

DOI: 10.5281/zenodo.19981475

PROSPECTS FOR USING SEVEN-VALUED JAIN LOGIC TO IMPROVE THE FRAMEWORK OF PHILOSOPHICAL CATEGORIES

Oleg Gabrielyan¹, Akhat Bakirov^{2*}, Dina Shaltykova³ and Ibragim Suleimenov⁴

¹Crimean Federal University named after V.I. Vernadsky, Simferopol, Crimean Republic Email:
gabroleg@mail.ru

²National Engineering Academy of the Republic of Kazakhstan, Almaty, Kazakhstan. Email: axatmr@mail.ru

³National Engineering Academy of the Republic of Kazakhstan, Almaty, Kazakhstan. Email:
dina_65@mail.ru

⁴National Engineering Academy of the Republic of Kazakhstan, Almaty, Kazakhstan. Email:
esenyeh@yandex.ru

Received: 15/03/2026

Accepted: 18/04/2026

Corresponding Author: Akhat Bakirov

(axatmr@mail.ru)

ABSTRACT

The article examines the possibility of using seven-valued Jain logic as a tool for clarifying and expanding the framework of philosophical categories. The point of departure is the assumption that interpreting logic exclusively as a means of establishing the truth of statements is insufficient for describing the real relations between the concepts employed by thought. In this context, formal logic is proposed to be understood more broadly, namely as a means of formalizing relations between the categories of natural and artificial language. On this basis, the basic construction of Jain logic, syādvāda, is analyzed, and a symmetric representation of its seven-valued structure is proposed, making it possible to compare it with a system of philosophical categories. It is shown that such a scheme allows for a new interpretation of the relations among the categories of matter, information, the material, and the ideal, and also makes it possible to consider multivalued logic as a means of classifying judgments without reducing them to the binary opposition of truth and falsehood. It is concluded that the seven-valued logical model may be regarded as a promising philosophical tool for the further analysis of complex forms of thinking and judgments represented in the contemporary information and communication environment.

KEYWORDS: Jain Logic; Seven-Valued Logic; Syādvāda; Multivalued Logic; Formal Logic; Philosophical Categories; Dialectics; Philosophy of Thinking.

INTRODUCTION

There is no doubt that human thinking does not fit into the set of operations formalized within the framework of binary logic (Lampinen et al, 2024; Van Benthem & Icard, 2023; Baron, 2023; Bhattacharjee et al, 2018; Zhang et al, 2025; Suleimenov et al, 2025; Ibragim et al, 2024). Otherwise, logic constructed on the basis of the opposition "Truth" - "Falsehood," understood in its "technical" sense, is obviously too impoverished to fully formalize the laws of thought. The fact that the modern "digital world" is built entirely on binary logic does not contradict the statement formulated above. Binary logic is the simplest form of logic; it is quite easily transformed into a correct mathematical form, and this is precisely why humans were able to "transfer this logic to machines."

It is appropriate to recall that G. Boole, as well as his predecessors and followers (Leitgeb et al, 2025; Community, 2019; Pan et al, 2023), viewed logic precisely as a tool for establishing the laws of thought, and specifically in a mathematically correct, i.e., highly formalized form. The fundamental ideas of this approach, which dates back to the fundamental works of G. Boole, who interpreted logic as a tool for uncovering the true laws of thought, are becoming particularly relevant in light of the negative trends emerging in the field of AI development (Bengio et al, 2024; Grace et al, 2025; Williamson & Prybutok, 2024; Saxena et al, 2025). It is becoming clear that the limitations of binary logic require a shift toward developing an algorithmic foundation for AI that increasingly approximates that underlying its biological prototype—human intelligence. It is also becoming evident that binary logic can only reflect a limited range of operations that human intelligence is capable of performing. In this regard, it is not surprising that there is increased interest in the practical application of various types of multi-valued logic, which, in principle, allow for the formalization of more complex operations than those within the purview of binary logic.

However, there is a more than significant nuance here. The formalization of logic—in the tradition that goes back to G. Boole—de facto means the formalization of the apparatus that allows us to judge the truth of certain propositions. G. Boole's ideas are de facto inextricably linked with the understanding of logic that goes back to Aristotle. In this sense, the "philosophical core" of any notion of logic in its traditional sense is the philosophical category of Truth.

It is important to emphasize that this tradition is also clearly evident in works devoted to the

development of various variants of multi-valued logics. There are ongoing attempts to interpret the values of variables in multi-valued logic through the prism of their "truth."

In our view, this approach—if we reason in terms dictated by practice, i.e., if we seek to formalize the real laws of thought—is methodologically limited.

