COMPLEMENT OPERATION

In mathematics and computing, the **method of complements** is a technique used to subtract one number from another using only addition of positive numbers. This method was commonly used in mechanical_calculators and is still used in modern computers in order to simplify the subtraction operation and for the logical manipulations. To subtract a number y (the subtrahend) from another number x (the minuend), the radix complement of y is added to x and the initial '1' of the result is discarded. Discarding the initial '1' is especially convenient on calculators or computers that use a fixed number of digits: there is nowhere for it to go so it is simply lost during the calculation.

For any number there are two types of complements.

Base or Radix complement

- 1. For decimal number: 10's complement
- 2. For binary number: 2's complement
- 3. For octal number: 8's complement
- 4. For hexadecimal number: 16's complement

One less than the base complement

- 1. For decimal number: 10's complement
- 2. For decimal number: 1's complement
- 3. For decimal number: 70's complement
- 4. For decimal number: 15's complement

DECIMAL COMPLEMENT

Obtain 9's	s complement of 187	Obtain 10's complement of 187
	9 9 9	9 9 9
	- 1 8 7	- 1 8 7
	8 1 2	8 1 2
Ans: 812		<u>+ 1</u>
		8 1 3 Ans: 813

Subtraction using decimal complement

9's complement method

9's complement of the subtrahend 475:

$$999 - 475 = 524$$
 $5 \quad 5 \quad 4$

$$554 - 475 = 79$$
 Ans.

7 9

b) 475 - 554

9's complement of the subtrahend 554:

$$999 - 554 = 445$$

No carry

- 9's complement of 920 = -79
- Ans.

10's complement method

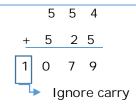
10's complement of the subtrahend 475:

$$999 - 475 = 524 + 1 = 525$$

b) 475 – 554

10's complement of the subtrahend 554:

$$999 - 554 = 445 + 1 = 446$$



Ans: 79

	4	7	5	
+_	4	4	6	
	9	2	1	
	No carry			

$$475 - 554 = - (10's complement of 921)$$

= - (78 + 1) = - 79 **Ans**.

BINARY COMPLEMENT

Obtain 1's complement of 1010₂

1's complement of $1010_2 = 0101_2$

Ans: 0101₂

Obtain 2's complement of 1010₂

1's complement of $1010_2 = 0101_2$

Now 0101 + 1 = 0110_2 is the 2's complement

Ans: 0110₂

Subtraction using binary complement

1's complement method

a) 1101₂ - 1001₂

1's complement of the subtrahend 1001=0110 1 1 0 1

Therefore, $1101_2 - 1001_2 = 100_2$ **Ans**.

b) $1001_2 - 1101_2$

1's complement of the subtrahend 1101 = 0010 1 0 0 1

No carry

Therefore, $1001_2 - 1101_2$

= - (1's complement of 1011)

 $= -0100_2 = -100_2$ Ans.

2's complement method

a) 1101₂ - 1001₂

2's complement of the subtrahend 1001 = 0110+1=0111

Therefore, $1101_2 - 1001_2 = 100_2$ **Ans.**

b) 1001₂ - 1101₂

2's complement of the subtrahend 1101 = 0010+1=0011

No carry

Therefore, $1001_2 - 1101_2$

= - (2's complement of 1100)

 $= -(0011+1) = -100_2$ Ans.

OCTAL COMPLEMENT

Obtain 7's complement of 467₈

Obtain 8's complement of 467₈

Ans: 310₈

Ans: 311₈

Subtraction using binary complement

7's complement method

7's complement of the subtrahend 467

Therefore, $764_8 - 467_8 = 275_8$ **Ans.**

b) 467 - 764

7's complement of the subtrahend 746

No carry

Therefore, $467_8 - 764_8$ = - (7's complement of 502) = -275₈ **Ans**.

8's complement method

8's complement of the subtrahend 467

Therefore, $764_8 - 467_8 = 275_8$ **Ans.**

b) 467 - 764

8's complement of the subtrahend 746

No carry

Therefore,
$$467_8 - 764_8$$

= - (8's complement of 503)
= - (274+1) = - 275₈**Ans**.

HEXADECIMAL COMPLEMENT

Obtain 15's complement of 7CA₁₆

Obtain 16's complement of 7CA₁₆

Ans: 835₁₆

Ans: 836₈

Subtraction using binary complement

15's complement method

a)
$$8AB_{16} - 7CA_{16}$$

15's complement of the subtrahend 7CA = 835

Therefore, $8AB_{16} - 7CA_{16} = E1_{16}$ Ans.

b) $7CA_{16} - 8AB_{16}$

15's complement of the subtrahend 8AB =

No carry

Therefore, $7CA_{16} - 8AB_{16} =$

- $(15' \text{ complement of F1E}) = - \text{E1}_{16} \text{ Ans.}$

16's complement method

a)
$$8AB_{16} - 7CA_{16}$$

16's complement of the subtrahend 7CA =

$$835 + 1 = 836$$

Therefore, $8AB_{16} - 7CA_{16} = E1_{16}$ Ans.

b) $7CA_{16} - 8AB_{16}$

15's complement of the subtrahend 8AB =

$$754 + 1 = 755$$

No carry

Therefore, $7CA_{16} - 8AB_{16} =$

- $(16' \text{ complement of F1F}) = - (E0=1)_{16}$

=- E1₁₆ Ans.