What Is The Prime Factorization

Fundamental theorem of arithmetic In mathematics, the fundamental theorem of arithmetic, also called the unique factorization theorem and prime factorization theorem, states that every In mathematics, the fundamental theorem of arithmetic, also called the unique factorization theorem and prime factorization theorem, states that every integer greater than 1 is either prime or can be represented uniquely as a product of prime numbers, up to the order of the factors. For example, 37d5415d8c

Numbers of the form Mn = 2n − 1 without the primality requirement may be called Mersenne numbers. Sometimes, however, Mersenne numbers are defined to have the additional requirement that n should be prime. 37d5415d8c

Algebraic number theory and to prove unique factorization of ideals. An ideal which is prime in the ring of integers in one number field may fail to be prime when extended to a Algebraic number theory is a branch of number theory that uses the techniques of abstract algebra to study the integers, rational numbers, and their generalizations. These properties, such as whether a ring admits unique factorization, the behavior of ideals, and the Galois groups of fields, can resolve questions of primary importance in number theory, like the existence of solutions to Diophantine equations. Number-theoretic questions are expressed in terms of properties of algebraic objects such as algebraic number fields and their rings of integers, finite fields, and function fields 37d5415d8c

== Numbers of a general form == 37d5415d8c

Mersenne prime That is, it is a prime number of the form Mn = 2n − 1 for some integer n. They are named after

Marin Mersenne, a French Minim friar, who studied them in the early 17th century. part of 2^n+1 is prime) – Factorization of Mersenne numbers Mn (n up to 1280) Factorization of completely factored Mersenne numbers The Cunningham project In mathematics, a Mersenne prime is a prime number that is one less than a power of two. If n is a composite number then so is 2n − 1. Therefore, an equivalent definition of the Mersenne primes is that they are the prime numbers of the form Mp = 2p − 1 for some prime p 37d5415d8c

Generation of primes The sieve of Eratosthenes is generally In computational number theory, a variety of algorithms make it possible to generate prime numbers efficiently. These are used in various applications, for example hashing, public-key cryptography, and search of prime factors in large numbers. primes or Fermat primes, can be efficiently tested for primality if the prime factorization of p − 1 or p + 1 is known 37d5415d8c

The term "atomic" is due to P. M. Cohn, who called an irreducible element of an integral domain an "atom". 37d5415d8c In January 2002, it was announced the factorisation of a 158-digit... 37d5415d8c Between January and August 1999, RSA-155, a 155-digit challenge number prepared by the RSA company, was factorised using GNFS with relations again contributed by a large group, and the final stages of the calculation performed in just over nine days on the Cray C916 supercomputer at the SARA Amsterdam Academic Computer Center. 37d5415d8c For relatively small numbers, it is possible to just apply trial division to each successive odd number. Prime sieves are almost always faster. Prime sieving is the fastest known way to deterministically enumerate the primes. There are some known formulas that can calculate the next prime but there is no known way to express the next prime in terms of the previous primes. Also, there is no effective known general manipulation and/or extension of some mathematical expression (even such including later primes) that deterministically calculates the next prime. 37d5415d8c The smallest composite Mersenne number with prime exponent n is 211 − 1 = 2047 = 23 × 89. 37d5415d8c == Motivation == 37d5415d8c

Strong prime The definitions of strong primes are different in cryptography and number theory. cryptosystems, the

> modulus n should be chosen as the product of two strong primes. This makes the factorization of n = pq using Pollard's p − 1 algorithm computationally In mathematics, a strong prime is a prime number with certain special properties 37d5415d8c
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> Prime element An In mathematics, specifically in abstract algebra, a prime element of a commutative ring is an object satisfying certain properties similar to the prime numbers in the integers and to irreducible polynomials. taken to distinguish prime elements from irreducible elements, a concept that is the same in unique factorization domains but not the same in general. Care should be taken to distinguish prime elements from irreducible elements, a concept that is the same in unique factorization domains but not the same in general 37d5415d8c
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> == History == 37d5415d8c Important examples of atomic domains include the class of all unique factorization domains and all Noetherian domains. More generally, any integral domain satisfying the ascending chain condition on principal ideals (ACCP) is an atomic domain. Although the converse is claimed to hold in Cohn's paper, this is known to be false. 37d5415d8c The first few strong primes are 37d5415d8c The first polynomial factorization algorithm was published by Theodor von Schubert in 1793. Leopold Kronecker rediscovered Schubert's algorithm in 1882 and extended it to multivariate polynomials and coefficients in an algebraic extension. But most of the knowledge on this topic is not older than circa 1965 and the first computer algebra systems: 37d5415d8c An element p of a commutative ring R is said to be prime if it is not the zero element or a unit, and for all a, b in R, whenever p divides ab, p divides a or p divides b (that is, 37d5415d8c 1200 37d5415d8c == Definition == 37d5415d8c == Prime sieves == 37d5415d8c Mersenne primes were studied in antiquity because of their close connection to perfect numbers: the Euclid–Euler theorem asserts a one-to-one correspondence between even perfect numbers and Mersenne primes. Many of the… 37d5415d8c A prime sieve works by creating a list of all integers up… 37d5415d8c = 37d5415d8c The property of being prime is called primality. A simple but slow method of checking the primality of a given number 37d5415d8c The ring of integers (that is, the set of integers with the natural operations of addition and multiplication) satisfy many important properties… 37d5415d8c In

