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 complement of 187

```
  9  9  9
- 1  8  7
-------
  8  1  2
```

Ans: 812

Obtain 10's complement of 187

```
  9  9  9
- 1  8  7
-------
  8  1  2
+        1
-------
  8  1  3
```

Ans: 813

Subtraction using decimal complement

9's complement method

a) 554 – 475

9's complement of the subtrahend 475:

999 – 475 = 524

```
    5  5  4
+   5  2  4
-------
1   0  7  8
      +  1
-------
      7  9
```

554 – 475 = 79 **Ans.**

b) 475 – 554

9's complement of the subtrahend 554:

999 – 554 = 445

```
    4  7  5
+   4  4  5
-------
    9  2  0
```

No carry

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

10's complement method

a) 554 – 475

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

5 5 4 + 5 2 5 1 0 7 9 Ignore carry **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 1010 $_2$ 1's complement of 1010_2 = 0101_2 **Ans: 0101_2**	**Obtain 2's complement of 1010_2** 1's complement of 1010_2= 0101_2 Now 0101 + 1 = 0110_2 is the 2's complement **Ans: 0110_2**
Subtraction using binary complement	
1's complement method **a) $1101_2 - 1001_2$** 1's complement of the subtrahend 1001=0110 1 1 0 1 + 0 1 1 0 1 0 0 1 1 + 1 0 1 0 0 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 + 0 0 1 0 1 0 1 1 No carry Therefore, $1001_2 - 1101_2$ = - (1's complement of 1011) = -0100_2 = -100_2 **Ans.**
2's complement method **a) $1101_2 - 1001_2$** 2's complement of the subtrahend 1001 =0110+1=0111 1 1 0 1 + 0 1 1 1 1 0 1 0 0 Ignore carry Therefore, $1101_2 - 1001_2 = 100_2$ **Ans.**	**b) $1001_2 - 1101_2$** 2's complement of the subtrahend 1101 = 0010+1=0011 1 0 0 1 + 0 0 1 1 1 1 0 0 No carry Therefore, $1001_2 - 1101_2$ = - (2's complement of 1100) = -(0011+1) = -100_2 **Ans.**

OCTAL COMPLEMENT

Obtain 7's complement of 467_8

```
    7  7  7
-   4  6  7
    -------
    3  1  0
```

Ans: 310_8

Obtain 8's complement of 467_8

```
    7  7  7
-   4  6  7
    -------
    3  1  0
+          1
    -------
    3  1  1
```

Ans: 311_8

Subtraction using binary complement

7's complement method

a) 764 – 467

7's complement of the subtrahend 467

= (777-467)=310

```
    7  6  4
+   3  1  0
    -------
 1  2  7  4
    +  1
    -------
    2  7  5
```

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

b) 467 – 764

7's complement of the subtrahend 746

= (777-764)=013

```
    4  6  7
+   0  1  3
    -------
    5  0  2
```

No carry

Therefore, $467_8 - 764_8$

= - (7's complement of 502)

$= -275_8$ **Ans.**

8's complement method

a) 764 – 467

8's complement of the subtrahend 467

= (777-467)=310+1=311

```
    7  6  4
+   3  1  1
    -------
 1  2  7  5
```

Ignore carry

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

b) 467 – 764

8's complement of the subtrahend 746

= (777-764)=013+1=14

```
    4  6  7
+   0  1  4
    -------
    5  0  3
```

No carry

Therefore, $467_8 - 764_8$

= - (8's complement of 503)

= - (274+1) = -275_8 **Ans.**

HEXADECIMAL COMPLEMENT

Obtain 15's complement of $7CA_{16}$

```
   15 15 15
 -  7  C  A
   ---------
    8  3  5
```

Ans: 835_{16}

Obtain 16's complement of $7CA_{16}$

```
   15 15 15
 -  7  C  A
   ---------
    8  3  5
 +        1
   ---------
    8  3  6
```

Ans: 836_8

Subtraction using binary complement

15's complement method

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

15's complement of the subtrahend 7CA = 835

```
    8  A  B
 +  8  3  5
   ---------
 1  0  E  0
    ------>
          + 1
   ---------
    0  E  1
```

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

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

15's complement of the subtrahend 8AB =

```
   15 15 15
 -  8  A  B
   ---------
    7  5  4
    7  C  A
 +  7  5  4
   ---------
    F  1  E
```

No carry

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

- (15' complement of F1E) = - $E1_{16}$ **Ans.**

16's complement method

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

16's complement of the subtrahend 7CA =

835+1=836

```
    8  A  B
 +  8  3  6
   ---------
 1  0  E  1
    ------>
    Ignore carry
   ---------
    0  E  1
```

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

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

15's complement of the subtrahend 8AB =

754+1=755

```
    7  C  A
 +  7  5  5
   ---------
    F  1  F
```

No carry

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

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

=- $E1_{16}$ **Ans.**