Truth is undoubtedly a crucial philosophical category; however, the structuring of thought as such is clearly not limited to this category. At a minimum, any manifestation of imagination, not to mention the human capacity to lie, generates other forms of "truth." Thus, any of Shakespeare's works is formally a lie, but literary scholars rightly speak of "artistic truth" as a means of reflecting human characters, the spirit of a particular era, and so on.

Accordingly, the present paper starts from a broader understanding of logic. Formal logic is treated here not only as a means for evaluating the truth of statements, but also as a framework for describing stable relations between concepts used in natural and artificial language. From this perspective, seven-valued Jain logic is considered not as an object of historical reconstruction for its own sake, but as a productive model for classifying conceptual relations that cannot be reduced to the binary opposition of true and false. The paper first clarifies this expanded interpretation of formal logic, then introduces a symmetrical representation of *syādvāda*, and finally shows how this scheme helps reinterpret the categories of matter, information, the material, and the ideal, with possible relevance for the analysis of judgments in contemporary digital communication.

1. RESULTS

2.1. Interpretations of the concept of "formal logic"

As noted in the introduction, binary logic should be considered a special—and simplest—case of multi-valued logic, and its exceptional position as a means of creating the modern digital world is ultimately determined only by the fact that it is precisely the simplest form of logic—in terms of formalization—that humans have been able to "transfer to machines."

However, even starting from the simplest—binary—logic, it is possible to demonstrate the ambiguity of the very concept of "formal logic."

The modern digital world is built not only on binary logic as such, but also on its technical embodiment. Digital circuits typically distinguish two states: "current present" and "current absent." One of these states is assigned the value "logical zero," and the other "logical one," and the choice of

this correspondence is nothing more than a matter of convention.

Any operations on currents—provided they correspond to the "On/Off" pair—can be interpreted as logical. It is this fact that makes it possible to implement binary adders, memory cells, and ultimately, highly complex computing systems, including AI, in practice.

This clearly illustrates that formal logic, when reduced to algebraic operations, is nothing more than a reflection (model) of certain real processes. Modern mathematics is dominated by the axiomatic approach (Steingart, 2023; Hintikka, 2011; Cellucci, 2022; Rav, 2008; Borceux, 2014), according to which any mathematical object is defined by a list of formal axioms that themselves bear no relation to the real world. Such a high degree of abstraction has obvious advantages. Thus, group theory uses the same tools to describe both crystallographic symmetry classes and symmetry classes of irreducible polynomials (as well as many other objects (Davyaz, 2021; Antoine, 2021; Muller, 2013)).

From this perspective, it can be argued that binary formal logic, operating with the symbols 0 and 1, also allows for a wide variety of interpretations. In particular, it does not necessarily have to be about the opposition "True - False." Any other opposition, such as the pair "Quantity - Quality," can be viewed from exactly the same perspective. To illustrate this point, let's once again turn to classical digital circuits: anything can be assigned to a logical zero and a logical one (current, for example), as long as it doesn't lead to contradictions (which is the fundamental requirement of the axiomatic approach, which has become classical).

We emphasize that oppositions such as "Quantity - Quality" are fundamental to dialectics (both materialistic and idealistic). Specifically, any natural or artificial language must contain undefined concepts (more precisely, concepts whose meaning cannot be interpreted in the style of definitions given

in textbooks, in which the meaning of one word is revealed through other words). Objective dialectics defines such concepts through oppositions: "Content - Form," "Quantity - Quality," etc.

The method of dialectical pairs, however, allows only limited application (Suleimenov *et al*, 2025). The connections between concepts in natural and artificial languages, generally speaking, are much more complex, by no means exhausted by simple oppositions. Nevertheless, a conclusion can be drawn from the identification of the simplest form of connections between philosophical categories: the fundamental concepts that form the "framework" of natural language are given meaning precisely by the connections between them.

Accordingly, formal logic can be understood, among other things, as a tool for formalizing the establishment of connections between concepts used in human thought. With this approach, the transition to the use of multi-valued logic becomes entirely natural.

At this point, the key idea can be stated more simply. If logic is understood as a way of organizing relations between concepts, then binary opposition appears only as the simplest case. More complex conceptual relations require a richer formal structure. Classical dialectics already points in this direction, because it does not stop at simple oppositions, but also introduces mediating terms such as "measure," arising from the relation between quantity and quality.

Furthermore, the work cited above demonstrated that, even within the framework of classical dialectic, it is permissible to discuss other formal logical operations linking philosophical categories. One of these is directly related to Hegel's triad of "Thesis-Antithesis-Synthesis." In particular, the application of this triad to the opposition "Quantity - Quality" leads to the formation of the category "Measure", Fig. 1.

