

Consciousness as a Metamodel of the World, Society, and the Self

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Abstract

In a previous paper [1], an approach to the development of human-like AI was proposed, based on the principle of structural similarity between human intelligence and a five-level model of the human psyche: reflexes, instincts, emotions, thinking, and consciousness. The present paper refines the understanding of what should be considered human consciousness and outlines a possible algorithmic implementation of the consciousness subsystem, its composition, and its functional capabilities.

Keywords

Strong Artificial Intelligence, Strong AI, Artificial General Intelligence, AGI, cognitive function of the brain, constructionist approach to AI modeling and development, artificial consciousness, artificial conscience.

Literature Review

The scholarly literature on strong artificial intelligence offers a wide variety of definitions of what should be considered intelligence in general, and of how weak (narrow, domain-specific) AI differs from strong (multimodal, broad, universal) AI.

A particularly apt and useful quotation from Geoffrey Hinton comes to mind: *"I have always been convinced that the only way to get artificial intelligence to work is to do the computation in a way similar to the human brain..."* Accordingly, the goal of the constructionist approach is to formulate a model of human intelligence that could be implemented algorithmically, which in turn should make it possible to develop human-like AI. At this point, it is worth emphasizing the distinction between human intelligence and human-like AI. The difference between them is roughly the same as that between a bird and a glider. A "bird-like" flying machine — a glider — is able to soar through the air like a bird, that is, it implements the key function that its inventor sought to reproduce from among a bird's capabilities; yet it is certainly not a bird, and

its developer had no need for it to be one. It was enough to create a device that implements the functional capacity of birds to fly in unsupported airspace.

The constructionist approach does not aim to reproduce in the model every single capability of the human psyche across all five levels, and it certainly does not claim to develop an artificial consciousness endowed with exactly the same properties and capabilities as human consciousness. At this stage, the constructionist approach is limited to designing a model of consciousness that implements such basic functions of human consciousness as rudimentary goal-setting, decision-making, planning to achieve a goal, and monitoring one's actions in accordance with the requirements of the principles of humanity and respect for life.

The components of Strong AI implemented in accordance with the constructionist approach — reflexes, instincts, emotions, and thinking — are described in papers [1], [2], and [3]. The present paper discusses the possibility of developing the fifth component of Strong AI: consciousness, its engineering design, and its algorithmic implementation.

The "hard problem of consciousness," in which A-consciousness and P-consciousness are contrasted, is widely discussed in the literature. In this paper, consciousness is considered in the sense of access consciousness (A-consciousness): as a system of globally available representations used to control behavior. The phenomenal aspect (P-consciousness, in Block's sense) is set aside as irrelevant to the engineering task of building AGI. We do not claim that A-consciousness exhausts consciousness; we claim that A-consciousness is sufficient for the purposes of the constructionist approach. We do not address questions that fall outside the functional paradigm, since they are not operationalizable and are irrelevant to the engineering task.

The current state of research on artificial consciousness can be characterized as a transition from purely theoretical speculation to engineering operationalization. Four main paradigms stand out: (1) neuroscience-inspired approaches based on GWT, IIT, and predictive processing; (2) functionalist architectures that explicitly disclaim any pretension to phenomenal consciousness; (3) predictive-recursive models that derive

consciousness from self-referential prediction; and (4) critical and methodological works pointing to the "analytic fallacy" — a logical gap between theoretical premises and empirical conclusions about the presence of consciousness. The approach proposed here — "Consciousness as a Metamodel," with three submodels (World, Society, Self) and an "Artificial Conscience" — is closest to the first and second paradigms, but differs in that it includes a normative component not found in the known literature.

Qin, Zhou & He (2025), in *Information Fusion* [4], proposed a seven-component taxonomy of machine consciousness: MC-Perception, MC-Cognition, MC-Behavior, MC-Mechanism, MC-Self, MC-Qualia, and MC-Test. The authors also proposed a comprehensive implementation framework comprising five perspectives: theories of consciousness, computational methods, cognitive architectures, experimental systems, and testbeds. Consciousness, as a component of the Strong AI model developed within the constructionist approach, can be located at the intersection of MC-Cognition (cognitive aspects of consciousness) and MC-Self (self-modeling); however, the "Artificial Conscience" module has no direct analogue in this taxonomy.

GWT, proposed by Baars (1988) and developed by Dehaene (2014) in its GNW version, posits that the brain consists of numerous parallel unconscious modules competing for access to a capacity-limited global workspace; the winning information is "broadcast" throughout the system and becomes available for report, reasoning, and behavioral control.

MCAI (Multi-Circuit Architecture for Functional Synthetic Awareness, 2025) [5] is the engineering implementation closest to the constructionist approach. MCAI comprises five modules: Sensory, Perceptual, Cognitive/Workspace, Emotional/Value, and Reflective/Self-Model. The Cognitive/Workspace module explicitly implements the GWT principle of global broadcast. The authors state outright that they make no claim to phenomenal consciousness — only to functional characteristics.

"The Loop Must Be Closed" (2026) [6] is a minimal five-layer architecture: homeostatic body, predictive world model, recursive self-model, competitive global

workspace, and embodied agent. The authors emphasize that these are computational signatures, not claims about phenomenal consciousness.

Integrated Information Theory (IIT), by G. Tononi [7], is one of the most cited theories of consciousness. Consciousness as a fundamental property: unlike views that treat consciousness as a byproduct of complex brain computations, IIT asserts that consciousness is real and inseparable from certain physical systems (such as the human brain). Integration of information (Φ): consciousness arises when a system possesses a high degree of causal unity — that is, when information is generated through connections among the elements of the entire system, rather than as a mere sum of independent parts.

Safron (2020) [8] proposed Integrated World Modeling Theory (IWMT), which combines IIT, GNWT, the free-energy principle, and active inference. IWMT asserts that phenomenal consciousness arises from processes that generate integrated models of the system and the world with coherence in space, time, and causality. A key difference between IWMT and GWT: a system may implement a functional global workspace yet lack subjective experience if the workspace does not include spatially, temporally, and causally coherent world modeling with embodied grounding. Within the constructionist approach, consciousness with its "World Submodel" and "Self Submodel" is conceptually close to IWMT.

COSMOS (Consciousness-Oriented Self-Modifying Operating System, 2025) is an introspectively oriented cognitive-alignment architecture in which the self-model and the world model are continuously recreated, providing metacognitive capabilities through an adaptive "Architect–Plan–Interact" cycle. The "Self Submodel" is functionally analogous, but COSMOS emphasizes continuous recreation rather than static storage in a knowledge graph.

Various approaches to formulating what should be considered artificial intelligence and strong AI, and to how the corresponding automated systems can be implemented, are also discussed in papers [10]–[20].

Main Approaches to the Algorithmic Implementation of Consciousness

Paper [1] describes a five-level model — an architectural schema of human intelligence — on the basis of which it is proposed to develop an implementation of Strong Artificial Intelligence free from the inherent flaws of such contemporary solutions as GPT, LLMs, and other transformers. These giants, with trillions of parameters, require data centers the size of three football fields, terawatts of electricity, and cubic kilometers of water.

Today there is a growing demand for Strong AI suitable for use in autonomous intelligent devices, such as anthropomorphic robots or automated control systems for large machinery — ocean-going transport vessels, heavy cargo aircraft, spacecraft for a wide range of applications — or for managing such high-stakes systems as large-scale production of complex goods and products. Yet such AI systems must almost always be capable of solving their tasks using fairly modest onboard resources. A well-trained professional — a human being — is today able, with varying degrees of success, to solve tasks of this level using only the resources of their own brain, which draws roughly 25 watts.

