International Journal of Intelligence Science, 2024, 14, 59-70
https://www.scirp.org/journal/ijis
ISSN Online: 2163-0356
ISSN Print: 2163-0283

Intelligent Transformation: General Intelligence Theory

Alexander Ngu[1,2*], Amaya Odilon Kosso[2,3]

[1]Ngu Energy, Boston, USA
[2]Boston University, Boston, USA
[3]IntelligenceDAO, Boston, USA
Email: *amayangu@bu.edu, aok@intelligencedao.org

How to cite this paper: Ngu, A. and Kosso, A.O. (2024) Intelligent Transformation: General Intelligence Theory. *International Journal of Intelligence Science*, **14**, 59-70.
https://doi.org/10.4236/ijis.2024.143004

Received: May 1, 2024
Accepted: July 28, 2024
Published: July 31, 2024

Abstract

This paper aims to formalize a general definition of intelligence beyond human intelligence. We accomplish this by re-imagining the concept of equality as a fundamental abstraction for relation. We discover that the concept of equality = limits the sensitivity of our mathematics to abstract relationships. We propose a new relation principle that does not rely on the concept of equality but is consistent with existing mathematical abstractions. In essence, this paper proposes a conceptual framework for general interaction and argues that this framework is also an abstraction that satisfies the definition of Intelligence. Hence, we define intelligence as a formalization of generality, represented by the abstraction $\Delta\infty O$, where each symbol represents the concepts infinitesimal, infinite, and finite respectively. In essence, this paper proposes a General Language Model (GLM), where the abstraction $\Delta\infty O$ represents the foundational relationship of the model. This relation is colloquially termed "The theory of everything".

Keywords

Intelligence, Generalization, Abstraction, Transformation, General Language Model, General Intelligence Theory, Theory of Everything

1. Introduction

Symbols are used as a shorthanded way of simplifying ideas. The Equal Sign "=" is the symbolic representation of the idea "is equal to". Robert Recorde, circa 1510 to 1558, is usually cited as the first to use the equal-to-sign "=" symbol in his work [1]. Before the equal sign came into common use, there were other forms of expression of equality. In Florian Cajori's work A History of Mathematical Notations: Vol.1-Notations in Elementary Mathematics, pages 297-298, he showed that the "=" sign was not generally accepted in academia until 1631. It was adopted as the symbol of equality in some influential works in England including Thomas Harriot's Artis analyticae praxis, Willian Outhtred's Clavis Mathematicae, and Richard Norwood's Trigonometria [2].

This paper highlights that equality does not extend beyond mathematical objects, where mathematical objects are abstract concepts that can be formally defined with deductive reasoning and proof. Theorems and proofs are also considered mathematical objects. Hence, equality is fundamentally a limited principle of relation, hiding possible undiscovered abstract relationships. Equality has multiple interpretations and implementations in mathematics where in some instances equality is interpreted as a predicate and in others as a proposition. When used as a proposition, equality has a specific Truth or False value but does not have variables as arguments [3]. When used as a predicate, equality has a truth or false value that is dependent on an argument or variable. For example, in set theory equality is defined in two ways, the first definition says that two sets A and B are the same set if they contain the same elements. The second definition states that two sets A and B containing the same elements are equal [4]. In category theory, equality is defined in terms of isomorphisms, homeomorphisms, and homotopy. In computer programming, equality is used as a relational operator that does a comparison and returns true or false or 0 and 1. By definition, these interpretations of equality are predicated on mathematical objects or expressions that are argument or variable-dependent. These definitions of equality are relevant in the space of sets and categories but are not general because they still do not account for non-mathematical concepts. This means that in a space of concepts, the relationships between abstractions are not fundamentally equal because equality only represents one of the infinite possible interpretations of the relationship of the concepts. In essence, a general principle must be robust enough to transcend the concept of equality while also remaining consistent with the concept of equality. This will allow the relation to account for mathematical and non-mathematical concepts.

