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Communication

A Solution to the P Versus NP Problem

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Abstract

According to conventional wisdom, the relationship between P and NP must be one of two possibilities: either P=NP or P≠NP. Unlike traditional approaches that base mathematical concepts on equivalent transformations—and, by extension, on the principle that correspondence remains unchanged—my theory is founded on non-equivalent transformations. By constructing a special non-equivalent transformation, I will demonstrate that for a problem Pa in the complexity class P and its corresponding problem Pb in the complexity class NP, Pa is a P non-equivalent transformation of Pb, and Pb is an NP non-equivalent transformation of Pa. That is, the relationship between Pa and Pb is neither P=NP nor P≠NP.

Keywords: Gödel's incompleteness theorem; non-equivalent transformations

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1. Instruction

Why can we design different mathematical concepts, and why can we use different tools to change the reality?

People establish the correspondence between theory and reality in order to use theory to explain reality. But this implies that theory cannot change reality—if theory were capable of altering reality, the correspondence between theory and reality would no longer hold.

Unlike traditional approaches that base mathematical concepts on equivalent transformations—and, by extension, on the principle that correspondence remains unchanged—my theory is founded on non-equivalent transformations.

In Gödel's incompleteness theorems, Gödel discovered properties beyond such correspondence—incompleteness. However, he did not realize how to introduce non-equivalent transformations or change of correspondence into mathematics.

2. Proof

Introduction to Gödel Numbering [1]

Theorem 2.1 Gödel numbering assigns a unique natural number (called a Gödel number) to every well-formed expression in a formal system. This is achieved through a one-to-one mapping that ensures each formula or sequence has a distinct numerical representation. The key insight is that by using properties of prime numbers and factorization, the system can encode complex logical structures into integers, which can then be manipulated arithmetically within the formal system itself.

Step-by-Step Mechanics

The encoding process involves the following steps:

(1) Symbol Assignment:

Assign a unique prime number to each primitive symbol in the formal alphabet. For instance:

Logical connectives like "¬" (negation) might be assigned 2.

Variables like "x" could be assigned 3.

Quantifiers like "∀" (universal quantifier) might get 5.

Parentheses or other delimiters receive distinct primes (e.g., "(" = 7, ")" = 11).

This ensures all symbols have unique identifiers

(2) Formula Encoding:

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Consider a formula φ composed of a sequence of symbols: $s_1, s_2, \ldots, s_k$.
The Gödel number of φ, denoted [φ], is calculated as:
$[\varphi]=p^{c(s_1)}{}_1 \times p^{c(s_2)}{}_2 \times \ldots p^{c(s_k)}{}_k$
where:

(1) p_i is the i-th prime number (e.g., $p_1 = 2$, $p_2 = 3$, $p_3 = 5$, ...).

(2) $c(s_i)$ is the numerical code assigned to symbol s_i.

(3) Decoding and Properties:

Due to the fundamental theorem of arithmetic (which states that every integer has a unique prime factorization), each Gödel number can be uniquely decoded back into the original symbol sequence.

This bijective mapping ensures that operations on formulas (e.g., concatenation or substitution) can be represented as arithmetic operations on their Gödel numbers.

To construct Formula G **[2]**, a self-referential statement is formed using Gödel numbering. Specifically, the expression (∀x)¬Dem(x, sub(n, 13, n)) — which asserts that no proof exists for the formula obtained by substituting its own Gödel number into itself — is assigned a unique Gödel number, say n.

Definition 2.2 If we only modify the Formula Encoding in Gödel numbering as follows:

Consider a formula φ composed of a sequence of symbols: $s_1, s_2, \ldots, s_k$.
The Gödel number of φ, denoted [φ], is calculated as:
$[\varphi]=p^{c(s_1)}{}_1 \times p^{c(s_2)}{}_2 \times \ldots p^{c(s_k)}{}_k$
where:
p_i is the (i+1)-th prime number (e.g., $p_1 = 3$, $p_2 = 5$, $p_3 = 7$, ...).
$c(s_i)$ is the numerical code assigned to symbol s_i.
Then we will construct Formula H replace Formula G.

Definition 2.3 In Gödel's incompleteness theorems, it is entirely possible to construct undecidable formulas using numerical variables other than x (such as y, z, k, etc.).