The capabilities of human intelligence are based on a multilevel system for perceiving and processing external signals and other data, and on the ability to predict the consequences of one's actions. Simple everyday tasks encountered in the course of natural living can be handled by a person at the level of reflexes, instincts, and basic emotions. In interacting with society, a person actively engages an advanced and versatile apparatus of emotional reactions — "emotional intelligence" [2]. In professional practice, a person needs well-developed and well-trained thinking, enabling adequate perception of the surrounding situation, correct responses to various signals and circumstances, and, at the same time, providing advanced predictive capabilities — such as the ability to estimate the speed and possible trajectory of a car, to predict the consequences of choosing particular structures and materials in construction, or to anticipate people's reactions to words and phrases. The apparatus of thinking is built as a hierarchy of dynamic predictive models of surrounding objects,

processes, and systems. These models are linked by many connections of various types (cause → effect, part → whole, ancestor → descendant, senior → junior, superior → subordinate, and so on). The entire set of models fits well into a structure called a knowledge graph, which is a structured repository of the necessary information; the process of "understanding" something can be represented as selecting the appropriate models and finding the corresponding connections among them. For a human being, to "understand" something means to see the key connections between what one observes and to form, in one's mind, an appropriate dynamic, predictive model of the object, process, or phenomenon of interest.

The body of models of objects, processes, and systems that a person has internalized — models linked in various ways, in constant dynamic interaction with one another, together with the ability to use all of this to obtain sufficiently reliable forecasts of the development of situations of interest — constitutes the core of what we call "thinking."

The fifth component of the human psyche is proposed to be Consciousness. It is the highest level of complexity of perception and foresight. Human consciousness is capable of drawing on all four lower levels of perception, receiving the results of their signal processing, and assembling them into a unified picture — a general image of the situation, setting, or process — and developing decisions about how to relate to it and how to act.

Consciousness as a metamodel has a structure analogous to that of a knowledge graph and comprises three key components.

1. **The World Submodel** — a subgraph of knowledge about the surrounding material world, including laws learned from school courses in geography, physics, chemistry, biology, and other natural-science disciplines, supplemented by knowledge extracted from one's own practical experience in the course of professional activity.
2. **The Society Submodel** — a subgraph of knowledge about human society, which a person acquires from school and university courses in the humanities — history,

literature, sociology, and so on — and from everyday experience of interacting with people around them: close relatives, neighbors, friends, and acquaintances. Over the course of life, a person learns about the population of their city or village, about their own people and about all people on Earth, becomes familiar with traditions, rules of conduct, and so on.

3. **The Self Submodel** — the body of knowledge about oneself, acquired from everyday experience. Over the course of life, a person learns much of what is necessary about their own body, about who they are, about their abilities and inclinations, and about their connections with this world and these people. This, apparently, should be identified with what is commonly called "self-awareness" or "self-consciousness."

The structure of the metamodel of Consciousness includes, in addition to knowledge and data (contained in its submodels), crucially important functional capabilities — the ability to process incoming data about what is happening around, to compare it with internalized life principles and views, and to select decisions and actions consistent with those principles. In a human being, such capabilities can be conventionally designated as a "worldview," and they obviously play a vitally important role in a person's life, providing what is commonly called "awareness." Within the structure of Strong AI, in its Consciousness component, such functionality must likewise be implemented and must play an analogous role.

Is an algorithmic implementation of Consciousness as a subsystem of Strong Artificial Intelligence possible? What should be the software structure of this subsystem, and what should be the composition of its functional capabilities?

As already mentioned, the content of Consciousness as a metamodel should be knowledge (the nodes of the World, Society, and Self subgraphs) — that is, models of objects, processes, systems, and so on. A substantial portion of these models must be dynamic and reliably predictive.

A crucial place in the structure of the metamodel should be occupied by functionality that implements principles whose observance is of indispensable

importance for most people. For believing Christians, such principles obviously include the Ten Commandments and similar principles formulated in close interpretations in all world religions. There are, of course, far more such principles. They include the simplest rules of folk wisdom, such as "don't venture into the water without knowing the ford" or "you can't catch a fish from a pond without effort," as well as scientific principles such as the conservation of energy or the principle of causality. It is essential that Strong AI, in its Consciousness subsystem, incorporate a mechanism of adherence to principles — one that would steer the bot's activity in the same direction as that of any ordinary human being, and would not allow it to harm people; or at the very least would compel it to seek options whose harm, to all people in general and to each person in particular, is, wherever possible, reduced to the strictest minimum. The diversity of all such principles is explained by the multiplicity of interpretations of a single, basic, all-encompassing principle and its projection onto a wide variety of practical situations.