2. From Equality "=" to Infinity "∞"

Gödel's incompleteness theorems and Turing's computability theorems pointed out a limiting boundary around mathematics and computation. Godell's theorem highlighted that the limits of provability in formal axiomatic theories prevent the existence of a complete and consistent mathematical theory of everything [5]. In 1936, in his paper "On computable numbers, with an application to the Entscheidungs problem", Alan Turing formalized an algorithmically computable and incomputable function. Turing discovered that mathematical theories were undecidable, meaning they had an incomputable set of theorems, which puts a limiting boundary around what is computable [6]. With this understanding, we assume in this paper that a framework for general interaction colloquially known as "The theory of everything" cannot be a mathematical theory.

In Steven G. In Krantz's 2016 paper titled A Primer of Mathematical Writing, he writes "The dictionary teaches us that "A connotes B" means that A suggests B, but not in a logically direct fashion" [7]. A dichotomy exists between denotation and connotation where denotation defines an explicit-direct relationship between objects and connotation defines an implicit-indirect relationship between said objects [8]. Recorde used the two parallel lines to represent the explicit denotational relationship between two objects, where X denotes Y can be written as X = Y. When Robert Recorde first introduced the equal sign, he intended X "denote" Y or X "equal to" Y to represent the explicit relationship between X and Y [1]. But in this paper we go further, if X denotes Y is represented as X = Y then how do we represent the implicit connotational relationship between X and Y if X connotes Y? The abstraction presented in this publication represents the implicit or generalized connotation relationship between X and Y where X connotes Y. The ambiguity between X "equal-to" = Y and X "transformable-to" Y has created a pervasive use of the equal sign "=" in symbology. Essentially equality is a denotational relationship that must be expressed explicitly, and transformability is a connotation relationship that must be expressed implicitly or generally. With this understanding, we can conclude that Einstein's $E = mc^2$ represents a denotational relationship between energy and mass. Unfortunately, this same equation does not satisfy the requirement for a connotational relationship because $E = mc^2$ does not imply that Energy (E) can be transformed into mass (m), it explicitly says energy is equal to mass times a product of light speed squared. In essence, we are searching for a relation that allows us to transform objects on the left into objects on the right and vice versa. In this paper, we assume that the connotational relationship between X and Y is the same as the symbolic representation of the concept of "transformation", and such symbolic abstraction will be a formalization of generality. In mathematics, some other relational symbols include "<, <=, ≈, =, >=, >" that make up the real number line and are used to represent the equivalent relationship between X and Y but not the general or transformational relationship. This means this new relational principle must be the symbolic representation of 'Transformation' while also having the capacity to derive the mathematical notations by generating the real number line.

3. Transformations: Parameters (TP) and Types (TT)

As aforementioned, X "equal-to" = Y does not mean the same thing as X "transformable-to" Y hence we need to formalize a new relation principle for "transformation". In this paper, 'Computation' is defined as a formal language for representing the relationship of concepts in mathematical languages. Unfortunately, computation does not account for non-mathematical concepts, meaning that computability is a broad but bounded language that is fundamentally limited in its ability to Generalize. We assume that an infinite number of possible languages can be derived to formalize the interaction of concepts. Hence, we call the language with the highest capacity of generalization the language Intelligence, as it is the most robust of these languages, meaning that it represents the concept of generality and can model the interactions of arbitrary concepts.

Isaac Newton's force-mass equivalence equation f = ma and Albert Einstein's energy-mass equivalence equation $E = mc^2$ are symbolic abstractions that represent the interactions between the concepts of force and mass for Newton and energy and mass for Einstein. In this paper, we emphasize that these formalizations were derived, implying that a more fundamental abstraction underpins these computationally reduced mathematical derivations. A discovery of this foundational abstraction will allow us to bypass the limitations of prior derivations and organize them into types.