P(M) is one set of formulas containing Formula G and some formulas constructed above.

(P(N) is another set of formulas containing Formula H and others constructed using the same method as P(M).

Peano Arithmetic is denoted as X.

P(M) is defined as one extension of X, and P(N) as another.

To construct the fomula G, the numerical variable y is associated with prime number 13, and the formula (∀x)¬Dem(x, sub(n, 13, n)) is associated with the unique number n.

Proof 2.4 If Formula G is denoted by (13, n) or (13, G_1), then we can define a sequence of denotations for formulas in P(M) as follows: (13, G_1), (17, G_2), (19, G_3), ..., (P_k, G_k), and similarly for P(N):(13, H_1), (17, H_2), (19, H_3), ..., (P_k, H_k) .

Define a non-equivalent transformation in the following way:
X_1=13+0 Y_1=G_1+S_1 Z_1=H_1+O_1
X_2=17+0 Y_2=G_2+S_2 Z_2=H_2+O_2
..,
X_k=P_k+0 Y_k=G_k+S_k Z_k=H_k+O_k
(K is an even)
$S_1 \in N^+, S_2 \in N^+, .., S_k \in N^+$
$O_1 \in N^+, O_2 \in N^+, .., O_k \in N^+$

Definition 2.5 Define the group G: G contains the elements $a_1, a_2, \ldots, a_k$. The ordering of the elements in G is $a_1, a_2, \ldots, a_k$.
a_1=X_1+Y_1i
(Y_1i indicates that Y_1 is the value of the imaginary part of the complex number a_1)
a_2=X_2+Y_2i

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..

$a_k=X_k+Y_ki$

Define the group H: H contains the elements b_1, b_2, ..., b_k. The ordering of the elements in H is b_1, b_2, ..., b_k.

$b_1=X_1+Z_1i$

(Z_1i indicates that Z_1 is the value of the imaginary part of the complex number b_1)

$b_2=X_2+Z_2i$

..

$b_k=X_k+Z_ki$

Assign all elements in group G to subgroup G-A and subgroup G-B using a specific random allocation method Y, ensuring that the number of elements in subgroup G-A is equal to the number of elements in subgroup G-B.

Using the same allocation method Y, assign all elements in group H to subgroup H-A and subgroup H-C, so that the number of elements in subgroup H-A is equal to the number of elements in subgroup H-C.

We can employ different allocation methods. When the absolute value of the difference between the sum of the imaginary parts in subgroup H-C and that in subgroup H-A is an extreme value (either the maximum or minimum) and is unique among all possible allocations, we denote this allocation method as K (for the maximum) or K* (for the minimum).

Allocation method K (or K*) must also satisfy the following conditions:

1. The absolute value of the difference between the sum of the real parts in (subgroup G-B and subgroup G-A) and the difference between the sum of the real parts in (subgroup H-C and subgroup H-A) are both unique values within their respective sets of possible outcomes, but neither is an extreme value (i.e., neither a maximum nor a minimum).

2. The absolute value of the difference between the sum of the imaginary parts in subgroup G-B and that in subgroup G-A is also a unique but non-extreme value.

Then, denote the maximum absolute value of the difference (between the sum of the real parts in subgroup G-B and the sum of the real parts in subgroup G-A) as q1, and the minimum absolute value of the difference as q2. Proposition Q is formulated as: which allocation method can find the maximum absolute value of the difference q1 (or which allocation method can find the minimum absolute value of the difference q2). The allocation method that finds the maximum absolute value of the difference q1 (or finds the minimum absolute value of the difference q2) can be determined through the bubble sort algorithm, and bubble sort belongs to class P in the P/NP problem.

If Peano Arithmetic is expressed as X, then proposition Q is expressed as proposition Pb, and Pb Non-Deterministic Polynomial solvable problem.

If Peano Arithmetic is expressed as proposition P(N), then proposition Q is expressed as proposition Pa, and Pa is a polynomial-time solvable problem.

Thus Pa is a P non-equivalent transformation of Pb, and Pb is an NP non-equivalent transformation of Pa. That is, the relationship between Pa and Pb is neither P = NP nor P ≠ NP.

References

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