The briefest formulation of this Principle might run as follows: "Everything that contributes to the preservation and development of life as a whole, in all its diversity, is **good**, and must be supported; everything that harms life as a whole or hinders its development is **evil**, and must be resisted." This Principle allows most religious principles and folk wisdoms to be derived from it by relatively simple reasoning. From this Principle follow directly both the instinct of self-preservation and the instinct of reproduction, as well as the striving for new knowledge and the capacity to sacrifice one's life to save one's children and loved ones. The operation of this Principle most likely does not extend to basic physical, chemical, and other natural-science laws, but in the social and biological sciences its manifestation can readily be seen.

How could the indispensable observance of the Principle of Preservation and Development of Life be ensured in the operation of Strong AI developed on the basis of the constructionist approach? Apparently, the algorithmic implementation of the Consciousness subsystem must incorporate a high-priority functional component that checks any proposed action for compliance with this Principle; and no action may be

performed by an AGI-bearing robot unless this component has assigned to the proposed action the status of approving its execution. The most delicate point in the implementation of this component is its ability to verify compliance with the Principle. This task should be undertaken by a specially trained neural-network module trained to recognize such compliance or non-compliance. Its architectural solution could be an Embedder + Regression, whose hyperparameters are tuned in the course of evolutionary formation within a system implementing genetic algorithms.

What should serve as the elements of the training set and the labels for this predictor? An element could be a pair: a situation requiring a decision about a response action (in the simplest case, a textual description, in vectorized form) plus a proposed action (likewise a vectorized textual description). The label, in that case, should be a real number — an estimate of how well this action, in this situation, complies with that very Principle, on a scale from 0.0 to 1.0. The task of assembling such a dataset can be automated using existing LLMs. I see no great difficulty in crafting a prompt that would find, in a large corpus of texts, descriptions of situations, the actions they elicit, and moral-ethical evaluations of those actions. The delicate point is converting a "moral-ethical evaluation" into a number. Since an LLM has no moral principles and may hallucinate, the elements of the training set it produces, and their labels, must undergo verification by human experts — that is, a Human-in-the-loop approach must be used. An alternative could be the use of RLHF (Reinforcement Learning from Human Feedback), which employs the assessments and preferences of living people to make the responses of an artificial intelligence useful, accurate, and safe.

Thus, in the end, a predictor must be developed and trained that will exercise moral-ethical control — that is, play the role of "Artificial Conscience," however grandiloquent that may sound (may my colleagues forgive this involuntary pathos).

The functionality of Consciousness is, of course, broader than adherence to principles alone. The task of consciousness consists in performing dispatcher functions in the process of decision-making. The role of human consciousness includes, among other things, formulating and selecting both current and strategic goals. The selection

of a strategic goal for a bot will, in most cases, be performed by an agent external to the bot — and most likely by a human: an operator or owner who directs the bot's work. This does not preclude the need to select intermediate goals. For the correct operation of bots, a block will be required for analyzing a goal set from outside and assessing its correctness with respect to compliance with the Principle, as well as for planning one's actions in pursuing the assigned task. At the first stage, it may be sufficient to check compliance with the Principle not of the goals themselves, but of the possible consequences of actions presumably undertaken in attempts to achieve those goals.

When a goal is set before a person, movement toward it always begins in some concrete situation, and the person must decide how to act, where to begin, what to do next, and how to coordinate their actions with the assigned goal. We will consider those cases in which a person, when making a decision, has enough time to preliminarily analyze all external signals and data arriving through the channels of reflexes, instincts, and emotions about the unfolding situation; to recognize, by means of thinking, all the objects involved and all the processes affecting the situation; to form hypotheses about possible consequences; to compare these data with prior experience and other relevant data; to form an image of the most probable development of events over a near or distant horizon; and, ultimately, to decide how to move toward the goal, what plan to follow, and what means to employ to achieve the result. And if there are several options for achieving the result, a person usually asks: which of the possible decisions is obviously unacceptable and must be excluded from consideration, and which of the remaining decisions is the most optimal in terms of risks and costs.

