Lab 2

Number Theory

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1. Problem Statement

1. Prime Number Checker:

Determines if a number is prime using the Sieve of Eratosthenes.

2. Prime Factorization:

Computes the prime factors of a number.

3. GCD and LCM Computation:

- Using the Euclidean algorithm.
- Using prime factorization.

2. Key Data Structures

Array: For the Sieve of Eratosthenes.

HashMap: To store prime factors and their multiplicities for factorization and GCD/LCM computation

3.Sample Runs

1. Prime Number Checker:

```
Operations:
 1. Check Primality
2. Get Prime Factorization
3. Greatest Common Divisor
4. Least Common Multiple
Please Select What You Want: 1
Please Enter Positive Number: 0
Not Prime Number
Do You Want Something (Y):
Y
Operations:
 1. Check Primality
2. Get Prime Factorization
3. Greatest Common Divisor
4. Least Common Multiple
Please Select What You Want: 1
Please Enter Positive Number: 1
Not Prime Number
Do You Want Something (Y):
Y
Operations:
 1. Check Primality
2. Get Prime Factorization
3. Greatest Common Divisor
4. Least Common Multiple
Please Select What You Want: 1
Please Enter Positive Number: 2
Prime Number
Do You Want Something (Y):
Y
Operations:
 1. Check Primality
2. Get Prime Factorization
3. Greatest Common Divisor
4. Least Common Multiple
Please Select What You Want: 1
Please Enter Positive Number: 7
Prime Number
Do You Want Something (Y):
Y
Operations:
 1. Check Primality
2. Get Prime Factorization
3. Greatest Common Divisor
4. Least Common Multiple
Please Select What You Want: 1
Please Enter Positive Number: 12
Not Prime Number
Do You Want Something (Y):
Y
Operations:
 1. Check Primality
2. Get Prime Factorization
3. Greatest Common Divisor
4. Least Common Multiple
Please Select What You Want: 1
Please Enter Positive Number: 35
Not Prime Number
Do You Want Something (Y):
Y
Operations:
 1. Check Primality
2. Get Prime Factorization
3. Greatest Common Divisor
4. Least Common Multiple
Please Select What You Want: 7919
Please Enter a Valid Operation: 1
Please Enter Positive Number: 7919
Prime Number
Do You Want Something (Y):
Y
Operations:
 1. Check Primality
2. Get Prime Factorization
3. Greatest Common Divisor
4. Least Common Multiple
Please Select What You Want: 1
Please Enter Positive Number: 1234
Not Prime Number
Do You Want Something (Y):
Y
Operations:
 1. Check Primality
2. Get Prime Factorization
3. Greatest Common Divisor
4. Least Common Multiple
Please Select What You Want: 1
Please Enter Positive Number: 19
Prime Number
Do You Want Something (Y):
N
```

2. Prime Factorization:

```
Operations:
 1. Check Primality
2. Get Prime Factorization
3. Greatest Common Divisor
4. Least Common Multiple
Please Select What You Want: 2
Please Enter Positive Number: 1
Do You Want Something (Y):
Y
Operations:
 1. Check Primality
2. Get Prime Factorization
3. Greatest Common Divisor
4. Least Common Multiple
Please Select What You Want: 2
Please Enter Positive Number: 2
2 -> 1
Do You Want Something (Y):
Y
Operations:
 1. Check Primality
2. Get Prime Factorization
3. Greatest Common Divisor
4. Least Common Multiple
Please Select What You Want: 2
Please Enter Positive Number: 12
2 -> 2
3 -> 1
Do You Want Something (Y):
Y
Operations:
 1. Check Primality
2. Get Prime Factorization
3. Greatest Common Divisor
4. Least Common Multiple
Please Select What You Want: 2
Please Enter Positive Number: 35
5 -> 1
7 -> 1
Do You Want Something (Y):
Y
Operations:
 1. Check Primality
2. Get Prime Factorization
3. Greatest Common Divisor
4. Least Common Multiple
Please Select What You Want: 2
Please Enter Positive Number: 1234
2 -> 1
617 -> 1
Do You Want Something (Y):
Y
Operations:
 1. Check Primality
2. Get Prime Factorization
3. Greatest Common Divisor
4. Least Common Multiple
Please Select What You Want: 2
Please Enter Positive Number: 1024
2 -> 10
Do You Want Something (Y):
Y
Operations:
 1. Check Primality
2. Get Prime Factorization
3. Greatest Common Divisor
4. Least Common Multiple
Please Select What You Want: 2
Please Enter Positive Number: 88
2 -> 3
11 -> 1
Do You Want Something (Y):
N
```

