

## 1.Binary Addition

**Binary addition** is similar as doing everyday **addition** (decimal **addition**). For example: in decimal **addition**, if you add  $8 + 2$  you get ten, which you write as 10; in the sum this gives a digit 0 and a carry of 1.

$$0+0=0$$

$$0+1=1$$

$$1+0=1$$

$$1+1=10 \quad (\text{with carry of } 1)$$

↑  
Carried bit

1 1 1 ← Carried Bits

10101

+ 11

11000

1 1  
1 0 1 0 1

111111

111111

+ 10 111111

10 111101

For Example:

In decimal addition

In binary addition

1

1

+1

+1

2

10

(1 is carried bit)

Binary of 2 is 10

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In decimal term  $1+1+1=3$

In binary term binary of 3 is 11

↑  
Carried bit

$1+1+1+1=4$  (binary of 4 is 100)

$0+1+1+1=3$  (11)

$1+1+1+1+1=5$  (101)

## 2. Binary Subtraction

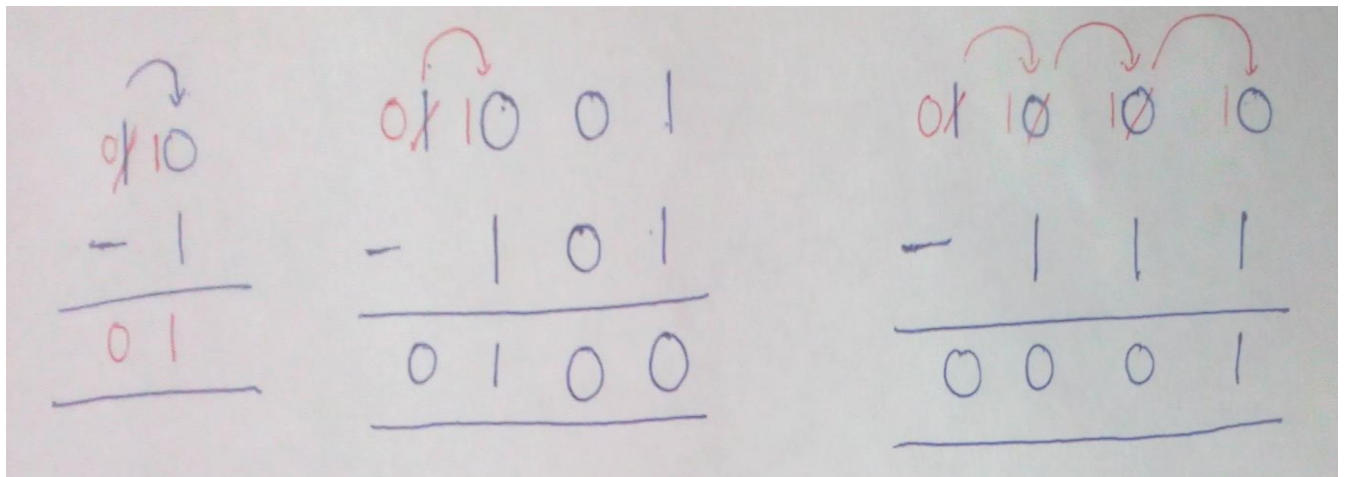
**Binary subtraction** is also similar to that of decimal **subtraction** with the difference that when 1 is subtracted from 0, it is necessary to borrow 1 from the next higher order bit and that bit is reduced by 1 (or 1 is added to the next bit of subtrahend) and the remainder is 1.

$$0-0=0$$

$$1-0=1$$

$$1-1=0$$

$$0-1=1 \quad (\text{with borrow of } 1)$$



### 3. Binary multiplication

Binary multiplication is similar to decimal multiplication and it is similar than decimal multiplication because only 0's and 1's are involved.

$$0 \times 0 = 0$$

$$0 \times 1 = 0$$

$$1 \times 1 = 1$$

$$\begin{array}{r} 110 \\ \times 010 \\ \hline 000 \end{array}$$

$$\begin{array}{r} 110x \\ 000x \\ \hline 01100 \end{array}$$

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## 4. Binary Division

Binary division is similar to decimal division. It is called as the long division procedure.

$$0 \div 1 = 0$$

$$1 \div 1 = 1$$

The image shows handwritten mathematical work on a whiteboard. On the left, a binary long division is performed: the divisor is 101 (labeled 'binary' and '5'), and the dividend is 101001. The quotient is 100, and the remainder is 0. On the right, two divisibility checks are shown: 110 is shown to be divisible by 101 (labeled '5') with a quotient of 6, and 11 is shown to not be divisible by 5 with a quotient of 3.

binary  
5 → 101

$$\begin{array}{r} 101 \\ \overline{) 101001} \\ \underline{-101} \phantom{00} \\ 00101 \\ \underline{-101} \\ 0 \end{array}$$

$2^2 \downarrow 4$   
 $2^1 \downarrow 2$   
 $2^0 \downarrow 1$

110 → 6 ← Divisible by 101 → (5)  
11 → 3 ← Not Divisible by 5 X