Complementary Method of Binary Subtraction:

The direct method of subtraction using borrow concept seems to be easy when people perform subtraction with paper and pencil. However, when subtraction is implemented by means of digital components this method is found to be less efficient than the complementary method of subtraction. There are two complementary method one is by taking 1's complement of subtrahend and other is by taking 2's complement of subtrahend.

Binary Subtraction of Unsigned Binary Number Using 1's Complement:

Unsigned Binary numbers are the numbers which have no signs. If there are two unsigned binary numbers. Then there will be two different cases of subtraction. And each of them is explained below with examples. We will take help of 1's complement to subtract these two binary numbers.

Case One: When Minuend is greater than Subtrahend

We must follow the following given steps to do the binary subtraction of unsigned numbers using 1's compliment.

1. **Find the 1's complement of number subtrahend.**
2. **Add minuend and 1's complement of subtrahend.**
3. **Discard end carry from the sum obtained in second step. The most significant bit of the result of addition is the end carry.**
4. **Finally add 1 to least significant bit and that is the result of subtraction.**

Question: Subtract the unsigned Binary numbers 11100 from 11010 using 1's complement method.

Step 1: First we are going to find the 1's complement of 11010. 1's Complement of a binary number is obtained by changing 0's to 1's and 1's to 0's. Thus 1's complement of 11010 is 00101.

Step 2: Now adding 11100 and 0010 gives result 100001.

Step 3: Now we will discard the end carry of 100001. Thus 100001 becomes 00001.

Step 4: Finally adding 1 to 00001 gives result 00010. Hence the required value of subtraction is 00010.

Case Two: When Minuend is less than Subtrahend

Following steps are used to get the result of subtraction when minuend is less than subtrahend using 1's complement.

1. **Find out the 1's complement of subtrahend.**
2. **Find the sum of minuend and 1's complement of subtrahend.**
3. **In this case there is no end carry. So the result is 1's complement of the sum obtained in second Step with a negative sign.**

Question: Subtract unsigned Binary number 10010 from unsigned binary number 11000.

Step 1: First we will find 1's complement of subtrahend. 1's complement of 11000 is 00111.

Step 2: Now adding 10010 and 00111 gives result 11001.

Step 3: Now the 1's complement of 11001 is 00110. We will write the number 00110 followed by a negative sign.

Hence the required value of subtraction is – 00110.

Binary Subtraction of Unsigned Binary Number Using 2's Complement:

Rules for Binary subtraction of unsigned Binary number using 2's complement is given below. Here, there will be two cases depending upon the values of minuend and subtrahend.

Case One: When Minuend is greater than Subtrahend

Following steps are used to find the result of subtraction using 2's complement method.

1. **Find out the 2's complement of subtrahend.**
2. **Add minuend and 2's complement of subtrahend.**

Discard end carry from the sum obtained in Step two. After discarding end carry from sum the rest number will be the required value of subtraction.

Question: Subtract 10100 from 01111 using 2's complement method.

Step 1: 2's complement of 01111 is 10001.

Step 2: By adding 10100 and 10001, we get 100101.

Step 3: 100101 becomes 00101 after removing end carry. And hence the required value of subtraction is 00101.

Case Two: When minuend is less than subtrahend

Following steps are used to get the result of subtraction when minuend is less than subtrahend by using 2's complement method.

1. **First we need to find the 2's complement of subtrahend.**

2. **Now we have to add minuend and 2's complement of subtrahend.**
3. **Since there would be no end carry, therefore the result is the 2's complement of the sum with a negative sign.**

Question : Subtract the binary number 00101 from 10001.

Step 1: 2's complement of 10001 is 01111.

Step 2: By adding 00101 and 01111. It gives 10100.

Step 3: So the required answer is 2's complement of 10100 with a negative sign. Hence the required answer is – 01100.

Binary Subtraction of Signed Binary Number Using 2's Complement:

A signed number is written either with a positive or negative sign. There will be two cases of subtraction depending upon the numbers.

Case One: When minuend is greater than subtrahend

Following steps are used to subtract a signed Binary number from another signed Binary number.

1. **Represent the given numbers into signed form.**
2. **Find the 2's complement of subtrahend.**
3. **Find the sum of minuend and 2's complement of subtrahend.**
4. **Discard end carry from the number obtained in Step three.**
5. **After discarding end carry the most significant bit of the rest number is used to present plus sing and rest digits make up the number. Thus the final answer is written with a positive sign.**

Question: Subtract signed binary number + 101001 from signed binary number + 011010.

Step 1: Signed representation of Binary Number +101001 is 0101001 and signed representation of + 011010 is 0011010. Zero at most significant bit represent + sign.

Step 2: Now finding 2's complement of 0011010. 2's complement of a Binary number is obtained by changing 1's with 0's and 0's with 1 and then adding 1 to least significant bit. Thus 2's complement of 0011010 is 1100110.

Step 3: Now adding 0101001 and 1100110 gives 10001111.

Step 4: Now the End carry from the sum obtained in third step is removed.

Step 5: Therefore the result is 0001111 or + 001111. The most significant bit 0 of 0001111 will be used to represent plus sign.

Case Two: When minuend is less than subtrahend

Following steps are used to get the result of subtraction of two signed binary numbers when minuend is less than subtrahend by using 2's complement method.

1. **Represent the given numbers in signed binary form.**
2. **Find out the 2's complement of subtrahend.**
3. **Add minuend and Binary number obtained step two.**
4. **In this case there would be no end carry, the required answer will be the 2's complement of the sum except sing bit.**

Question: Subtract +011010 from +101001.

Step 1: Signed representation of + 011010 is 0011010 and + 101001 is 0101001.

Step 2: 2's complement of 0 101001 is 1010111.

Step 3: sum of 0011010 and 1010111 is 1110001.

Step 4: The required answer is 2's complement of 110001 (Sign bit is not included). Hence the required answer is 1001111 or – 001111. Most significant bit 1 represents minus sign.

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