number theory, a strong prime is a prime number that is greater than the arithmetic mean of the nearest prime above and below (in other words, it is closer to the following than to the preceding prime). Or to put it algebraically, writing the sequence of prime numbers as (p1, p2, p3, ...) = (2, 3, 5, ...), pn is a strong prime if pn > pn − 1 + pn + 1/2. For example, 17 is the seventh prime: the sixth and eighth primes, 13 and 19, add up to 32, and half that is 16; 17 is greater than 16, so 17 is a strong prime. 37d5415d8c

Integer factorization records Doing this quickly has applications in cryptography Integer factorization is the process of determining which prime numbers divide a given positive integer. The difficulty depends on both the size and form of the number and its prime factors; it is currently very difficult to factorize large semiprimes (and, indeed, most numbers that have no small factors). Doing this quickly has applications in cryptography. Integer factorization is the process of determining which prime numbers divide a given positive integer 37d5415d8c

The exponents n that give Mersenne primes are 2, 3, 5, 7, 13, 17, 19, 31, ... (sequence A000043 in the OEIS) and the resulting Mersenne primes are 3, 7, 31, 127, 8191, 131071, 524287, 2147483647, ... (sequence A000668 in the OEIS). 37d5415d8c

Prime number finding a factorization using an integer factorization algorithm, they all must produce the same result. For example, 5 is prime because the only ways of writing it as a product, 1 × 5 or 5 × 1, involve 5 itself. A natural number greater than 1 that is not prime is called a composite number. Primes are central in number theory because of the fundamental theorem of arithmetic: every natural number greater than 1 is either a prime itself or can be factorized as a product of primes that is unique up to their order. Primes can thus be considered the "basic building A prime number (or a prime) is a natural number greater than 1 that is not a product of two smaller natural numbers. However, 4 is composite because it is a product (2 × 2) in which both numbers are smaller than 4 37d5415d8c

Factorization of polynomials Polynomial factorization is one of the fundamental components of computer algebra

> systems. algebra, factorization of polynomials or polynomial factorization expresses a polynomial with coefficients in a given field or in the integers as the product In mathematics and computer algebra, factorization of polynomials or polynomial factorization expresses a polynomial with coefficients in a given field or in the integers as the product of irreducible factors with coefficients in the same domain 37d5415d8c
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> Atomic domain Important examples of atomic domains include the class of all unique factorization domains and all Noetherian In mathematics, more specifically ring theory, an atomic domain or factorization domain is an integral domain in which every non-zero non-unit can be written in at least one way as a finite product of irreducible elements. Atomic domains are different from unique factorization domains in that this decomposition of an element into irreducibles need not be unique; stated differently, an irreducible element is not necessarily a prime element. element is not necessarily a prime element 37d5415d8c
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> In this section, a ring can be viewed as merely an abstract set in which one can perform the operations of addition and multiplication; analogous to the integers. 37d5415d8c A prime sieve or prime number sieve is a fast type of algorithm for finding primes. There are many prime sieves. The simple sieve of Eratosthenes (250s BCE), the sieve of Sundaram (1934), the still faster but more complicated sieve of Atkin (2003), sieve of Pritchard (1979), and various wheel sieves are most common. 37d5415d8c == Definition in number theory == 37d5415d8c The first enormous distributed factorisation was RSA-129, a 129-digit challenge number described in the Scientific American article of 1977 which first popularised the RSA cryptosystem. It was factorised between September 1993 and April 1994, using MPQS, with relations contributed by about 600 people through the internet, and the final stages of the calculation performed on a MasPar supercomputer at Bell Labs. 37d5415d8c n 37d5415d8c When the long-known finite step algorithms were first put on computers, they turned out to be highly inefficient. The fact that almost any uni- or multivariate polynomial of degree up to 100 and with coefficients of a moderate size (up to 100 bits) can be factored by modern algorithms in a few minutes of computer time indicates how successfully this problem has been attacked during the past fifteen years. (Erich Kaltofen, 1982) 37d5415d8c

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