Discrimination of "Prime" and "Combination" of Arbitrary Large Odd Numbers and Factorization of "Combination Odd Numbers"

Shuxun Wang

Xinjiang Production and Construction Corps, Huocheng, Xinjiang, 835200, China

Abstract: The discriminant of "prime" and "combination" of any large odd number is derived from the root formula of the quadratic equation with one variable.

Keywords: Odd number, Odd prime number, Odd composite number

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Author Introduction: Shuxun Wang, male, Han nationality, native of Chongqing, bachelor degree, majoring in mathematics.

A

Discrimination of "Prime" and "Combination" of Arbitrary Large Odd Numbers

Introduction: In the natural positive integer Z-set, for any large odd number m: ($m \gg 1 - m$).

Author: To explore various research methods different from the existing ones.

Constructing the Discriminant of "Odd Composite Number"

1. Basic concept

1.1 Number concept: in the natural positive integer Z-set, the odd number is set as: m.

That is, ($m \gg 1 - m$) (m cannot be divided by 2).

1.2 Concept of odd composite number: set two different odd numbers as p and q, p ≠ q.

P and q can be odd composite numbers or odd prime numbers.

Change: $m = p \times q$). Then m is named "Odd Composite Number".

P and q are the products of two different odd factors of m.

1.3 Mathematical expression of odd composite number:

Transforming m into $[\sqrt{m}\,]^2 + n$, Divide the odd number m into two unequal positive integers: $[\sqrt{m}\,]$ is the largest integer part of the square root of m, *N is the remainder of* $[\sqrt{m}\,]$.

Set $[\sqrt{m}\,]=a$, the result: m=$a^2 + n$ (For example: 123=$11^2 + 2$)

By: $m = p \times q$

Order: $p > a$, then $p = a + x$ (Introduce unknown quantity x)

$q < a$, then $q = a - y$ (Introduce unknown quantity y)

The result: $m \Rightarrow p \times q = (a + x)\,(a - y)$ …… (A−1)

(A − 1) introduce two unknowns x and y, set x ≠ y, and make x and y sum $m \Rightarrow [\sqrt{m}\,] = a$

Build the mathematical correlation of unknown quantity x, y and known quantity a:

$m \Rightarrow p \times q = (a + x)\,(a - y)$

(A−1) is the mathematical expression of "odd composite number" ($m \gg 1 - m$).

2. Simplification (A − 1): $m = (a + x)\,(a - y)$

In equation (A − 1):

The definition fields of x and y are:

$1 < y < [\sqrt{m}\,] = a$

$1 < x < \left(\frac{m}{a - y} - a\right)$

$m \Rightarrow p \times q \Rightarrow (a + x)\,(a - y) \quad a^2 + n \Rightarrow a^2 + a(x - y) - xy$

$n = a(x - y) - xy$

$\Rightarrow xy - a(x - y) - n = 0$……*Formula* (A−2)

3. *Formula*(A − 2): $xy - a(x - y) - n = 0$:

Set: $x = y + g$, *G is the difference of x-y, namely:* $x - y = g$

G is the "parameter" introduced by two unknowns x and y

Substitute $x - y = g$, into the formula (A − 2) :

The result: $y^2 + g \times y - ag - n = 0$

Use the root formula of y, that is, the root formula of the quadratic equation with one variable:

$$y = \frac{-g \pm \sqrt{g^2 + 2ag - n}}{2}$$

In the above formula, a, x and y are odd and even numbers, and x and y are both odd and even numbers.

Can reduce denominator 2

The result: $y = -g \pm \sqrt{g^2 + 2ag - n}$ ……(A−3)

Equation (A − 3) is the equation for solving y.

From $m \Rightarrow p \times q \Rightarrow a^2 + n \Rightarrow (a + x)(a - y)$

$\Rightarrow y = -g \pm \sqrt{g^2 + 2ag - n}$

That is, the solution equation of: $m \gg 1 - m$, m.

Whether m has a positive integer solution, it can be judged by the algebraic expression "$g^2 + 2ag - n$" in the root sign:

The value of "$g^2 + 2ag - n$" is greater than 0.

Then y has two unequal real roots:

Positive integer, rational fraction, irrational number.

It is agreed in this document as "positive integer".

In order for y to have a positive integer solution, the value of the algebraic formula "$g^2 + 2ag - n$" must be a perfect square.

Y can have a positive integer solution.

Algebraic formula "$g^2 + 2ag - n$" …… (A − 4)

4. Lemma (1):

Algebraic formula (A − 4) $g^2 + 2ag - n$

If and only if $g^2 + 2ag - n = K^2$ (introducing unknown quantity K^2)

$m \gg 1 - m \Rightarrow m \Rightarrow a^2 + n$

Then m is an odd composite number.

