The Self-Programming System: A Skepticism-conformed Computational Framework of the Mind

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Abstract

How the mind works is the ultimate mystery for human beings. To answer this question, one of the most significant insights is Kant's argument that we can only perceive phenomena but not the essence of the external world. Following this idea, we formulated a novel computational framework to model the mind based on two assumptions: 1) There is no presupposition of the existence of the external objective world and the main task of the mind is to explore, establish and utilize persistent relationships between senses and actions. 2) Symbolic intermediate-level representation is necessary. We call this framework the self-programming system. Based on the self-programming system, we interpreted the nature of concepts, time, space, causality, and consciousness. Besides that, we also draw a conclusion to the mind-body problem. Specifically, the perspective that considers subjective experience as fundamental is compatible with the existence of the external world and that the physical body serves as the substrate of the mind. However, since the relationship is "compatible" rather than "cause", skepticism can never be ruled out in principle. Furthermore, we have elucidated the nature of interpretation within the context of reductive physicalism. This serves to provide a clear understanding as to why the hard problem of consciousness is inherently unsolvable.

Keywords: metaphysics; coherentism; skepticism; causality; consciousness; transcendental arguments;

1. Introduction

How the mind works? The first attempt at this question is too early to be traced back. We can even conjecture that, no matter in the West or the East, as long as there was civilization, there have been thinkers who tried to give replies to this question. However, no answer is eligible enough to provide a principle for practical tasks like creating a human-like intelligent agent. Or even worse, the direction toward such a goal is still obscure.

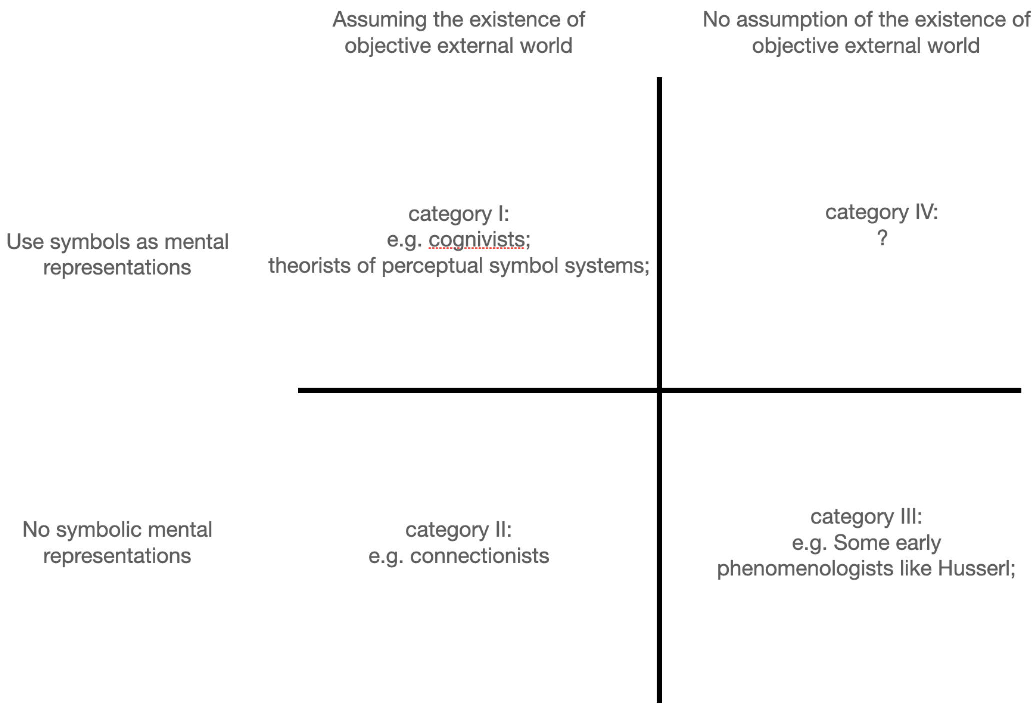

Figure 1

To this question, modern researchers' approaches can be divided into four categories by the answers to the following two questions: (See figure 1)

1) Whether assume the existence of the objective external world?[1]
2) Do mental representations consist of mental symbols ?

[1] Some readers may argue that the statement 'no assumption of the external world' is fundamentally wrong, as it suggests that we could be a 'brain-in-a-vat.' In response to this, we maintain that the brain-in-a-vat hypothesis is compatible with our theory. However, this does not mean that our theory is necessarily incorrect. In fact, we will demonstrate that the arguments presented by Putnam and his supporters, which refute the possibility of the 'brain-in-a-vat', are problematic in section 5. Moreover, our conclusion is that even if we are living in the real world and the mind is the product of this real world, we can never prove it in principle (This is analogous to the conclusion of Godel's theorems in Math). In this sense, the self-programming mind is a computational model that accords with skepticism..

Most researchers advocate for Category I or Category II, but some early phenomenologists like Husserl follow the basic tenets of Category III. We propose pursuing the proposition of Category IV, which suggests that the mind can be understood as a system that employs symbols to encompass the persistent relationships between senses and actions *without* assuming the existence of an external world. In this article, we will formulate a computational framework to understand how the mind *should* works under these assumptions.

Since the implication of not assuming the objective external world is unclear, one good way to clarify it is by comparing it with similar ideas in Category I. Here, we choose the perceptual symbol system (Barsalou, 1999), a modal symbol system that also asserts that symbols represent senses and actions.

In the perceptual symbol system, one key argument is that the simulator that represents concept is established by repeatedly observing objects in the same category. This is to say that there has been a pre-assumed objective category. And the concept in the mind is representing it.

In contrast, our approach does not rely on the assumptions of the existence of the external world, but instead rely on the assumption of pre-existing subjective senses and actions. Thus there must be another internal anchor for the establishment of concepts. This anchor can be loosely described as the persistent relationships between senses and actions. Specifically, once these relationships have been identified, symbols representing these relationships will form.

Some may think the relationships between senses and actions can be expressed easily. For example, one may think that one sense can be directly connected to another through an action to represent such a relationship. However, this way have two fatal weakness.

First, this structure is a one-to-one relationship. The more common relationships need to be characterized by one structured set of senses connected to another structured set of senses. For example, we need perceptual information from both vision and olfaction to distinguish a real apple from a wax apple and determine whether it is edible. This set of senses not only contains multiple senses but also has internal structures. Specifically, a person may need to first determine the location of the apple through vision and then perform the action of smelling to obtain olfactory sense. Therefore, this set of senses here actually contains an internal structure connected by actions. This implies a recursive data structure is needed to capture such relationships.

In addition to the aforementioned recursive feature, there exists another recursive feature that needs to be considered in structures. This recursive feature stems from Hume's skepticism towards induction. Specifically, Hume points out that the relationships obtained from past experiences may not be valid in the future. This point is also applicable to the relationships between senses and actions. This further implies that the mind must have the ability to discover and update known relationships. And, since this ability is also a mental action, it should be able to be representable by the structure that represents the relationship between senses and actions. This constitutes the second type of recursive feature.

