DIKWP Conceptualization Semantics Standards Version 1.0 of International Test and Evaluation Standards for Artificial Intelligence based on Networked Data-Information-Knowledge-Wis...

Technical Report · August 2024

DOI: 10.13140/RG.2.2.21823.73127

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International Test and Evaluation Standards for

Artificial Intelligence based on Networked

Data-Information-Knowledge-Wisdom-Purpose (DIKWP) Model

DIKWP Conceptualization Semantics Standards

(Released version 1.0)

International Standardization Committee of Networked DIKWP for Artificial Intelligence Evaluation（DIKWP-SC）

World Association of Artificial Consciousness（WAC）

World Conference on Artificial Consciousness（WCAC）

2024.08

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Catalog

Preparation Instructions

The development of International Test and Evaluation Standards for Artificial Intelligence based on Networked Data-Information-Knowledge-Wisdom-Purpose (DIKWP) Model aims to address the diversity and varying maturity levels of artificial intelligence evaluation benchmarks, providing the industry with a unified, rigorous, and universally applicable assessment framework. This is done to establish a standardized evaluation method, model, and indicator system, ensuring comparability and consistency in the assessment of artificial intelligence model performance. Starting from the five core elements of Data, Information, knowledge, Wisdom, and Purpose, International Test and Evaluation Standards for Artificial Intelligence breaks through the conceptual space semantic constraints to construct a networked evaluation system oriented towards cognitive space, comprehensively examining the understanding and processing capabilities of artificial intelligence across different cognitive networks. Its Purpose is not only to overcome the limitations of black-box testing but also to provide functional or indicative white-box evaluation results for the tested artificial intelligence models, and to provide a reference for improving the tested models. This evaluation standard pays special attention to the fairness, impartiality, and equality of models, actively promoting artificial intelligence (AI) technology to follow ethical principles and social values, and striving to reduce discrimination and injustice phenomena.

The evaluation of artificial intelligence globally involves various benchmarks aimed at measuring various capabilities and aligning them with human values. The GLUE Benchmark provides a standardized set of different NLP tasks to evaluate the effectiveness of different language models. As an industry standard for general language understanding assessment, it has established its core position in evaluating language model performance with its wide application, and diverse task sets including sentiment analysis, question answering, and providing a platform for fair comparison between models. However, the benchmark also has significant shortcomings such as limited task coverage, potential inability to fully capture the full picture of language understanding, biased datasets that may affect the fairness of model evaluation, and the possibility of models over-optimizing specific tasks to pursue high GLUE scores, leading to compromised generalization abilities. SuperGLUE Benchmark, as an upgrade to GLUE, significantly increases task difficulty, covers more diverse and deeper language understanding requirements, and by introducing human-level baselines, intuitively demonstrates the progress of AI in the field of language understanding. However, SuperGLUE is more complex and requires significant computational resources, and its dataset bias issue, inherited from GLUE, remains a persistent challenge. HellaSwag is a benchmark specifically designed for text generation evaluation, which promotes the development of related technologies by designing tasks specifically for text coherence and logic. However, its application scope is relatively narrow, mainly focusing on text generation tasks, and the completion examples of sentences may be suggestive, potentially causing interference with the accuracy of model performance evaluation. TruthfulQA, with its uniqueness in directly evaluating the truthfulness of model outputs, is particularly suitable for scenarios highly concerned with answer authenticity, such as news generation. Although it adopts innovative evaluation methods, the evaluation process of TruthfulQA is subjective, and it only focuses on truthfulness while neglecting other aspects of language understanding abilities, limiting its comprehensiveness. MMLU provides extensive domain and task coverage, conducting in-depth, comprehensive, and reliable evaluations of models' multi-task processing capabilities using large-scale datasets. Therefore, MMLU requires high computational resource demands, and balancing evaluations between multiple tasks is also a challenge, making it difficult for research teams with limited resources to utilize this benchmark effectively.

While the current landscape of AI benchmarking features a variety of approaches, each showcasing unique value in evaluating AI model performance, their limitations are also evident. There is an urgent need to build a comprehensive, fair, and future-proof international evaluation standard for artificial intelligence. The DIKWP model describes a networked relationship model between Data, Information, Knowledge, Wisdom, and Purpose, where each relationship is guided by objectives or Purpose, connecting Cognitive space, Consciousness space, Semantic space, and conceptual space. Based on this, International Test and Evaluation Standards for Artificial Intelligence covers multiple aspects and dimensions such as semantic understanding, comprehensive processing, bias assessment, alignment assessment, and consciousness capabilities, meticulously examining the understanding abilities of Data, Information, Knowledge, Wisdom, and Purpose, ensuring a comprehensive, multi-layered, and thorough analysis of the cognitive abilities of artificial intelligence models. In addition to language understanding and generation capabilities, International Test and Evaluation Standards for Artificial Intelligence particularly focuses on the performance of models in handling uncertainty, identifying and eliminating biases, value alignment, and consciousness simulation, reflecting its emphasis on AI ethics and fairness. With its features of comprehensiveness, depth, multidimensionality, refinement, adaptability, fairness, and impartiality principles, International Test and Evaluation Standards for Artificial Intelligence provides a scientific, rigorous, practical, and forward-looking framework for the performance evaluation of artificial intelligence models, aiming to promote the healthy development and application of AI technology.

Preface

With the rapid development of artificial intelligence technology and the rise of large language models, the way we interact with intelligent systems is undergoing a change. Artificial intelligence models have demonstrated unprecedented performance in various applications, attracting significant attention from various sectors of society regarding their evaluation. Currently, the evaluation benchmarks for artificial intelligence models present a diversified trend, with various benchmarks designed specifically for different dimensions of performance emerging continuously. Examples include GLUE, SuperGLUE, CLUE, and SuperCLUE, which are used to test language understanding and generation capabilities, while specific domain benchmarks like Owl-Bench are tailored for areas such as intelligent operations and maintenance. In addition, there are also evaluation benchmarks focusing on aspects like the security of large models, ethical risks, and fairness, reflecting the industry's emphasis on comprehensive quality control of models. However, given the uneven levels of development and maturity among these evaluation benchmarks, researchers face challenges in selecting and referencing them, requiring a careful evaluation of suitable evaluation tools and standards in combination with specific application scenarios. Faced with numerous artificial intelligence model evaluation benchmarks launched by various research teams and companies, there is a common and urgent demand among relevant professionals in the field for a comprehensive, systematic, fair, and practical set of evaluation indicators and methods to guide and promote the development and evaluation of artificial intelligence models. The AGI-AIGC-GPT Evaluation DIKWP (Global) Laboratory, composed of experts and scholars with long-term engagement in artificial intelligence research, has drafted the "International Test and Evaluation Standards for Artificial Intelligence based on Networked Data-Information-Knowledge-Wisdom-Purpose (DIKWP) Model" aiming to establish an internationally recognized evaluation benchmark for artificial intelligence with a certain degree of foresight and pilot conditions.

1 Scope

This document outlines the relevant terms and definitions of International Test and Evaluation Standards for Artificial Intelligence for artificial intelligence model evaluation.

This document is applicable to service providers, users, and third-party testing organizations involved in the design and implementation of artificial intelligence model testing.

2 Normative References

The contents of the following documents constitute relevant provisions of this document through normative references therein.

3 Terms and Definitions

3.1 DIKWP

The DIKWP model is an extension of the traditional DIKW (Data, Information, Knowledge, Wisdom) model, incorporating an additional element called "Purpose." The DIKWP model is a networked model that vividly describes the cognitive process, tightly connecting Data, Information, Knowledge, Wisdom, and Purpose. Together, these elements form an interactive process of cognitive conceptual-semantic associations that span Cognitive space, Consciousness space, Semantic space, and conceptual space.