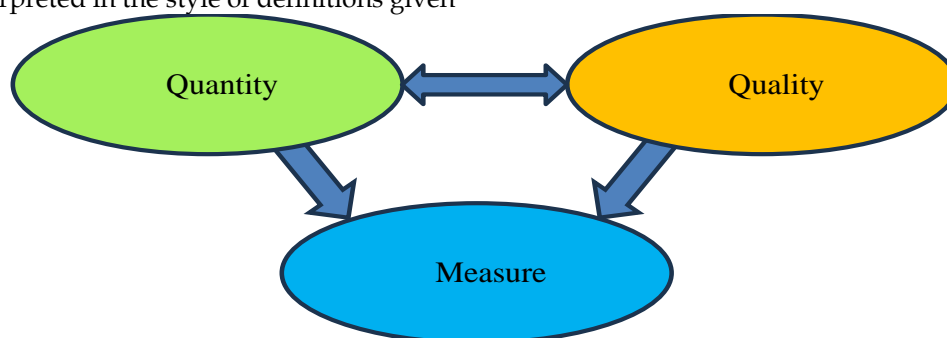


Figure 1: The Triad "Quantity - Quality - Measure".

Another example of the formation of formal logical operations based on classical dialectics is

based on an examination of the essence of the category "Information." In (Shaltykova et al, 2025; Suleimenov et al, 2019), it was shown that "Information" should also be interpreted as a dialectical category, paired with the category "Matter."

At first glance, the use of such a contrast seems to render the definition of information unconstructive. It becomes too general to be used for practical purposes (which, in particular, implies a certain "value" of information).

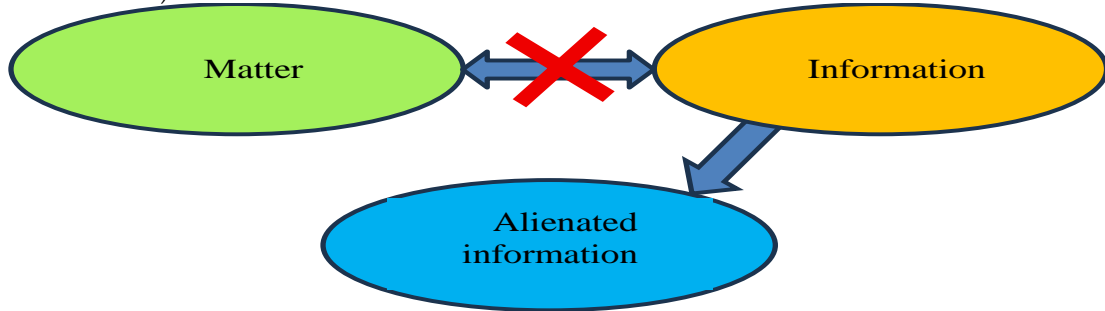


Figure 2: Introduction Of the Category Of "Alienated Information".

Any objectively existing object—an atom, a molecule, or something macroscopic—has both material and informational "components." On the one hand, any material object carries information about itself and others like it. On the other hand, any object that can be considered primarily informational cannot exist without a material carrier of information.

This corresponds to considering the categories of matter and information as a dialectical pair: on the one hand, they are opposed, and on the other, they form a unity in their opposition. Procedures such as studying a particular substance in a laboratory setting "break" the aforementioned dialectical unity—information about the object is transferred to another medium (note that information alienation can also occur at the molecular level; examples of this, particularly in the case of tunable sorbents, are presented in (DeWitt, 2020; Hua et al, 2021))

From this standpoint, language models provide an instructive example. They process not isolated true-or-false propositions, but context-dependent semantic configurations in which compatibility, partial expressibility, and indeterminacy matter alongside contradiction. A logical framework intended for such material must therefore describe several types of relations between concepts and judgments, not only binary opposition.

For this reason, Jain logic is relevant here. Its basic construct, *syādvāda*, incorporates conditionality, perspectival plurality, and partial expressibility into the logical form itself. The next subsection uses

This difficulty can be overcome by introducing the category of alienated information (Fig. 2, (Suleimenov et al, 2025)). This category allows us to resolve many of the contradictions and difficulties that arise when attempting to reveal the essence of information in the applied sense of this term. Specifically, this applies to attempts to use the distinction between "microinformation and macroinformation" or to attempts to provide a consistent interpretation of the concept of "valuable information."

syādvāda as a convenient model for extending the analysis of conceptual relations.

2.2. *Syādvāda* as a tool for describing connections between concepts

Syādvāda is the doctrine that all propositions are conditional, or more precisely, valid only under certain conditions, circumstances, or meanings, expressed by the word *syāt* (Sanskrit: "may be").