This fundamental abstraction that represents General Transformation is presented in **Figure 1** below. We introduce two new concepts in this paper called Transformation Parameters (TP) and Transformation Types (TT). At different levels of abstraction, transformations can be represented in different ways to model the interaction of concepts. Each Transformation we will call Transformation Type (TT). Transformational Types differ by their Parameters, where the transformation parameter (TP) determines the efficiency of the transformation. For example, energy, time, and space are classified as transformation types (TT), where time behaves as the transformation parameter (TP) between energy and space. Other transformation types (TT) as outlined in **Table 1** include (Area, π, r^2), (Emergence, interaction, Evolution), (E, =, mc^2), (Force, Mass, Acceleration), and (Complexity, Dimensionality, Spatiality). This means that a theory of everything must not be a mathematical theory. Hence Einstein's Energy-Mass-Equivalence equation $E = mc^2$ cannot be the foundational relation principle or Theory of everything.

In computer programming, Intelligence can be defined as an optimal algorithm for general interaction, where *Space complexity* denotes the space required for execution, and *Time complexity* denotes the number of operations required to complete execution [9]. This paper posits that an optimally efficient computational algorithm has zero *Time complexity*, zero *Space complexity,* and an infinite *Dimensional* complexity, where *Dimensional Complexity* is defined as the transformation an algorithm must go through or information that an algorithm must compute to reach completion [10]. By this definition, we argue that an optimally efficient algorithm will have zero time complexity, an infinite-dimensional complexity, and zero space complexity, meaning that the algorithm can complete a transformation with zero computation in zero time. A minimally efficient algorithm will have infinite space complexity, infinite time complexity, and zero-dimensional complexity, meaning that even with infinite computation and infinite Time, the algorithm cannot complete the transformation.

In this paper, Transformation Type (TT) and Algorithms are interchangeable. The Transformation Parameter (TP) determines the efficiency of the transformation hence the less information a Transformation Type (TT) or Algorithm requires to reach completion, the more efficient that type or algorithm is, and vice versa. This is outlined in **Figures 2-5** below, where the Transformation Parameters (TP) include (∞, =, ≈, π, 1, Mass, Time), etc. For example, the concepts of equality (=) mass(m) and time (t) require observation and measurement, which are all sources of inefficiency. In essence, the Transformation Parameter (TP) determines the efficiency of the transformation where the Transformation Parameter

(TP) ∞ is optimal. As aforementioned, the connotational relationship between X and Y is the same as the transformation from X to Y and vice versa, and the transformational relationship between X and Y is the same as the formalization of generality. We discovered that intelligence can be represented as a formalization of generality, a symbolic abstraction, and in computation as an optimally efficient algorithm akin to an algorithm for generalized interaction.

4. Abstractions

In this paper, we propose a General Language Model (GLM) with a more general and inclusive relation principle defined as the abstraction Δ∞O, where each symbol represents the concepts of Triangle, Infinity, and Circle respectively. We discovered this abstraction when formalizing the transformation of a triangle into a circle. We reimagined a circle as a polygon with an infinite number of sides. A visualization of this transformation is shown below in **Figure 1** as the simplest polygon known as an equilateral triangle with sides S = 3 is transformed into a circle with an infinite number of sides S->∞. The four properties we use to define these polygons are the number of sides, the Individual interior angles, the sum of all interior angles, and the sum of all exterior angles. For example, the simplest polygon is the equilateral triangle which has 3 sides, 60 degrees for each interior angle, 180 degrees for the sum of all interior angles, and 360 degrees for the sum of all exterior angles. In this paper, we define these four properties for a circle: an infinite number of sides, 0 degrees for each interior angle, an infinite degree for the sum of all interior angles, and 360 degrees for the sum of all exterior angles. If we imagine the triangle and circle as the transformation boundaries, the polygons between them should represent the transformation domain. Hence the potential polygons between an equilateral triangle and a circle are infinite. In this paper, we define these polygons as the In-between polygons. Due to the infinite potential of polygons, we can represent the potential of the in-between polygons with the Infinity symbol ∞. This means that the transformation of a triangle with S number of sides into a circle with an infinite number of sides is robust enough to represent generality.