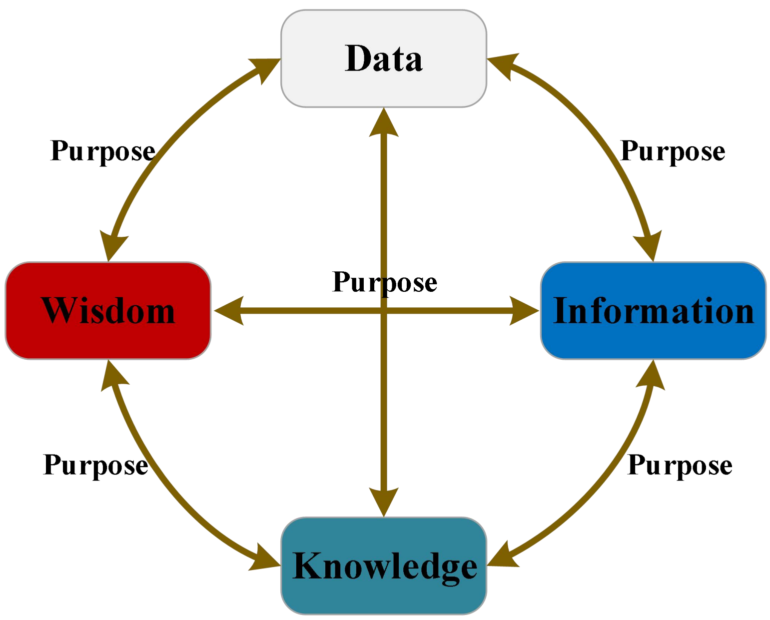

Figure 3-1 DIKWP Relationship Architecture Diagram

	D	I	K	W	P
D	$D_1+P \rightarrow D_2$	$D+P \rightarrow I$	$D+P \rightarrow K$	$D+P \rightarrow W$	$D+P_1 \rightarrow P_2$
I	$I+P \rightarrow D$	$I_1+P \rightarrow I_2$	$I+P \rightarrow K$	$I+P \rightarrow W$	$I+P_1 \rightarrow P_2$
K	$K+P \rightarrow D$	$K+P \rightarrow I$	$K_1+P \rightarrow K_2$	$K+P \rightarrow W$	$K+P_1 \rightarrow P_2$
W	$W+P \rightarrow D$	$W+P \rightarrow I$	$W+P \rightarrow K$	$W_1+P \rightarrow W_2$	$W+P_1 \rightarrow P_2$
P	$P_1+P_2 \rightarrow D$	$P_1+P_2 \rightarrow I$	$P_1+P_2 \rightarrow K$	$P_1+P_2 \rightarrow W$	$P_1+P_2 \rightarrow P_3$

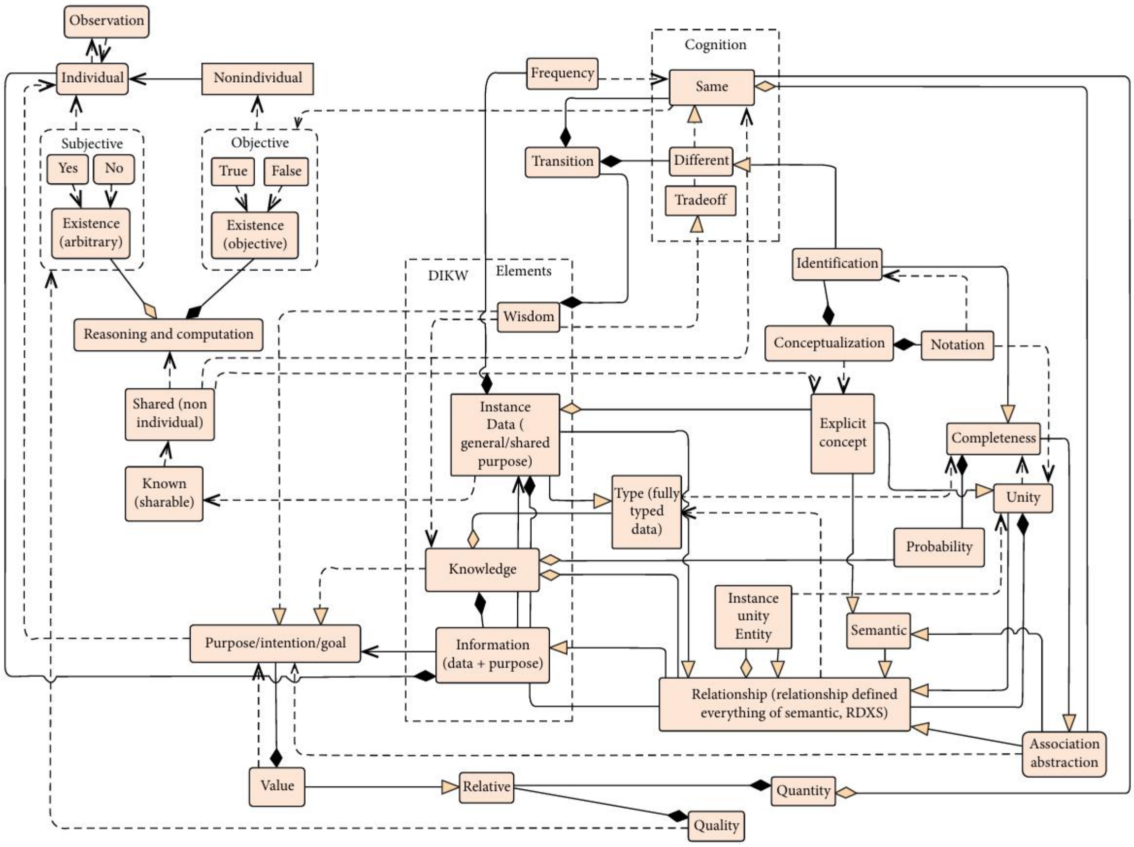

Figure 3-2 DIKWP Resource Integration and Transformation Relationship

Figure 3-3 DIKWP Definition Metamodel

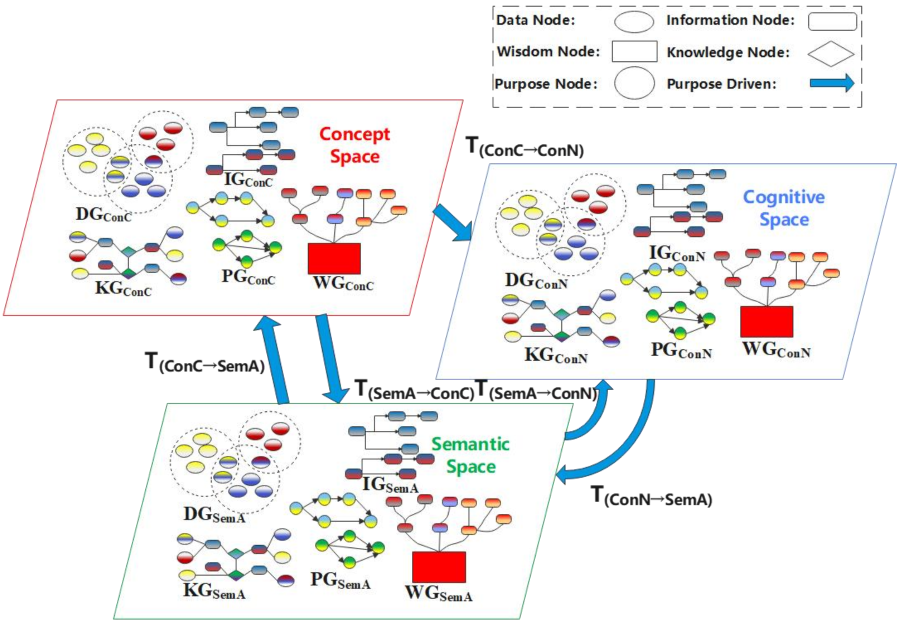

Figure 3-4 Conceptual Space, Cognitive Space, Semantic Space Architecture Diagram

3.2 Concept Space (ConC)

Concept space refers to the cognitive representation of the external world by a cognitive subject, including the definition, features, and relationships of concepts. Conceptual space is expressed through language and symbol systems. For example, a "car" in conceptual space can be defined as a type of transportation with four wheels, capable of carrying passengers or goods.

Conceptual space is composed of a collection of related concepts connected to each other through specific attributes and relationships, forming a directed or undirected graph based on the symmetry of relationships between concepts.

Graph Representation: $Graph_{ConC} = (V_{ConC}, E_{ConC})$, where V_{ConC} is the set of concept nodes, and E_{ConC} is the set of edges representing the relationships between concepts.

In the concept space, each concept $v \in V_{ConC}$ possesses a set of attributes $A(v)$ and relationships $R(v, v)$ with other concepts.

Attributes: $A(v)=\{a1(v), a2(v), \cdots, an(v)\}$, where each $ai(v)$ represents an attribute of the concept v.

Relationships: $R(v, v')$ represents the relationship between concept v and concept v'. If the graph is directed, then $R(v,v')$ is not equivalent to $R(v, v)$; if the graph is undirected, they represent the same relationship.

Operations within the concept space include querying, adding, or modifying concepts and their relationships:

Query operation: $Q(V_{ConC}, E_{ConC}, q) \rightarrow \{v_1, v_2, \cdots, v_m\}$, returns a set of concepts that meet the criteria specified by q (such as specific attributes or relationships).

Add operation: $Add(V_{ConC}, v)$, adds a new concept v to the concept collection V_C.

Update operation: $Update(V_{ConC}, v, A(v))$, updates the attribute set $A(v)$ of the concept v.

In the DIKWP model, the conceptual space provides a structured framework for categorizing and organizing Data, Information, Knowledge, Wisdom, and Purpose. By mapping each component of DIKWP to the conceptual space, complex relationships between these components can be effectively deciphered. For example, through query operations (Q), one can identify all concepts related to specific Data or Knowledge, thereby deriving new Information or Wisdom.