"*Syād*" can be interpreted in this context as "in some sense," "from a certain point of view," "in some aspect," "somehow," "perhaps," and so on. According to Jain logic, reality is complex, so no single statement can fully express its nature. Accordingly, each statement is prefixed with "*syāt*" (or, depending on the grammatical form, "*syād*"), imparting a conditional point of view and thereby eliminating any dogmatism in the statement.

Syādvāda is known as the theory of the seven conditional predicates.

These seven statements are:

1. In some sense, this is true.
2. In some sense, this is not true.
3. In some sense, it is indescribable.
4. In some sense, it is, and it is not.
5. In some sense, it is, and it is indescribable.
6. In some sense, it is not, and it is indescribable.
7. In some sense, it is, and it is not, and it is indescribable.

Each of these seven statements examines the complex and multifaceted nature of reality from the relative perspective of time, space, substance, and mode of existence. According to the jainist viewpoint

(Burch, 1964), to ignore the complexity of reality is to commit the error of dogmatism.

Attempts to formalize the logical structure of *syādvāda* are known in the literature (Ohta et al, 2013). In the cited work, the logical structure of *syādvāda* was associated with a set on which an ordering operation was defined (with seven statements being associated with seven truth values: *t* (true), *f* (false), *i* (undefined), and their combinations

tf, *ti*, *fi*, *tfi*, respectively). This corresponds to the graphical representation in Fig. 3. More precisely, this structure was associated with an upper semilattice (in the mathematical sense of the term). Recall that in mathematics, an upper semilattice is defined as a partially ordered set for which there exists a join point (least upper bound) for any non-empty finite subset.

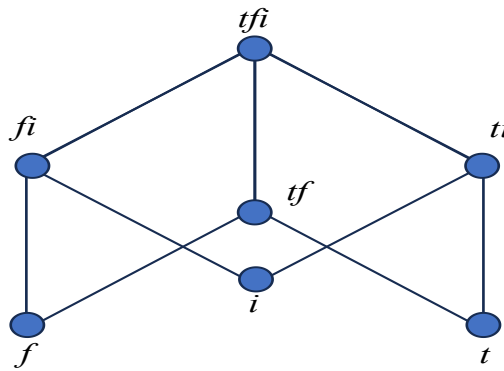


Figure 3: Seven Truth Values of Jain Logic as an Upper Semilattice (Ohta Et Al, 2013).

For the purposes of this paper, the diagram in Figure 3 is interesting because it can be seen as analogous to the diagram in Figure 1. The formation of the vertices *tf*, *ti*, *fi* can be viewed in terms of an analogy with the operation of formal-logical "synthesis," interpreted in accordance with classical dialectics.

As noted above, such an operation corresponds, among other things, to the establishment of connections between concepts that are actually used in human thought.

Consequently, if it is permissible to move from the constructs of classical dialectics to the construction of formal-logical operations of the type indicated above, then a similar approach can also be applied to operations corresponding to the logical structure of *syādvāda*.

For this purpose, it is appropriate to use the symmetrical graphical representation of the values of

the variables of seven-valued Jain logic, presented in Figure 4. As will become clear below, the advantage of this representation is the ability to generalize the apparatus of paired dialectical categories.

The same notations as in Figure 4 are used to denote the vertices of the diagram (graph) in Figure 4. 3. The difference in notation is that each letter combination is assigned a specific number. These numbers can also be considered as elements of the Galois field $GF(7)$. As shown in (Suleimenov et al, 2023), a one-to-one correspondence between the set of values of a variable in multivalued logic and the set of elements of a Galois field allows any logical operations to be reduced to algebraic ones. Such a correspondence is valid only if the number of values of the variables in multivalued logic is prime or an integer power of a prime. This condition is certainly satisfied in the case under consideration, since the number 7 is prime.

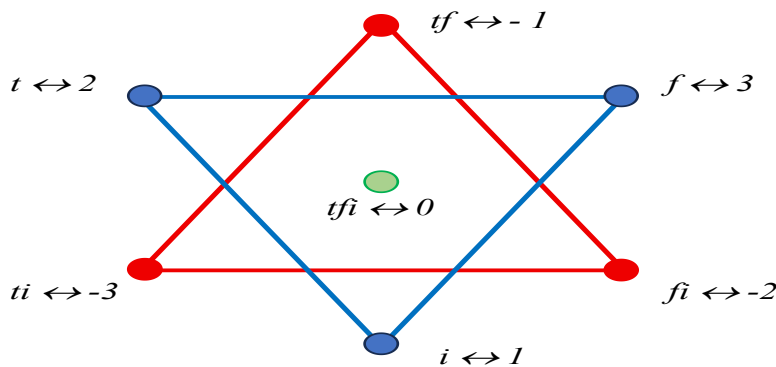


Figure 4: Seven Truth Values of Jain Logic - Reduction to a Symmetrical Structure.