It is proved that formula (A − 1) ⇒ (A − 2) ⇒ (A − 3) ⇒ (A − 4)

The algorithm of arithmetic operation, the setting of unknown quantity and known quantity are used to deduce and obtain the proof.

5. Lemma (2):

Algebraic formula (A − 4) " $g^2 + 2ag - n$"

When and only when $g^2 + 2ag - n \neq K^2$

$m \gg 1 - m \Rightarrow m \Rightarrow a^2 + n$

Then m is an odd prime number.

It is proved that there are only two elements in the odd positive number Z-set: "odd composite number" and "odd prime number". According to the natural number axiom of mathematical logic, these two elements have no "successor", either one or the other. That is, "odd composite number" and "odd prime number" must be one of them.

According to lemma (1), it is proved that when the algebraic formula $g^2 + 2ag - n = K^2$ is a complete square number, $a^2 + n$ has a positive integer solution value and only one unique solution value K^2. Other solution values are rational fractions and irrational numbers, and there are infinitely many solution values. It can only be an incomplete square solution.

Namely: $g^2 + 2ag - n \neq K^2$ lemma (2) is proved [1].

B

Discriminant Theorems of "Odd Composite Number" and "Odd Prime Number" Theorem: algebraic expression "$g^2 + 2ag - n$"

1. When: $g^2 + 2ag - n = K^2$

Then: $m \gg 1 - m \Rightarrow m \Rightarrow a^2 + n$ m is "odd composite number".

2. When: $g^2 + 2ag - n \neq K^2$,

Then: $m \gg 1 - m \Rightarrow m \Rightarrow a^2 + n$, m is "odd prime number".

It is proved that: (A − 1) ⇒ (A − 2) ⇒ (A − 3) ⇒ (A − 4) ⟹ Lemma (1) ⟹ Lemma (2) ⟹ Theorem.

It is proved by combining two lemmas (1) and (2).

This theorem is the same algebraic expression: "$g^2 + 2ag - n$"

When: $g^2 + 2ag - n = K^2$,

Then: $m \gg 1 - m \Rightarrow m \Rightarrow a^2 + n$ m is "odd composite number".

When: $g^2 + 2ag - n \neq K^2$

Then: $m \gg 1 - m \Rightarrow m \Rightarrow a^2 + n$, m is "odd prime number".

According to (B) theorem:

Algebraic formula "$g^2 + 2ag - n$"

When: $g^2 + 2ag - n = K^2$,

Then: $m \gg 1 - m \Rightarrow m \Rightarrow a^2 + n$ m is "odd composite number".

It is obtained that: $g^2 + 2ag - n = K^2$ …… (B − 1)

(B − 1) Formula $g^2 + 2ag - n = K^2$

This equation is a "bivariate quadratic indefinite equation" with characteristic values.

It is "the equation for solving the factorization of m as odd composite number".

There are many solutions today.

The purpose of this paper is to find the factorization of non arithmetic expressions for the purpose of decomposing "$m \gg 1 - m$", into the product of two unequal odd numbers p and $q(p \neq q)$.

In formula (B − 1) $g^2 + 2ag - n = K^2$:

a, n is the m arbitrarily selected for the working target.

$m \Rightarrow (m \gg 1 - m) = a^2 + n$ is regarded as a constant (known quantity)

$a \Rightarrow (a \gg 1 - a)$

The numerical value of a determines the length of the working target m .

Set g as the difference of $(x - y)$. g and K are unknown quantities (independent variables).

The definition domain of g and K is determined by the value of a.

a is countable, that is, the definition fields of g and K are also countable, and the valence number is used to represent the digit of m :

$m = 10^n a$ where a =1, 2, 3……9

n = 1, 2, 3……$n \gg 1 - n$

$n \gg 1 - n$, n can be arbitrarily large,

Then $m = 10^n a$ is also arbitrarily large.

When n = 6 or 5: $g^2 + 2ag - n = K^2$ manual calculation is easier;

When n = 7, 8, 9……16: $g^2 + 2ag - n = K^2$ it is difficult to calculate manually;

When n = 17, 18…… ($n \gg 1 - n$), $g^2 + 2ag - n = K^2$

The calculation of non artificial energy must be completed with scientific and technological equipment.

For the example of manual calculation, the working length of 15>n is selected.

Namely, the odd numerical value within 15 bits is used for mathematical operation deduction [2].

C

How to solve equation(B − 1): $g^2 + 2ag - n = K^2$

1. *Formula*(B −1): $g^2 + 2ag - n = K^2$

This equation is a "bivariate quadratic indefinite equation".