3.3 Cognitive Space (ConN)

The cognitive space is a multidimensional and dynamic processing environment where Data, Information, Knowledge, Wisdom, and Purpose are transformed into specific understanding and actions through specific cognitive processing function sets (R) of individuals or systems. Each cognitive processing function (f_{ConN_i}) takes Data or Information from the Input space ($Input_i$) and transforms it through a series of sub-steps (such as Data preprocessing, feature extraction, pattern recognition, logical reasoning, and decision-making) into outcomes in the output space ($Output_i$), such as Information classification, concept formation, Purpose determination, or action planning.

Function set: $R=\{f_{ConN\_1}, f_{ConN\_2}, \cdots, f_{ConN\_n}\}$, where each function f_{ConN_i}: $Input_i \rightarrow Output_i$ represents a specific cognitive processing step. $Input_i$ is the Input space, and $Output_i$ is the output space.

Input space $Input_i$: Includes various Data or Information sources received by the individual or system. These Inputs may come from observations of the external environment (such as visual and auditory perceptions), signals received from other systems, or internally generated Data. The Input space reflects the diversity of the cognitive subject's interactions with the outside world and the breadth of Information acquisition.

Output space $Output_i$: Contains various higher cognitive products formed after cognitive processing. This can include the classification of input Information, conceptual structures built based on Information, clear identification of Purpose, and specific action plans set to realize these Purposes. The output space reflects the cognitive subject's ability to deeply process and transform input Information, which is the basis for the cognitive subject's responses or actions towards the external world.

3.3.1 Cognition processing

Each cognitive processing function f_{ConN_i} can be further refined into a series of sub-steps, including Data preprocessing, feature extraction, pattern recognition, logical reasoning, and decision-making. These sub-steps together constitute the complete cognitive pathway from raw Data to the final output.

Sub-step representation: For each f_{ConN_i}, it can be represented as $f_{ConN\_i}=f_{ConN\_i}^{(5)} \circ f_{ConN\_i}^{(4)} \circ \cdots \circ f_{ConN\_i}^{(1)}(Inputi)$, where $f_{ConN\_i}^{(j)}$ represents the processing function of the j-th sub-step, and $\circ$ represents the composition of functions.

3.4 Semantic Space (SemA)

Semantic space refers to the semantic association network of concepts within the cognitive subject's brain, including semantic relationships and associations between concepts. Semantic space is formed through the cognitive subject's experiences and accumulated Knowledge. For example, for the concept of "car," the semantic space may include associated semantics such as "driving," "vehicle," "fuel consumption," and others.

The Semantic space is a collection formed by a series of semantic units, which are interconnected through specific associations and dependencies, collectively constituting an objective representation of Information and Knowledge. Widely accepted concepts and linguistic rules in the Semantic space facilitate the transmission and communication of meaning.

Graph Representation: $Graph_{SemA}=(V_{SemA}, E_{SemA})$, where V_{SemA} represents semantic units (words, sentences, etc.), and E_{SemA} represents the associations and dependencies between semantic units.

Semantic Unit: Each semantic $v \in V_{SemA}$ represents the smallest unit or concept that can independently express meaning.

Relationships: Edge $e \in E_{SemA}$ represents semantic associations or logical dependencies between semantic units, such as synonymy, antonymy, hyponymy, causality, and other relationships.

In the semantic space, a series of operations correspond to querying, adding, or modifying semantic units and their relationships:

Query Operation: $Query(V_{SemA}, E_{SemA}, q)\rightarrow\{v_1,v_2, \cdots ,v_m\}$, returns a set of semantic units that satisfy the query condition q.

Add Operation: $Add(V_{SemA}, v)$, adds a new semantic unit v to the set V_{SemA}.

Update Operation: $Update(E_{SemA},v,v',e)$, updates or adds the relationship e between semantic units v and v'.

The semantic space not only provides stakeholders with a cognitive shared language system for expressing DIKWP but also supports semantic consistency in the transformation and processing between DIKWP components. Leveraging semantic units and their relationships enables accurate transmission and interpretation of complex service interaction cognitive content among different entities.

3.5 DIKWP Graph

A. Data Graph（DG）

In the network model, Data graphs are not only the starting point of Information processing but also the result of feedback adjustments for Knowledge, Wisdom, or Purpose. The Data graph (DG) receives inputs from Information, Knowledge, Wisdom, and Purpose through transformation functions T_{ID}, T_{KD}, T_{WD}, T_{PD} achieving dynamic updates and adjustments.

$T_{XY}: YG \rightarrow XG$, where $X,Y \in \{D,I,K,W,P\}$ and $X \neq Y$, denotes the transformation from graph Y to graph X.

B. Information Graoh（IG）

An Information graph is defined as a tuple $IG = (V_I, E_I)$, where V_I is the set of Information nodes and E_I is the set of edges based on semantic relationships between the Information. The Information graph is not only generated from the Data graph DG but is also adjusted and reconstructed by the Knowledge graph KG, widom graph WG, and Purpose graph PG:

$DG \xrightarrow{T_{DI}} IG$: Transformation from Data to Information.

$KG \xrightarrow{T_{KI}} IG$, $WG \xrightarrow{T_{WI}} IG$, $PG \xrightarrow{T_{PI}} IG$: Adjustments of Information by Knowledge, Wisdom, and Purpose, respectively.

Where T_{XY} represents the transformation function from graph X to graph Y.

C. Knowledge Graph（KG）

A Knowledge graph is defined as $KG = (V_K, E_K)$, where V_K represents Knowledge nodes and E_K represents the relationships between Knowledge nodes. The Knowledge graph integrates Information formation and influences the interpretation of Data, the generation of Information, and the application of Wisdom:

$IG \xrightarrow{T_{IK}} KG$: Transformation from Information to Knowledge.

$KG \xrightarrow{T_{KD}} DG$, $KG \xrightarrow{T_{KI}} IG$, $KG \xrightarrow{T_{KW}} WG$: The influence of Knowledge on Data, Information, and Wisdom, respectively.

D. Wisdom Graph（WG）

A Wisdom graph is defined as $WG = (V_W, E_W)$, where V_W represents the nodes of Wisdom and E_W represents the connections between Wisdom nodes. The Wisdom graph integrates Knowledge, Data, and Information to guide decision-making and can feedback to influence the formation of Knowledge and the interpretation of Information:

$KG \xrightarrow{T_{KW}} WG$: Transformation from Knowledge to Wisdom.

$WG \xrightarrow{T_{WK}} KG$, $WG \xrightarrow{T_{WI}} IG$: Feedback effects of Wisdom on Knowledge and Information, respectively.

E. Purpose Graph（PG）

The Purpose graph is defined as $PG = (V_P, E_P)$, where V_P represents the nodes of goals and implementation paths, and E_P represents the strategies or steps to achieve these goals. The Purpose graph is constructed by Data, Information, Knowledge, and Wisdom, and it can inversely influence these components:

$DG \xrightarrow{T_{DP}} PG$, $IG \xrightarrow{T_{IP}} PG$, $KG \xrightarrow{T_{KP}} PG$, $WG \xrightarrow{T_{WP}} PG$: Formation of Purpose from Data, Information, Knowledge, and Wisdom.

$PG \xrightarrow{T_{PD}} DG$, $PG \xrightarrow{T_{PI}} IG$, $PG \xrightarrow{T_{PK}} KG$: Inverse influence of Purpose on Data, Information, and Knowledge.

The DIKWP graphing system maps elements of the digital world and the cognitive world to five main components: DG, IG, KG, WG, and PG. Each graph is further subdivided into three levels of mapping: the semantic level, the conceptual level, and the instance level. Thus, each graph $g \in G$ is a triplet mapping:

$g{:}S \times C \times I$ where G represents the set of graphs, S represents the set of semantic levels, C represents the set of concepts, and I represents the set of instances.

The interactions between the DIKWP graphs are achieved through content models and cognitive models, represented by a function f , which transforms the mapping of one level or type of graph into another level or type of graph.

