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A Solution to the P Versus NP Problem

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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—this theory is founded on non-equivalent transformations. By constructing a special non-equivalent transformation, I will demonstrate that for a problem P(a) in the complexity class P and its corresponding problem P(b) in the complexity class NP, P(a) is a P non-equivalent transformation of P(b), and P(b) is an NP non-equivalent transformation of P(a). That is, the relationship between P(a) and P(b) is neither P=NP nor P≠NP.

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1. Introduction

People establish the correspondence between theory and reality in order to use theory to explain reality. However, this implies that theory cannot change reality—if theory were capable of altering reality, the correspondence between theory and reality would no longer hold. Similarly, due to this correspondence and its immutable nature, people cannot construct different mathematical concepts either.

People create facts rather than investigate them; they formulate mathematical concepts rather than discover them. But then, why can people design different mathematical concepts and use different tools to change reality?

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 changes in correspondence into mathematics.

2. Proof

2.1. Introduction to Gödel Numbering [1]

Theorem 2.2 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:

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:

$$\lceil\varphi\rceil = p^{c(s_1)}{}_1 \times p^{c(s_2)}{}_2 \times \ldots p^{c(s_k)}{}_k$$

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 2.3 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:

$$\lceil\varphi\rceil = p^{c(s_1)}{}_1 \times p^{c(s_2)}{}_2 \times \ldots p^{c(s_k)}{}_k$$

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.
This constructs Formula H replace Formula G.

Definition 2.4 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): A set containing Formula G and related formulas
P(N): A set containing Formula H and analogs
Peano Arithmetic is denoted as X.
P(M) is defined as one extension of X, and P(N) as another.

To construct Formula 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 2.5 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)
$S_1\in N^+, S_2\in N^+, \ldots, S_k\in N^+$
$O_1\in N^+, O_2\in N^+, \ldots, O_k\in N^+$

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Definition 2.6 Define sequence G: G contains the elements a_1, a_2, ..., a_k. The ordering of the elements in G is a_1, a_2, ..., 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)

$a_2=X_2+Y_2i$

..

$a_k=X_k+Y_ki$

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 the maximum value (denoted as m_1) or the minimum value (denoted as m_2), and this maximum m_1 (or minimum m_2) is unique among all possible allocation schemes, we denote this allocation method as K (for the maximum case) or K* (for the minimum case), respectively.

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

1. When allocation is performed using method K (or K*), the absolute value n_1 of the difference between the sum of the real parts in subgroup G-B and subgroup G-A, or equivalently the absolute value of the difference between the sum of the real parts in subgroup H-C and subgroup H-A, must be unique and neither a maximum nor a minimum.

2. When allocation is performed using method K (or K*), the absolute value n_2 of the difference between the sum of the imaginary parts in subgroup G-B and subgroup G-A must be neither a maximum nor a minimum.

Finding allocation method K can be achieved using bubble sort. Since bubble sort is a polynomial-time algorithm, it is a problem in class P.

Definition 2.7 Proposition P(a) is formulated as: What allocation method can be used to make the absolute value of the difference between the sum of the imaginary parts in subgroup H-C and that in subgroup H-A reach the maximum value m_1 or the minimum value m_2?

Proposition P(b) is formulated as:Under what allocation method K is the absolute value n_1 of the difference between the sum of the real parts in subgroup G-B and subgroup G-A determined?

If Peano Arithmetic is expressed as X, then proposition Q is expressed as proposition P(b), and P(b) Non-Deterministic Polynomial solvable problem.

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

Thus P(a) is a P non-equivalent transformation of P(b), and P(b), is an NP non-equivalent transformation of P(a). That is, the relationship between P(a) and P(b) is neither $P = NP$ nor $P \neq NP$.

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