Arithmetic Operations on Binary

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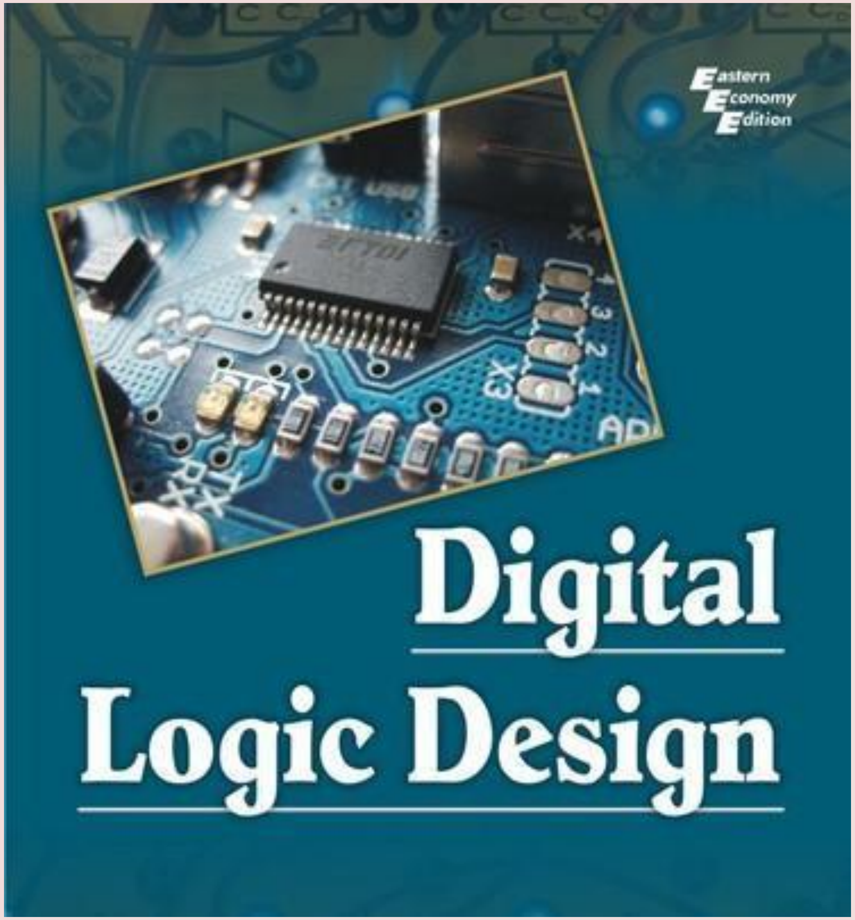


1. Binary Addition

- The four basic rules for adding binary digits (bits) :

0+0=0	Sum of 0 with a carry 0
0+1=1	Sum of 1 with a carry 0
1+0=1	Sum of 1 with a carry 0
1+1=1 0	Sum of 0 with a carry 1

Binary Addition

❖ **Examples:**

110	6	111	7	1111	15
+ 100	+ 4	+ 011	+ 3	+ 1100	+ 12
____	____	____	____	____	____
1010	10	1010	10	11011	27

2. Binary Subtraction

The four basic rules for subtracting are as follows:

0-0=0

1-1=0

1-0=1

0-1=1 it means 0 – 1 with a borrow of 1

Binary Subtraction

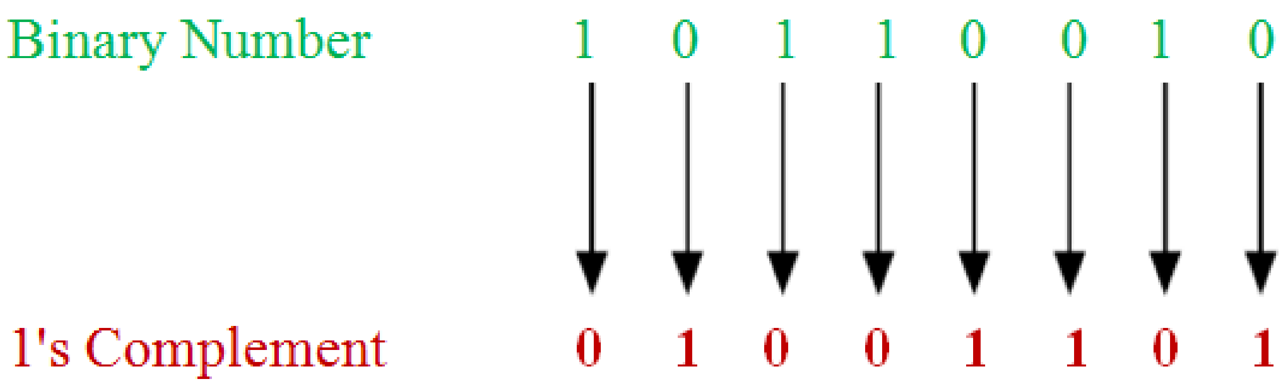
- **Examples:**

$$\begin{array}{r} 11 \\ -\ 01 \\ \hline 10 \end{array} \qquad \begin{array}{r} 3 \\ -\ 1 \\ \hline 2 \end{array} \qquad\qquad \begin{array}{r} 11 \\ -\ 10 \\ \hline 01 \end{array} \qquad \begin{array}{r} 3 \\ -\ 2 \\ \hline 1 \end{array} \qquad\qquad \begin{array}{r} 101 \\ -\ 011 \\ \hline 010 \end{array} \qquad \begin{array}{r} 5 \\ -\ 3 \\ \hline 2 \end{array}$$

$$\begin{array}{r} 110 \\ -\ 101 \\ \hline 001 \end{array} \qquad \begin{array}{r} 6 \\ -\ 5 \\ \hline 1 \end{array} \qquad\qquad \begin{array}{r} 101101 \\ -\ 001110 \\ \hline 011111 \end{array} \qquad \begin{array}{r} 45 \\ -\ 14 \\ \hline 31 \end{array}$$

3. 1's And 2's Complement of Binary Number

- The 1's complement and the 2's complement of binary number are important because they permit the representation of negative numbers.



2's Complement of Binary Number

2's Complement of a binary number is found by adding 1 to the LSB of the 1's Complement.

2's Complement= (1's Complement) +1

Binary number		10110010
1'scomplement		01001101
Add 1	+	1

2's complement		01001110

4. Binary Multiplication

To multiply two numbers, take each digit of the multiplier and multiply it with the multiplicand. This produces a number of partial products which are then added.

$(11001)_2$	$(214)_{10}$	Multiplicand
x $(10101)_2$	x $(152)_{10}$	Multiplier
$(11001)_2$	$(428)_{10}$	Partial products
$(11001)_2$	$(1070)_{10}$	
+ $(11001)_2$	+ $(214)_{10}$	
$(1000001101)_2$	$(32528)_{10}$	Result

```
   0011010   = 26₁₀
  x0001100   = 12₁₀
-----------
   0000000
  0000000
 0011010
0011010
-----------
0100111000   = 312₁₀
```

```
   1011.01
x    110.1
----------
    101101
   0000000
  10110100
 101101000
----------
1001001.001
```

5. Binary Division

Binary Division

Divide the binary number A = 1010_2 by B = 10_2

```
    ____101___
 10) 1010
     10
 ______________
       010
        10
 ______________
         0
```

```
        110
 11 | 10010
      11
     ____
       11
       11
      ____
        00
         0
       ____
         0
```

```
         00010
 111 | 100100.11
    - 0
   ________
      10
    - 0
   ________
      100
    -   0
   ________
      1001
    -  111
    + 1001
   ________
     100100
    -    0
   ________
       1000
```

Thanks …