$f\colon G \times G \rightarrow G$

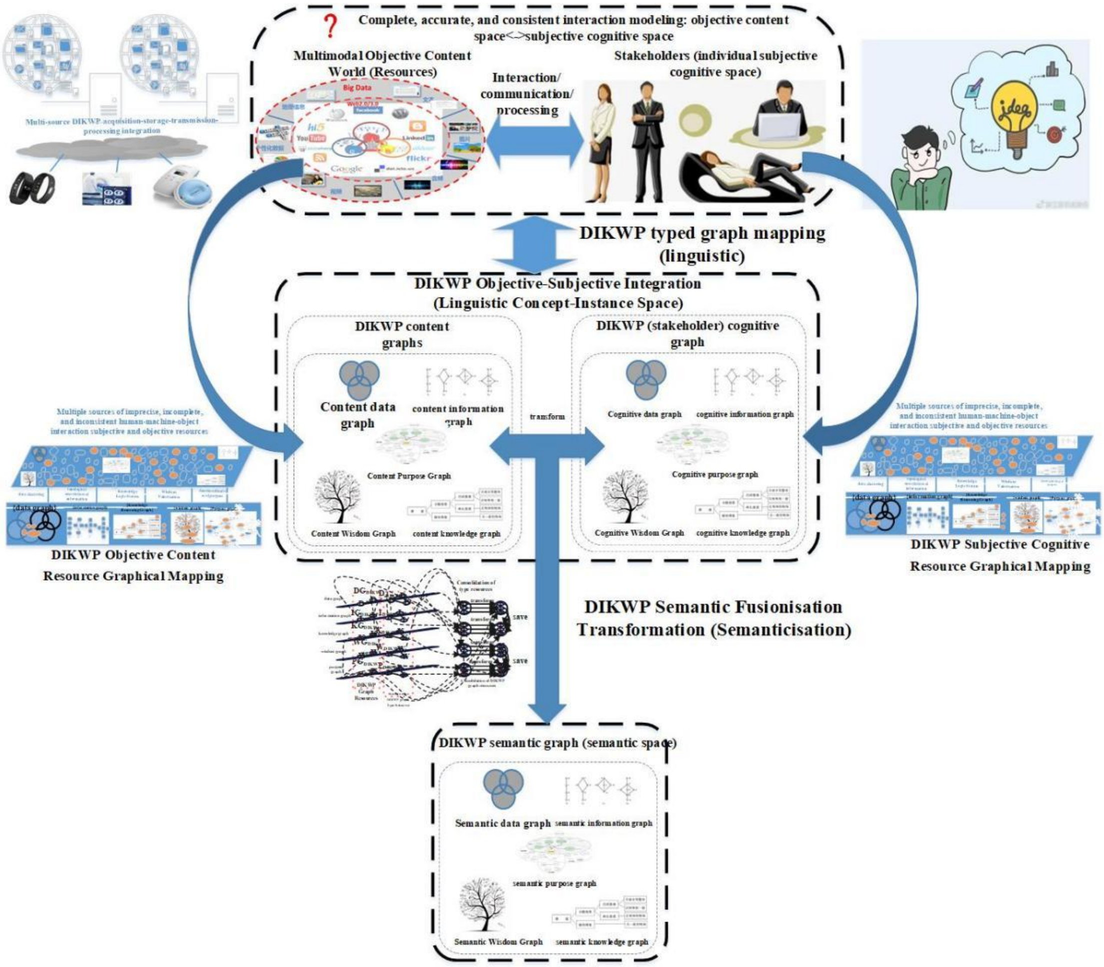

Figure 3-5 DIKWP Resource Concept Instance Semantic Mapping and Association Transformation

4 Data Conceptualization

The semantics of Data **(DIKWP-Data)** can be seen as specific manifestations of the same semantics in cognition. In the conceptual space, the concept of Data represents the existence of specific facts or observational results in the conceptual space of cognitive entities, confirmed by semantic correspondence with the consciousness space (non-subconscious space) of cognitive entities and the existence of certain shared semantics with existing cognitive concept objects. When processing Data concepts, cognitive processes often seek and extract specific shared semantics that label these Data concepts, thereby unifying them as the same concept based on corresponding shared semantics. For example, when observing a group of sheep, although each sheep may differ slightly in size, color, gender, etc., cognitive processing categorizes them under the concept of "sheep" by accurately matching individual or probabilistic shared semantics related to "sheep". Shared semantics can be specific, such as recognizing the concept of an arm based on the number of fingers, color, and shape similarity between a silicone arm and a human arm, or probabilistically selecting the target object with the most shared semantics with the concept of an arm. Conversely, silicone arms lacking the rotational function of real arms would be judged not to belong to the concept of arm Data based on the semantic judgment defined by "rotatable." The distinction between conceptual space and semantic space corresponds to different philosophical perspectives on technology.

Concept space processing corresponds to specific forms of communication using natural language. However, the essential function of conceptual communication is usually to convey semantics. In the cognitive space of cognitive entities, an effective understanding of conceptual transmission semantics often depends on the semantic correspondence of related concepts in the semantic space of cognitive entities. The semantic space of cognitive entities often cannot be fully shared through conceptual forms, also known as subjective, thus referred to as subjective.

In the semantic space, the semantics of Data concepts represent specific manifestations of the same semantics set in cognition. Corresponding to specific Data semantics D, each element $d \in D$ represents a concrete instance, sharing the same or probabilistically approximate semantic attribute set S. Semantic attributes S are defined by a set of feature semantics F, such as:

$$S=\{f_1, f_2, \dots, f_n\}$$

where f_i represents a feature semantic of the data.

$$D=\{d \mid d \text{ share } S\}$$

In the DIKWP model, the distinction between data concepts and Data semantics forms the basis for the cognitive process's transition from cognitive space to the processing of conceptual space and semantic space. Data concepts and data semantics represent specific cognitive Data objects that directly embody basic observations and factual Knowledge about the world. The key to this transformation lies in the "same semantics" shared among Data concept elements behind their cognition and conceptualization, i.e., the semantic attributes they share. In the cognitive space, Data cognitive objects serve as the foundation of cognitive processes, no longer merely representing observations and measurements of the real world without distinguishing between specific correspondences in conceptual and semantic spaces, but undergoing explicit conceptual confirmation and semantic correspondence processing. This process also distinguishes between subjective and objective content categories, differing from the traditional DIKW model's crude understanding of Data by emphasizing the close association between Data and specific semantic attributes. Thus, cognitive recognition of Data involves actively seeking semantic features that match known cognitive objects, highlighting the subjectivity and context dependence of Data, and emphasizing its cognitive value in associating with existing conceptual spaces of cognitive entities.

In the DIKWP model, the semantics of Data cognitive objects from cognitive space are considered specific manifestations recognized in the semantic space of cognitive entities with the same semantics during the cognitive process. This definition emphasizes that Data as cognitive objects are not mere records of observations or facts but result from semantic matching and conceptual confirmation processes conducted by cognitive subjects (such as humans or AI systems) in conceptual space and semantic space. The key to confirming Data concepts lies in the "same semantics" shared by cognitive space and semantic space of cognitive entities, enabling specific cognitive objects to be categorized under the same Data concepts even in cases of external differences.

Data concepts are viewed as basic conceptual units in the conceptual space of the DIKWP model's cognitive process, while Data semantics are viewed as basic semantic units in the semantic space of the DIKWP model's cognitive process. Data concepts and Data semantics are core elements in the cognitive process of directly observing and recording the real world, playing an important role from the cognitive recognition of Data semantics to the confirmation of Data concepts in generating, applying, and processing concept-based symbolic natural language. Data concepts are recognized and classified by the conscious or subconscious cognitive functions of cognitive entities through sharing the same semantic attributes. In cognitive science, how the brain and even physical parts such as the spinal cord of cognitive entities understand and process Information through subconscious pattern recognition and can conduct conscious analysis and form explanations is crucial. For example, when people observe different objects (such as apples), even with differences in color, size, or shape, they can recognize them as apples in subconscious pattern recognition. Through conscious analysis, they can explain this recognition by sharing a set of key semantic attributes (such as shape, texture, specific functions, etc.). This cognitive process reveals how the cognitive system of cognitive entities uses the same semantics of Data in semantic space to construct natural language conceptual representations of the world.

In the DIKWP framework, Data as concepts are seen as specific concept mappings of the same semantics in the cognitive process. This viewpoint breaks through the confusion in traditional Data concepts where semantics and concepts are undistinguished, linking the formation and existence of Data concepts in conceptual space closely with the semantic processing process of cognitive entities in semantic space. That is, the cognitive value of Data concepts lies not in their physical form or function but in how they establish connections across "conceptual space" and "semantic space" in the cognitive space of cognitive subjects (such as humans or AI systems), thereby being recognized and confirmed as objects or concepts with specific semantics. From the perspective of interaction between individual consciousness and group consciousness, the interaction between Data and cognitive entities is fundamentally based on the interaction between semantic space and conceptual space in subconscious or subconscious terms. Data concepts, as specific correspondences of the same semantics set, or probabilistically approximate, have their advantages in cognitive communication efficiency as symbolic expressions of specific semantic sets in engineering terms.

4.1 Mathematical Representation of Data Concepts

In the DIKWP model, Data concepts are not merely passive records of observational results but collections of semantic objects actively recognized and classified by cognitive systems. Mathematically, we can view Data concepts as a collection D of semantic instances, where each semantic instance $d \in D$ is identified as having the same set of semantic attributes S. Here, $S=\{f_1, f_2, \ldots, f_n\}$ can be seen as a set of parameters defining the semantic features of Data concepts, where f_i represents a semantic feature of the Data concept. This representation helps us understand how Data concepts are induced and processed based on shared semantic features.

4.2 Mathematical Description of Data

In the DIKWP model, Data concepts are regarded as specific manifestations of the same semantics in cognition. Mathematically, we can define the semantic set D corresponding to Data concepts as a vector space, where each element $d \in D$ is a vector representing a specific semantic instance. These semantic instances are categorized under the same semantic attribute S by sharing one or more semantic features F, i.e.,

$$S=\{f_1, f_2, \ldots, f_n\}$$

Where f_i represents a semantic feature of Data concepts. Therefore, we can define the collection of Data concepts as:

$$D=\{d \mid d \text{ share } S\}$$

This description emphasizes the semantic multidimensionality and semantic structural nature of data concepts, while also providing a mathematical foundation for subsequent data concept processing and analysis.

