Practical - 2

Mid Square Method was proposed by Van Neumann. In this method, we have a seed and then the seed is squared and its midterm is fetched as the random number. Consider if we have a seed having N digits we square that number to get a 2N digits number if it doesn't become 2N digits we add zeros before the number to make it 2N digits.

The most common method of generating the random number sequence is known as **the residue method**. Multiply the previous random number by the constant a, add on another constant c, take the modulus by M, and then keep just the fractional part (remainder) as the next random number.

Arithmetic Congruential Method uses 2 seed values to generate random numbers. It is described by formula :
$R_{n+1} = (R_{n-1} + R_n)\text{mod } M$

Code :

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

long long  a[] = { 1, 10, 100, 1000, 10000, 100000, 1000000, 10000000, 100000000 };
int middleSquareNumber(int numb, int dig)
{
    long long int sqn = numb * numb, next_num = 0;
    int trim = (dig / 2);
    sqn = sqn / a[trim];
    for (int i = 0; i < dig; i++)
    {
        next_num += (sqn % (a[trim])) * (a[i]);
        sqn = sqn / 10;
    }
    return next_num;
}
void midsq()
{
   cout<<"Enter the seed value :";
   int seed;
   cin>>seed;
   int dig;
   cout<<"Enter the number of digits :";
   cin>>dig;
   int n;
   cout<<"Enter the number of random numbers you want to generate: ";
   cin>>n;
   cout<<"The random numbers are: ";
   cout<<seed<<", ";
   int ni=seed;
   for(int i=1; i<n; ++i)
   {
        ni = middleSquareNumber(ni,dig);
        cout<<ni<<", ";
   }
```

```cpp
        cout<<"\n";


    }
    void residue()
    {
        int a,c,M,r;
        cout<<"Enter the value of 'a', 'c' and 'M': ";
        cin>>a>>c>>M;
        cout<<"Enter the number of random numbers you want :";
        int n;
        cin>>n;
        cout<<"Enter the first random number: ";
        cin>>r;
        cout<<"The random numbers are: ";
        cout<<r<<", ";
        int rd=r;
        for(int i=1; i<n; ++i)
        {
            r= (a*rd+ c)%M;
            rd=r;
            cout<<r<<", ";
        }
        cout<<"\n";

    }
    void arithmeticCong()
    {

    int n,a,b,m;
    cout<<"Enter the number of random numbers you want to generate :";
    cin>>n;
    cout<<"Enter the seed values: ";
    cin>>a>>b;
    cout<<"Enter the value of M";
    cin>>m;
    int r;
    cout<<"The random numbers generated are :";
    for(int i=0; i<n; ++i)
    {
        r=(a+b)%m;
        b=a;
        a=r;
        cout<<r<<", ";
    }
    cout<<"\n";
    }
    int main()
    {

        int choice;
        do{
        cout<<"Enter the choice of Algorithm for generating random numbers\n1.Mid
    square method\n2.Residue Method\n3.Arithmetic Congruential Method\n4.Exit\n";
        cin>>choice;

        switch(choice)
        {
        case 1: midsq();
            break;
        case 2: residue();
```

```
            break;
        case 3: arithmeticCong();
            break;
        case 4:
            break;
        default:
            cout<<"Wrong choice\n";
            break;
        }
        }while(choice<4);
    }
```

Output: