Number Concepts Practice Problems

Digit Manipulation

1. Reverse digits of an integer (LeetCode: Reverse Integer)
2. Find the sum of digits of a number (Basic Level)
3. Check if a number is a palindrome (LeetCode: Palindrome Number)
4. Rearrange digits to form the largest number (GeeksforGeeks: Largest number from digits)
5. Count the number of digits in an integer (Easy)

Prime Numbers

1. Check if a number is prime (Basic Level)
2. Generate all prime numbers up to N (Sieve of Eratosthenes)
3. Count prime numbers up to a given integer (LeetCode: Count Primes)
4. Find the largest prime factor of a number (Intermediate Level)
5. Check if two numbers are co-prime (GCD = 1)

GCD, LCM, Modular Arithmetic

1. Calculate GCD and LCM of two numbers (GeeksforGeeks)
2. Find modular exponentiation (Codeforces: Exponentiation)
3. Count trailing zeros in N! (GeeksforGeeks: Trailing zeros in factorial)
4. Find modular multiplicative inverse (Advanced Level)
5. Calculate Fibonacci using matrix exponentiation (Medium)

Patterns and Properties

1. Find all divisors of a number (Easy Level)
2. Check if a number is perfect (GeeksforGeeks)
3. Verify Armstrong number (LeetCode: Armstrong Number)
4. Find the sum of divisors of a number (GeeksforGeeks)
5. Generate all permutations of a number’s digits (LeetCode)

Binary Representation

1. Convert a number to binary (Easy)
2. Count set bits in a number (LeetCode: Number of 1 Bits)
3. Check if a number is a power of 2 (LeetCode: Power of Two)
4. Find the XOR of all numbers up to N (Medium)
5. Convert binary to decimal and vice versa (GeeksforGeeks)

Advanced Number Crunching

1. Check if a number is a power of another (Math)
2. Find the nth Fibonacci number (DP: LeetCode)
3. Sum of the first N numbers (Basic Level)
4. Find the cube root of a number using binary search (Advanced)
5. Check for recurring cycles in a fraction (LeetCode: Recurring Decimal)

Miscellaneous

1. Check if a number is a happy number (LeetCode: Happy Number)
2. Find the smallest magic number greater than N (Math-based)
3. Calculate the sum of N natural numbers (Basic)
4. Check if a number is harshad (GeeksforGeeks)
5. Find the product of digits of a number (Easy)

Combinatorics and Permutations

1. Generate all subsets of digits in a number (GeeksforGeeks)
2. Calculate nCr using modular arithmetic (Codeforces)
3. Find the next permutation of a number (LeetCode: Next Permutation)
4. Generate all possible arrangements of a number’s digits (Hard)
5. Find the largest sum of subsets in an array of numbers (Medium)

Problem-Solving Applications

1. Divide a number without using division (LeetCode)
2. Rotate digits of a number (GeeksforGeeks)
3. Find the smallest missing number from a sorted array (Hard)
4. Merge digits to form the smallest possible number (LeetCode)
5. Check if a number is palindrome in base K (Advanced)

Mixed Challenges

1. Find the kth digit of a number raised to a power (Advanced)
2. Check for Hamming Numbers (GeeksforGeeks)
3. Write a program for binary addition (Basic)
4. Implement Karatsuba multiplication (Advanced)
5. Solve the Towers of Hanoi problem for N disks (Algorithm-based)

Topics for Special Number Concepts

1. Divisibility Rules & Divisibility-Based Numbers

- **Harshad Numbers**: Numbers divisible by the sum of their digits.

- **Triperfect Numbers**: Numbers whose divisors sum to three times the number itself.

2. Number Properties

- **Armstrong Numbers (Narcissistic Numbers)**: Numbers equal to the sum of their own digits raised to the power of the number of digits.
- **Perfect Numbers**: Numbers equal to the sum of their proper divisors.
- **Friendly Numbers / Brothered Numbers**: Pairs of numbers for which the sum of the divisors of one number equals the other number.
- **Abundant Numbers**: Numbers whose sum of divisors (excluding the number itself) is greater than the number.

3. Mathematical Sequences & Series

- **Triangular Numbers**: Numbers that can form an equilateral triangle (1, 3, 6, 10,...).
- **Square Numbers**: Numbers that are squares of integers (1, 4, 9, 16,...).
- **Fibonacci Numbers**: Sequence where each number is the sum of the two preceding ones (0, 1, 1, 2, 3,...).

4. Palindrome Numbers

- **Palindrome Numbers**: Numbers that remain the same when reversed.
- **String Numbers**: Numbers represented as strings that could also be palindromes or checked for properties based on their string representation.

5. Prime Numbers & Their Variants

- **Prime Numbers**: Numbers greater than 1 with no divisors other than 1 and itself.
- **Twin Primes**: Pairs of prime numbers that differ by 2 (e.g., 3 and 5, 11 and 13).
- **Cousin Primes**: Pairs of primes that differ by 4 (e.g., 7 and 11).

6. Special Mathematical Properties

- **Armstrong Numbers**: As mentioned above.
- **Perfect Numbers**: As mentioned above.
- **Friendly Numbers**: As mentioned above.

7. Miscellaneous

- **Strong Numbers**: Numbers equal to the sum of the factorials of their digits (e.g., 145).
- **Happy Numbers**: Numbers that eventually reach 1 when replaced by the sum of the square of their digits repeatedly.

1. Divisibility Rules & Divisibility-Based Numbers

- Check if a number is a Harshad number.
- Find all triperfect numbers within a given range.
- Check if a number is divisible by the sum of its digits.

2. Number Properties

- Check if a number is an Armstrong number.
- Find all perfect numbers up to N.
- Check if two numbers are Brothered numbers.
- Check if a number is abundant.
- Determine if a number is a happy number.

3. Mathematical Sequences & Series

- Check if a number is a triangular number.
- Find the Nth Fibonacci number.
- Find all square numbers up to N.

4. Palindrome Numbers

- Check if a number is a palindrome.
- Find the largest palindrome in a list of numbers.

5. Prime Numbers & Their Variants

- Check if a number is prime.
- Find all twin prime pairs up to N.
- Check if a number is a cousin prime.

6. Special Mathematical Properties

- Check if a number is perfect.
- Generate all Armstrong numbers up to N.
- Find if a number is friendly with another.

7. Miscellaneous

- Check if a number is a Strong number.
- Find the sum of squares of digits for a happy number.
- Check if a number is both an Armstrong number and a Harshad number.

Key Notes for Interview Preparation

- **Divisibility-Based Numbers**: Key for solving problems related to divisibility rules and number properties.
- **Number Properties**: Often asked in interviews to test understanding of unique mathematical properties.
- **Prime Number Variants**: A fundamental concept with various problem types, especially around number theory.
- **Special Mathematical Properties**: Some unique number types like Armstrong numbers, Brothered numbers, etc., might be tested in puzzles or algorithm questions.