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Contents

§I. Primes

§I.1. Introduction

Primes, prime factorization, and greatest common divisor are fundamental concepts in number theory and play a crucial role in various mathematical and computational applications. In this document, we will explore these concepts and their properties through various theorems and examples. Let's dive into the world of numbers and uncover some intriguing patterns and relationships!

§I.1.1. Lorem Break

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§I.2. Getting Mathy

Theorem I.2.1. (Euler's primes)
Primes are positive integers greater than 1 that have no divisors other than 1 and themselves.

Lemma I.2.1. (Prime Factorization)
Prime factorization is the process of representing a composite number as a product of its prime factors.

Corollary I.2.1. (Fundamental Theorem of Arithmetic)
The Fundamental Theorem of Arithmetic states that every positive integer greater than 1 can be expressed as a unique product of prime numbers.

Problem I.2.1. (Prime Factorization of 84)
Find the prime factorization of the number 84.

Example. (Prime Factorization Example)
Let's find the prime factorization of the number 84 step by step. 84 can be divided by 2 to get 42. 42 can be divided by 2 to get 21. 21 can be divided by 3 to get 7. 7 is a prime number. Therefore, the prime factorization of 84 is $2 \cdot 2 \cdot 3 \cdot 7$.

Definition I.2.1.1. (Greatest Common Divisor (GCD)) The greatest common divisor (GCD) of two or more integers is the largest positive integer that divides each of them without any remainder.

Observation I.2.1.1. (GCD Terminology) The GCD is also known as the greatest common factor (GCF) or highest common divisor (HCD).

Hint. (Finding GCD) To find the GCD of two numbers, find their prime factorizations and identify the common prime factors.

Claim I.2.1.1. (GCD of 36 and 48) The GCD of 36 and 48 is 12.

Proof. (Proof of GCD Claim) Let's prove the claim by finding the prime factorizations of 36 and 48. Prime factorization of 36: $2 \cdot 2 \cdot 3 \cdot 3$ Prime factorization of 48: $2 \cdot 2 \cdot 2 \cdot 2 \cdot 3$ The common prime factors are 2 and 3. Therefore, the GCD of 36 and 48 is $2 \cdot 2 \cdot 3 = 12$. □