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):

V

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

3. GCD and LCM (Using Euclidean algorithm):

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3. Greatest Common Divisor
Operations:
1. Check Primality
                                            4. Least Common Multiple
2. Get Prime Factorization
                                            Please Select What You Want: 3
3. Greatest Common Divisor
                                            Please Enter Positive Number: 95
4. Least Common Multiple
                                            Please Enter Positive Number: 1024
Please Select What You Want: 3
                                            Euclidean
Please Enter Positive Number: 250
                                            gcd(95, 1024) = 1
Please Enter Positive Number: 640
                                            By Prime Factorization
Euclidean
                                            gcd(95, 1024) = 1
gcd(250, 640) = 10
                                            Do You Want Something (Y):
By Prime Factorization
gcd(250, 640) = 10
                                            Operations:
Do You Want Something (Y):
                                            1. Check Primality
                                            2. Get Prime Factorization
Operations:
                                            3. Greatest Common Divisor
1. Check Primality
                                            4. Least Common Multiple
2. Get Prime Factorization
                                            Please Select What You Want: 3
3. Greatest Common Divisor
                                            Please Enter Positive Number: 24
4. Least Common Multiple
                                            Please Enter Positive Number: 80
Please Select What You Want: 3
                                            Euclidean
Please Enter Positive Number: 25
                                            gcd(24, 80) = 8
Please Enter Positive Number: 60
                                            By Prime Factorization
Euclidean
                                            gcd(24, 80) = 8
gcd(25, 60) = 5
                                            Do You Want Something (Y):
By Prime Factorization
gcd(25, 60) = 5
Do You Want Something (Y):
                                            Process finished with exit code o
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):
Operations:
1. Check Primality
2. Get Prime Factorization
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4. GCD and LCM (Using prime factorization.):

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