**1. 1's Complement (Binary):**

* **Definition**: In 1's complement, each bit is inverted (i.e., 0 becomes 1, and 1 becomes 0).
* **Formula**:
  + To find the 1's complement of a binary number, replace all 0s with 1s and all 1s with 0s.

Example:

* + For 10101010, the 1's complement is 01010101.

**2. 2's Complement (Binary):**

* **Definition**: In 2's complement, you first find the 1's complement and then add 1 to the result.
* **Formula**:
  1. Find the 1's complement of the number.
  2. Add 1 to the 1's complement.

Example:

* 1. For 10101010:
     + 1's complement: 01010101
     + Add 1: 0101+1=01100101 + 1 = 0110, so the 2's complement is 01100110.

**3. 9's Complement (Decimal):**

* **Definition**: In 9's complement, each digit of a decimal number is subtracted from 9.
* **Formula**:
  + For a number NN in decimal, the 9's complement is calculated as: 9’s complement of N=9999…−N\text{9's complement of } N = 9999\ldots - N (Subtract each digit from 9).

Example:

* + For 548548, the 9's complement is 451451 because 9−5=49 - 5 = 4, 9−4=59 - 4 = 5, 9−8=19 - 8 = 1.

**4. 10's Complement (Decimal):**

* **Definition**: In 10's complement, first find the 9's complement, then add 1 to the result.
* **Formula**:
  1. Find the 9's complement of the number.
  2. Add 1 to the result.

Example:

* 1. For 548548:
     + 9's complement: 451451
     + Add 1: 451+1=452451 + 1 = 452, so the 10's complement is 452452.

**5. r's Complement (General Formula):**

* **Definition**: The r's complement is used in different bases and is found by subtracting each digit from the base minus 1. For base rr, the formula is:
* **Formula**:

r’s complement of N=(rk−N)wherek is the number of digits.\text{r's complement of } N = (r^k - N) \quad \text{where} \quad k \text{ is the number of digits}.

* + For example, in base 10 (decimal), r=10r = 10, for base 2 (binary), r=2r = 2.

**Summary of Complement Formulas**

| **Complement Type** | **Formula** | **Example** |
| --- | --- | --- |
| **1's Complement** | Flip all bits (0 → 1, 1 → 0) | 10101010 → 01010101 |
| **2's Complement** | 1's complement + 1 | 10101010 → 01100110 |
| **9's Complement** | Subtract each digit from 9 | 548548 → 451451 |
| **10's Complement** | 9's complement + 1 | 548548 → 452452 |
| **r's Complement** | rk−Nr^k - N | Base 10: 9999−548=94519999 - 548 = 9451 |