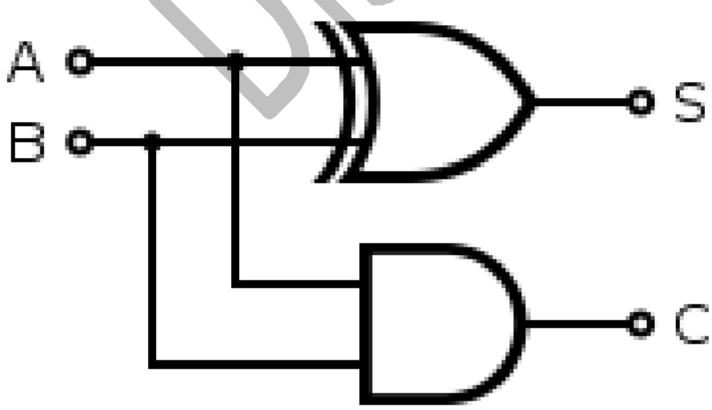
Unit – 3
Adders

ADDERS

- In electronics, an **adder** or **summer** is a digital circuit that performs addition of numbers.
- In modern computers adders reside in the arithmetic logic unit (ALU) where other operations are performed.
- Although adders can be constructed for many numerical representations, such as Binary-coded decimal or excess-3, the most common adders operate on binary numbers.
- In cases where two's complement or one's complement is being used to represent negative numbers, it is trivial to modify an adder into an adder-subtractor.
- Other signed number representations require a more complex adder.

HALF ADDER

- A **half adder** adds two one-bit binary numbers *A* and *B*.
- It has two outputs, *S* and *C* (the value theoretically carried on to the next addition); the final sum is 2*C* + *S*.
- The simplest half-adder design, pictured on the right, incorporates an XOR gate for *S* and an AND gate for *C*.
- Half adders cannot be used compositely, given their incapacity for a carry-in bit.



X_0	Y_0	Z_0	C_1
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

$$\bar{A}B + A\bar{B} = A \oplus B$$

C=AB

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FULL ADDER

- When more than two binary digits are to be added, several half – adders will not be adequate, for the half – adder has no input to handle carries from other digits.

- A **full adder** adds binary numbers and accounts for values carried in as well as out.

- A one-bit full adder adds three one-bit numbers, often written as *A*, *B*, and C_{in}; *A* and *B* are the operands, and C_{in} is a bit carried in (in theory from a past addition). The circuit produces a two-bit output sum typically represented by the signals C_{out} and *S*, where sum = 2 X C_{out} + S.

- The one-bit full adder's truth table is:

$$S = \bar{X}\bar{Y}Ci + \bar{X}Y\bar{Ci} + X\bar{Y}\bar{Ci} + XYCi$$

Input			Output	
X	Y	C_i	S	C_O
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

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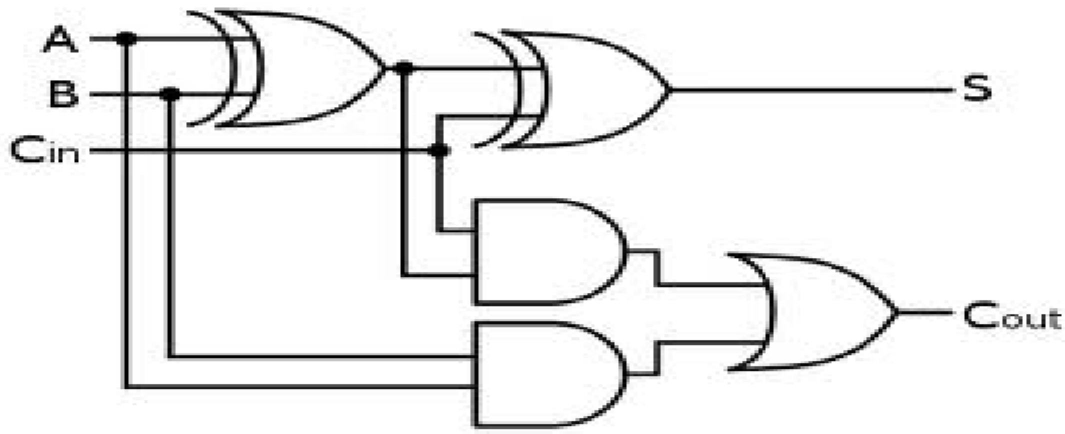
Co = XCi + XY + YCi

Adders



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