3. GCD and LCM (Using Euclidean algorithm):

```
Operations:
1. Check Primality
2. Get Prime Factorization
3. Greatest Common Divisor
4. Least Common Multiple
Please Select What You Want: 3
Please Enter Positive Number: 250
Please Enter Positive Number: 640
Euclidean
gcd(250, 640) = 10
By Prime Factorization
gcd(250, 640) = 10
Do You Want Something (Y):
y
Operations:
1. Check Primality
2. Get Prime Factorization
3. Greatest Common Divisor
4. Least Common Multiple
Please Select What You Want: 3
Please Enter Positive Number: 25
Please Enter Positive Number: 60
Euclidean
gcd(25, 60) = 5
By Prime Factorization
gcd(25, 60) = 5
Do You Want Something (Y):
y
Operations:
1. Check Primality
2. Get Prime Factorization
3. Greatest Common Divisor
4. Least Common Multiple
Please Select What You Want: 3
Please Enter Positive Number: 40
Please Enter Positive Number: 41
Euclidean
gcd(40, 41) = 1
By Prime Factorization
gcd(40, 41) = 1
Do You Want Something (Y):
y
Operations:
1. Check Primality
2. Get Prime Factorization
3. Greatest Common Divisor
4. Least Common Multiple
Please Select What You Want: 3
Please Enter Positive Number: 95
Please Enter Positive Number: 1024
Euclidean
gcd(95, 1024) = 1
By Prime Factorization
gcd(95, 1024) = 1
Do You Want Something (Y):
y
Operations:
1. Check Primality
2. Get Prime Factorization
3. Greatest Common Divisor
4. Least Common Multiple
Please Select What You Want: 3
Please Enter Positive Number: 24
Please Enter Positive Number: 80
Euclidean
gcd(24, 80) = 8
By Prime Factorization
gcd(24, 80) = 8
Do You Want Something (Y):
n

Process finished with exit code 0
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4. GCD and LCM (Using prime factorization.):

```
Operations:
1. Check Primality
2. Get Prime Factorization
3. Greatest Common Divisor
4. Least Common Multiple
Please Select What You Want: 4
Please Enter Positive Number: 250
Please Enter Positive Number: 640
Euclidean
lcm(250, 640) = 16000
By Prime Factorization
lcm(250, 640) = 16000
Do You Want Something (Y):
y
Operations:
1. Check Primality
2. Get Prime Factorization
3. Greatest Common Divisor
4. Least Common Multiple
Please Select What You Want: 4
Please Enter Positive Number: 25
Please Enter Positive Number: 60
Euclidean
lcm(25, 60) = 300
By Prime Factorization
lcm(25, 60) = 300
Do You Want Something (Y):
y
Operations:
1. Check Primality
2. Get Prime Factorization
3. Greatest Common Divisor
4. Least Common Multiple
Please Select What You Want: 4
Please Enter Positive Number: 41
Please Enter Positive Number: 40
Euclidean
lcm(41, 40) = 1640
By Prime Factorization
lcm(41, 40) = 1640
Do You Want Something (Y):
y
Operations:
1. Check Primality
2. Get Prime Factorization
3. Greatest Common Divisor
4. Least Common Multiple
Please Select What You Want: 4
Please Enter Positive Number: 1024
Please Enter Positive Number: 95
Euclidean
lcm(1024, 95) = 97280
By Prime Factorization
lcm(1024, 95) = 97280
Do You Want Something (Y):
y
Operations:
1. Check Primality
2. Get Prime Factorization
3. Greatest Common Divisor
4. Least Common Multiple
Please Select What You Want: 4
Please Enter Positive Number: 80
Please Enter Positive Number: 24
Euclidean
lcm(80, 24) = 240
By Prime Factorization
lcm(80, 24) = 240
Do You Want Something (Y):
n

Process finished with exit code 0
```