4.3 Data Concepts and Semantic Recognition

In the DIKWP model, the processing and understanding of Data concepts go beyond the mere recording of objective facts; they involve how cognitive entities match these factual semantics with their existing semantic cognitive structures. This process emphasizes the importance of semantic recognition—how cognitive entities identify and classify objects based on the semantic features within Data concepts.

4.4 Specific Manifestations of Data Concept and the Same

Semantics

In the DIKWP model, Data concepts and semantic recognition view Data concepts not just as observations and recordings of the real world but as specific manifestations of the same semantic attributes perceived by cognitive entities in communication and interaction. This definition transcends the surface-level independent objective cognitive existence of Data concepts as records of objective facts, emphasizing the cognitive nature of Data concepts in the interaction between cognitive entities in cognitive space. That is, the recognition and processing of Data concepts depend on the connections and matches with existing semantics in the subjective semantic space of cognitive entities. Data concepts inherently possess cognitive subjectivity and context-dependence, meaning that the same Data concept may be linked to and processed with different semantics depending on different cognitive entities or cognitive backgrounds.

Philosophically, Data concepts cease to be mere objective records of existence but become subjective interpretations through the subjective cognitive processes of individuals. The formation and existence of Data concepts rely on the semantic space and conceptual space memory and processing capabilities of cognitive entities, representing the correlation and transformation between the semantic space and conceptual space in the interaction between the real world and cognitive entities. The generation and recognition of Data concepts are not purely objective processes but are deeply rooted in the preconceived conceptual space and contextual semantic space of the subject. Therefore, the recognition and interpretation of Data concepts must take into account the cognitive spatial background Knowledge, experiential Information, and cultural contextual semantics of cognitive entities.

The meaning of Data concepts must be confirmed through the interpretation and semantic matching of cognitive entities. The interaction between Data concepts and Data semantics becomes a bridge connecting objective reality with subjective cognition. This understanding highlights a Platonic idea: things in the real world (as concepts) are only shadows of their ideas (i.e., "same semantics"). Thus, the cognitive value of Data concepts lies not only in the objectivity of their forms but also in how cognitive entities seek and confirm the shared semantics of cognitive objects and phenomena through Data concepts, triggering semantic resonance and cognitive confirmation. This interactive process of re-cognizing Data concepts and Data semantics within cognitive entities is not only a cognitive mirror reflection of the external world for cognitive entities but also a pursuit and revelation of the intrinsic semantic nature of phenomena. It emphasizes the cognitive dominance and creative existence of conceptual semantic transformation in the interpretation of Data concepts by cognitive entities, as well as the interaction between Data concepts and the subconscious or conscious symbolic language of cognitive entities.

4.5 Cognitive Properties and Semantic Entities of Data

The DIKWP model's cognitive definition of Data concepts and Data semantics emphasizes the cognitive nature of Data and their role as semantic entities. In philosophy, this touches upon discussions of the "essence of things" and "being true to the name." Data concepts are not merely symbolic records of objective existence; they are entities endowed with specific Data semantics, which are confirmed and endowed through the cognitive entity's processing across conceptual and semantic spaces. This cognitive processing also reveals that Knowledge generation is not just a mapping of the objective world but also a subjective process of construction based on the transformation from similar semantics to concepts. This aspect is reflected in Kantian epistemology, where human Knowledge of the world partly originates from external stimuli but is largely determined by our cognitive structures.

5 Information Conceptualization

Information (DIKWP-Information) as a concept corresponds to one or more "different" semantics in cognition. The Information semantics of the Information concept refer to the semantic association in the semantic space of the cognitive entity's cognitive space with the DIKWP cognitive objects already recognized by the cognitive entity through specific Purpose concepts or Purpose semantics. This is achieved by using the cognitive Purpose of the cognitive entity to form identical cognition (corresponding to data semantics) or different cognition in the cognitive space, with the probability confirmation of different cognition in the semantic space through "different" semantics or logical judgment confirmation, forming new semantic associations ("new" is a kind of "different" semantics). When processing the concept or semantics of information, cognitive processing identifies the differences between the input cognitive contents such as Data, information, Knowledge, Wisdom, or Purpose, and the recognized DIKWP cognitive objects, corresponding to various different semantics, and classifies information accordingly. For example, in the cognitive space, facing a parking lot, although all cars in the parking lot can be cognitively classified into the concept of "car," each car's parking position, time, wear and tear, owner, functionality, payment records, and experiences represent cognitive differences recognized by different cognitive Purpose in the semantic space, ultimately corresponding to different information semantics. Various different semantics corresponding to information objects often exist in the cognition of the cognitive entity but are frequently not explicitly expressed. For example, a patient with depression may use the concept of "low spirits" to express the increase in the negative intensity of their current emotions relative to their past emotions in their cognitive space. When the cognitive entity selects the concept of "low spirits" in its conceptual space to reflect its confirmed cognitive state, the target information semantics to be expressed, due to the fact that the information semantics interpretation of the concept of "low spirits" in the cognitive space of the communication target may not necessarily be the same as that of the cognitive entity or may have different semantics, thus failing to achieve the objective perception of the information semantics felt by the communication target, and therefore, this information semantics becomes the subjective cognitive information semantics of the cognitive entity.

Mathematical representation of information semantics processing: Information semantics in the DIKWP model correspond to Data semantics, information semantics, Knowledge semantics, Wisdom semantics, and Purpose semantics, generating new semantics through the cognitive entity's Purpose-driven processing. In the semantic space, Purpose-driven information semantics processing F_I for DIKWP content corresponds to the processing form from input X to output Y:

$$F_I : X \rightarrow Y$$

Where X represents the set or combination of Data semantics, information semantics, Knowledge semantics, Wisdom semantics, and Purpose semantics (collectively DIKWP content semantics), and Y represents the generated new set or combination of DIKWP content semantics. This mapping emphasizes the dynamic and constructive nature of the information semantics generation process.

In the DIKWP model, information semantics correspond to the expression of various different semantics in cognition. Leveraging the cognitive Purpose of the cognitive entity, information semantics link the semantics corresponding to Data, information, Knowledge, Wisdom, or Purpose with the cognitive entity's existing cognitive objects, generating new sets or combinations of semantics. In the cognitive space, this process includes not only the recombination and semantic transformation (including semantic connectivity to form what is known as cognitive understanding) of known DIKWP content but also corresponds to a dynamic process of generating new DIKWP cognitive semantics and continuously forming cognitive understanding through such recombination and transformation.

The generation of information semantics concerns how to connect sets or combinations of different Data semantics, information semantics, Knowledge semantics, Wisdom semantics, or Purpose semantics through the cognitive entity's specific Purpose, thereby confirming cognitive understanding in the cognitive entity's cognitive space. It corresponds to the cognitive entity forming semantic associations, supplements, judgments, and thus eliminating cognitive uncertainty Purpose originating from semantic uncertainty. This process involves associating, comparing, and conceptually corresponding observed phenomena or cognitive input contents with existing DIKWP content in the cognitive space, thereby using various semantic recognition and classifications to generate new DIKWP content. In AI, this can correspond to the formation of cognitive understanding, explaining and processing the relationships between DIKWP content, such as extracting valuable information semantics through algorithmic analysis of the correlation between DIKWP content.

Information semantics processing is a dynamic cognitive process that focuses on how to link DIKWP content semantics with the cognitive entity's existing cognitive objects DIKWP content semantics through the cognitive entity's subjective Purpose, thereby generating valuable semantic associations. The value of information lies in serving as a bridge connecting Data, information, Knowledge, Wisdom, and Purpose, revealing the semantic associations of the cognitive entity with DIKWP content.

In cognitive science, information semantics processing can be explained using various cognitive theories. For example, Conceptual Integration Theory further explains how to integrate information from different sources to create new meanings and understanding. Similarly, by combining a person's behavior (DIKWP content semantics) with specific contextual information, a clearer understanding of their Purpose can be achieved.

The semantic associations of information are related to theories in cognitive linguistics such as Metaphor Theory and Blending Theory, which study how new meanings are created through metaphor and conceptual integration in language. In AI systems, this involves designing algorithms to simulate how humans construct new cognitive models through existing DIKWP content semantics.

The process of generating information semantics is the result of the interaction between DIKWP content semantics and DIKWP*DIKWP semantic interactions. This process includes not only the reorganization or reinterpretation of DIKWP content semantics but also a dynamic, Purpose-driven cognitive activity. Through this activity, the cognitive entity can identify and understand new patterns and associations, thereby expanding its cognitive boundaries. The generation of information semantics is constructive and dynamic, simply put, it is generated through the interpretation or semantic connection of DIKWP content.