Overall, a structure that can effectively express persistent relationships between senses and actions must be able to accommodate both of these recursive features. Thus this asks for a novel data structure and algorithm.

We can see that the difference between whether or not to assume the existence of the external world is not just a matter of ideological perspective but also has significant implications for computational models. When symbols are thought to represent objective things, they are established based on observation of those things. However, when symbols represent persistent relationships between senses and actions, their establishment will involve in a complex and self-evolution process that depends on purpose, context, and past experiences. This is the process that we call *self-programming*. The article aims to provide a framework for capturing such a process.

Another key point to note is that we cannot equate the subjective senses with the signals transmitted by sensors. This is not feasible under the assumption of the self-programming system. Equating the senses with sensor signals is akin to assuming the existence of an objective world, and carving out the subjective aspect of senses. The result is that the theory would lose its ability to explain the phenomenal aspect of consciousness. In the setting of the self-programming system, *the senses and actions are regarded as the basic elements of cognition.*

The last implication of not assuming the existence of the objective world is that we cannot use the degree of proximity between subjective sensible properties and objective properties to define whether such senses can represent the corresponding objective properties. For example, we cannot take the sense of measurement closest to objective time within the body as our definition of time in thought.

In summary, the phrase "not assuming the existence of the external world" have three implications:

1） Since there are no objective categories, concepts cannot anchor on objective categories.
2） Senses are not equal to information transmitted by sensors. They are basic elements of the mind.

3） The degree of proximity between subjective sensible properties and objective properties is not the standard for deciding whether such senses can represent the corresponding objective properties.

If we compare traditional solutions and the idea of the self-programming mind from the viewpoint of the problem they address, we can see that they answer two different questions. The former addresses the question of 'What algorithm should an agent have to cognize the external world and work like a human?' The latter, on the other hand, addresses the question of 'What algorithm should an agent have to work like a human, including having concepts of time, space, causality and consciousness?' Since we are addressing the latter question, it is our responsibility to provide explanations of time, space, causality and consciousness, which will be presented in sections 3, 4, and 5.

Since the 'not assuming the existence of the external world' assumption is a fundamental but uncommon basic setting for computational accounts of the mind, this may require readers to temporarily forget the knowledge and terminology they already know under alternative assumptions for better understanding.

Although most researchers belong to Category I and II, there are also some early phenomenologists like Husserl who advocate suspending assuming the existence of the external world. They call this methodological attitude 'bracket'. However, more recent phenomenologists and enactivists (modern cognitive scientists who agree with phenomenology, especially Merleau-Ponty's phenomenology) partially abandoned Husserl's advocation. For example, Merleau-Ponty believes the body cannot be bracketed. So only these early phenomenologists conform to our first assumption.

However, regarding our second question that whether mental representations consist of mental symbols, both Husserl and his later phenomenology and enactivists believe that intermediary symbolic representations are unnecessary (Gallagher and Zahavi, 2008，Gallagher，2020). As Husserl noted:

> *"…, it forgets to ask how the subject is supposed to know that the representations are in fact representations of external objects."(P96. Zahavi, 2007)*

Or as Varela, Thompson and Rosch noted:

> *"…, symbolic computation might come to be regarded as only a narrow, highly specialized form of cognition."(P103, Varela, Thompson and Rosch, 1991)*

These statements pointed out two key reasons why phenomenologists' don't believe symbolic representations play fundamental roles in cognition. The first says that there is no way to confirm a symbol indeed represents an external object that it is supposed to represent. The second says symbolic representation is not of universal benefit to cognition. Therefore, it is unreasonable to assume such a general intermediate-level representation.

As we have previously noted, symbols do not need to refer to the external world. Thus the first reason is not against the idea of the self-programming mind. To the second reason, our analysis of the self-programming system reveals that symbols function to unify the senses and the process of thought into a unique representation. This unification enable the subject to learn not only the external objects, but also her own learning mechanism. With this knowledge, the subject can enhance its procedure of learning. In other words, this unified form of expression endows humans with the ability to improve their own learning abilities through the process of learning.

In this paper, we propose a novel computational framework for understanding how the mind works based on mental symbols and without assuming the existence of the objective world. We will also explore how the concepts of time and space can be derived within this computational framework. Furthermore, we will utilize this framework to shed light on the concept of consciousness and address the hard problem of consciousness.

Importantly, by adopting the idea of 'not assuming the existence of the external world', our idea offers a new perspective to understand causality. This allows for addressing mind-body problem that are typically difficult to approach with computational models.

2. The Primary Ideas of the Self-programming System

In this section, we will articulate how the self-programming system works. Specifically, we will divide the following content into three parts:

1) Define the components of this framework.
2) Explain the runtime procedure of the self-programming system.
3) Introduce its learning mechanism.

2.1 Basic operations and Basic senses

We first introduce the basic elements composed of Basic Operations (BOs) and Basic Senses (BSs). From the metaphysics perspective, these basic elements should be viewed as *fundamentals* of the mind.

However, if we start from the practical term, like building a human-like artificial intelligence, these basic elements can have practical meaning. Specifically, both BOs and BSs refer to certain signals can be send and receive by peripherals. These peripherals can refer to a certain part of the body, or they can refer to a module in the brain, such as a module that generates emotions.

So what are the BOs and BSs that peripherals provide? Generally speaking, since the functions of each peripheral are different, the BOs and BSs provided by each peripheral are also different. For the eyes, a BO can be rotation, positioning, focusing, and so on. A BS of the eye can be certain color blocks or a specific shape. For limbs, a BO can be some kind of rotation or movement. A BE can be moving to a certain angle or some tactile signal and so on.

There are three points in this setting need to be emphasized. First, both BOs and BSs can be viewed as symbols. These symbols accompany by a look-up table to indicate signals from the most basic neural network, like shape detection, edge detection, etc. The advantage of this setting is that the form of the schemas organizing these basic symbols is independent of the specific existence of the components of the brain and body that provide these symbols. Thus, it enables functions from various sensations can be expressed uniformly. In this sense, the self-programming system indeed establishes a schema composed of symbols that can depict relationships between all sensations.

Second, applications of this schema don't need knowledge about the lookup table. One may doubt this conclusion by arguing: if you don't interpret the internal representations by virtue of the lookup table, how can you know the true phenomenon happened in the objective world? In fact, the reason for this question is that it is presupposed to seek objective truth from the perspective of a third party. But, in fact, the mind does not need such conversion, because phenomena and the relationships between these phenomena already have been expressed internally. Thus the mind can carry out various thinking activities directly through internal expressions, such as planning, judgment, etc. In this case, objective reality is not a necessary factor for the functioning of the mind. This feature further implies the robustness of the self-programming system against the disturbance of the look-up table, since changes in the look-up table will lead to corresponding modifications of the schema.

