

# The Separation of Intelligence and Wisdom: A Mathematical Definition of an Adaptive Bidirectional Computational Model

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## Abstract

To address the long-standing issue of the ambiguous concept of “intelligence” in the field of artificial intelligence, this paper proposes the idea of separating the concepts of intelligence and wisdom: intelligence is an inherent information processing mechanism of a system that does not depend on specific content, while wisdom is the collection of symbols, requirements, memories, and rules of a system at a given moment. On this basis, a closed, adaptive information processing model—the SymbolSet-Requirement-Memory-Rule (SRM-R) model—is constructed, and its mathematical foundation, the IntLog logic language, is established.

The concept of metawords is introduced to support recursive self-nesting information representation, rules as first-class objects participating in computation, and bidirectional computational semantics of rule application and rule derivation. Based on the SRM-R model, rigorous mathematical definitions of intelligence and wisdom are provided. Furthermore, the logical framework for information processing, the explanation of common intelligent capabilities, the characterization of personalized wisdom features (such as consciousness, emotion, and language), and interpretable symbolic neurons and distributed information systems are derived.

Finally, the dilemmas of theoretical verification and engineering challenges are discussed, and the guiding significance of the model for AI research directions—such as the interpretability of data-driven models, information encryption and privacy protection, and the integration of information fusion and decision-making—is elaborated. The SRM-R model provides a computable and deducible mathematical foundation for artificial general intelligence and is expected to promote formal research into the essence of intelligence.

**Full Text**

**Preamble**

## **The Separation of Intelligence and Wisdom: A Mathematical Definition of an Adaptive Bidirectional Computational Model**

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**Abstract**

**[Objective]** This study aims to address the long-standing problem of conceptual ambiguity regarding “intelligence” within the field of Artificial Intelligence.

**[Methods]** We propose a conceptual separation between “Intelligence” and “Wisdom.” Based on this distinction, we construct the SRM-R (SymbolSet-Requirement-Memory-Rule) closed adaptive information processing model. Furthermore, we establish the IntLog logical language and introduce the concept of “metawords.”

**[Results]** The study provides rigorous mathematical definitions for both intelligence and wisdom. From these definitions, we derive a logical framework for information processing and characterize the personalized features of wisdom.

**[Limitations]** The proposed framework faces challenges regarding theoretical verification and engineering implementation; further breakthroughs are required for practical application and deployment of the model.

**[Conclusion]** The SRM-R model provides a computable and deducible mathematical foundation for Artificial General Intelligence (AGI), advancing the formalization of the essence of intelligence.

**Keywords:** Separation of Intelligence and Wisdom; SRM-R Model; IntLog Logical Language

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## **1. Introduction**

The term “intelligence” has become ubiquitous in contemporary society, reflecting a fundamental shift in how we interact with technology. In modern engineering and computer science, intelligence often refers to the capacity of a system to perceive its environment, process complex data, and take actions to achieve specific goals. However, as AI systems grow in complexity, the technical clamor surrounding advancements—from large-scale models to brain-computer interfaces—seems to obscure a fundamental confusion: what exactly are we simulating?

Although Artificial Intelligence (AI) has surpassed human performance in specific tasks, the academic community has yet to reach a consensus on the ontological question of “what intelligence itself is” [?]. There is a distinct lack of a mathematical framework capable of precisely characterizing its essence [?]. This lack of mathematical rigor makes it difficult for the field to achieve the same level of theoretical deduction found in mature disciplines like physics. Consequently, it remains challenging to effectively integrate cross-disciplinary research results, creating a bottleneck for Artificial General Intelligence (AGI) [?].

Existing theories, such as Howard Gardner’ s Theory of Multiple Intelligences, are essentially descriptive classification systems rather than formal computational frameworks [?]. Philosophy often focuses on the ontological roots of consciousness, such as Searle’ s Chinese Room Argument, which negates functionalist definitions without providing a constructive path for formal study [?, ?]. Therefore, constructing a framework that encompasses multi-dimensional characteristics while maintaining rigorous formalized expression is essential.

## 2. Related Work

The pursuit of a unified theory of intelligence has historically coalesced into three major schools:

1. **Symbolism:** Views intelligence as symbolic manipulation and logical reasoning [?], but struggles with real-world uncertainty and the “symbol grounding problem” [?].
2. **Connectionism:** Defines intelligence as the result of distributed representations in neural networks [?], yet lacks interpretability and strong symbolic reasoning [?].
3. **Behaviorism:** Asserts that intelligence is adaptive behavior emerging from environment interaction [?], but struggles to describe high-level cognitive functions.

Current research paradigms remain fragmented and lack a unified formal theory [22]. Engineering implementations lack formal specifications to serve as a reliable basis [23-24].

## 3. Theoretical Framework: Separation of Intelligence and Wisdom

This study breaks through traditional limitations by delineating the boundaries between “intelligence” and “wisdom.”

- **Intelligence:** Defined as the inherent, invariant processing mechanism of an information processing system. It is innate, universal, and stable.
- **Wisdom:** Defined as the collective set of information within the system at a specific point in time. It is acquired, personalized, and dynamically evolving.

Intelligence defines the fundamental rules for the evolution of wisdom, including the representation mechanism, information categories, and transformation patterns. While intelligence remains stable, the wisdom information set iteratively evolves. This separation allows us to treat intelligence as a mathematically solvable information model, specifically the **SRM-R (SymbolSet-Requirement-Memory-Rule)** model.