The choice of the structure shown in Figure 2 is determined, in particular, by the following considerations. The letter combination *tf* is complementary to the combination *i*. Accordingly, in Figure 2, these combinations are located at opposite vertices (similarly for the other two pairs of opposite vertices). The elements of the Galois field corresponding to opposite vertices have opposite signs. Furthermore, judgments or concepts corresponding to the letter combination *tf* can be viewed as the result of a dialectical synthesis (in the sense of Hegel's triad) of judgments or concepts corresponding to combinations *t* and *f*. Accordingly, the vertex *tf* in Figure 2 occupies an intermediate position in relation to the vertices *t* and *f*.

This structure can be used, in particular, to clarify the position occupied by the category of information (as well as related categories) in the system of philosophical categories.

Material and Ideal: Interpretation from the Point of View of the Jain Logical System

As noted above, from the perspective of classical dialectics, "Matter" and "Information" should be interpreted as paired dialectical categories, which allows us to uncover their meaning. However, a significant nuance arises, related to the historically conditioned opposition between the material and the ideal, between materialism and idealism. More precisely, the following apparent contradiction arises. The opposition between the categories of "Matter" and "Information" seemingly leaves no room for the "Ideal"—in the classical sense of the term, at least if we operate with binary logic (including in the sense of paired dialectical categories). This contradiction is resolved using the

logical structure presented in Figure 4.

As noted above, any object existing in the surrounding reality simultaneously possesses attributes corresponding to both the categories of "Matter" and "Information." Consequently, any objects existing in nature cannot, in reality, correspond to either the category of "Matter" or the category of "Information" separately (the same applies to judgments about them, which returns to the views of Jainism). Objects existing in nature (and, more importantly, judgments about them, formed in the spirit of classical materialism) therefore correspond to the vertex *tf* of the diagram, Fig. 2, if the categories of "Matter" and "Information" are associated with vertices *t* and *f*. "Synthesis," understood in the spirit of Hegel, is thus one of the elements in the formation of this diagram. This synthesis can be designated by the category of "Material." This implies, first of all, that such a synthesis corresponds to judgments and concepts developed within the framework of classical materialist doctrines (Fig. 5).

The opposite of the "Material" in the sense of the operations depicted in Figure 2 is the "Ideal." It is precisely this category that corresponds to the constructs of classical idealistic doctrines, including those developed by thinkers such as Hegel.

Thus, the constructs of Jain logic can indeed be used to refine the apparatus of philosophical categories. However, this does not exhaust the question. As shown above, formal logical connections between concepts also have independent significance. Consequently, the logical structure depicted in Figure 5 can also be used for this purpose.

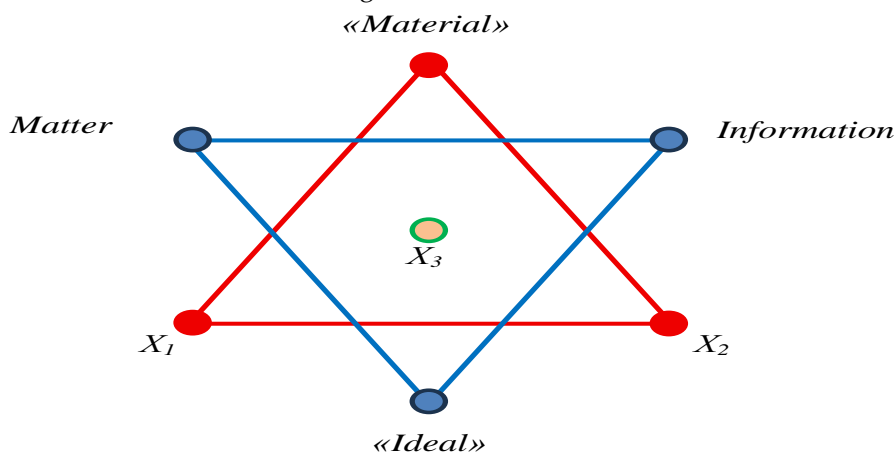


Figure 5: Using The Structure of Jain Logic to Interpret the Opposition "Material - Ideal".