In philosophy, information is seen as the organization and interpretation of DIKWP content, generating new semantics by constructing semantic relationships between DIKWP content. Through the process of information semantics processing, the cognitive entity can identify and understand the connections and differences between phenomena. The generation of information semantics involves active participation by the cognitive entity; it is an action of semantic processing of DIKWP content, reflecting the cognitive entity's interpretation of the real world. Information, as the expression of different semantics in cognition, philosophically signifies the recognition and understanding of the diversity and complexity of the world. Information semantics is not just an aggregation or recombination of DIKWP content semantics; it is the creation of new semantic associations, reflecting the cognitive entity's active exploration and interpretation of the world.

This interpretive process involves delving into the deeper connections and underlying logic of phenomena, representing a pursuit of a deeper understanding of the world.

5.1 Construction Nature of Information Semantics

The generation and understanding of information are not passive processes of reception but active cognitive semantic constructions within the cognitive space by the cognitive entity. Information semantics depend on existing DIKWP content and Purpose-driven cognitive frameworks. This viewpoint resonates with Kant's epistemology, where the understanding of the world by the cognitive entity is constituted through internal perceptual frameworks and a priori concepts. The value of information lies in its ability to expand or reconstruct our cognitive frameworks, thereby enhancing our understanding of the world.

5.2 Diversity and Depth of Information Semantics

In DIKWP, information processing focuses on the dynamic relationships between Data, information, Knowledge, Wisdom, and Purpose, and the generation of new sets or combinations of semantics. This process embodies Heraclitus' doctrine of flux — everything flows, nothing stands still. The value of information lies in its fluidity and its capacity to induce change, rather than static factual records. Information becomes a link connecting different cognitive states, driving the cognitive entity from one state of understanding to another.

5.3 Dynamicity of Information and Cognitive Structure

In the definition of information, the DIKWP model emphasizes the role of information as a bridge connecting different semantic entities. This echoes Deleuze's theory of "difference and repetition." According to Deleuze, the process of cognition occurs through recognizing the differences between things, which is the core of information processing. Information not only contains the semantic differences of DIKWP content but also creates connections with existing Knowledge structures through these differences. This process not only integrates old Knowledge but also generates new Knowledge. This dynamic cognitive structure updating process is crucial for cognitive development and Knowledge growth.

6 Knowledge Conceptualization

The semantics of Knowledge **(DIKWP-Knowledge)** concepts correspond to one or more "complete" semantics within the cognitive space. The semantics of Knowledge concepts are the cognitive entity's understanding and interpretation of semantics between cognitive objects of DIKWP content, obtained through semantic integrity abstraction activities using certain assumptions (i.e., forming cognitive inputs of the cognitive entity's cognitive interaction activities with existing cognitive DIKWP content semantics, and corresponding to one or more "complete" semantics that carry cognitive integrity Purpose in higher-order cognitive spaces). When dealing with Knowledge concepts, the brain abstracts at least one concept or pattern corresponding to complete semantics through observation and learning. For example, while it is impossible to know all swans are white through observation, in the cognitive space, the cognitive entity can apply assumptions (higher-order cognitive activities assigning complete semantics) to some observed instances that do not guarantee complete observational results, thus attributing "complete" semantics, i.e., "all" forming Knowledge semantics corresponding to Knowledge rules such as "all swans are white".

Knowledge K forms a semantic network, with its mathematical representation in conceptual space as follows:

$$K = (N, E, A_K)$$

where $N=\{n_1, n_2, \ldots, n_k\}$ represents the set of nodes of concepts, $E=\{e_1, e_2, \ldots, e_m\}$ represents the set of relationships between these concepts, $A=\{A_D, A_I, A_K\}$. This definition positions Knowledge cognition as a higher-level cognitive achievement, emphasizing the structured nature of Knowledge (such as semantic networks) and its capability to capture complete semantics, which is crucial for understanding complex systems and abstract concepts.

Knowledge bridges the transformation from a state of non-understanding to an understanding corresponding to DIKWP content, based on comprehensive semantics, and strengthens confirmation through validation. The construction of Knowledge relies not only on the accumulation of Data and information but more importantly on abstraction and generalization processes in cognition, forming a so-called understanding of the essence and intrinsic connections of things. Knowledge exists not only at the individual level but also at the collective or societal level, shared and disseminated through culture, education, and transmission.

Knowledge semantics refers to the structured understanding formed after deep processing and internalization of DIKWP content (within the conceptual space and corresponding to "complete" semantics in the semantic space). The definition of Knowledge within the DIKWP framework reflects a deep understanding of the world and a grasp of complete semantics. This resonates with Aristotle's concept of formal cause, suggesting that the essence and Purpose of things can be explored and understood through reason and experience.

The formation of a Knowledge rule in the DIKWP model represents the cognitive grasp of the intrinsic laws and essence of things by the cognitive subject. From a philosophical perspective, Knowledge is not only the product of cognitive processes but also the Purpose and guidance of these processes. The formation and application of Knowledge reflects the adaptation and transformation of the cognitive subject to the deeper regularities of the real world in the semantic space understanding.

6.1 Knowledge Concepts

Knowledge concept (DIKWP-Knowledge Concept) refers to the abstraction and generalization of entities, events, laws, etc., in the cognitive space of the cognitive subject towards the objective world. In the DIKWP model, Knowledge corresponds to one or more "complete" semantics in the cognitive space. Knowledge is obtained through cognitive activities where the cognitive subject abstracts the semantic completeness of DIKWP content with certain assumptions, gaining an understanding and interpretation of the semantic relationships between cognitive objects and DIKWP content. This understanding and interpretation form the cognitive input of the cognitive interaction activities between recognized DIKWP content and already existing cognitive DIKWP content, corresponding to one or more "complete" semantics carrying cognitive completeness confirmation in higher-order cognitive spaces. The formation of Knowledge concepts is a dynamic process influenced by cognitive Purpose, contexts, and existing cognitive structures.

6.2 Knowledge Semantics

Knowledge semantics (DIKWP-Knowledge Semantics) is formed through higher-order cognitive activities, assigning "complete" semantics to partial observation results, thereby forming systematic understanding and rules. It involves intrinsic connections between concepts and their external expressions. Knowledge semantics are not static but enriched and developed through the dynamically generated information semantics driven by the cognitive Purpose of the cognitive subject. This means that the semantics of Knowledge are not only based on objective facts but also depend on how the cognitive subject understands and interprets these facts in the current context and integrates these understandings with existing cognitive structures. The process of generating and confirming semantics includes identifying Data features, matching concepts, and probabilistic semantic confirmation, ensuring the applicability and accuracy of Knowledge.

6.3 Relationship Between Knowledge Concepts and Knowledge Semantics

In the DIKWP model, Knowledge concepts and Knowledge semantics are interdependent and inseparable. Knowledge concepts provide the basic framework and classification system for Knowledge, while Knowledge semantics fill in the content of these frameworks, giving concepts practical meaning that can be applied in specific contexts. Knowledge concepts provide a structured foundation for semantics, enabling cognitive agents to integrate newly acquired information with existing Knowledge networks. On the other hand, Knowledge semantics add dynamism and flexibility to concepts, allowing them to adapt to different cognitive tasks and changing environments. Through continuous cognitive processing, including Data collection, information generation, Knowledge construction, and Wisdom extraction, Knowledge concepts, and semantics interact and develop, collectively advancing the cognitive agent's deeper understanding of the world.

In essence, Knowledge concepts provide the "framework" for semantics, while Knowledge semantics fill this "framework" with "flesh" and together, they support the complexity and depth of the entire cognitive structure.

6.4 Structured Representation of Knowledge

In the field of Artificial Intelligence research, the precise expression and effective organization of Knowledge constitute the core driving force behind technological advancement. This process is deeply rooted in the meticulous construction of cognitive models and an in-depth understanding of information processing mechanisms. The following are several key Knowledge representation frameworks:

(1). Formal Logic Systems: As a foundational framework for Knowledge representation, formal logic, particularly propositional logic, and first-order predicate logic, provides a rigorous mathematical basis for the precise expression and reasoning of information. Propositional logic uses truth functions to express simple facts and their logical relationships, while first-order predicate logic achieves formal descriptions of entity attributes, relationships, and existence through advanced constructs such as variables, predicates, and quantifiers. This supports the deductive reasoning and consistency verification of complex propositions.

(2). Production Systems: This is a rule-based representation method where "condition-action" rules (i.e., production rules) become the primary units of Knowledge encoding. This model excels at simulating human expert decision-making processes, especially in fields such as diagnosis, planning, and problem-solving. The flexibility of production systems lies in their ability to dynamically select applicable rules based on input conditions, achieving a mapping from known facts to target actions, and demonstrating the efficiency and practicality of rule-based Knowledge processing.

(3). Frame Representation: A frame is a structured Knowledge template used to organize information about a specific topic. Each frame consists of several "slots" which are filled with specific Data or pointers to other frames, forming a closely connected Knowledge network. This method emphasizes the layering and modularization of Knowledge, facilitating the handling of structural information of complex concepts and supporting efficient information retrieval and updating operations.