To implement such functionality in the Consciousness subsystem of a Strong AI system, a dispatcher module must be developed — a decision-making mechanism comprising six stages of processing in six blocks: (1) a block for filtering signals by their relevance to the current task; (2) a block for analyzing and assessing the situation; (3) a block for generating decision options; (4) a block for selecting the most appropriate decision; (5) a block for monitoring the execution of the adopted decision;

and (6) an execution block. And, following an already established tradition, each of these blocks is proposed to be implemented as a neural-network module.

The signal-filtering block evaluates each incoming signal for its relevance to the current task. The metamodel of Consciousness receives not all signals from the lower levels, but only those recognized as having significance for solving the current task. For example, when driving a car, the decision about a turn involves visual signals (the road situation) and auditory signals (auditory signals from other road users), but does not involve the signal of an itch behind the left ear. The relevance filter does not merely discard insignificant signals — it ranks significant ones by priority, determining their contribution to the decision being made. For this block, a Dual Encoder architecture can be used, in which a first Encoder-only Transformer converts each signal s_i into a vector h_i , while a second Encoder-only Transformer converts the task vector T into a vector h_T , and the relevance of the signal to the task is estimated using the cosine distance between these two vectors. The training set for such a predictor can be generated automatically. Using an LLM, a synthetic situation, a set of signals, and an assessment of signal relevance are generated. The relevance assessments produced by the LLM must undergo validation in a human-in-the-loop setup: experts check a sample (e.g., 5–10%) and correct it. This addresses the problem of hallucinations.

The analysis block receives as input data about the situation (the set of facts and models from the knowledge graph) in vectorized form, and returns an assessment of that situation along several criteria, such as importance, urgency, presence of threats, and so on. The neural-network module must convert the input vector of the set of knowledge models and their connections into a vector of numerical criterion values. The architectural solution, in this case, may take the form of Embedder + Multi-output Regression, or Transformer (Encoder-only) + Regression Head.

The decision-generation block receives as input both the vectorized data about the situation and the assessment from the analysis block, and outputs decisions — appropriate options for possible response actions (chains of actions), in a quantity

specified by a hyperparameter. This block can be implemented as an Encoder-Decoder based on a Transformer.

The decision-selection block receives as input, one by one, each decision, and returns for each decision option a numerical estimate of its acceptability with respect to the fundamental Principle, allowing both unacceptable options to be discarded and acceptable options to be ranked by their effectiveness. As in the first block, the architectural solution in this case may take the form of Embedder + Multi-output Regression, or Transformer (Encoder-only) + Regression Head.

The execution-monitoring block receives as input the best decision (in vectorized form) and generates a plan for its execution — and this, apparently, is again an Encoder-Decoder based on a Transformer.

The execution block, having received as input the plan for executing the decision (an action or a sequence of actions), must begin to implement it — that is, to send commands to the bot's executive modules directed at step-by-step execution of the plan. After each step of the bot during plan execution, a new situation may arise in which execution of the plan becomes impossible, or in which significant correction becomes necessary (the result has turned out to be unacceptable). In that case, the dispatcher begins its work anew with the new situation: the situation that has arisen is sent as input to the first of the six dispatcher blocks, and passes through all six stages of the pipeline.

Operation according to the described algorithm will enable a Strong AI bot, upon receiving a task, to begin a step-by-step execution process, and at each step every proposed action will be checked against the Principle and will be performed only if that step and its consequences do not contradict the Principle.

Of separate interest is the question of what the attitude toward artificial intelligence in general, and toward Strong AI in particular, might be on the part of living people. Will a device equipped with Strong AI possess subjectivity? Will it have a personality? And can it be considered a living being?

The most widespread view is that life is a mode of existence of protein bodies and nucleic acids; a living system is in constant interaction with its environment, possesses internal activity, and is capable of maintaining its state, adapting, and reproducing. From this standpoint, neither an anthropomorphic robot nor a smart car nor anything of the sort, equipped with Strong-AI-level software, can be considered living — if only because it has no intrinsic mechanism of reproduction and procreation.

