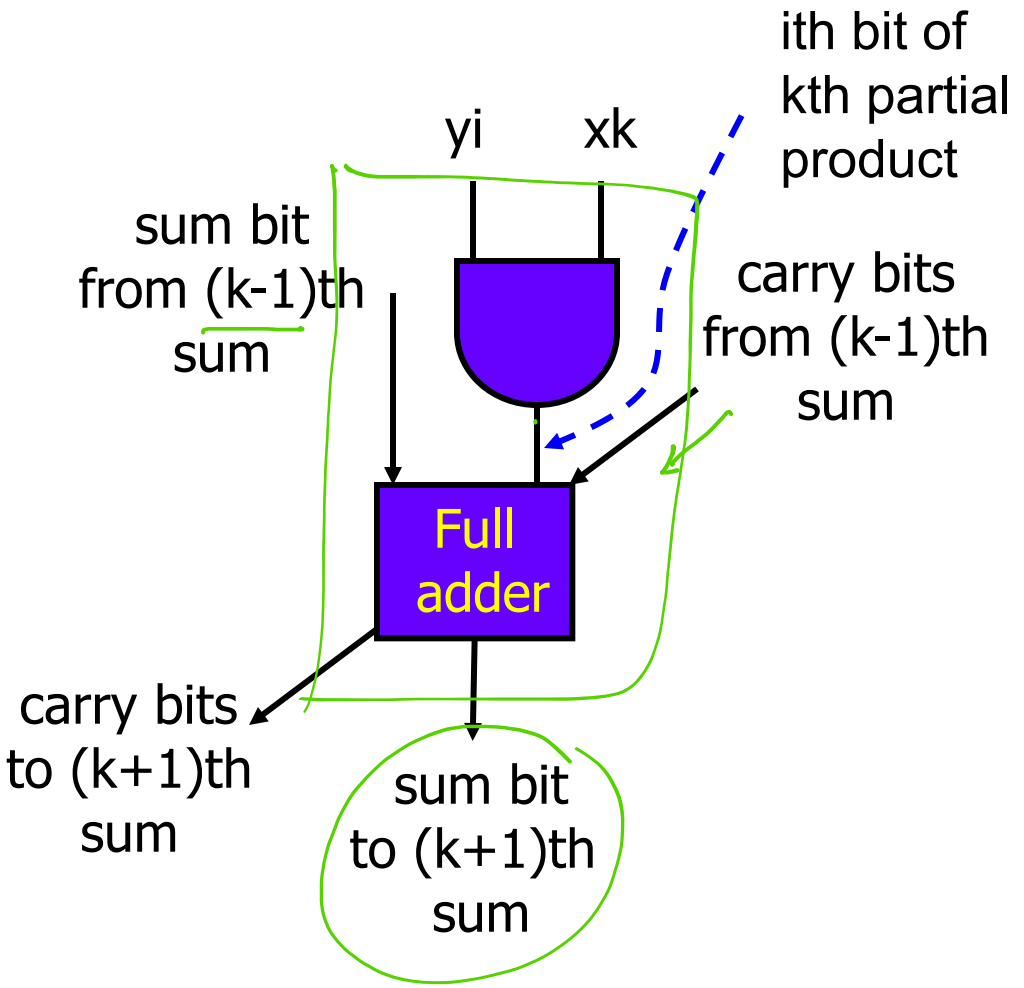
Addition 621

Basic Building Blocks

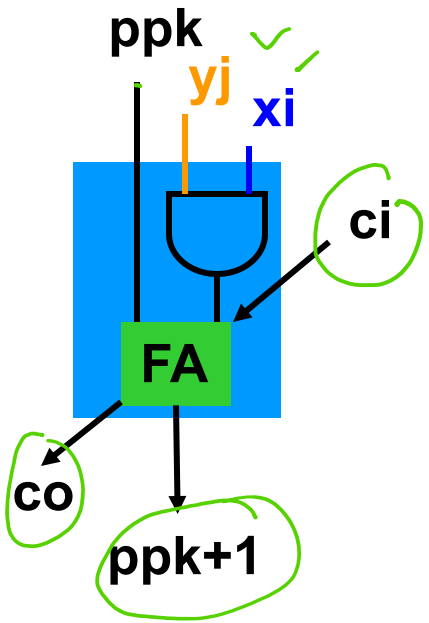
- Two-input AND
- Full-adder



0th partial product



Array Multiplier



Thank You