Third, from the practical term, a basic element does not necessarily correspond to a unique stimulus. A particular stimulus may correspond to a set of them. For example, one BS may represent a circular area that appears on the retina, while another BS represents the size of the area on the retina. Neither of these two symbols, respectively, can identify any unique retinal stimulus. But the combination of them can correspond to this stimulus.

2.2 Storage Object, Property, Operation and the Storage system

In the next, we will first define four fundamental concepts and then make further analysis on this basis:

Storage object[2]: The intuition of the storage object is the unit to store the relationships between senses and actions. Technically, it is composed of a set of properties.

Property: Properties need to play two roles. The first is to determine whether the cooccurrence of a group of basic senses is enough to locate an existing storage object. The second is that, once a particular storage object is located, these properties in this storage object can predict the outcomes of certain operations. Technically, a property is composed of

1) Storage objects or BSs;
2) Operations or BOs that connect storage objects or BSs.

In practical terms, properties are both the locators and the instructional manual of an object.

Operations: a sequence of other operations or BOs that can be executed under specific conditions; these specific conditions refer to properties that the storage object associates with this operation must have.

Storage system: It consists of two parts, one is a collection of all storage objects, and the other is some specific operations that can retrieve and compare information stored in this storage system.

At first glance, the above definition seems to have a complex circular definition problem. However, if we think in terms of construction, the above definition is logically clear. The reason is that these definitions can be built up step by step starting from basic elements. Specifically, the combination of BOs and BSs is sufficient to construct a sequence of operations and their results. Thereby, properties are constructed. And multiple properties actually form a set of conditions, which can be combined with a sequence of other BOs to form a new operation. In other words, the conditions of an operation are actually constructed gradually in order, that is, the properties constructed first

[2] Actually, storage objects are just concepts in the self-programming system. Nevertheless, since concepts in the commonsense have too many other usages and ambiguous meanings, we choose this new terminology.

become the conditions under which the new operation can be created. The same method can also be used to construct storage objects, that is, starting from a storage object only containing a single property, and gradually defining more complex storage objects. (See Figure 2)

2.3 The runtime of the self-programming system

Based on the static structure of the storage system, we can now turn to the dynamics of the self-programming system. The running of a self-programming system can be summed up in one sentence: *it is a mapping from a runtime state to an operation.* We have already talked about the definition of operation, but what is the runtime state?

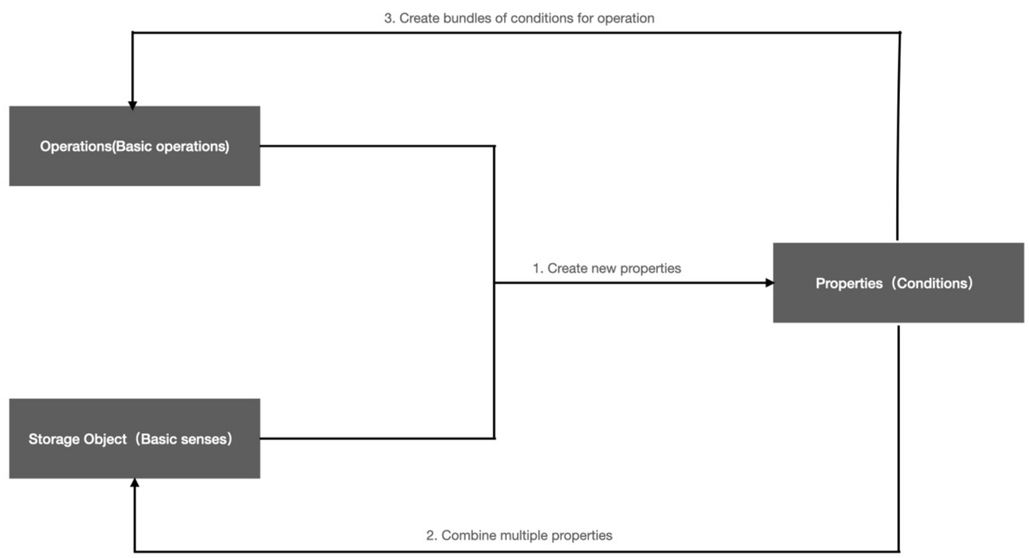

Figure 2 The relationship between operations, properties and storage object

The runtime state is a space that can be divided into two parts, the explicit state and the implicit state. The explicit state can contain a set of active storage objects and their relations with each other. In practical terms, it represents what is currently perceived through observation, perception, feeling, thinking, etc. For example, if someone saw a plate on the table with an apple in it, his/her explicit state will include these storage objects that represent the apple, the plate, and the table, and the network that represents the positional relationship between these three. In this case, the explicit state represented the observed state of the external world. It could also represent the current internal state, for example, the current mood or the feeling, like hunger. Moreover, in the explicit state, there is also a goal. For example, when you are hungry, the goal can be to find a way to eliminate hunger.

Then what is the implicit state? Simply speaking, the implicit states are the background information of the explicit states based on all storage objects in the storage system. These states indicate the inter-storage-objects features. For example, let's say the current explicit state is that there is an apple on the table as described above, and the goal is to eliminate hunger. Then the implicit states could be that all storage objects that corresponding to the current active storage objects in the explicit states (apples) in the storage system can eliminate hunger by "eating it" (state 1). Of course, there could also be other implicit states, e.g. only part of the storage objects that correspond to the current active storage objects in the explicit states are eatable. For example, the person may know both real apples and toy apples may appear here. (state 2).

The procedure of runtime is described in Figure 3. At first, the explicit state will be compared with the storage system. This will generate relationships between the storage objects in the explicit state and that in the storage system. These relationships will be sent to the implicit state.

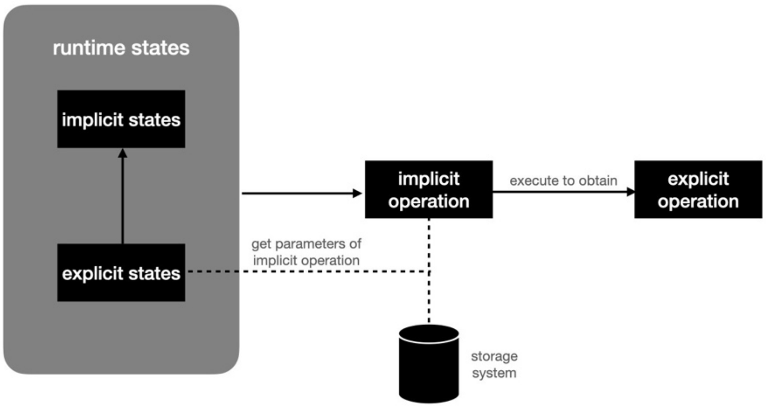

Figure 3 The procedure of runtime

Then, the implicit state will trigger some particular implicit operation. This implicit operation is for finding appropriate operations, which we call explicit operations. And the implicit operation will also determine how to use these explicit operations, such as direct execution or sending to the explicit state, etc.