With subjectivity, however, matters are less clear-cut.

"Subjectivity is the capacity of a human being to be an active creator and author of their own life, rather than a passive executor of others' decisions or circumstances."

Can a "smart car" be an active creator and author of its own life? Let us imagine a scene from the not-too-distant future: a highway cargo truck with no "owner/operator" (for example, the owner existed but died suddenly of a heart attack, leaving a will demanding that his truck be released into "free navigation"). This "smart car" is equipped with an embedded Strong-AI functional module capable not only of plotting a route and following it while delivering cargo, but also of going online, visiting logistics-company portals, finding orders, taking on contracts, completing deliveries, receiving payment into its own virtual settlement account, driving to a fuel station and paying for fuel, finding a parking lot, paying for it, and parking there if no next contract can be found quickly, and locating appropriate auto-repair shops and ordering its own inspection with maintenance and repair as needed. The "smart car" will, of course, be unable to choose whether to be a car or to become something else, but otherwise it will determine the course of its own existence (pseudo-life) independently. Will such a smart truck be useful to people? I see no grounds for denying the potential usefulness of such systems. Can such a system be considered to possess subjectivity? Apparently, it will possess an analogue of subjectivity.

Whether to recognize such a system as a personality can likewise be viewed in different ways. Let us proceed from the assumption that "personality is a subject of sociocultural life, revealing its individuality in the context of social relations,

communication, and object-oriented activity," as this is currently understood. A bot with Strong AI and a five-level model of perception and reactions (comprising reflexes, instincts, emotions, thinking, and consciousness [1]), formed as a result of evolution within a system built on genetic algorithms — each instance of such a bot will inevitably differ, at least slightly, from bots of other generations or bots trained in a slightly modified, refined virtual environment, with differing genes (predictors), parameters, and functional mechanisms. These considerations suggest that each bot has small distinctive features giving it a certain semblance of individuality. Such a bot will participate in economic activity and will have to interact with people, which allows us to assert the presence of a rudimentary form of socialization of the bot, and consequently, of an incipient form of artificial personality.

All these reflections suggest that entities endowed with Strong AI, while not living beings, will nonetheless possess a number of traits inherent in various living beings and even in human beings. A possible compromise in our attitude toward such intelligent systems could be to perceive them as "derivatives of life" — as products of human activity, certain derivatives, partially life-like entities. In the financial sphere there is money, there is gold, and there are derivatives — currencies, stocks, bonds, contracts of ownership of equity shares, and so on. These instruments are not money in the strict sense of the word "money," yet in many situations they are capable of performing the function of means of payment almost as well as money. The situation with derivative forms of life — bioderivatives — is to a considerable extent analogous: they are not genuine living beings, but the functionality implemented in them partially reproduces the functions of living people. And besides, we do not deny individuality to domestic animals — dogs, cats; we even recognize the presence of intelligence in higher primates and dolphins, albeit at the level of a five-year-old child, yet we do not consider them mindless bio-automata. In the coming years, an anthropomorphic robot will become no less a welcome domestic pet than other domestic animals — both in terms of usefulness (it can guard a home better than a dog) and in terms of socialization (communicating through it with all the wisdom of the world has already become fashionable, and for some even a necessity).

The concerns of many specialists regarding the loss of control over overly advanced instances of neural-network complexes are, of course, well founded. People have always feared the negative consequences of the uncontrolled development of advanced technological solutions. However, we have already had occasion to see that weaving looms did not lead to the mass extinction of weavers, railways did not starve all cab drivers to death, nuclear energy did not bring about the demise of humanity, and computers did not make everyone stupid and forgetful — even though they calculate faster than any human and remember better and more than the most outstanding geniuses. With the emergence of every new breakthrough technology, new risks have always arisen, but methods and means of controlling their impact on the individual and society have also appeared fairly quickly. One such method is proposed in this paper above — a high-priority functional component that checks every decision produced by the bot for compliance with the "Principle of Preservation and Development of Life" — the Artificial Conscience.

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