2. DISCUSSION

The discussion may be formulated more directly

in relation to the paper's central claim. The relationships between concepts represented by the diagram in Figure 4 are important not only for philosophical interpretation, but also for the classification of judgments that arise in the contemporary information space. This perspective may be relevant for the monitoring of digital communication and for the development of corresponding analytical procedures (Hrytsiuk, 2020; Riabtsev & Marchuk, 2025; Edelsbrunner *et al.*, 2024), including in contexts associated with information warfare (Bakirov & Suleimenov, 2025). In such environments, one encounters judgments that are conditional, mixed, perspectival, or only partially expressible, and for this reason they cannot be adequately reduced to binary (Aristotelian) logic.

The discussion can now be stated more narrowly. The value of the proposed scheme lies not in reconstructing Jain doctrine for its own sake, but in showing that seven-valued logic offers a compact way to classify judgments and conceptual relations that are neither simply true nor simply false. This is potentially relevant for the analysis of contemporary digital communication, where many statements are conditional, mixed, strategic, or only partially expressible.

This can be illustrated by the debate on digital immortality, which has been actively discussed in recent decades (Chernavskaya, 2024; Savin-Baden *et al.*, 2017; Swan & Howard, 2012; Smart, 2021; White, 2022). One line of judgment assumes that personality can, in principle, be transferred to a non-biological informational carrier. Within the framework proposed here, such judgments gravitate toward the category of the "Material," since individuality is treated as an informational structure reproducible across different material media. The opposing line of judgment proceeds from the assumption that individuality is grounded in something non-reducible to informational transfer, for example in a spiritual or transcendental principle; in this sense, such judgments gravitate toward the "Ideal" pole of the scheme. The point of this example is not to resolve the truth of either position, but to show that the proposed framework makes it possible to classify conceptually opposed judgments without reducing them to the simple true/false format.

This formulation of the question is justified, among other things, from the perspective of the problem of monitoring the digital space. Specifically, the overwhelming majority of bloggers do not bother to find adequate arguments, yet their impact on public opinion is often significant. In the terminology of (Yefanov & Tomin, 2020), the activities of bloggers,

especially successful ones, lead to the emergence of certain information objects that can "live an independent life" and whose essence has no relation whatsoever to the category of Truth.

The logical structure presented in Figure 5 potentially allows for the classification of a wide range of judgments, as it—in a spirit close to classical dialectics—comprehends and reflects their contradictory nature, taking into account three basic components: material, informational, and transcendental. Moreover, unlike the authors of (Ohta *et al.*, 2013), we prioritize not the formalization of *syādvāda* constructs, but rather the conformity of its logic with the possibility of classifying various assertions.

The diagram in Figure 5 still contains three vertices, designated X_1 – X_3 . At the present stage, they should be interpreted only as preliminary and open positions within the proposed classification. It may be assumed that these vertices correspond to forms of judgment and meaning that are not exhausted by the opposition between the "Material" and the "Ideal," but their precise semantic interpretation requires separate study. In this sense, the proposed framework does not claim to provide a finished taxonomy of all possible judgments; rather, it indicates a broader formal space for their classification. Such caution is also consistent with a wider humanities tradition, according to which science based on one or another form of logic and a binary understanding of Truth represents only one form of knowledge of the world (Nielsen & Lynch, 2022; Oberheim, 2025; Ganeri, 2019).

At the same time, we do not claim any exclusive status for seven-valued logic as such. The choice of a formal logical apparatus is determined by the nature of the problem being solved, as well as by considerations of efficiency and convenience. Binary logic remains the simplest and historically most successful form of formalization, which largely explains its central role in the development of modern computing. At the same time, the growing interest in beyond-binary architectures and multiple-valued logic shows that other formal systems may be productive for other classes of problems (Sandhie *et al.*, 2021; Kim *et al.*, 2024). In this regard, seven-valued Jain logic appears useful not as a universal alternative, but as a convenient framework for the analysis of complex judgments presented in the contemporary information and communication environment.

3. CONCLUSIONS

The analysis demonstrates that seven-valued Jain

logic can be productively used not only as a historical and philosophical object of study but also as a conceptual framework for refining the apparatus of philosophical categories. Its significance lies in its ability to transcend the truth-centered understanding of logic and to consider logical structures as a means of identifying complex relationships between concepts and types of judgments. The proposed interpretation demonstrates that the categories of "matter," "information," "material," and "ideal" can be situated in a richer formal-semantic space than is

permitted by binary logic or a system of simple dialectical oppositions. However, the obtained results do not imply the exclusive status of seven-valued logic: its advantages stem from its convenience for solving this class of problems. Prospects for further work lie in refining the semantics of the intermediate positions of the proposed framework, expanding the range of analyzed categories, and developing procedures for classifying complex judgments arising in modern digital communication.