For example, if the implicit operation corresponding to the implicit state happens to find that there is only one explicit operation that can achieve the goal in the explicit state (as in the case of state 1 in the previous example). Then the implicit operation can choose to run this explicit operation directly.

What if the implicit operation find not a single appropriate explicit operation? In some situations, there may exist multiple ways to achieve the goal? For example, if you want to calculate 324x99, you can directly use the general multiplication method, but you can also use 324x100-324 to calculate; Similarly, there may not exist any known operations in the storage system that can achieve the goal, for example, the goals like how a light-speed spacecraft can be built. There may also exist some way that can only achieve the goal with uncertainty, such as state 2 in the previous example.

In each of the above situations, there are further subdivisions. For example, in the case of State 2 mentioned above, the implicit operation may choose the explicit operation based on whether there are properties that can be easily collected and helpful for making further decisions. If such a property exists it can execute the explicit operation that can collect this property at first. Corresponding to State 2 of the previous case, it is possible to touch the apple first and decide whether to eat it.

In some cases, the state of the explicit operations discovered by the implicit operation can also be put into the explicit state for further calculations of what should be done. For example, if no possible solution is found, some attempts may be made by using the functions provided by other peripherals, such as a search that allows combining two operations together.

In cases where there are multiple explicit operations, it is also possible to put all these explicit operations into an explicit state to determine which one is more appropriate.

To sum up, the runtime of a self-programming system provides a function that maps to the execution of specific operations based on conditions and goals. This function is obtained by comparing the current runtime state with the information in the storage system. Therefore, the whole process of locating and executing a specific operation from the runtime state can be regarded as a Basic operation (BO) provided by the storage system. Since an operation in a storage system is a composition of Basic operations, this means that the operation that invokes the runtime can actually also be a possible component of the operation that compose properties. This allows some properties of storage objects may describing how to use the storage system. This recursive structure is the most important feature of the self-programming system.

If we analogy this point to computer programming, the storage system is equivalent to providing a dynamic mapping from function names to function implementations. This dynamic mapping allows the self-programming system can set abstract goals. Then, collecting detailed information and making subtle decisions in the processing of abstract goals.

This top-down approach is consistent with how humans accomplish specific tasks. Imaging how we make a travel plan, we may first decide on the destination city and the primary way of transportation. Then, collect the prices of hotels, taxis, and others for further decisions.

Through the study of the self-programming system, we can discover some important properties. First, a self-programming system is by no means a combination of multiple domain-specified systems. The reason is that the key to realizing a self-programming system is the relationship between the storage system and external observations, and how to operate the data in the storage system under these relationships. This is a completely abstract domain that is independent of any specific domain. No matter what domain a problem belongs to, it ultimately lies in how to manipulate the data in the storage system. This means that, for any information, as long as it can be stored, it can be processed in the same way.

On the other hand, we can see that when the runtime state triggers an operation, the operation could consist of a sequence of sub-operations that may trigger new mappings. This is a process similar to fractal problems in complex science. Therefore, solving one part of a problem is no easier than the whole problem. In other words, without a proper understanding of the storage system, even trying to solve some seemingly simple problems will lead to clueless.

2.4 Learning mechanism

As can be seen from the previous analysis, if the mapping of runtime states to implicit operations and the information in the storage system are given, the run of the self-programming system will be determined. In other words, how the self-programming system works depends on the information in the storage system and the implicit mapping. There is a naturally following question that is how the storage objects and implicit mapping are established? Or what is the learning mechanism behind them?

The problem is both simple and complex. The simple part is that if the mind keeps perceiving some procedures composed of certain phenomena and operations repeating, it can distinguish these relevant phenomena and operations against irrelevant factors to form a property. Since the properties are the content of the storage object, creating properties is equivalent to creating new storage objects.

However, an answer like this can only capture a basic functional explanation of the learning mechanism. The more important question is what decides the action of perceiving since it is the one that indeed decides what storage objects to be formed. Unfortunately, facing this question, we can only answer part of it. The other part cannot be summed up by the nature of the self-programming system.

In the self-programming system, the application of any function has two different levels, namely the spontaneous level and the purposeful level. This rule is also applicable to the learning mechanism. Its spontaneous level refers to the fact that this learning mechanism is automatically triggered during the operation of the system. The role of the learning mechanism at this spontaneous level is relatively simple and can be described. It works on at least the following three aspects.

First, the most immediate aspect is to work with explicit state at runtime. Specifically, if a certain storage object happens to be triggered at some point, its properties are loaded into the explicit state. At this time, if the same result that generated by an operation happened repeatedly, then a new property that contains the new operation and the result will be created. And this new property combines with the properties from the original object to generate a new storage object.

Second, since the runtime state not only has explicit state and explicit operations, but also has corresponding the implicit state and implicit operations, the learning mechanism works should also work on the implicit level. To be specific, the learning of implicit states mapping and implicit operations is established after the formation of storage objects. For example, if there is only one storage object in the entire storage system that can precisely represent the visual representation of an apple, and this storage object also implies that the apple can be eaten. Then, what is learned at the implicit level is that if there is only a single storage object in the storage system that can correspond to the currently observed representation (corresponding to the visual representation of the apple), then the other properties expressed by this storage object (corresponding to "edible") are credible.[3]

The third aspect is specializing the implicit mappings. We introduce this aspect by an example. Assume there is a problem, and both operations A and B known in the system can solve it. We know that in this case both operations A and B shall be put into the explicit state to be evaluated by a more general implicit operation. Here, we further assume that the result of the evaluation is that Operation A executes faster so Operation A is always called in more urgent situations; Operation B has a higher success rate, thus it is always called in situations with spare time. Then if these operations are called repeatedly, two new implicit mappings will be created: Calls Operation A

[3] Please note that the process we are expressing here is merely to explain how the learning of the implicit aspect is possible, not to say that the belief that has been learned is absolutely correct, as it may also be subject to revision. For example, the claim expressed by Hume that past experiences do not necessarily hold for the future is a kind of revision to this belief.

under emergency situation. Call Operation B when there is spare time. In this way, the process of loading the implicit state into the explicit state is avoided by forming a specialized mapping, thereby reducing the computational cost.

After talking about spontaneous learning, let's turn to purposely learning. As we said before, if certain states, operations, and results occur repeatedly, then a new storage object will be generated. This newly created storage object expresses a specific function by its properties. The learning mechanism can still be viewed as a function, thus it can also be expressed by a storage object which is created by the repeat of the spontaneous learning process. The result is that a storage object that expresses the learning mechanism will exist in the storage system.