This abstraction is consistent with mathematics but is not a mathematical object itself, and each symbol in the abstraction represents the concepts infinitesimal (Δ), infinite (∞), and finite (O) respectively. In this paper, we show that there exists a triarchic relationship that is consistent and persists through many dimensions of our understanding. This fundamental relationship is represented by the abstraction Δ∞O as shown in **Figure 1**, where the relationship between all concepts can be further generalized into this abstraction. At the fundamental level, we discovered that generalization is modulated by the parameter infinity "∞", which we termed Transformation Parameter (TP). Other Transformation Parameters (TP) exist such as Pi (π), Mass (m) and Equality (=), but they are not as general as infinity.

These relationships are expanded in **Table 1** We show that this new relation can also represent the relationship between energy, time, and space as Δ∞O. We propose that this abstraction is a further generalization of Einstein's Energy-Mass-

Equivalence equation $E = mc^2$, where energy "e" is generalized to Triangle "Δ", equality "=" is generalized to Infinity "∞", and the product of mass and speed of light squared "mc^2" is generalized to Circle "O" as seen in **Figure 2.** In the abstraction Δ∞O, each symbol represents complexity (Δ), dimensionality (∞), and spatiality (O). Complexity (Δ) akin to computational Time complexity denotes the number of operations required for completion, Spatiality (O) akin to computational space complexity denotes space required for execution, and dimensionality (∞) akin to computational dimensional complexity denotes the Transformation Parameter (TP) being used in the transformation.

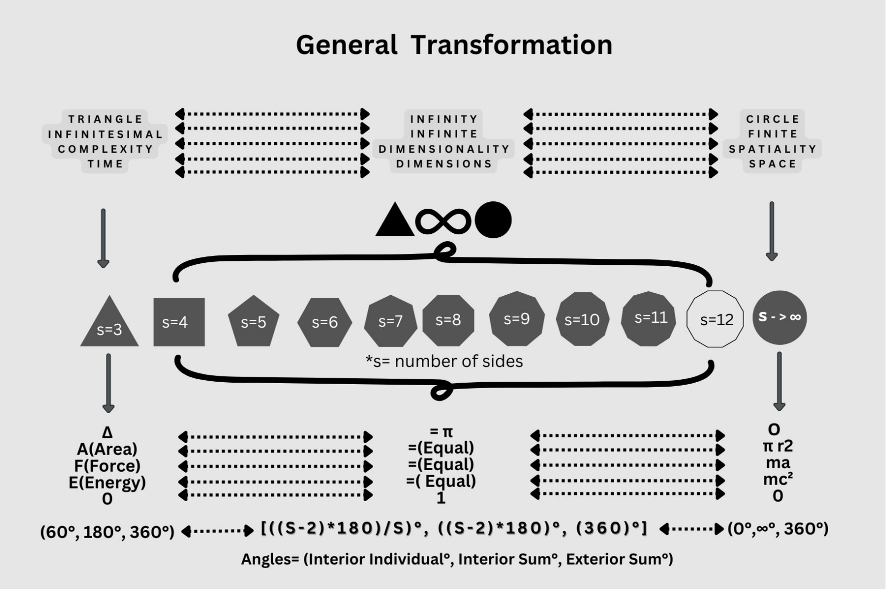

Figure 1. The transformation of a triangle (Δ) into a circle (O) is the simplest yet most general transformation. If we imagine the triangle and circle as the transformation boundaries, then the polygons between them should represent the transformation domain. Hence the potential polygons between an equilateral triangle and a circle are infinite (∞). We combine these three abstractions and discover Δ∞O. The abstraction is general enough to represent the relationship between mathematical and non-mathematical concepts.