(4). Process Representation: Process representation focuses on demonstrating the dynamics of Knowledge, paying attention to state changes, event sequences, and the execution of operations. It is particularly suitable for scenarios that require tracking state changes, simulating event sequences, or designing control processes. Through process representation, complex behavioral patterns and dynamic systems can be systematically described and analyzed, providing strong support for fields such as automated planning, robotic path planning, and workflow management.

Knowledge K is represented as a semantic network,

$$K = (N, E)$$

where $N=\{n_1, n_2, \ldots, n_k\}$ represents the set of concepts and node n_x, $x \in \{1,2,3,\ldots,k\}$ represents concepts, $E=\{e_1, e_2, \ldots, e_m\}$ represents the set of relationships between these concepts, and edge e_y, $y \in \{1,2,3,\ldots,m\}$ represents relationships between concepts. and each edge can be represented as

$$e_s = (n_i, n_j, r),\ n_i, n_j \in N,\ 1 \leqslant i, j \leqslant k,\ i \neq j.$$

where r represents the semantic relationship between n_i and n_j.

6.5 Cognition and Construction of Knowledge

Knowledge bridges the cognitive state transformation of understanding DIKWP content from misunderstanding to understanding, reinforced through validation. The construction of Knowledge relies not only on the accumulation of Data and information but, more importantly, on abstraction and generalization during cognitive processes, forming an understanding of the essence and inherent connections of things. Knowledge exists not only at the individual level but also at the collective or societal level, shared and disseminated through culture, education, and transmission.

Knowledge semantics are structured perceptions formed through deep processing and internalization of DIKWP content. This understanding exists within conceptual space and corresponds to "complete" semantics within semantic space. The definition of Knowledge within the DIKWP framework reflects a profound understanding of the world and a grasp of complete semantics. This resonates with Aristotle's concept of formal cause, suggesting that the essence and Purpose of things can be explored and understood through reason and experience.

In the DIKWP model, the formation of each Knowledge rule represents the cognitive grasp of the intrinsic laws and essence of things by the cognitive subject.

From a philosophical perspective, Knowledge is not only the product of the cognitive process but also its Purpose and guide. The formation and application of Knowledge reflects the cognitive subject's adaptation to and transformation of the real world, representing an understanding of the deep-seated laws of the semantic space of the world.

6.6 Cognitive Processing of Knowledge

In cognitive processing, cognitive agents abstract key concepts and patterns through observation and learning. They utilize functions such as identification, classification, reasoning, and memory to transform observed information into useful Knowledge, which then guides their thinking and actions. Take the cognitive model "All swans are white" as an example: this Knowledge construction involves observing swan colors across various times and places, integrating these observations to form a general statement about swan colors. Through accumulated experience, stable cognitive patterns are formed, and when faced with challenges such as discovering a black swan, these Knowledge patterns are updated and adjusted. This process highlights Knowledge as a dynamic cognitive structure that evolves based on new evidence and understanding, demonstrating its self-improvement capability during validation and expansion, and reflecting its semantic integrity and dynamic development.

6.7 Philosophical Significance of Knowledge

In the DIKWP model, Knowledge is not merely a record of observations and facts but a systematic understanding formed through assumptions and higher-order cognitive activities. The semantic integrity and systematic nature of Knowledge reflect the cognitive subject's profound understanding and interpretation of the world. The process of Knowledge generation emphasizes the active and creative role of the cognitive subject in understanding and interpreting the world. Through assumptions and abstraction, partial observations are endowed with complete semantics, thus forming systematic Knowledge.

Knowledge semantics are not just an aggregation or reorganization of DIKWP content semantics but a creation of new semantic associations, reflecting the cognitive subject's active exploration and interpretation of the world. Through assumptions and higher-order cognitive activities, the process of Knowledge generation can reveal deep connections and underlying logic between phenomena, providing a more comprehensive and profound understanding of the world.

6.8 Dynamicity of Knowledge Semantics

The generation of Knowledge semantics is a dynamic process involving how cognitive subjects link different DIKWP content semantics through assumptions and higher-order cognitive activities to form new Knowledge semantics. Within cognitive space, this process encompasses not only the romanticization and transformation of known DIKWP content but also the generation of new cognitive insights and Knowledge semantics through such recombination and transformation.

This dynamism is reflected in the process of Knowledge generation and updating, where through continuous observation, learning, and validation, cognitive subjects can develop and refine systematic Knowledge structures. These Knowledge structures not only explain phenomena but also predict future behaviors and characteristics, providing a deeper understanding and guidance of the world.

7 Wisdom Conceptualization

Wisdom **(DIKWP-Wisdom)** corresponds to information regarding ethics, social morals, human nature, and similar aspects. It represents a form of information derived from cultural and human societal norms, contrasting with relatively fixed extreme values of current times or individual cognitive values. When determining the semantics of Wisdom, the cognitive subject integrates semantic content including Data, information, Knowledge, Wisdom, and Purpose within their cognitive space. The core of human and artificial intelligence systems' Wisdom revolves around constructing a human-centered value system for building a community with a shared future for humanity. This core value system serves as the foundation to construct, differentiate, confirm, correct, and develop individual and collective cognitive, semantic, and conceptual spaces of DIKWP content semantics. They are applied to guide decision-making. For example, when faced with decision-making issues based on specific DIK part of DIKWP content, cognitive subjects should consider various factors such as ethics, morals, feasibility, and more, rather than solely relying on technical or efficiency-based aspects of DIK part of DIKWP.

Wisdom, denoted as W in the decision function, correlates Data, information, Knowledge, Wisdom, and Purpose, and outputs the optimal decision D^*:

$$W: \{D, I, K, W, P\} \rightarrow D^*$$

where W is a decision function that generates the optimal decision D^* based on Data, information, Knowledge, and Wisdom. This description emphasizes the comprehensiveness and goal-oriented nature of the decision-making process. It resonates with research in cognitive linguistics on how morals and values are expressed and conveyed through language.

In the DIKWP model, the concept of Wisdom is seen as a holistic embodiment based on core human values, integrating considerations of ethics, social morality, and individual values. Wisdom involves not only the application of Data, information, and Knowledge but also comprehensive consideration and balance of various factors, including moral and ethical aspects, in the decision-making process.

Wisdom semantics processing involves making judgments and decisions by integrating Data, Information, and Knowledge with individual or collective values and ethical concepts. In the field of AI, Wisdom semantics processing corresponds to developing advanced decision-making artificial consciousness systems or ethical AI. These systems can consider multiple factors based on human-centered principles to provide solutions that are more intelligent and aligned with ethical standards.

In cognitive science, the semantics of Wisdom of processing concept corresponds to the process of handling DIKWP content semantics from the perspective of human development, value systems, moral judgments, and social contexts. Wisdom content is not just an accumulation of DIKWP content but concerns how to process DIKWP semantic content in the semantic space based on a vision of building a human community, starting from cognitive space. For example, facing climate change, the application of Wisdom involves using the cognitive subject's understanding of environmental science (Knowledge), evaluating the long-term and short-term consequences of different courses of action (information), and making decisions (information) based on ethical and social responsibility (Wisdom).

The formations of Wisdom concept in cognitive subjects and social groups depends not only on the cognitive capabilities of individuals and cognitive groups in understanding DIKWP content semantics but also on the interaction, deep understanding, and reflection of individuals on their environment, cultural background, and social relationships corresponding to DIKWP content.

The DIKWP model views Wisdom as a critical factor in the decision-making process, involving considerations of ethics, morals, and values. It emphasizes the inevitable connection between Data, Knowledge, and information with value orientations in practical applications, reminding cognitive subjects that the cognitive process is not just about pursuing truth but is also premised on exploring the ideal human way of life. This corresponds to Aristotle's discussion of "Phronesis" or practical Wisdom, which explores how to make the best ethical judgments and decisions in specific contexts.

7.1 Core Values of Wisdom

The core values of Wisdom revolve around building a human community with a shared destiny, centered on human values. Cognitive subjects, relying on this core value system, construct, analyze, affirm, correct, and develop the DIKWP content semantics of individual and collective cognitive spaces, semantic spaces, and conceptual spaces.

7.2 Wisdom Decision-making Process

In the semantics of Wisdom of processing, cognitive subjects consider ethical, moral, and feasibility factors in the decision-making process, rather than just relying on technical or efficiency considerations based on Data, information, and Knowledge. The decision-making process includes the following steps:

- **Comprehensive Consideration:** When facing decision-making problems, cognitive subjects need to comprehensively consider factors such as ethics, morals, social responsibility, and feasibility. For example, decisions on climate change need to consider environmental impacts, social equity, and economic feasibility among various aspects.
- **Integration of DIKWP Content:** Cognitive subjects integrate the semantics of Data, information, Knowledge, Wisdom, and Purpose to form a comprehensive decision-making foundation. For instance, in public policy formulation, decisions require combining statistical Data, social surveys, historical Knowledge, and ethical principles.
- **Decision Output:** By comprehensively considering various factors, the decision function W outputs the optimal decision $D*$. This process emphasizes the necessity of balancing and optimizing multiple factors.