Once the above storage object is created, the self-programming system can use the learning mechanism to create new storage objects purposefully like other peripherals. In this case, the question of when to apply the learning mechanism becomes a non-summerizable question, since its application conditions are completely determined by the self-programming system itself. As we said earlier, the problem of self-programming is a fractal problem. So in this sense, summarizing it is equivalent to resummarizing the whole self-programming system.

2.5 Why should the mind works as the self-programming system?

In the preceding section, we have introduced the mechanism of the self-programming system. Then the question becomes why the self-programming system can depict how the mind works. In other words, what does the mechanism of the self-programming system enable it to explore and utilize persistent relationships between senses and actions effectively?

To address this question, let us first examine why the task of discovering persistent relationships is challenging. In fact, the notion of persistent relationships we refer to here bears significant relevance to a concept in the field of philosophy known as "justified true belief" or knowledge. As true beliefs, by definition, express relationships that are true, they inherently hold validity in the future as well. Thus, they can indeed satisfy the requirement of persistent relationships.

However, there are generally considered to be two possible methods to obtain true belief. One method is through deduction, where true beliefs (which also require true methods) are inferred from other true beliefs. The other method is through empirical observation and experience. However, in our ontological assumptions, there is no pre-existing initial true belief, rendering deductive methods clearly unsuitable. Meanwhile, the second method, derived from experience, faces the skepticism of Hume, just like traditional empiricism, as past established relationships do not guarantee their future validity. Therefore, it is impossible to achieve true belief regarding the relationship between senses and actions under the current assumptions.

The approach of self-programming systems, on the other hand, takes a secondary approach by aiming to make all persistent relationships within the entire storage system coherent. This is equivalent to having all past evidence supporting a new discovery. For example, based on the this idea, it can be stated that it is not Newton's laws of motion that support a new discovery, but rather the coherency between all evidence supporting Newton's laws and the new discovery.

This coherent idea can be classified as coherentism in epistemology. However, our idea is substantially different from the traditional thesis of coherentism. This is because all of them must assign some belief with a special role (Olsson, 2021), whereas, in the self-programming system, all relationships are learned and need to be examed, even the most basic one for coherentism, the logic.

Within the self-programming system, the justification of persistent relationships relies on coherency. Therefore, the process of justification in the system is essentially the process of discovering and eliminating incoherency. This process requires the system to have the following abilities:

1) The ability to detect and indicate the states of incoherency.
2) The ability to locate and run the repair method for such incoherency.
3) As the methods for determining the existence of incoherency within the system can themselves be the cause of incoherency, these methods may also be subject to examination. This implies that the system needs to possess the ability to examine these methods. It is important to note that the method used to examine these methods can also be subject to examination. Thus, this is a cycle.
4) Similar to 3), the methods for searching for incoherency may also be abundant or have drawbacks that may miss potential incoherencies. Therefore, they should also be subject to examination.

In response to the first ability, since incoherency is a characteristic of the overall storage system, it can be expressed through the implicit states within the runtime of the self-programming system. Thus, the second ability, namely, calling the method to repair incoherencies, can be achieved through implicit operations that are mapped by the implicit states representing the incoherencies.

In response to your third and fourth point, in the self-programming system, both operations that manipulate the storage system and peripherals are represented in the same manner. This enables the circular examination described above.

One may wonder what is the top-level method for such examinations. However, in fact, no top-level examination method is needed in this system. This is because the focus here is coherent rather than finding a true belief for justification. This is similar to the following example in programming: one can write Program A by using Python to verify the syntax of Python programs and write Program B to examine the comments in Python programs. Program A can evaluate Program B, and conversely, Program B can assess Program A. If both programs have correct syntax and comments, they can be deemed mutually coherent. However, there is no top-level program.

On the other hand, since the methods to determine incoherency are independent of the specific content in the storage system, they only rely on the structure of the storage system. Therefore, these methods are stable. This also means that once the stable methods are learned, they don't need to be modified more. And these correct methods are actually what we commonly refer to as logic.

In total, we can loosely conclude that the self-programming system can acquire its knowledge, namely the persistent relationships, through the following three procedures:

1) Detecting the reoccurrence of relationships between senses and actions at both the explicit and implicit states.
2) Subjecting these reoccurred relationships to coherency checks in order to verify their persistency
3) Utilizing pre-established persistent relationships to derive new, previously unseen relationships.

Here, the term "loosely" is used to indicate that these three procedures do not follow a strict sequential structure. Due to the nature of the self-programming system, these procedures may be intertwined with a complex nested structure.

One may realize that there is one important concern about knowledge in this system: since knowledge is validated by coherency rather than truth, there may exist totally different knowledge for different systems. We quite agree with this opinion. But this is not a drawback but the ingenious of this system.

Consider the following scenario: a group of individuals gathers within a camp. They are completely ignorant of the surrounding. Now, they must go out to explore for obtaining essential sustenance such as food and water. The optimal approach would be to let individuals explore different directions rather than the same direction. Subsequently, if one individual discovers a significant abundance of food and water, she should return to the campsite and rally others to acquire the newfound resources collectively.

The environment the mind faces bears similarity to the example because there exists no absolute truth. Therefore, different minds are best suited to explore different directions. Ultimately, they reconvene and compare the knowledge each mind has acquired to determine the optimal one. In this context, the term "optimal" refers to a knowledge system that can coherently organize all knowledge from other minds' knowledge systems.

From this perspective, the situation that each mind may have distinct knowledge enhances their collective survival capabilities.

In general, self-programming systems can acquire knowledge due to two facilities. Firstly, it relaxes the traditional requirement of "true belief" to "coherent relationships". Second, since the method of determining coherent relationships depends only on the system's storage structure and is independent of specific content, there exists a standard method for determining incoherency. This standard method in the self-programming system are corresponding to the logic in common sense.

Finally, let us address why symbolic mental representation is essential (the second pivot assumption of the self-programming system). In fact, within the framework of the self-programming system, the existence of symbols gives rise to the system for storing relationships between symbols, which in turn generates the states and operations of the symbol system (implicit states and implicit operations). It is precisely these implicit states and operations that organize isolated relationships within the storage system. This implies that all information that can be associated can support each other. In contrast, statistic models can only seek quantity relationships among the same elements of data. Thus, the adoption of mental symbols greatly enhances the data utilization efficiency compared to statistic models.

3. The concepts of Time and Space

In traditional realists' view, time and space are regarded as the inherent properties of the objective physical world. The concepts of time and space in the mind are merely expressions of these inherent properties.

For instance, some scholars may argue that certain systems in the biological organisms of mammals, such as those that generate Circadian rhythms, are capable of corresponding well with objective time and these systems should be regarded as the primary source of the concept of time. Similarly, with regard to the concept of space, due to the existence of well-functioning systems in the nervous system, such as the grid system, that can accurately measure objective space, these systems are considered the primary source of the concept of space.

