Greatest common Divisor

GCD

a = 4, b = 6

2 X 2
1 X 4
1, 2, 4

3 X 2
1 X 6
1, 2, 3, 6

GCD = 2

a = 7, b = 13

1 X 7
1, 7

1 X 13
1, 13

GCD = 1

Naive solution

1) **Point to know:** we know that GCD of two numbers cannot be greater than minimum of 2 numbers given

Eg: a = 100 b = 200

GCD = 100

As said previously the GCD of two numbers cannot exceed minimum of 2 numbers

a = 10, b = 15

min = 10
min = 9
min = 8
min = 7
min = 6
min = 5

```
int min = Math.min(a,b);   a=10  b=15
while(min>0)
{
    if(a%min==0 && b%min==0)
    {
        break;
    }
    min--;
}
return min;
```

Time complexity

$\Theta(\min(a,b))$

Euclidean Algorithm

Basic Idea:

Let 'b' be smaller than 'a' then gcd can be written as

$$gcd(a, b) = gcd(a-b, b)$$

This approach uses repective subtraction

```
int gcd (int a, int b)
{
    while (a != b)
    {
        if (a > b)
            a = a-b;
        else
            b = b-a;
    }
    return a;
}
```

a = 12 , b = 15

a = 12 , b = 3

a = 9 , b = 3

a = 6 , b = 3

a = 3 , b = 3

optimized Implementation

```
int gcd (int a, int b)
{
    if (b == 0)
        return a;
    else
        return (b, a%b);
}
```

gcd (12, 15)

↳ gcd (15, 12)

↳ gcd (12, 3)

↳ **gcd (3, 0)**