

Binary addition & subtraction Using 2's complement

Class note of Sem3

PaperCC7

Case 1: Addition of the positive number with a negative number when the positive number has a greater magnitude.

Initially find the 2's complement of the given negative number. Sum up with the given positive number. If we get the end-around carry 1 then the number will be a positive number and the carry bit will be discarded and remaining bits are the final result.

Example: 1101 and -1001

1. First, find the 2's complement of the negative number 1001. So, for finding 2's complement, change all 0 to 1 and all 1 to 0 or find the 1's complement of the number 1001. The 1's complement of the number 1001 is 0110, and add 1 to the LSB of the result 0110. So the 2's complement of number 1001 is $0110+1=0111$
2. Add both the numbers, i.e., 1101 and 0111;
 $1101+0111=1\ 0100$
3. By adding both numbers, we get the end-around carry 1. We discard the end-around carry. So, the addition of both numbers is 0100.

Case 2: Adding of the positive value with a negative value when the negative number has a higher magnitude.

Initially, add a positive value with the 2's complement value of the negative number. Here, no end-around carry is found. So, we take the 2's complement of the result to get the final result.

Example: 1101 and -1110

1. First, find the 2's complement of the negative number 1110. So, for finding 2's complement, add 1 to the LSB of its 1's complement value 0001.
 $0001+1=0010$
2. Add both the numbers, i.e., 1101 and 0010;
 $1101+0010= 1111$
3. Find the 2's complement of the result 1110 that is the final result. So, the 2's complement of the result 1110 is 0001, and add a negative sign before the number so that we can identify that it is a negative number.

Case 3: Addition of two negative numbers

In this case, first, find the 2's complement of both the negative numbers, and then we will add both these complement numbers. In this case, we will always get the end-around carry, which will be added to the LSB, and forgetting the final result, we will take the 2's complement of the result.

Note: The resultant is a negative value.

Subtraction using 2's complement

These are the following steps to subtract two binary numbers using 2's complement

- In the first step, find the 2's complement of the subtrahend.
- Add the complement number with the minuend.
- If we get the carry by adding both the numbers, then we discard this carry and the result is positive else take 2's complement of the result which will be negative.

Example 1: $10101 - 00111$

We take 2's complement of subtrahend 00111, which is 11001. Now, sum them. So,

$$10101 + 11001 = 1\ 01110.$$

In the above result, we get the carry bit 1. So we discard this carry bit and remaining is the final result and a positive number.

Example 2: $10101 - 10111$

We take 2's complement of subtrahend 10111, which comes out 01001. Now, we add both of the numbers. So,

$$10101 + 01001 = 11110.$$

In the above result, we didn't get the carry bit. So calculate the 2's complement of the result, i.e., 00010. It is the negative number and the final answer.