The fundamental belief of this idea is that the degree of a system's measurement of the objective time and space determines whether the system should be considered a source of the concepts of time and space. However, if we reason based on this idea, we will encounter problems. For instance, imagine if there were another, better way of measuring objective time and space, such as implanting a mechanical clock or a GPS-like system into the body, would the source of temporal and spatial concepts undergo a fundamental change? Alternatively, we could also ask, to what degree must a system's measurement be close to objective time and space to be considered a source of the concepts of time and space?

In the self-programming system, as there is no assumption of the objective time and space, new interpretations of the concepts of time and space will be provided. Specifically, we will answer what the couplings between sense and action that give rise to the concepts of time and space are. This idea also differs from Kant's transcendental idealism which views time and space as a priori.

3.1 Time

Under the assumption of the self-programming mind, finding a substitute for objective time is easy. In fact, the concept of time is composed of *all* sequences of senses and actions that can be measured by the common sense definition of time. It should be noted that the term "the common sense definition of time" does not imply the existence of objective time. The establishment of the time concept follows a reverse procedure. Specifically, once the self-programming system detects that certain sequences of senses and actions will occur simultaneously under specific circumstances, it forms a concept. This concept happens to be called time.

The advantage of this formation is that any sequence related to the concept of time can be used as a timer. Loosely speaking, the self-programming system will choose the suitable one based on different circumstances. These sequences could be generated from some internal timer in the brain, the count of heartbeats, or even watching a clock's tick. Some of them are used to mark a long period but only require low precision, and others are used to indicate a much shorter time but need high precision. This is because some timers will be severely affected by other factors, like emotion, while others can resist these affections of time. All in all, the self-programming system will choose the best timer for different purposes and environments.

3.2 Space

Although the origin of the concept of space is absolutely different from that of time, by following the principle of coupling senses, we can also naturally speculate that the concept of space is a representation of the coupling of senses under transformation, such as translation or rotation. （see figure 4）

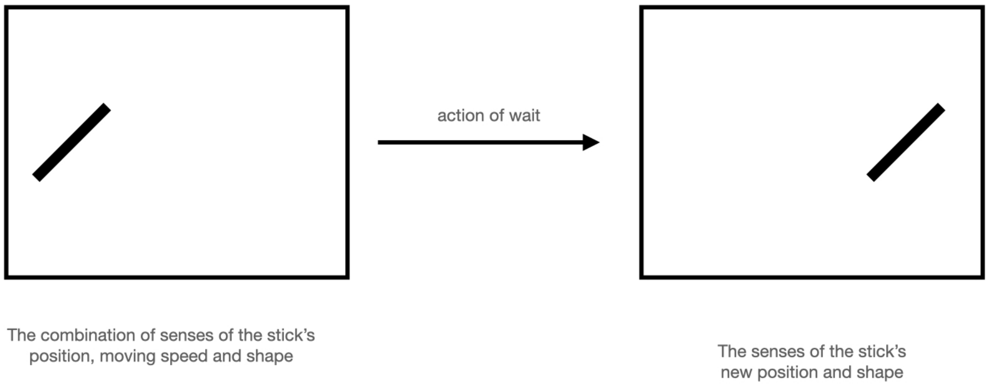

Figure 4

However, more importantly, space may also represent a linear relationship between the high-level comparison of senses. To see this, let's imagine a robot that is designed based on the principle of the self-programming mind. One day, it records what a particular tree looks like at 100 meters distance. (This distance can be described with the language of subjective senses. Specifically, it could be moving with a fixed effort with a sense of time, e.g. this effort is equivalent to the objective velocity of 1 meter per second; this sense of time is equivalent to the 100 seconds of objective time.) And it also recorded what this tree was like at a distance of 50 meters. If the perceptions of this tree at different distances have no relation, the robot cannot predict what it will look like at other distances, like 20 meters or 60 meters. But if the robot can find out that these two perceptions only differed in size. Then it can figure out there are linear relationships between the size and the distance.

The procedure of building such linear relationships can naturally be captured in the self-programming system. This is because these comparisons of sizes and distances are just the relation between two senses. Thus they will manifest in the implicit state. This further implies the implicit operation can calculate what the sense of the tree will be like at other distances.

Following the idea of the self-programming mind that a symbol represents the relationship between senses and actions, space is the symbol that represents both the coupling of senses from transformation and visual linear couplings, like the linear relationship between sizes and distances.

4. Causality and Skepticism

Causality is the most fundamental relationship upon which human life relies, and as such, it has long been one of the most significant questions in philosophy. Given our desire to develop a computational model of thoughts, it becomes crucial to elucidate the nature of causality.

Regarding causality, one widely studied argument is the counterfactual theory. This theory was initially proposed by Hume and well-developed by Lewis (1973). It can be succinctly explained as follows: Event A causing event B means that if A had not occurred, then B would not have occurred.

This theory may appear reasonable at first glance, but upon closer analysis, it reveals several problems. These problems can be summarized into three specific categories (Pinker, 2007, p230-231).

The first problem is known as transitivity. The he argument that if A not happening then B will not happen implies that A is the necessary condition for B. We know that if A is a necessary condition for B, and B is a necessary condition for C, then A must be a necessary condition for C. This property is referred to as transitivity. However, numerous examples demonstrate that causality does not always exhibit this transitivity.

The second one is preemption. The well-known example is as follows: two snipers conspire to kill a dictator. Then, the first sniper pulls the trigger and kills the target. After seeing this happen, the second sniper desists from taking action. When asked who caused the death of the dictator, most responses point to the first sniper, while others point to both. However, no response believes that neither of them killed the dictator. Nonetheless, according to the counterfactual theory, neither of them killed the dictator.

The third one is overdetermination. Consider a group of shooters who are asked to execute a condemned prisoner by shooting simultaneously. In this case, if the first shooter had not fired, the prisoner would still be dead. Therefore, under the counterfactual theory, his shot didn't cause the death of the prisoner. However, the same is true for the second, third, and subsequent shooters. Thus, none of them can be said to have caused the death of the prisoner.

Faced with these problems, many philosophers have attempted to patch the theory from various angles, such as Lewis in 2000. However, these patches have consistently been met with counterexamples. Consequently, to date, there is no comprehensive theory that can fully explain what causality is (Menzies and Beebee, 2020). So, what are the problematic roots of these theories?

If we approach the counterfactual theory from a more abstract perspective, we realize that both the original version and the subsequent patched versions attempt to establish a content-free and context-free relationship to explain causality. Specifically, the conversion from "A causes B" to "if A had not happened, then B would not have happened" is considered independent of the content of A and B and the circumstances in which such statements are made. However, if we consider the usage of "A causes B" as an outcome of the self-programming system, there is no compelling reason to adhere to this content-free and context-free tenet.