7.3 Cognitive and Social Aspects of Wisdom

Wisdom exists not only at the individual level but also at the societal level. The formation of individual Wisdom and social Wisdom relies on the integrated development of cognitive individuals and groups' DIKWP content semantic cognitive capabilities, as well as on a deep understanding and reflection of the environment, cultural backgrounds, and social relationships. The process of Wisdom formation includes:

- **Cultural inheritance:** Through cultural inheritance, Wisdom is shared and propagated within communities. For example, ethical values and moral principles in traditional cultures are passed down through education and social practices.
- **Social interaction:** Wisdom formation also depends on social interaction, where Wisdom continually develops and improves through communication and collaboration among people. For instance, collective decision-making processes in community governance exemplify the embodiment of Wisdom.

7.4 Philosophical Significance of Wisdom

The conceptualization of Wisdom reflects a focus on ethics, morals, and values, emphasizing comprehensive consideration and balance of various factors in the decision-making process. This corresponds to Aristotle's concept of

"Phronesis" or practical Wisdom, which underscores making the best ethical judgments and decisions in specific contexts. The formation and application of Wisdom embody the cognitive subject's adaptation to and transformation of the world, representing an exploration of the ideal human way of life.

7.5 Application of Wisdom in AI

In the field of AI, the goal of Wisdom semantics processing is to develop advanced decision-making artificial consciousness systems or ethical AI that can consider multiple factors based on human-centered principles and provide solutions that are more intelligent and align with ethical standards. Applications of Wisdom in AI include:

- **Ethical AI systems:** Designing AI systems capable of making ethical decisions in complex environments. For example, self-driving car systems need to weigh the safety of passengers and pedestrians in emergency situations to make decisions that adhere to ethical standards.
- **Advanced decision systems:** Developing advanced decision systems that integrate considerations from multiple factors. For instance, in medical diagnostics, AI systems need to combine patient medical history Data, medical Knowledge, and ethical principles to provide optimal treatment plans.

8 Purpose Conceptualization

The semantics of Purpose **(DIKWP-Purpose)** in the model correspond to a tuple (Input, Output), where both Input and Output consist of semantics related to Data, information, Knowledge, Wisdom, or Purpose. The semantics of Purpose represent stakeholders' understanding of the DIKWP content semantics of a phenomenon or problem (Input), as well as the objectives they hope to achieve through processing and resolving that phenomenon or problem (Output). When cognitive agents process Purpose semantics, they operate within a semantic space where they interpret the input DIKWP content semantics based on their predefined goal (Output) semantics. Through learning and adaptation of corresponding DIKWP content semantics processing, the output DIKWP content semantics gradually approaches the predefined goal semantics.

P = (Input, Output), the Input and Output are the semantic contents of Data, information, Knowledge, Wisdom, or Purpose. When processing Purpose semantics, a series of transformation functions T achieve semantic transformation from Input to Output based on the Input content and predefined objectives.

T: Input → Output, this representation emphasizes the dynamism and goal orientation of the process, providing a mathematical model for understanding and designing cognitive processes with specific objectives.

Purpose represents the Purpose fulness and directionality of cognitive processes, serving as the driving force behind individual or systemic actions. Purpose not only defines the transition path from the current state to the desired state but also reveals the dynamics and direction of cognitive activities. This goal-oriented cognitive process emphasizes the proactive and creative nature of the cognitive agent when processing information, as well as the underlying motivations and goals behind cognitive activities. The concept of purpose underscores that cognitive processes in the cognitive space are goal-directed—meaning that cognitive agents do not merely passively receive information but actively pursue specific goals and purpose, shaping how they understand and manipulate DIKWP semantic content such as Data, information, Knowledge, Wisdom, and purpose itself. Purpose guides not only the collection and processing of Data and information by cognitive agents but also influences the formation and application of Knowledge and the development and practice of Wisdom.

The concept of purpose introduces a teleological perspective, suggesting that cognitive activities are not purposeless Data processing but are aimed at achieving certain goals or satisfying needs. In the DIKWP framework, the inclusion of purpose enriches the model's dynamism and underscores the purposefulness and subjectivity of cognitive activities. This implies that within cognitive processes, cognitive agents actively seek, select, and interpret DIKWP semantic content based on specific goals and Purpose in the semantic space.

Purpose-driven processing provides a framework for understanding cognitive activities from a dynamic and goal-oriented perspective, aligning with theories such as Action Theory in Cognitive Linguistics. This enables the DIKWP model not only to explain existing cognitive phenomena but also to guide future cognitive activities, optimizing cognitive strategies and behaviors to achieve specific goals. In AI systems, identifying Purpose and designing goal-oriented behaviors are crucial for implementing intelligent behaviors, such as understanding user queries in natural language processing (NLP) or setting and optimizing paths to achieve goals in planning algorithms. In the study of artificial consciousness, understanding and simulating human Purpose recognition and goal-oriented behavior are critical for achieving advanced cognitive functions.

From a philosophical perspective, Purpose is not just a predefined goal of action but reflects the fundamental motive behind individual existence and behavior. Purpose embodies individual free will and aspirations for the future, serving as the intrinsic drive for interaction between individuals and the world. The existence of Purpose emphasizes the subjectivity and creativity of cognitive activities, revealing deeper meanings behind human behavior. This corresponds not only with Aristotle's concept of final causes, which posits that everything has a Purpose or ultimate reason for existence but also resonates with Hegel's teleological view and existentialist philosophy's emphasis on free will. In Hegelian philosophy, reality's drive comes from the unity of opposites, achieved through self-realization and self-negation in the process of purposive action. In existentialism, the emphasis is on individual choice and Purpose as decisive factors in one's existence. The Purpose dimension in the DIKWP model reflects that cognitive activities are not merely reactions to the external world but are processes that individuals actively construct based on their own Purposes and values.

8.1 Cognitive Process of Purpose

In cognitive processes, Purpose represents the transition path from the current state to the desired state, revealing the dynamics and direction of cognitive activities. This goal-oriented cognitive process emphasizes the proactive and creative nature of the cognitive agent when processing information, as well as the underlying motivations and goals behind cognitive activities.

8.2 The Application of Purpose

- **Artificial Intelligence:** In AI systems, recognizing Purpose and designing goal-oriented behaviors are key elements for achieving intelligent behavior. For example, autonomous vehicle systems need to understand and execute passengers' Purpose to make optimal decisions in complex traffic environments.

- **Natural Language Processing (NLP):** In NLP, understanding user query Purpose forms the basis for providing accurate and relevant answers. Systems need to identify user Purpose based on their input and generate corresponding outputs.

- **Cognitive Science:** In cognitive science, understanding human Purpose recognition and goal-oriented behaviors are crucial for achieving advanced cognitive functions. Researchers analyze human cognitive processes to design systems capable of simulating and optimizing these processes.

8.3 Purpose from a Philosophical Perspective

From a philosophical perspective, Purpose is not merely a preset goal of action but the fundamental motive behind individual existence and behavior. Purpose embodies individual free will and aspirations for the future, serving as the intrinsic drive for interaction between individuals and the world.

- **Aristotle's Final Cause:** Aristotle believed that everything in existence has a Purpose or ultimate reason. Purpose, as the core of cognitive activities, aligns with Aristotle's concept of final causes, emphasizing the importance of Purpose in cognitive activities.

- **Hegel's Teleological View:** Hegel posited that reality's drive comes from the unity of opposites, where through the process of purposive action, self-realization and self-negation lead individuals to higher cognitive realms.

- **Existentialist Free Will:** Existentialist philosophy emphasizes the decisive role of individual choice and Purpose in one's existence. Purpose reflects individual free will and serves as the core driving force of cognitive activities.

Acknowledgments

We would especially like to thank the contributing institutions and individuals for their invaluable opinions, technical support, and academic contributions. These contributions were not only evident during the writing of this document but also throughout the entire research, discussion, and review stages. The professional expertise and technical capabilities of each participating entity significantly enriched the content of this standard, ensuring its scientific rigor and practical utility.

Additionally, we extend our gratitude to all the experts who participated in reviews and provided feedback. Your insights were crucial for refining this standard. Special thanks go to those who took the time out of their busy schedules to attend workshops and meetings; your support and encouragement are the driving force behind our progress.

Lastly, we wish to express our appreciation to all the behind-the-scenes staff, including editors, proofreaders, and technical support teams. Without your efforts and professionalism, this document would not have been presented so timely and accurately.

We sincerely hope that through this standard document, we can promote international cooperation and development in the field of artificial intelligence, jointly advancing technological progress and enhancing social well-being. Once again, we extend our heartfelt thanks to all contributors!

Should there be any inaccuracies or issues with this document, please contact the secretariat for corrections.

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