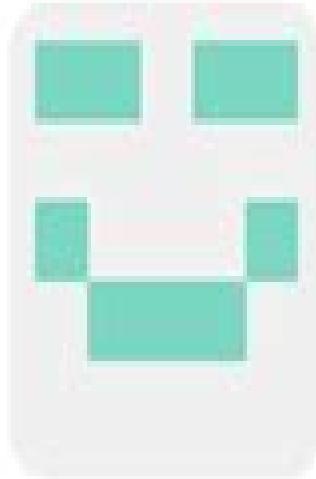


# MathSquared/general-number-field-sieve



An implementation of the General Number Field Sieve

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# Number Field Sieve

**Arjen K. Lenstra, Hendrik W.Jr. Lenstra**

## **Number Field Sieve:**

The Development of the Number Field Sieve Arjen K. Lenstra,H. W. Lenstra,1993-08-30 The number field sieve is an algorithm for finding the prime factors of large integers It depends on algebraic number theory Proposed by John Pollard in 1988 the method was used in 1990 to factor the ninth Fermat number a 155 digit integer The algorithm is most suited to numbers of a special form but there is a promising variant that applies in general This volume contains six research papers that describe the operation of the number field sieve from both theoretical and practical perspectives Pollard's original manuscript is included In addition there is an annotated bibliography of directly related literature

### **Pollard's Number**

**Field Sieve** Alexander Shaumyan,1998 The Number Field Sieve has revolutionized the field of computational number theory and enabled researchers to factor very large integers a task which seemed insurmountable with the best computers and the best factorization techniques that were available a few years earlier We'll illustrate how the Number Field Sieve works using various examples of factorizations in different number fields We'll also see how the method can be extended to factor any integer  $m$  not just a special  $m$  which can be written in the form  $m = rS$  for which the original algorithm was developed We'll look at the modified version of the Number Field Sieve known as the General Number Field Sieve GNFS and look at an example of a number factored with GNFS But in order to understand the process we need to introduce the concepts of algebraic number fields and algebraic numbers

The Development of the Number Field Sieve Arjen K. Lenstra,Hendrik W.Jr. Lenstra,1993-08-30 The number field sieve is an algorithm for finding the prime factors of large integers It depends on algebraic number theory Proposed by John Pollard in 1988 the method was used in 1990 to factor the ninth Fermat number a 155 digit integer The algorithm is most suited to numbers of a special form but there is a promising variant that applies in general This volume contains six research papers that describe the operation of the number field sieve from both theoretical and practical perspectives Pollard's original manuscript is included In addition there is an annotated bibliography of directly related literature

The Number Field Sieve Johnny Bigert,2000 *Number-Theoretic Algorithms in Cryptography* Oleg Nikolaevich Vasilenko,2007 Algorithmic number theory is a rapidly developing branch of number theory which in addition to its mathematical importance has substantial applications in computer science and cryptography Among the algorithms used in cryptography the following are especially important algorithms for primality testing factorization algorithms for integers and for polynomials in one variable applications of the theory of elliptic curves algorithms for computation of discrete logarithms algorithms for solving linear equations over finite fields and algorithms for performing arithmetic operations on large integers The book describes the current state of these and some other algorithms It also contains extensive bibliography For this English translation additional references were prepared and commented on by the author

### **The**

**Development of the Number Field Sieve** Arjen K. Lenstra,Hendrik W.Jr. Lenstra,2014-01-15 *Biscuits of Number Theory* Arthur T. Benjamin,Ezra Brown,2020-07-29 An anthology of articles designed to supplement a first course in number

theory *Factoring Integers with the Number Field Sieve* Reina-Marije Elkenbracht-Huizing, 1997 Zsfassung in niederl nd Sprache *Cryptography and Secure Communication* Richard E. Blahut, 2014-03-27 This fascinating book presents the timeless mathematical theory underpinning cryptosystems both old and new written specifically with engineers in mind Ideal for graduate students and researchers in engineering and computer science and practitioners involved in the design of security systems for communications networks **An Implementation of the Number Field Sieve** R. M. Huizing, 1995 Abstract The Number Field Sieve NFS is the asymptotically fastest known factoring algorithm for large integers Ths article describes an implementation of the NFS including the choice of two quadratic polynomials both classical and lattice sieving the block Lanczos method and a new square root algorithm Finally some data on factorizations obtained with this implementation are listed including the record factorization of 12151 1 *Summary of the Number Field Sieve* Michael Peterson, 2004 *A Look at the Special Number Field Sieve Using Ideals as Implementable in the Magma Computational Algebra Software System*, 2011 The security of RSA the most well known and widely used public cryptographic system nowadays rests on the presumption that factoring integers either cannot be done efficiently or at least nobody knows how to do it efficiently that is by a polynomial time algorithm With the ever increasing need to secure information that travels on the Internet the problem of factoring has been the focus of attention of researchers throughout the world professional and amateur alike This thesis is about the Special Number Field Sieve SNFS one of the best algorithms in the literature for factoring large integers The algorithm is designed to factor positive integers  $n$  of the form  $r^t s$  where  $r$   $t$  and  $s$  are known It is called the SNFS because it does part of the work in an algebraic number field double  $Q$  lower case alpha where double  $Q$  is the field of rational numbers and lower case alpha is a root of an irreducible monic integral polynomial  $f$  determined from  $n$  In 1990 Lenstra Lenstra Manasse and Pollard factored the ninth Fermat number  $F_9 = 2^{128} + 1$  a 155 digit integer using the SNFS However they used a trick to stay out of double  $Q$  lower case alpha and work in double  $Z$  the integer ring Instead of directly using the principal ideals left angle bracket lower case beta right angle bracket with lower case beta a  $b$  lower case alpha lower case epsilon double  $Z$  lower case alpha to generate an algebraic number field factor basis they used a one to one correspondence existing between lower case beta and the pair  $p$   $r$  where lower case alpha  $\equiv 0 \pmod{p}$  Here  $p$  is prime not exceeding upper case Beta the smoothness bound For the sieve to find smooth relations  $a$   $b$  the norm is computed as  $N = a^d b^d$  The factorization of this is done by each of the pairs  $p$   $r$  in the factor basis by testing if lower case alpha  $\equiv 0 \pmod{p}$  While it holds keep dividing the norm by  $p$  then move to the next pair The use of quadratic characters is also introduced to assist in determining perfect squares in double  $Z$  lower case alpha The contribution of this work is to show that by using the power of the MAGMA Computational Algebra System to work directly with ideals in an algebraic number field the above tricks are not necessary This thesis demonstrates the direct correlation between the rational and algebraic parts of the SNFS

algorithm A different sieving procedure is also implemented  
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**Algorithmic Number Theory** ,2002  
**Polynomial Selection for the Number Field Sieve** Shi Bai,2011 The number field sieve is asymptotically the most efficient algorithm known for factoring large integers It consists of several stages the first one being polynomial selection The running time of subsequent steps depends on the quality of the chosen polynomials In the thesis we discuss the current state of the art in polynomial selection  
**Integer Factorization with the General Number Field Sieve** Viet Pham Hoang,2008  
**A Course in Computational Algebraic Number Theory** Henri Cohen,1993 Describes 148 algorithms that are fundamental for number theoretic computations including computations related to algebraic number theory elliptic curves primality testing and factoring A complete theoretical introduction is given for each subject reducing prerequisites to a minimum The detailed description of each algorithm allows immediate

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