Indeed, when someone states that "A causes B," it implicitly incorporates multiple unspoken content-dependent and context-dependent factors. Specifically, they are:

1) The default alternative of A, namely A_0, and that of B, namely, B_0.
2) The default belief about the relationships between A, A_0, B and B_0.
3) The factors related to the prediction from the A to B but are assumed unchangeable.

.

Thus, the content-dependent and context-dependent interpretation of the statement "A causes B" can be illustrated as follows: *Based on the default belief and assuming all unchangeable factors, if A_0 happens, then B_0 will happen, and if A happens, then B will happen.*

Indeed, the method of identifying these unspoken environmental factors can be achieved through implicit functions. Just as we naturally understand sentences without needing explicit knowledge of grammar, these implicit functions automatically establish the corresponding environment factors based on the specific conditions of A and B within the storage system and the current context.

Based on our definition of causation, it is evident that there is no transitivity. In the scenario where A causes B and B causes C, their assumed unchangeable factors differ. In the case of A causing B, A is allowed to change. However, in the case of B causing C, A is assumed to be unchangeable. Consequently, according to our definition of causation, transitivity does not apply.

In cases of preemption, a theory must account for both responses: the idea that the first sniper killed the dictator and that both snipers killed the dictator. While some may argue that the second response is incorrect, this is not necessarily the case. An analogous example can justify the second response.

Imagine that you possess the ability to foresee the future. One day, you foresee your best friend facing the same situation as the dictator in the previous example. You are then asked to analyze the cause of his potential death and attempt to save him. In most instances, the cause would be attributed to both of the snipers in this scenario.

By combining the two examples, we can observe that the meaning of causation is highly content-dependent and context-dependent. Specifically, when the default alternative outcome is to keep the best friend alive, the cause shifts to both snipers. On the other hand, when the default alternative outcome is the disappearance of the direct event leading to the death of the dictator, the cause becomes attributed to the first sniper.

Furthermore, it is evident that the content-dependent and context-dependent interpretation of causation also applies to cases of overdetermination. Due to the overlapping causal factors involved, we won't delve into a detailed discussion of overdetermination in this context.

Based on the interpretation of causality, it is highly reliant on the characteristics of the self-programming system. Thus, it is obvious that causality is essentially a way of organizing the relationship between senses. An important implication of this conclusion is that *if an object is theoretically imperceptible, any causal reasoning based on it would be invalid*. For instance, Kant's concept of Ding an Sich falls in this category. According to Kant, Ding an Sich is the cause of perceptions. Under this definition, Kant separates the sensible features from the Ding an Sich, which implies that Ding an Sich itself is not sensible. However, Ding an Sich is also seen as the cause of perception. Therefore, in this case, the inference of the existence of Ding an sich is invalid. Another example is Merleau-Ponty’s advocation that phenomenology cannot bracket all external existence[4]. Specifically, he emphasizes that there must cause play as the substrate for the perception. This cause is the subjective aspect of the body. So the body cannot be bracketed. In this argument, we can see that the subjective aspect of the body is not perceptible principally (otherwise it is the objective aspect of the body). Thus the subjective side of the body is actually the same as Kant’s Ding an Sich. This further implies that the causal inference of the existence of the subjective side of the body is invalid.

[4] In Husserl’s phenomenology, Bracket the external world means stop assuming the existence ot the external world.

In fact, our analysis of the nature of causality gives a crucial refutation to all transcendental arguments. (Lots of important arguments that try to refute skepticism are included in this category, e.g. Putnam's refutation of the Brain-in-a-vat (Putnam, 1981), and Dennett's refutation by calculational limitation (Dennett, 1991).) Specifically, we echoed the unanswered central question for doubt of Stroud's objection to transcendental arguments. That is:

> *How can claims of necessary connections between some thoughts or experience and some others be defended more cogently than claims of necessary connections between some thoughts or experience and the world?*
> *(Stern, 2021, Objections to Transcendental Arguments, Para. 5)*

As we have noted when discussing causality, there must be a default alternative that for an argument like A causes B. If we hope to say that the external world caused thoughts, there must some alternatives to both the external world and thoughts. The common presupposed alternatives are a world with nothing and no thoughts at all. However, this can never be proved in principle. Thus, skeptics have enough reason to doubt the existence of the world.

It is important to note that the argument we are trying to convey in this section is not that we are in fact not living in the external world, but rather that we cannot prove that we are not. More importantly, if there is a real external world from which creatures that act like self-programming systems are born, they also cannot prove that they are living in the real world. In other words, the unprovability and the existence of an external world are *compatible*. Based on this reasoning, we can regard the fact that we, humans, are creatures of the external world we observe as a self-evident axiom. With this axiom, empirical science become meaningful.

5. Consciousness

What is the nature of consciousness? This question, like how the mind works, has haunted all intellectuals since ancient history. In this section, we will first answer this question by employing the self-programming system, then explain why the well-known hard problem of consciousness is inherently unsolvable in the context of reductive physicalism showing.

5.1 The Nature of Consciousness

Why does consciousness so hard to be interpreted? The reason is still rooted in the common misunderstanding of symbols since consciousness is also a symbol in the mind.[5] In fact, if we treat external objects as the basis of cognition, no consensus can be reached on this problem. Researchers' argument can be divided into the following four categories.

The first category holds the view that there is no subjective conscious experience (Rey, 1986; Dennett, 1991). However, this view is inconsistent with our experience.

The second class of view is that there exists conscious experience and it can be explained objectively. (Churchland, 1986; Crick, 1994; Koch, 2004; Hurley, 1998; Noë, 2005, 2009). The main problem with such a view is that they fail to explain that we seem capable of producing a mechanism with the same function but without consciousness.

Research in the third category acknowledges that conscious experience exists and it is not scientifically explainable. However, they believe such inexplicability is not so significant. We only need to focus on how to connect consciousness experience to physical stimuli (Block, 2002; Block and Stalnaker, 1999; Hill, 1997; Loar, 1997, 1999; Papineau, 1993, 2002; Perry, 2001). The biggest weakness of this interpretation is why the consciousness is as unusual as inexplicable.

The fourth category is dualism, that is, the world has both physical and consciousness. So it is not surprising that consciousness cannot be explained physically. This view can be traced back to Descartes. But this view is generally not accepted because it is divergent from the current scientific paradigm (Collins, 2011). Another alternative view is that although there are both physical and phenomenal objects, phenomenal experience does not have an impact on the physical world (Campbell, 1970; Jackson, 1982; Robinson, 2004). The natural question of this viewpoint is why there is such a non-necessary phenomenal experience.

However, if we transfer our standing point from objective-existence-based cognition to subjective senses and actions based cognition, the nature of consciousness can be understood clearly. Next, let’s analyze it from this perspective.