Author Contributions: Conceptualization, O.G. and I.S.; methodology, O.G., and I.S.; validation, A.B., and D.Sh.; formal analysis, I.S.; investigation, I.S. and A.B.; resources, I.S.; data curation, O.G. and I.S.; writing – original draft preparation, O.G., A.B., D.Sh. and I.S.; writing – review and editing, O.G., A.B. and I.S.; visualization, I.S.; supervision, I.S.; project administration, I.S.; funding acquisition, I.S. All authors have read and agreed to the published version of the manuscript.

Acknowledgements: This research is funded by the Committee of Science of the Ministry of Science and Higher Education of the Republic of Kazakhstan: AP26104635.

REFERENCES

- Antoine, J. P. (2021). Group Theory: Mathematical Expression of Symmetry in Physics. *Symmetry*, 13(8), 1354.
- Bakirov, A., & Suleimenov, I. (2025). Theoretical Bases of Methods of Counteraction to Modern Forms of Information Warfare. *Computers*, 14(10), 410.
- Baron, J. (2023). *Thinking and deciding*. Cambridge University Press.
- Bengio, Y., Hinton, G., Yao, A., Song, D., Abbeel, P., Darrell, T., ... & Mindermann, S. (2024). Managing extreme AI risks amid rapid progress. *Science*, 384(6698), 842-845.
- Bhattacharjee, D., Kim, W., Chattopadhyay, A., Waser, R., & Rana, V. (2018). Multi-valued and fuzzy logic realization using TaOx memristive devices. *Scientific reports*, 8(1), 8.
- Borceux, F. (2014). *An axiomatic approach to geometry* (Vol. 1). Berlin: Springer.
- Burch, G. B. (1964). Seven-valued logic in Jain philosophy. *International Philosophical Quarterly*, 4(1), 68-93.
- Cellucci, C. (2022). Analytic-Synthetic Method and Axiomatic Method. In *The Making of Mathematics: Heuristic Philosophy of Mathematics* (pp. 165-194). Cham: Springer International Publishing.
- Chernavskaya, O. (2024). To the problem of digital immortality. *Cognitive Systems Research*, 88, 101303.
- Community, T. (2019). The lean mathematical library. *Proceedings of the 9th ACM SIGPLAN International Conference on Certified Programs and Proofs*
- Davvaz, B. (2021). *A first course in group theory* (p. 43). Springer Singapore.
- DeWitt, K. (2020, April). Nano-engineered sorbent materials for chemical sensing. In *Micro-and Nanotechnology Sensors, Systems, and Applications XII* (Vol. 11389, p. 1138908). SPIE.
- Edelsbrunner, H., Ölsböck, K., & Wagner, H. (2024). Understanding higher-order interactions in information space. *Entropy*, 26(8), 637.
- Ganeri, J. (2019). Epistemic pluralism: From systems to stances. *Journal of the American Philosophical Association*, 5(1), 1-21.
- Grace, K., Sandkühler, J. F., Stewart, H., Weinstein-Raun, B., Thomas, S., Stein-Perlman, Z., ... & Korzekwa, R. C. (2025). Thousands of AI authors on the future of AI. *Journal of Artificial Intelligence Research*, 84.
- Hintikka, J. (2011). What is the axiomatic method? *Synthese*, 183(1), 69-85.
- Hrytsiuk, V. V. (2020). Algorithm of the automated events classification process in the information space.
- Hua, B., Ding, Y., Alimi, L. O., Moosa, B., Zhang, G., Baslyman, W. S., ... & Khashab, N. M. (2021). Tuning the porosity of triangular supramolecular adsorbents for superior haloalkane isomer separations. *Chemical Science*, 12(37), 12286-12291.
- Iacona, A. (2021). *LOGIC: lecture notes for philosophy, mathematics, and computer science*. Springer International Publishing.
- Ibragim, S., Oleg, G., & Yelizaveta, V. (2024). Problems of many-valued logic from the point of view of the