Its element is "g and K".

According to the "number formula" feature of this formula, it is a "complete square formula equation".

The remainder of K^2 divided by 16 is: 0, 1, 4, 9.

With 16 as the model, "mod 16" constructs the congruence equation: $g^2 + 2ag - n = K^2$ (mod 16)

The remainder of g divided by 16 is set to g_0. g_0 = 0, 1, 2, 3……16. There are 16 g_0.

2*a The remainder divisible by 16 is set as* $2a_0$. $2a_0$ = 2, 4, 6,……32. There are 16 n_0.

The remainder of n divided by16 is set to n_0. n_0 = 0, 1, 2……16. There are 17 n_0.

16 g_0, 16 $2a_0$, 17 n_0. Three or three combinations:

16 × 16 × 17 = 4352 K_0.

At 4352 of the K_0 values, only 171 K_0 value can be matched to shape, such as the "complete square equation of initial value" of $g_0^2 + 2a_0 g_0 - n_0 = K_0^2$.

The calculation process is too lengthy, leaving only 171 numerical tables of "complete square equation of initial value". The appendix is at the end of the text, and the rest is rounded off.

2. How to use the numerical table of "complete square equation of initial value" to carry out "arbitrary large odd composite number".

Factorization of $(m \gg 1 - m)$.

1) Any large odd composite number selects the odd composite number m which is about 15 digits

Example setting m = 631697288726223

Convert 631697288726223 into $a^2 + n$:

$m \Rightarrow = a^2 + n \Rightarrow 25133588^2 + 42972479$

then: a = 25133588, n = 42972479

Calculate: $2a_0 \Rightarrow 2 \times 25133588 \Rightarrow \frac{2\times 25133588}{16} \Rightarrow 8 \Rightarrow 2a_0$

That is: $2a_0$ = 8, is 2 × 25133588 remainder divided by 16.

$n_0 \Rightarrow \frac{42972479}{16} \Rightarrow 15 \Rightarrow n_0$ is the remainder of 42972479 divided by 16.

2) List of values in the initial value complete square equation

Horizontal sequence ① + ② × ③ – ④ = ⑤ = ⑥

Look up ③ ($2a_0$) – ④ (n_0)

In the same column of serial numbers, if parallel ① + ② ⑤ = ⑥ exists,

Then m is a composite number (if it does not exist, then m is a non composite number).

3) This example: $2a_0$ = 8 n_0 = 15

Looked up value list (3-1) ① + ② × ③—④ = ⑤ = ⑥

①	②	③	④	⑤	⑥
g_0^2	g_0	$2a_0$	$-n_0$	$g_0^2 + g_0 \times 2a_0 - n_0$	K_0^2
…	…	…	…		…
12^2	12	8	− 15	144 + 96 − 15	(225)15^2
⋮	⋮	⋮	⋮	⋮	⋮

Find out ③ column $2a_0$ = 8 ④ column $n_0 = -15$

Juxtaposed ① $g_0^2 = 12^2$ ② g_0 = 12

Initial value sequence formed: $12^2 + 12 \times 8 - 15 = 15^2$

In (B − 1) $g^2 + 2ag - n = K^2$

The remainder of g divided by 16 is g_0 = 12

That is, $g = 16j + 12$ j j is the "parameter" of g divided by 16.

Constructing the "Complete Square Equation" of m

$(16j + g_0)^2 + 2a \times (16j + g_0) - n = K^2$

Solve the equation to obtain the solution values g and K^2.

In this paper, j is used as the positive natural number 1, 2, 3…… $j \gg 1 - j$

"One by one value taking method" to obtain the solution values of g and K .

The value range of j is: $1 \le j \le \left[\frac{a}{16}\right]$, j is countable.

Take j = 1, 2, 3......703

When the natural value of j is 703,

Change: $g = 703 \times 16 + 12 = 11260$

Substituted into: $g = 11260$ $2a = 2 \times 25133588$ $n = 42972479$

Numerical value of the formula $g^2 + 2ag - n = K^2$

Numerical value of the formula:

$11260^2 + 2 \times 25133588 \times 11260 - 42972479 = K^2$

$\Rightarrow 126787600 + 56008401760 - 42972479$

$\Rightarrow 566092216881$

$\Rightarrow \sqrt{566092216881}$

$\Rightarrow 752391$

$\Rightarrow 752391^2 \Rightarrow K^2$

That is, equation (B − 1): equation $g^2 + 2ag - n = K^2$ is solved.