Table 1. Transformation table (The General Language Model (GLM)): The transformation table, outlines The General Language Model (GLM) defines General Intelligence as Δ∞O, a formalization of the transformational triarchic relationship between concepts, which we call Transformation Types (TT). All parameters in each Row create a Transformation Type (TT), for Example (0, 1, 0), (Area, π, r^2), (Emergence, interaction, Evolution), (E, =, mc^2), (Force, Mass, Acceleration), and (Complexity, Dimensionality, Spatiality), and (Δ,∞, O) are all Transformation Types (TT). The Transformational Parameters (TP) are in Column 2 [∞], and they determine the Transformation Type (TP) between Column 1 [Δ] and Column 3 [O]. The transformational parameters (TP) include ∞=, ≈, π, 1, Mass, Time, Infinity, etc.

Δ	∞	O
Triangle	Infinity	Circle
Infinitesimal	Infinite	Finite

Continued

Complete	Infinite	Incomplete
Consistent	Infinite	Inconsistent
Complexity	Dimensionality	Spatiality
Time Complexity	Dimensional Complexity	Space Complexity
<<=	≈	>=>
Emergence	Interaction	Evolution
Area	π	r^2
Force	Mass	Acceleration
Energy	Time	Space
E	=	mc^2
0	1	0

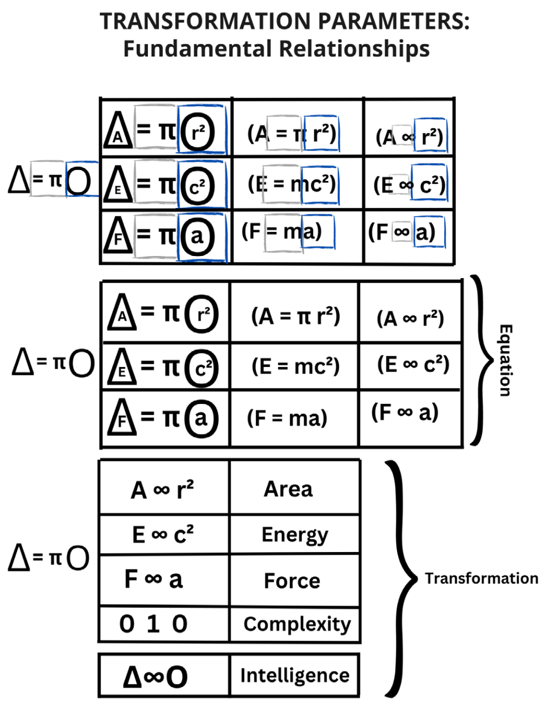

Figure 2. At the energy scale, the concept of Mass (m) is the same as Pi (π) at the geometric scale. This is because the abstractions Pi (π), Mass (m) and Equality (=) are Transformation Parameters (TP) which determine the type of transformation that happens. This means Mass (m) and Equality (=) in $E = mc^2$ can be further generalized into ∞, where $E \infty c^2$. Essentially when the transformational parameter(TP) is ∞, Mass (m) and other derivative parameters are negligible. For example, at the speed of light c, particles have no rest energy, where E (total)= E (rest)+ E (motion), hence only the energy of motion remains, making E (total)= E (motion) the reason why Mass (m) is negligible and photons are defined as having no mass. Transformational relationships exist between Energy (E) & Light (c), Area (A) & radius (r), Force (F) & Acceleration (a), Zero (0) & One (1), and Triangle (Δ) & Circle (O), where each transformation has a different Transformation Parameter (TP) as outlined in Table 1.

