**Binary subtractions:**

* **Procedures for Binary Subtraction by 1’s Complement**
* **Procedures for Binary Subtraction by 2’s Complement**
* **Direct subtraction ( if larger sum – smaller num)**

**As direct subtraction can not be done if smaller- larger**

**Procedures for Binary Subtraction by 1’s Complement**

* Write the 1’s complement of the subtrahend
* Then add the 1’s complement subtrahend with the minuend
* If the result has a carryover, then add that carry over in the least significant bit
* If there is no carryover, then take the 1’s complement of the resultant, and it is negative.
* **Question 1:**

(110101)2 – (100101)2

**Solution:**

(1 1 0 1 0 1)2= 5310

(1 0 0 1 0 1)2= 3710 – subtrahend

Now take the 1’s complement of the subtrahend and add with minuend.

1 carry

1 1 0 1 0 1

(+) 0 1 1 0 1 0

0 1 0 0 0 0

Therefore, the solution is 010000

(010000)2= 1610

**Question 2:**

(101011)2 – (111001)2

**Solution:**

Take 1’s complement of the subtrahend

1 1 1

1 0 1 0 1 1

(+) 0 0 0 1 1 0 (1’s complement)

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1 1 0 0 0 1

Now take the 1’s complement of the resultant since it does not carry 1

The resultant becomes 0 0 1 1 1 0

## **Binary Subtraction Using 2's Complement**

To learn how to subtract binary numbers using 2's complement, which is the subtraction of a smaller number from a larger number using 2’s complement subtraction, the following steps are to be followed:

* **Step 1:** Determine the 2’s complement of the smaller number
* **Step 2:** Add this to the larger number.
* **Step 3:** Omit the carry. Note that there is always a carry in this case.

**Subtract** (1010)2 **from** (1111)2 **using 2's complement method.**

* **Step 1:** 2's complement of (1010)2is (0110)2
* **Step 2:** Add (0110)2 to (1111)2

**1 1 1 1**

**+ 0 1 1 0**

1 carry 0 1 0 1

**Omit this carry**

To subtract a larger number from a smaller number using 2’s complement subtraction, the following steps are to be followed:

* **Step 1:** Determine the 2’s complement of the smaller number.
* **Step 2:** Add this to the larger number.
* **Step 3:** There is no carry in this case. The result is in 2’s complement form and is negative.
* **Since if we subtract larger no from smaller one , there will not be carry always( means result will be negative always)**
* **No carry means number is negative**
* **Step 4:** To get an answer in true form, take 2’s complement and change its sign.

**Subtract** (1010)2 **from** (1000)2 **using 2's complement.**

**Ans:**

* **Step 1:** Find the 2's complement of (1010)2 It is (0110)2
* **Step 2:** Add (0110)2 to (1000)2

**decimal**

**1000 8**

**+ 0110 -10**

**11 1 0 -2**

**No carry here means this is negative number so take its 2s complement**

* 1. **10110 – 11010**
  2. **10110-01111**
  3. **1001 - 0100 Ans:** 0101
  4. **0100 – 1011** **Ans:** 1011
  5. **0110 – 0100** **Ans:** 0010
  6. **10110- 11101** **Ans:** 00111
  7. 10010000 – 1111001
  8. 11100111-00010011
  9. 0011010 – 001100

Binary addition

**Rules of Binary Addition**

Binary addition is much easier than the decimal addition when you remember the following tricks or rules. Using these rules, any binary number can be easily added. The four rules of binary addition are:

* 0 + 0 = 0
* 0 + 1 = 1
* 1 + 0 = 1
* 1 + 1 =10

**Procedure for Binary Addition of Numbers:**

       101

(+) 101

* **Step 1:** First consider the 1’s column, and add the one’s column,( 1+1 ) and it gives the result 10 as per the condition of binary addition.
* **Step 2:** Now, leave the 0 in the one’s column and carry the value 1 to the 10’s column.

         1

       101

(+) 101

————–

          0

* **Step 3: Now add 10’s place, 1+( 0 + 0 ) = 1.** So, nothing carries to the 100’s place and leave the value 1 in the 10’s place

         1

       101

(+) 101

————-

        10

* **Step 4:** Now add the 100’s place ( 1 + 1 ) = 10. Leave the value 0 in the 100’s place and carries 1 to the 1000’s place.

         1

       101

(+) 101

————-

      1010

So, the resultant of the addition operation is 1010.

**Binary Addition Table**

The table of adding two binary numbers 0 and 1 is given below:

|  |  |  |
| --- | --- | --- |
| **x** | **y** | **x+y** |
| 0 | 0 | 0 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 0      (where 1 is carried over) |

**Example 1:** 10001 + 11101

**Solution:**

**1**

      1 0 0 0 1

(+) 1 1 1 0 1

———————–

     1 0 1 1 1 0

**Example 2:** 10111 + 110001

**Solution:**

**1 1 1**

            1 0 1 1 1

(+) 1 1 0 0 0 1

———————–

   1 0 0 1 0 0 0