Solution validation: $m \Rightarrow 631697288726223$

$p \Rightarrow (2 + g - K) \Rightarrow 25133588 + 11260 + 752391$

$\Rightarrow 25897239$

$q \Rightarrow (a + g - K) \Rightarrow 25133588 + 11260 - 752391$

$\Rightarrow 24392457$

$m \Rightarrow p \times q \Rightarrow 631697288726223$

$\Rightarrow 25897239 \times 24392457$

$\Rightarrow 631697288726223$

Solution validation: correct.

That is, $m = 631697288726223$. The factorization process is correct [3].

(End)

D

Appendix

Application of mathematical equation:

$g^2 + 2ag - n = K^2$

In the self positive integer Z-set with a smaller number field, the odd number is set to m, and the digits are set to 6 digits or less. The manual operation method of "factorization of odd composite numbers" and the discrimination of "congruence" and "primality" of odd numbers is the application of the mathematical equation "$g^2 + 2ag - n = K^2$".

The factorization of "odd resultant numbers" is the factorization of non "arithmetic standard expressions" for the purpose of decomposing into the product of two unequal odd numbers (or prime numbers).

Example of operation process

Example (I): Set an odd number of 6 digits $m \Rightarrow 732843$

(1)Change m into: $m \Rightarrow 732843 = 856^2 + 107$

then: $a = 856 \Rightarrow 2a = 1712$

$n = 107 \Rightarrow -n = -107$

Substituted into $g^2 + 2ag - n = K^2$:

The result: $g^2 + g \times 1712 - 107 = K^2$

(2) $g^2 + 2 \times 856 \times g - 107 = K^2$ Numerical calculus list

① + ② × ③ − ④ = ⑤ = ⑥

①	②	③	④	⑤	⑥
g^2	g	$2a$	$-n$	Non K^2 value	K^2 value
1	1	1712	–107	1606	
4	2	3424	–107	3321	
9	3	5136	–107	5038	
16	4	6848	–107	6757	
25	5	8560	–107	8478	
36	6	10272	–107		10201 *
49	7				
64	8				

(3)Explanation:

① g Values can be taken one by one: 1, 2, 3……

The value field of g is: $\left[\frac{a}{16}\right] > g > 1 \Rightarrow \left[\frac{856}{16}\right] > g > 1$

(*) ② g In the value taking calculation one by one, obtain K^2, The corresponding g value is 6, which is the solution value of odd resultant number m. This instance

$K^2 = 10201 \Rightarrow 101^2 \Rightarrow K = 101$

③ Validation of solutions to be obtained:

Setting by (A): $m \Rightarrow p \times q$ $p = a + g + K$ $q = a + g - K$

"g and K" is the solution value "number pair" of mathematical equation $g^2 + 2ag - n = K^2$.

In this instance: $m \Rightarrow p \times q \Rightarrow (a + g + K)(a + g - K)$

$\Rightarrow (856 + 6 + 101)(856 + 6 - 101)$

$\Rightarrow 732843 = 963 \times 761 = 732843$

(4)According to this manual operation, the calculation proves that: $m = 732843$ is "odd composite number".

Example (2): Set an odd nu mber of 5 digits $m \Rightarrow 41333$

(1) Work operation method according to example (I)

The result: $g^2 + g \times 2 \times 203 - 124 = K^2$

(2) $g^2 + g \times 2 \times 203 - 124 = K^2$ Numerical calculus list

①+ ② × ③ − ④ = ⑤ = ⑥

①	②	③	④	⑤	⑥
g^2	g	$2a$	$-n$	Non K^2 value	K^2 value
1	1	406	–124	283	
4	2	812	–124	692	
9	3	1218	–124	1103	
16	4	1624	–124	1516	
25	5	2030	–124	1931	
36	6	2436	–124	2348	
49	7	2842	–124	3767	
64	8	3248	–124	3188	
81	9	3654	–124	3611	
100	10	4060	–124	4036	
121	11	4466	–124	4463	
144	12	4872	–124	4892	
169	13	5278	–124	5323	

(3) Explanation: The maximum value of g is: $\frac{a}{16} \Rightarrow \frac{203}{16} \Rightarrow 13$

K^2 value is not obtained. No corresponding g value appears.

Terminate numerical calculus and prove inversely:

$m = 41333$ is "odd prime number".

Note: The odd number with "6 digits or less" is a practical method to distinguish it from "odd composite number" or "odd prime number" by using the manual numerical calculation list of the mathematical equation: $g^2 + 2ag - n = K^2$.

Concluding remarks

This manual list calculus method: "factorization of odd composite numbers" and "discrimination of the primality of odd prime numbers", applicable to the majority of number theory "enthusiasts".

References

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