Decimal Number System

Decimal number system is the number system that we use in our day to day life. The decimal number system has its base as 10 i.e any number in the decimal number system is represented using the digits 0-9. Eg. 678.

Binary Number System

Computers understand the language of 0s and 1s that is binary language. The base of the binary number system is 2 i.e only 0 and 1 are used to represent any number in the binary number system. Eg. 10011.

Conversion

We can represent a number in decimal system as

			1	5	2
<= So on	10000 (10^4)	1000 (10^3)	100 (10^2)	10 (10^1)	1 (10^0)

Above, we have tried to represent number 152.
152 can be written as
152 = 1*100 + 5*10 + 2*1
152 = $1*10^2 + 5*10^1 + 2*10^0$

The powers of 10(the number system's base) go on increasing by a factor of 1 as we move towards the most significant decimal digit.

Convert a Number from Binary to Decimal

A similar pattern is observed in the binary number system, suppose we have a number 1101 in the binary number system.

		1	1	0	1
<= So on	16 (2^4)	8 (2^3)	4 (2^2)	2 (2^1)	1 (2^0)

The number that is represented here is

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$1*2^3 + 1*2^2 + 0*2^1 + 1*2^0 = 1*8 + 1*4 + 0*2 + 1*1 = 13$

From here we learn that a number 13 in the decimal number system can be represented as 1101 in the binary system.

It is easy to convert a number from binary to decimal. Now let us see how to convert a decimal number to its corresponding binary.

Convert a Number from Decimal to Binary

Steps:

1. Store the remainder when the number is divided by 2 in a list.
2. Divide the number by 2
3. Repeat the above two steps until the number is greater than zero.
4. Reverse the list to get our number in its binary format.

Problems

Convert the given numbers from Binary to Decimal

1. 10001 (Ans = 17)
2. 11000001 (Ans = 193)
3. 111111111 (Ans = 511)

Convert the given numbers from Decimal to Binary

1. 247 (Ans = 11110111)
2. 148 (Ans = 10010100)
3. 18 (Ans = 10010)

Prime Numbers

Prime numbers are numbers which have only 2 distinct factors i.e 1 and the number itself. Eg. 2,3,5,7,19 etc.

Armstrong Numbers

Armstrong numbers are numbers which have their sum of cube of individual digits equal to the number itself. E.g $153 = 1^3 + 5^3 + 3^3 = 1 + 125 + 27 = 153$.

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Fibonacci Series

Fibonacci series is a series of numbers in which each number is the sum of the two preceding numbers.
Let us define the first two terms of our fibonacci series as a,b then the series would be of the form
a, b, a+b, a+2b, 2a+3b, 3a+5b and so on.

Let's consider a as 0 and b as 1. Then our series would come out to be of the form of
0, 1, 1, 2, 3, 5, 8, 13 and so on.

Factorial

Factorial is defined as the product of all positive integers less than or equal to a given positive integer and denoted by that integer and an exclamation point.

Factorial of a number n is denoted as n!.

E.g 4! = 4 * 3 * 2 * 1 = 24.

Problems

Checking if a number is prime

```cpp
#include <iostream>

using namespace std;

int main() {
   int n;
   cin >> n;

   bool flag = true;
   for (int i = 2; i * i <= n; i++) {
       if (n % i == 0) {
           flag = false;
           break;
       }
   }
```

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```
    if (n <= 1) {
        flag = false;
    }

    if (flag) {
        cout << "Prime\n";
    } else {
        cout << "Not Prime\n";
    }

    return 0;
}
```

Printing all the digits of a positive decimal number from right to left

```
#include <iostream>

using namespace std;

int main() {
    int n;
    cin >> n;

    while (n > 0) {
        int rem = n % 10;
        cout << rem << "\n";
        n = n / 10;
    }

    return 0;
}
```

Checking if a number is Armstrong number

```
#include <iostream>

using namespace std;

int main() {
    int n;
    cin >> n;

    int sum = 0, org_num = n;
    while (n > 0) {
        int rem = n % 10;
```

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```
        sum = sum + rem * rem * rem;
        n = n / 10;
    }

    if (org_num == sum) {
        cout << "Armstrong Number\n";
    } else {
        cout << "Not Armstrong Number\n";
    }

    return 0;
}
```

Calculating the factorial of a number n

```
#include <iostream>

using namespace std;

int main() {
    int n;
    cin >> n;

    int fac = 1;
    for (int i = 1; i <= n; i++) {
        fac = fac * i;
    }

    cout << fac << "\n";
    return 0;
}
```

Printing first n terms of Fibonacci Series with starting terms as 0,1

```
#include <iostream>

using namespace std;

int main() {
    int n;
    cin >> n;

    if (n == 1) {
        cout << "0\n";
    } else if (n == 2) {
        cout << "0 1\n";
```

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```
    } else {
        int curr_f, a = 0, b = 1, i = 3;
        cout << a << " " << b << " ";
        while (i <= n) {
            curr_f = a + b;
            cout << curr_f << " ";
            a = b;
            b = curr_f;
            i++;
        }
        cout << "\n";
    }

    return 0;
}
```

Reversing a Number

E.g Given a number 1879 we need to convert it to 9781.
100020 will be converted to 20001 (Note: We need to remove the trailing zeroes).

```
#include <iostream>

using namespace std;

int main() {
    int n;
    cin >> n;

    int rev_num = 0;

    while (n > 0) {
        int rem = n % 10;
        rev_num = rev_num * 10 + rem;
        n = n / 10;
    }

    cout << rev_num << "\n";

    return 0;
}
```

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