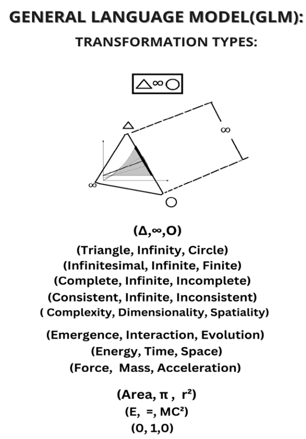

Figure 3. The intelligence engine diagram defines general intelligence as Δ∞O, a formalization of the transformational triarchic relationship between concepts, which we call Transformation Types (TT). For Example, (0, 1, 0), (Area, π, r^2), (Emergence, interaction, Evolution), (E, =, mc^2), (Force, Mass, Acceleration), and (Complexity, Dimensionality, Spatiality), and (Δ,∞, O) are all Transformation Types (TT). The Transformational Parameters (TP) are the middle notations separated by commas under [∞], and they determine the Transformation Type (TP) between the first notation under [Δ] and the third notation under [O]. The transformational parameters (TP) include ∞=, ≈, π, 1, Mass, Time, etc.

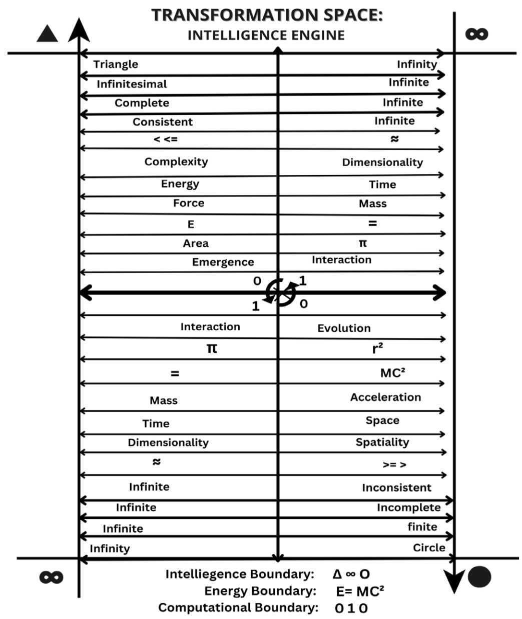

Figure 4. The Transformation Space diagram is read counter-clockwise in the order of Δ∞O, beginning with the first quadrant Triangle [Δ] and ending with the third quadrant circle [O]. The definitions remain consistent when read in the clockwise direction also but for the sake of consistency, we will read counter-clockwise throughout this publication. For Example, our diagram shows that there exists a Triarchic relationship between the three quadrants called Transformation Types (TT). For example (0, 1, 0), (Area, π, r^2), (Emergence, interaction, Evolution), (E, =, mc^2), (Force, Mass, Acceleration), (Complexity, Dimensionality, Spatiality), (Δ,∞, O) are all Transformation Types (TT). The Transformational Parameters (TP) are in the 3rd Quadrant [∞], and they determine the type of transformation or interaction between phenomena in Quadrant 1 [Δ] and Quadrant 3 [O]. The transformation parameters (TP) include ∞, =, ≈, π, 1, Mass, Time etc.

