AUGUST 18,2020

# DESIGN AND ANALYSIS OF ALGORITHMS

( QUESTION: 1, GCD USING EUCLID ALGORITHM )
EXERCISE 1

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# 1. The objective of the Experiment

The objective of the experiment is to find GCD (the largest number that divides both of them) of the given two numbers using Euclid's algorithm.

# 2. Solution Code

```
#include <iostream>
using namespace std;

class EuclidA {
    public:
        int a , b;
    EuclidA(){
        cout<<"Enter the values of a and b "<<endl;
        cin>>a>>b;
        cout<<"GCD of "<< a <<" and "<< b <<" is "<< gcd(a, b)<<endl;
    }

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

    EuclidA e;
    return 0;
}
```

## 3. Summary of the program

The Greatest Common Divisor (GCD) of two numbers is the largest number that divides both of them. The recursive Euclid's algorithm computes the GCD by using a pair of positive integers a and b and returning b and a % b till b is zero.

In the above program, gcd() is a recursive function. It has two parameters i.e. a and b. If b is equal to 0, then a is returned to the main() function. Otherwise, the gcd() function recursively calls itself with the values b and a % b. In the main() function, an object of class EuclidA is created and default constructor is called in which values of a and b are requested from the user. Then gcd() function is called and the value of GCD of a and b is displayed.

**Time Complexity** - $O(\log_2 n)$

**Best Case** - O(1)
When the value of b entered by the user is already zero, then gcd of the given two numbers is the value of a.

Eg-
Enter the value of a and b
110 0
GCD of 110 and 0 is 110

**Worst Case** - $O(\log_2 n)$
When both entered numbers are co-prime. A Co-prime number is a set of numbers or integers which have only **1 as their common factor**.
**A maximum number of calls will be there in this case**.

Eg-
Enter the value of a and b
21  22
GCD of 21 and 22 is 1

## 4. Sample Output

Enter the values of a and b
105 30
GCD of 105 and 30 is 15