### 3.1 Core Functional Requirements of Adaptive Systems

To achieve sustained operation in complex environments, any adaptive system must satisfy three core requirements: 1. **Universal Information Representation:** The ability to represent arbitrary information and construct structural representations of the world and internal states. 2. **Autonomous Decision-Making:** The capacity to generate, filter, and execute strategies for complex problems without explicit external guidance. 3. **Adaptive Iterative Development:** The ability to modify internal structures and behavioral strategies based on experience [?].

### 3.2 Conceptual Confusion in General Information Models

Traditional models often follow the form  $Y = F(X, S)$ , where  $F$  is a fixed rule and  $S$  is the memory state. These models suffer from: 1. **Fixed Rules:**  $F$  is usually manually designed and cannot achieve autonomous adaptive evolution. 2. **Preprocessing Constraints:** Input  $X$  must be converted into pre-defined formats. 3. **Passive Memory:** Updates to  $S$  are constrained by human-designed rules.

By treating the processing rule  $F$  itself as a category of information, we can redefine the mechanism as the transformation patterns between input, output, memory, and rules.

## 4. The SRM-R Model and IntLog Language

### 4.1 The IntLog Logic Language

To formalize the SRM-R model, we introduce **IntLog**, a symbolic logic language based on **metawords**.

**Syntax:** \* **Metawords ( $\mathcal{M}$ ):** Fundamental symbols  $\{P_0, P_1, \dots\}$  that map a set of atoms to a Boolean value. \* **Atoms:** Recursively defined as  $P(t_1, \dots, t_n)$  where  $P \in \mathcal{M}$ . \* **Rules:** Represented as atoms:  $RULE(\{HEAD(\{H_1, \dots, H_m\}), BODY(\{B_1, \dots, B_n\})\})$ , or  $H_1, \dots, H_m \leftarrow B_1, \dots, B_n$ .

**Semantics:** \* **Forward Computation (ruleExecu):** If body atoms are satisfied by the instance  $I$ , the head atoms are derived. \* **Backward Computation (ruleDrv):** If a requirement atom matches a head atom, the body atoms are derived as sub-requirements.

## 4.2 Mathematical Definition of SRM-R

**Definition 5 (SRM-R Model):** The SRM-R model is a decuple:  $\{Sym, Req, Mem, Rul, IN, OUT, trans, match, ruleExcu, ruleDrv\}$ , where:  
 \* **Sym:** The set of metawords. \* **Req:** Requirement atoms (goals to be achieved). \* **Mem:** Memory atoms (facts that have occurred). \* **Rul:** Rule atoms ( $Rul \subseteq Mem \cup Req$ ). \* **trans:** Bidirectional mapping between external formats and internal atoms. \* **match:** Predicate determining if a memory atom satisfies a requirement.

## 4.3 Adaptive Representation and Bidirectional Computation

The SRM-R model enables **Adaptive Information Representation** through recursive atomic structures. When the system encounters novel meaning, it adaptively generates new metawords (Input-driven or Demand-driven).

The model employs a **Bidirectional Coexistence Computing Pattern**: 1. **Requirement Derivation (Backward):** Decomposes complex goals into a requirement derivation graph. 2. **Input Processing (Forward):** External inputs are transformed into atoms, matched against requirements, and trigger rule execution to propagate satisfaction up the derivation chain.

This decouples input from output; behavior is not a passive reaction but an active generation driven by internal demands.

## 5. Theoretical Inferences

### 5.1 Intelligence and Wisdom Defined

**Definition 6 (Intelligence):** Intelligence is the closed, adaptive information-processing mechanism characterized by the SRM-R model. It is the system's inherent invariant.

**Definition 7 (Wisdom):** Wisdom is the state of the quadruple  $\langle Sym, Req, Mem, Rul \rangle$  at a given moment.

### 5.2 Consciousness, Emotion, and Language

- **Consciousness:** Defined as the dynamically evolving state of the wisdom quadruple. Uniqueness of consciousness stems from the unique history and state of the  $\langle Sym, Req, Mem, Rul \rangle$  set.
- **Emotion:** Represented as learned cognitive structures  $\langle SA, Fct \rangle$  that evaluate the system's internal demand states relative to objects.
- **Language:** Emerges from the necessity of information interaction. Shared symbolic systems and rules align through repeated interaction and adaptive symbol generation between agents.

### 5.3 Symbolic Neurons

Each metaword corresponds to a **symbolic neuron** storing its associated memories, requirements, and rules. This structure provides inherent interpretability, contrasting with the “black-box” nature of traditional neural networks. A network of these neurons forms a distributed information system characterized by robustness, topological dynamism, and locality of processing.

## 6. Discussion and Conclusion

### 6.1 Validation Dilemmas

Direct validation of these mechanisms at the biological/genetic level is currently limited by technology. Indirect validation via engineering implementation faces challenges such as state space explosion and the need for massive computational resources. We propose two pathways for engineering: the Human-Computer Interaction Platform and the Embodied Agent approach.

### 6.2 Significance for AI

The SRM-R model provides a computable foundation for AGI. It offers insights into: \* **Interpretability:** Symbolic neurons provide a transparent mapping of cognitive depth. \* **Privacy:** Since each agent evolves a unique, closed symbolic system, internal information is inherently “encrypted” against external eavesdropping. \* **Information Fusion:** Unifies data fusion and task decision-making by allowing requirements to drive the processing workflow.

**Conclusion:** The SRM-R model formalizes intelligence as a mathematical invariant and wisdom as an evolving state. This framework advances the transition of AI from empirical trial-and-error toward a principled mathematical science, providing a roadmap for the development of conscious, autonomous, and interpretable intelligent systems.

*Note: Figure translations are in progress. See original paper for figures.*

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