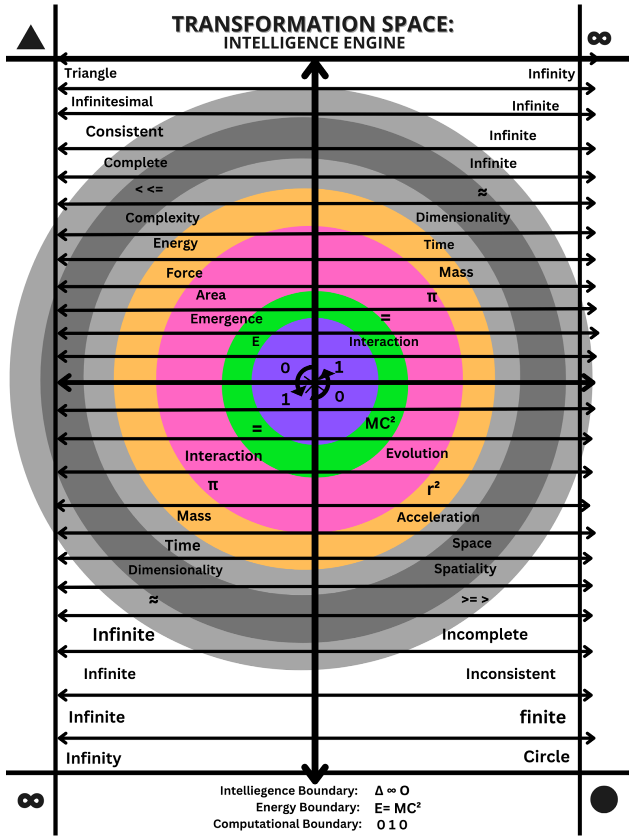

Figure 5. This is a colorized version of Figure 4. The Transformation Space diagram is read counter-clockwise in the order of Δ∞O, beginning with the first quadrant Triangle [Δ] and ending with the third quadrant circle [O]. The definitions remain consistent when read in the clockwise direction also but for the sake of consistency, we will read counter-clockwise throughout this publication. For Example, our diagram shows that there exists a Triarchic relationship between the three quadrants called Transformation Types (TT). For example (0, 1, 0), (Area, π, r^2), (Emergence, interaction, Evolution), (E, =, mc^2), (Force, Mass, Acceleration), (Complexity, Dimensionality, Spatiality), (Δ,∞, O) are all Transformation Types (TT). The Transformational Parameters (TP) are in the 3rd Quadrant [∞], and they determine the type of transformation or interaction between phenomena in Quadrant 1 [Δ] and Quadrant 3 [O]. The transformation parameters (TP) include ∞, =, ≈, π, 1, Mass, Time, etc.

5. Conclusions

The purpose of this paper was to formalize a general definition of intelligence beyond human intelligence. This was accomplished by reimagining the concept of equality as a fundamental abstraction for relationships, showing that equality limits the sensitivity of our mathematical language to abstract relationships. We then formalized a new abstraction for general interaction that accounts for these relationships and showed that this new abstraction remains consistent with Einstein's Energy-mass-equivalence equation $E = mc^2$. Thus, the abstraction Δ∞O can be interpreted as a further generalization of Einstein's Energy-Mass Equivalence equation $E = mc^2$. In essence, this paper introduces a General Language Model (GLM), where Δ∞O is the foundational relation of the model.

General Language Model (GLM)

Δ∞O	**Δ∞O**	**Δ∞O**
[	**[**	**[**
Triangle "Δ"	**Infinitesimal: "Δ"**	**Complexity: "Δ"**
Infinity: "∞"	**Infinite: "∞"**	**Dimensionality: "∞"**
Circle: "O"	**Finite: "O"**	**Spatiality: "O"**
]	**]**	**]**

This model is called a General language Model because it models the interaction of mathematical and non-mathematical concepts. This paper reconciles this new language with computation by formalizing and defining the relationships between the concepts of Complexity, Dimensionality, and Spatiality where Δ is infinitesimal and denotes Complexity ∞ is infinite and denotes Dimensionality, and O is finite and denotes Spatiality. We define intelligence as an abstraction of generality. This definition is colloquially termed "The theory of everything" because it is a complete and consistent language for general interaction that reconciles the infinitely small and the infinitely large.

6. Implications

In the Intelligence research community, intelligence has been benchmarked by comparing the efficiency at which algorithms complete human-specific tasks. This is what we call a "functional" definition of intelligence which allows researchers to experiment and even build interesting things as they have functional attributes. The issue with this functional definition is that the fundamental assumption is not generalizable and thus cannot fully represent intelligence. The transformation Δ∞O presented in this publication is classified as a "non-functional definition" because it is merely a symbolic representation of intelligence without asserting any predefined functions.

