Assignment 8

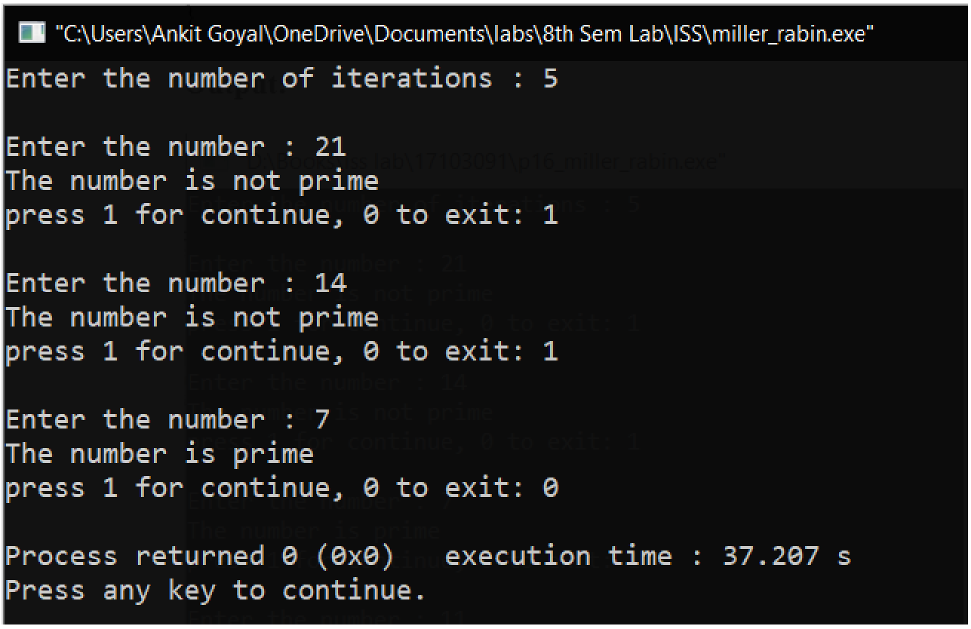
1. Miller–Rabin primality test

Code:

```
#include <bits/stdc++.h>
using namespace std;
int power(int x, unsigned int y, int p)
{
        int res = 1;
        x = x % p;
        while (y > 0)
        {
                if (y & 1)
                        res = (res*x) % p;
                y = y>>1;
                x = (x*x) % p;
        }
        return res;
}
bool miillerTest(int d, int n)
{

        int a = 2 + rand() % (n - 4);
        int x = power(a, d, n);
        if (x == 1 || x == n-1)
        return true;
        while (d != n-1)
        {
                x = (x * x) % n;
                d *= 2;
                if (x == 1)      return false;
                if (x == n-1) return true;
        }
        return false;
}
bool isPrime(int n, int k)
{

        if (n <= 1 || n == 4) return false;
        if (n <= 3) return true;


        int d = n - 1;
        while (d % 2 == 0)
                d /= 2;


        for (int i = 0; i < k; i++)
```

```
                    if (!miillerTest(d, n))
                              return false;
          return true;
}
int main()
{
          int k;
          cout<<"Enter the number of iterations : ";
          cin>>k;
          int t=1;
          while(t)
    {
       cout<<"\nEnter the number : ";
       int n;
       cin>>n;
       if(isPrime(n,k))
          cout<<"The number is prime\n";
       else
          cout<<"The number is not prime\n";
       int x;
       cout<<"press 1 for continue, 0 to exit: ";
       cin>>x;
       t=x;
    }
          return 0;
}
```

Output:


"C:\Users\Ankit Goyal\OneDrive\Documents\labs\8th Sem Lab\ISS\miller_rabin.exe"

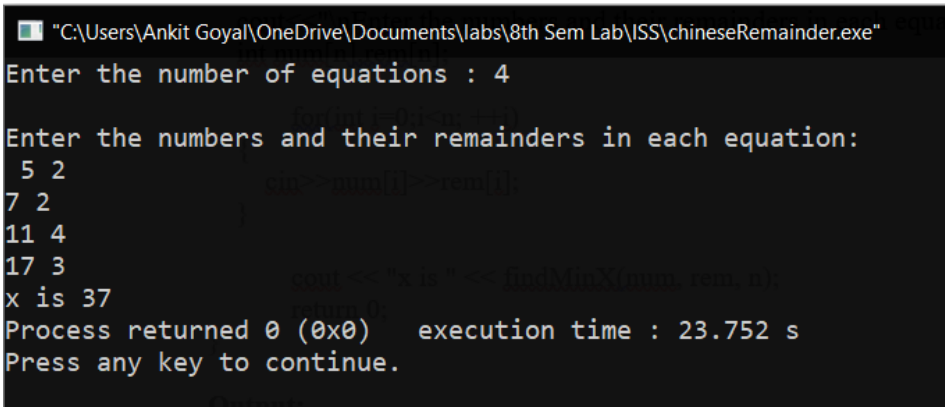
```
Enter the number of iterations : 5

Enter the number : 21
The number is not prime
press 1 for continue, 0 to exit: 1

Enter the number : 14
The number is not prime
press 1 for continue, 0 to exit: 1

Enter the number : 7
The number is prime
press 1 for continue, 0 to exit: 0

Process returned 0 (0x0)   execution time : 37.207 s
Press any key to continue.
```

2. Chinese Remainder Theorem

Code:

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

int inv(int a, int m)
{
	int m0 = m, t, q;
	int x0 = 0, x1 = 1;

	if (m == 1)
		return 0;

	while (a > 1) {
		q = a / m;
		t = m;
		m = a % m, a = t;

		t = x0;

		x0 = x1 - q * x0;

		x1 = t;
	}

	if (x1 < 0)
		x1 += m0;

	return x1;
}

int findMinX(int num[], int rem[], int k)
{
	int prod = 1;
	for (int i = 0; i < k; i++)
		prod *= num[i];

	int result = 0;

	for (int i = 0; i < k; i++) {
		int pp = prod / num[i];
		result += rem[i] * inv(pp, num[i]) * pp;
	}

	return result % prod;
}

int main(void)
{
    int n;
    cout<<"Enter the number of equations : ";
    cin>>n;
    cout<<"\nEnter the numbers and their remainders in each equation:\n ";
    int num[n],rem[n];

        for(int i=0;i<n; ++i)
    {
      cin>>num[i]>>rem[i];
    }

        cout << "x is " << findMinX(num, rem, n);
        return 0;
}
```

Output:


"C:\Users\Ankit Goyal\OneDrive\Documents\labs\8th Sem Lab\ISS\chineseRemainder.exe"

```
Enter the number of equations : 4

Enter the numbers and their remainders in each equation:
 5 2
7 2
11 4
17 3
x is 37
Process returned 0 (0x0)   execution time : 23.752 s
Press any key to continue.
```