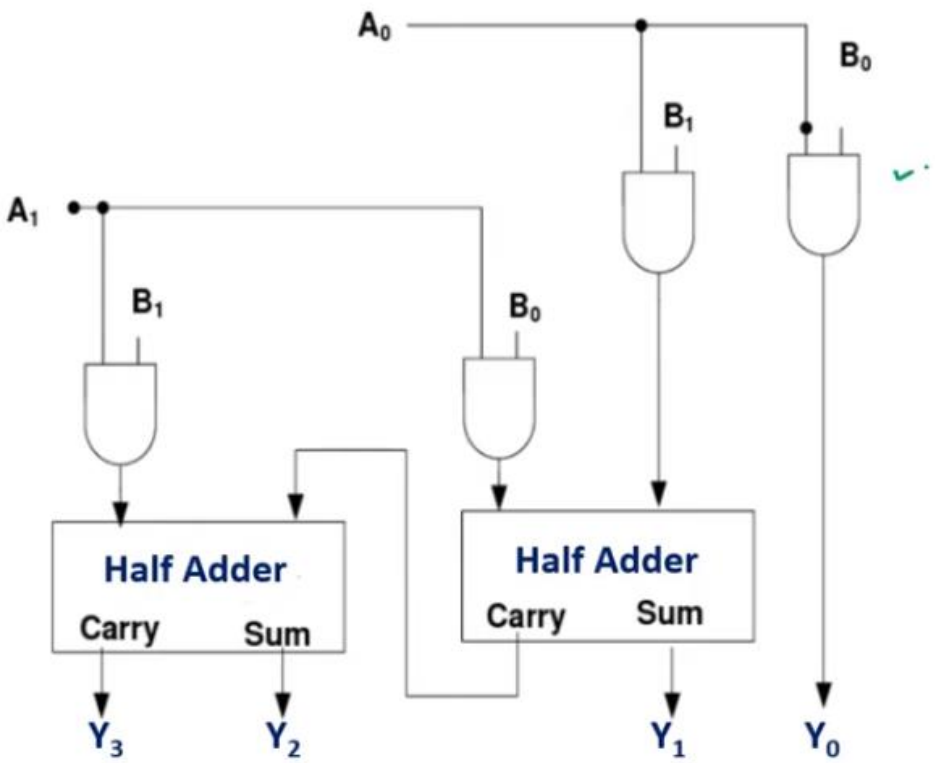
Array Multiplier

Array Multiplier

- **Multiplication** of **two binary numbers** can be performed with one microoperation by a **combinational circuit** which forms product bits all at once
- It is a **fast way of multiplying** two numbers since all it takes is the time for the signals to propagate through the gates that form the multiplication array

- An array multiplier is a **digital combinational circuit** used for **multiplying two binary numbers** by employing an **array of full adders** and **half adders**
- This array is **used** for the nearly simultaneous addition of the various product terms involved

Array Multiplier



2-bit by 2-bit Array Multiplier

- Array multiplier is **well known** due to its regular structure
- Multiplier circuit is based on **add and shift algorithm**
- Each **partial product** is **generated** by the multiplication of the multiplicand with one multiplier bit
- The **partial product** are **shifted** according to their bit orders and then added
- The **addition** can be **performed** with **normal carry propagate adder**
- N-1 adders are required where N is the multiplier length

$B_1 B_0 \times A_1 A_0$

$A_0B_1 \quad A_0B_0$

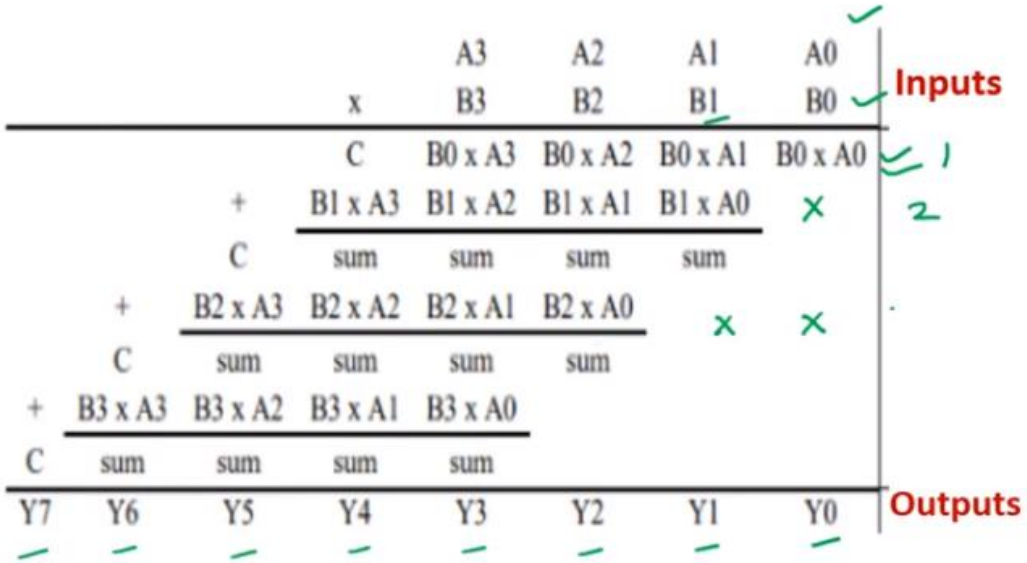
$A_1B_1 \quad A_1B_0 \quad \times$

$Y_3 \quad Y_2 \quad Y_1 \quad Y_0$

AND

(1)

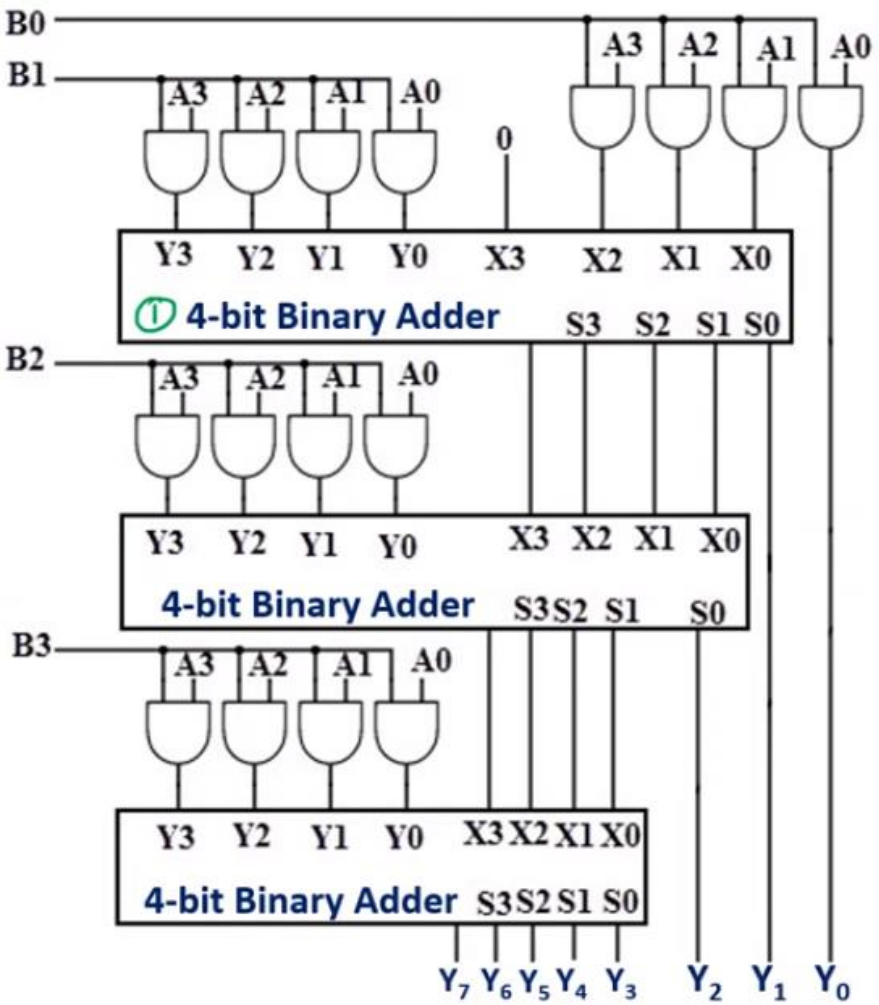
Array Multiplier



An example of 4-bit by 4-bit Array Multiplier

- These partial products are then added by using **4 bit parallel adder**
- The **three most significant bits** of first partial product with carry (considered as zero) are added with second partial term in the first full adder
- Then the result is added to the next partial product with carry out and it goes on till the final partial product
- Finally it produces **8 bit sum** which indicates the **multiplication value of the two binary numbers**

Array Multiplier



An example of 4-bit by 4-bit Array Multiplier

$a = A_3 A_2 A_1 A_0$

$b = B_3 B_2 B_1 B_0$

			A3	A2	A1	A0		Inputs
		x	B3	B2	B1	B0		
		C	B0 x A3	B0 x A2	B0 x A1	B0 x A0		
	+	B1 x A3	B1 x A2	B1 x A1	B1 x A0			
	C	sum	sum	sum	sum			
+	B2 x A3	B2 x A2	B2 x A1	B2 x A0				
C	sum	sum	sum	sum				
+	B3 x A3	B3 x A2	B3 x A1	B3 x A0				
C	sum	sum	sum	sum				
Y7	Y6	Y5	Y4	Y3	Y2	Y1	Y0	Outputs

Practice Problems

Q1. Design 3*3 bit array multiplier.

Q2. Solve 11010101x 10111001 by using Array multiplier.