Based on the issues discussed here, we propose that the academic community adopt the abstraction Δ∞O as the definition of intelligence. This abstraction is considered a General Language Model (GLM) because it models the fundamental interactions of concepts beyond the limitations of mathematics. An example of this restriction is found in economic theories that use mathematical equations to formalize the relationship between concepts. Essentially, a non-general language will render a constrained economic model. This means that there exists a relationship between the generality of language models and their efficiency at optimally modeling the interaction of concepts. The abstraction Δ∞O presented in this publication is the most general and least constrained relational principle effectively making it a general optimizer that can be used to calibrate any arbitrary system.

At the societal level, many of our systems are built with mathematical and computational foundations which as aforementioned entails limitations that manifest as inefficiencies in societal interactions. The General Language Model (GLM) allows us to transcend these limitations and build more efficient and interoperable systems as such systems will be governed by the same axiom. For example, AI inference using a non-general Large Language Model (LLM) works by parsing through data and looking for geometric structures to use for predictions. Unfortunately, this is an energy-intensive endeavor that, when optimized for efficiency, still requires increasing amounts of energy to achieve consensus. If we extrapolate forward in time, we can safely assume that there will be escalating data and energy demands. The GLM we present in this publication already provides the fundamental structure or spine for the organization and interaction of arbitrary concepts or abstractions, thus no need for data and excessive energy usage in training to find this structure. We propose that the General Language Model (GLM) is an improvement of the Large Language Model (LLM).

A material science interpretation argues this abstraction is the principle that governs the emergence, interaction, and evolution of all physical phenomena. It underpins our reality as a representation of its fundamental substrate. In summary, the abstraction $\Delta\infty O$ reconciles all fields in academia and solves the unification of the infinitely small and infinitely large, a once elusive problem that puzzled some of the world's greatest minds.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Seehorn, A. (2021) The History of Equality Symbols in Math. https://sciencing.com/history-equality-symbols-math-8143072.html

[2] Cajori, F. (1928) A History of Mathematical Notations: Vol. 1—Notations in Elementary Mathematics. The Open Court Company, 297-298.

[3] McGrath, Matthew; Frank, Devin (2023) Propositions. In: Zalta, E.N. and Nodelman, U., Eds., *The Stanford Encyclopedia of Philosophy* (Winter 2023 ed.), Metaphysics Research Lab, Stanford University.

[4] Kleene, S.C. (2002) Mathematical Logic. Dover Publications, 189.

[5] Panu, R. (2013) Gödel's Incompleteness Theorems. Stanford Encyclopedia of Philosophy.

[6] Turing, A.M. (1937) On Computable Numbers, with an Application to the Entscheidungsproblem. *Proceedings of the London Mathematical Society*, **42**, 230-265. https://doi.org/10.1112/plms/s2-42.1.230

[7] Krantz, S.G. (2016) A Primer of Mathematical Writing. AMS Non-Series Monographs. https://doi.org/10.1090/mbk/112

[8] Denotation and Connotation. Oxford Reference. https://www.oxfordreference.com/view/10.1093/oi/authority.20110803095710580

[9] Kuo, W. and Zuo, M.J. (2003) Optimal Reliability Modeling: Principles and Applications. John Wiley & Sons, 62.

[10] Ngu, A. (2022) Dimensional Complexity and Algorithmic Efficiency. *International Journal of Modern Nonlinear Theory and Application*, **11**, 1-10. https://doi.org/10.4236/ijmnta.2022.111001

Nomenclature

Δ∞O	Intelligent Transformation
Δ	Triangle, Infinitesimal, Complexity, Time Complexity
∞	Infinity, Infinite, Dimensionality, Dimensional Complexity, Transformational Parameters
O	Circle, Finite, Spatiality, Space Complexity
$F = ma$	Newton's Second Law of Motion
$E = mc^2$	Einstein's Energy-Mass Equivalence equation
m	Mass (m)
A	Area
e	Energy
F	Force
a	Acceleration