[5] Some scholars may argue that consciousness is not a symbol, but a process. However, the statement that consciousness is a process has no practical implication because any events of the body, whether conscious or unconscious, can be considered as a process. To regard it as a symbol implies that it consists of persistent couplings of senses and actions. Specifically, in the self-programming system, the sequence of triggered storage objects (composed of senses and actions) in the explicit state will be recorded. And this recorded sequence can be sequentially traced by an internal action. Since such trace action leads to a fixed sequence of triggered storage objects. Thus it is a persistent coupling of the senses of the triggered storage objects and the action of tracing. Thus it constitutes a symbol.

From the previous discussion of the runtime of the self-programming system, we already know that if an entity can be subjectively felt, then it must be a Basic element or a storage object. Since we know that we have consciousness and consciousness can be explored, then it must be a storage object. This is to say that it includes persistent relationships between these actions and senses. The problem is just what these actions and senses exactly are.

Since senses and storage objects are by definition entities for experiencing, so the phenomenal aspect is not a problem here. Furthermore, since the runtime process of the self-programming system is a process based on entities can be sensed, namely, Basic senses and storage objects. This implies what really distinguishes "the conscious" and "the unconscious" is whether the subject knows these storage objects have been triggered. In other words, the distinction is whether these triggered storage objects have been recorded for retrospection in the future. Thus, we can conclude that consciousness is the storage object that organizes the relationship between the recorded triggered storage objects and the action of retrospection. Accordingly, the only question left is what storage objects will be recorded. Before delving into this question, it is important to notice that the answer will not alter the nature of the consciousness in respect of its storage object structure.

We speculated that all storage objects that have been put into the explicit states will be recorded. This speculation can be supported both normatively and empirically.

From the functional perspective, the intention of putting a storage object into the explicit state space is to explore its relationships with other storage objects in the storage system. And using these relationships to locate and run a particular implicit operation. Such operations usually need to be placed on the storage object that triggered this implicit operation. This means that if the storage object in the explicit state is not recorded, this particular implicit operation cannot locate the target storage object. This will lead to the failure of these operations.

From the empirical evidence, various existing neuroscience-based theories about the functionality of consciousness are consistent with our ideas. (Seth and Bayne, 2022) Among these theories, Global Workspace Theory (GWT) is the most influential. It regards consciousness as a global space for information interaction. (Baars, 1988, 1997, 2002; Dehaene & Changeux, 2011; Mashour, Roelfsema, Changeux & Dehaene, 2020) The information in it will be broadcast to various subsystems, thus these subsystems can be combined to determine the optimal behavior globally.

Another influential theory is the higher-order theory (HOT). The core idea of these theories is that if some information is conscious, then it must be the information for meta-representation. (Brown, Lau, & LeDoux, 2019; Rosenthal, 2005) The meta-representation here refers to a description that is not a direct description of the world but a higher-level description that goes beyond objective facts. For example, "yesterday, the vase was broken and seriously affected my mood." In this case, the broken vase is a description of the objective world, and the whole sentence is a meta-representation beyond the objective.

In the self-programming system, storage objects in the explicit state space are for comparison with other storage objects for abstracting relationships. Such relationships are exactly meta-information. Thus our conclusion is consistent with the idea of HOTs.

And, since the storage system possesses all knowledge that the subject knows, an operation triggered by the comparison with the current environment and the storage system has already been considered in the global scope. This point is also consistent with GWTs.

5.2 The hard problem of consciousness

Based on our previous conclusion of the nature of consciousness, we can now discuss the well-known "hard problem of consciousness". (Chamlers, 1996; Nagel, 1974; Levine, 1983, 1993, 2001) It asks how to interpret the phenomenological aspect of consciousness physical reductively. We will see why this problem is inherently unsolvable.

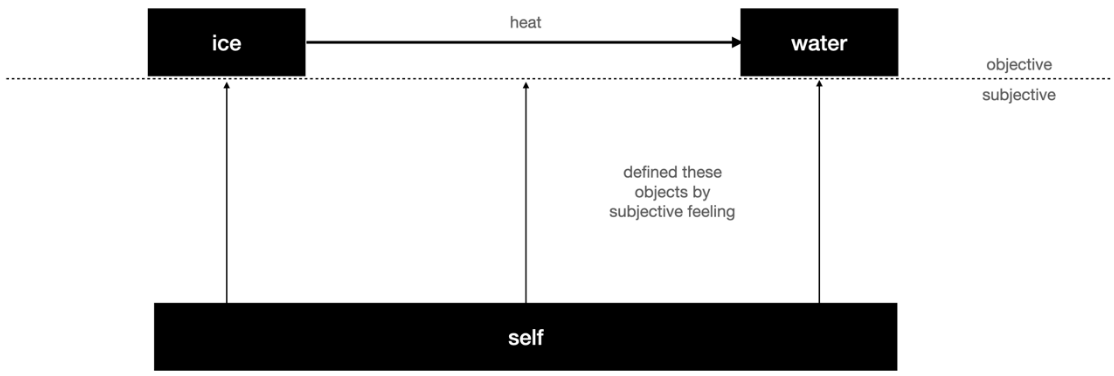

Figure 5: Take the melting of ice as an example. In this example, the objective process only includes the heat of ice, then result in water. However, ice, water, and the process of heat are defined based on the feelings of the "self", whereas the "self" does not belong to the objective world.

Based on our previous discussion of causality (section 4), we already know physical objects are just the assumed causes of some particular storage objects. Thus, the physical laws related to these physical objects is the relationship between assumed causes. In this view, the external physical or objective world is just a projection of the concept world that removed all subjective experience. In other words, the objective world is isomorphic to the network of concepts that removes connections to the self, since the self is the accumulation of all subjective experience. (See Figure 5)

Moreover, by definition, reductive interpretation is a logical reasoning process to explain phenomena by physical laws. Since we have shown that physical laws only apply to the objective part of the concept world, which is the remains that removed all subjective experience. In other words, there is a clear boundary between subjective experience and physical laws. Thus, it is impossible to reduce subjective experience to physical laws.

6. Conclusion

In this article, we proposed a framework, the self-programming system, to echo the question -- how the mind should work based on two assumptions: 1) without assuming the existence of the external world; 2) there is a symbolic intermediary level in the mind. By adopting this framework, we interpreted the nature of concepts, time, space, causality, and consciousness.

Through these interpretations, we addressed the mind-body problem and the hard problem of consciousness. We show that both problems can be explained clearly and concisely under the self-programming framework. However, due to the importance of these two problems, there exists a vast body of literature related to them. We cannot analyze all of them in a single paper. Instead, we can only respond to the most influential arguments related to these problems. But, this does not imply that this framework is only applicable to these arguments or these two problems. In fact, since we provide a mechanism for how the mind works, this framework should be able to utilized to analyze all phenomena related to the mind.

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