

source:

- forthright48
- Coding Blocks India (I'm yet to watch other videos)

```
#include <bits/stdc++.h>
using namespace std;
using ll = long long;

const int mx = 10000;
bitset<mx> bs;
vector<int> primes;
void sieve(long long upper_bound) {
    bs.set();
    bs[0] = bs[1] = 0;
    primes.push_back(2);
    for(long long i = 3; i <= upper_bound + 1; i += 2) {
        if(bs[i]) {
            for(long long j = i * i; j <= upper_bound + 1; j += 2*i)
                bs[j] = 0;
            primes.push_back((int) i);
        }
    }
}

int eulerPhi ( int n ) {
    int res = n;
    int sqrtn = sqrt ( n );
    for ( int i = 0; i < primes.size() && primes[i] <= sqrtn; i++ ) {
        if ( n % primes[i] == 0 ) {
            while ( n % primes[i] == 0 ) {
                n /= primes[i];
            }
            sqrtn = sqrt ( n );
            res /= primes[i];
            res *= primes[i] - 1;
        }
    }
    if ( n != 1 ) {
        res /= n;
        res *= n - 1;
    }
    return res;
}

int main() {
    sieve(1000);
    cout << eulerPhi(10) << endl;

    return 0;
}
```

### Properties, extensions and related stuff

- **Euler Totient or Phi ( $\Phi$ ) function:** Given an integer  $N$ , how many numbers less than or **equal** to  $N$  are there such that they are coprime to  $N$ ? > A number  $X$  is coprime to  $N$  if  $\gcd(X, N) = 1$  > For example, if  $N = 10$ , then there are 4 numbers, namely 1, 3, 7, 9 which are coprime to 10.
- For  $n > 2$ ,  $\phi(n)$  is always even.
- For any prime  $p$ ,  $\phi(p) = p - 1$

- Sum of integers that are coprime to  $n$  equals to  $\frac{\phi(n) \times n}{2}$ .
- Co-primes doesn't always need to be a prime number as you can see from the previous example 9 is one of the co-primes of 10.
- Euler Phi Extension Theorem: Number of elements  $e$ , such that  $\gcd(e, n) = d$  is equal to  $\phi(\frac{n}{d})$
- **Fermat's Little Theorem:** If  $a$  and  $p$  are coprime and  $p$  is a prime, then  $a^{p-1} \equiv 1 \pmod{p}$
- For any prime  $p$ ,  $\phi(p) = p - 1$

Tables	Are	Cool
col 1 is	left-aligned	\$1600
col 2 is	centered	\$12
col 3 is	right-aligned	\$1