- theory of sociocultural code. *J. Ecohumanism*, 3, 236-248.
- Kim, W., Ahn, D., Lee, M., Lim, N., Kim, H., & Pak, Y. (2024). From light to logic: Recent advances in optoelectronic logic gate. *Small Science*, 4(12), 2400264.
- Lampinen, A. K., Dasgupta, I., Chan, S. C., Sheahan, H. R., Creswell, A., Kumaran, D., ... & Hill, F. (2024). Language models, like humans, show content effects on reasoning tasks. *PNAS nexus*, 3(7), pga233.
- Leitgeb, H., Nodelman, U., & Zalta, E. N. (2025). A defense of logicism. *Bulletin of Symbolic Logic*, 31(1), 88-152.
- Müller, U. (2013). *Symmetry relationships between crystal structures: applications of crystallographic group theory in crystal chemistry* (Vol. 18). OUP Oxford.
- Nielsen, C. R., & Lynch, G. (Eds.). (2022). *Gadamer's truth and method: A polyphonic commentary*. Bloomsbury Publishing PLC.
- Oberheim, E. (2025). Paul Feyerabend on Meaning and Method: From the Limited Validity of Falsificationism to "Anything Goes". *HOPOS: The Journal of the International Society for the History of Philosophy of Science*, 15(2), 599-616.
- Ohta, S., Hagiwara, T., Sawamura, H., & Riche, J. (2013). Specializing the Logic of Multiple-Valued Argumentation to the Jaina Seven-Valued Logic. In *Proceedings on the International Conference on Artificial Intelligence (ICAI)* (p. 1). The Steering Committee of The World Congress in Computer Science, Computer Engineering and Applied Computing (WorldComp).
- Pan, L., Albalak, A., Wang, X., & Wang, W. (2023, December). Logic-lm: Empowering large language models with symbolic solvers for faithful logical reasoning. In *Findings of the Association for Computational Linguistics: EMNLP 2023* (pp. 3806-3824).
- Rav, Y. (2008). The axiomatic method in theory and in practice. *Logique et analyse*, 125-147.
- Riabtsev, V., & Marchuk, Y. (2025). Intelligent system for monitoring the information space of news about artificial intelligence. *Collection "Information Technology and Security"*, 13(2), 279-289.
- Sandhie, Z. T., Patel, J. A., Ahmed, F. U., & Chowdhury, M. H. (2021). Investigation of multiple-valued logic technologies for beyond-binary era. *ACM Computing Surveys (CSUR)*, 54(1), 1-30.
- Savin-Baden, M., Burden, D., & Taylor, H. (2017). The ethics and impact of digital immortality. *Knowledge Cultures*, 5(2), 178-196.
- Saxena, D., Jung, J. Y., Forlizzi, J., Holstein, K., & Zimmerman, J. (2025, April). AI mismatches: identifying potential algorithmic harms before AI development. In *Proceedings of the 2025 CHI Conference on Human Factors in Computing Systems* (pp. 1-23).
- Shaltykova, D., Sedláková, Z., Kopishev, E., & Suleimenov, I. (2025). From Neuromorphic to Sociomorphic Materials: Perspectives and Prognoses. *Symmetry*, 17(12), 2110.
- Smart, P. (2021). Predicting me: The route to digital immortality? In *The mind-technology problem: Investigating minds, selves and 21st century artefacts* (pp. 185-207). Cham: Springer International Publishing.
- Steingart, A. (2023). *Axiomatics: mathematical thought and high modernism*. University of Chicago Press.
- Suleimenov, I. E., Gabrielyan, O. A., Bakirov, A. S., & Vitulyova, Y. S. (2019, October). Dialectical understanding of information in the context of the artificial intelligence problems. In *IOP Conference Series: Materials Science and Engineering* (Vol. 630, No. 1, p. 012007). IOP Publishing.
- Suleimenov, I. E., Vitulyova, Y. S., Kabdushev, S. B., & Bakirov, A. S. (2023). Improving the efficiency of using multivalued logic tools. *Scientific Reports*, 13(1), 1108.
- Suleimenov, I., Gabrielyan, O., & Matrassulova, D. (2025). Philosophical Foundations of Sciences and Prospects of Multivalued Logic in Describing Thinking. *Science & Education*, 34(6).
- Swan, L. S., & Howard, J. (2012). Digital immortality: Self or 0010110? *International Journal of Machine Consciousness*, 4(01), 245-256.
- Van Benthem, J., & Icard, T. (2023). Interleaving logic and counting. *Bulletin of Symbolic Logic*, 29(4), 503-587.
- White, J. (2022). Theoretical and practical paralogisms of digital immortality. *Journal of aesthetics and phenomenology*, 9(2), 155-172.
- Williamson, S. M., & Prybutok, V. (2024). The era of artificial intelligence deception: unraveling the complexities of false realities and emerging threats of misinformation. *Information*, 15(6), 299.
- Yefanov, A., & Tomin, V. (2020). Public opinion leaders designing in modern neo-information society. In *IV International Scientific Conference "Communication Trends in the Post-literacy Era: Multilingualism, Multimodality, Multiculturalism"*. – Ekaterinburg, 2020 (pp. 299-311). Knowledge E.
- Zhang, D., Li, Z. Z., Zhang, M. L., Zhang, J., Liu, Z., Yao, Y., ... & Liu, C. L. (2025). From system 1 to system 2: a

survey of reasoning large language models. *IEEE Transactions on Pattern Analysis and Machine Intelligence*.