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Philosophy Made (Partially) Structured for Computer Scientists and Engineers

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Abstract

Within the discipline of philosophy, ideas cannot remain in a textual setting if they are to be truly effective. Examining and presenting concepts by use of visualization techniques are both not only possible but also necessary. This paper aims at representing philosophical writings in engineering-type schemata that use examples from Hume and Kant, and these can be regarded as a translation from text to drawings. The claim here is that, for computer scientists and engineers, such an effort is worth pursuing, especially since such schemata give them a familiar tool for facilitating understanding of philosophical works. The proposed diagrammatic language is introduced through examples taken from the two philosophers. Hume's and Kant's standing on philosophical issues is crucial for a proper understanding of modern philosophy in general. Their approaches to the theory of knowledge are first diagrammed, then Kant's and Hume's stands on the specific problem of Causality are introduced through examples. The resultant diagrammatic description seems to contribute to understanding of these philosophers' thoughts.

Keywords: *Diagrammatic representation; Engineering-like schemata; Hume; Kant; conceptual description; philosophy*

1. Introduction

Just as a sculptor must pay heed to the quality of his marble for the figure he plans to sculpt, a philosopher must attend to the suitability of his given language for the concepts he wishes to convey. Unlike the poet's work. however. we do not aim simply to appreciate the beamy of a philosophical effort; we also want to know if it is true. To do so, we must trace the conceptual and material directives of its meaningfulness; that is, we must *retrace* the linguistic construction [1].

This paper aims at just that: to make a diagram of the "conceptual and material directives" of philosophical meaningfulness of Hume and Kant. That is, to convey philosophical themes expressed in words, sentences, and paragraphs, visually. Visualization here denotes visualizing aspects of a theory, not data or information.

Visualization techniques used in science and the arts for the advanced analysis of information and theories can and should be similarly used in the humanities. Within the discipline of philosophy there are both the possibility and the necessity to examine and present ideas using visualization techniques [2].

However, because of this author's lack of credentials in philosophy and the difficulty of abstract thought, the aim of this paper is far more modest, the retracing of some of the thoughts of these philosophers through expression in engineering-like schemata mainly for the benefit of computer scientists and engineers.

Philosophy can provide a person with techniques that help in achieving coherence and rigor in thinking. The knowledge of the thoughts of great philosophers can be utilized in measuring one's own views against them and it fosters awareness of those questions which cannot be answered by rational methods [3].

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Nevertheless, "Philosophy is possibly the most difficult of studies, [and] is generally regarded as perhaps the most abstruse and abstract of all subjects, far removed from the affairs of ordinary life" [3].

The final intention is not a philosophical contribution; rather, it is to communicate philosophical texts in a diagrammatic form. The intention is not to reformulate philosophical problems, but to express diagrammatically the language of philosophy, consequently perhaps gaining insights into its meaning.

To emphasize the suggested methodology at the outset, consider the following statement by Hume:

All our *simple ideas* in their first appearance are derived from *simple impressions*, which are correspondent to them, and which they exactly represent. (As quoted in [4]; italics added)

This paper proposes to represent this statement in a diagram as shown in Figure 1, A simple idea (circle 1 in the figure) is created (2) in the mind through a simple impression (3); however, it is understood implicitly that the simple impression was created (4) by stimulus data received (5) from outside (6) the mind. Note that the solid arrow in the diagram represents a flow of data, while the dashed arrow indicates triggering of an event, as will be explained when the diagrammatic notation is introduced.

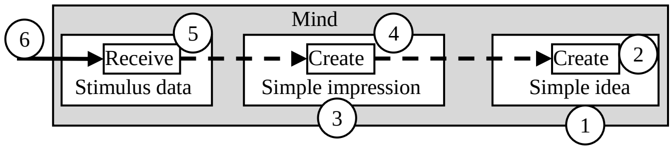

Figure 1. Diagrammatic Representation of Hume's Statement

If we consider diagramming to be primarily a language, we can portray the process described above as a *translation* from text to drawing. It is an *intersemiotic* translation, "an interpretation of verbal signs by means of signs of nonverbal sign systems" [5]. The resultant drawings approximate the conceptual (mental) *form* of the writer behind the text. The semantics and syntactic problems in this translation should not be underestimated. Such problems as equivalence, faithfulness, and communication of meaning are not discussed in this paper; further, the issue that the representation does not go beyond what is said in the text is not discussed.

The process can be thought of as *modeling* using diagrammatic modes of expression, just as an artist can depict a botanical specimen from a verbal description (see [6]). This modeling, as an act of representation, helps in understanding ideas and may give insights into how the writer thinks. "In model-making, visualization and understanding are inseparable" [6].

The case can also be made that the *mere* act of diagramming of philosophical theory is worth pursuing, especially for designers and engineers, since it would give them a familiar tool (flowcharting) to help in understanding of philosophical works.

Some of the tools that designers will have to add to their toolbox involve understanding how people construct meaning when they encounter information, objects or situations. There are very useful theories emerging from the social sciences, philosophy and cognitive studies that help designers understand what impact their work has on people's lives and perceptions [7].

And according to Henry [8],

These [philosophical] ideas cannot remain in a textual setting if they are to be truly effective. Designers need to be able to extract these theoretical ideas, visualize them and directly apply them to the project at hand. This is the realm of the futurist and the tools of the futurist are one way to think about building the theoretical foundation.

The methodology in this paper is to take examples of philosophical thought from text and to represent them in diagrams alongside the text, thus it is hoped that the reader will appreciate this new language. More formal evaluation of the relationship between the two representations can be developed after such initial appreciation of the new language. Accordingly, a main issue in this attempt is the range of expressive "power" of the visual language to represent philosophical ideas. Since this paper is an *attempt* in a continual state of flux to develop this relationship between the original text and its diagrammatic depiction, the "translation" is qualified as a "partial" expression, as reflected in the title of the paper. The term *structured* is used in imitation of the graphic representations of the structures of chemical compounds.

Generally, the issue in this attempt is the capability to evoke thought originally written in textual form through a visual depiction. Images are usually used to communicate information, *e.g.*, statistical graphs, in a way that "sees the significance within the whole" [9]. Diagrams probably rank among the oldest forms of human communication [10]. Probably all scientific fields utilize diagrams to represent or depict knowledge and to assist in understanding logic problems, *e.g.*, Plato's allegory of the cave visualizes situations and depicts knowledge configurations. Traditional logic diagrams (*e.g.*, Venn diagrams, Euler diagrams, Peirce existential diagrams) have been utilized as conceptual representations [11], and it has been claimed that, in general, these diagrammatic representations have advantages over linguistic ones [12-14].

Recently, researchers are becoming increasingly aware of the importance of the area of nonsymbolic, especially diagrammatic, representation systems.

Diagrams are usually adopted as a heuristic tool in exploring a proof, but not as part of a proof. It is a quite recent movement among philosophers, logicians, cognitive scientists and computer scientists to focus on different types of representation systems, and much research has been focused on diagrammatic representation systems in particular. [10]

Nevertheless, current diagrammatic representations of problems do not completely depict their underlying semantics or provide a clear, basic, static structure with elementary dynamic features, creating a conceptual gap that sometimes causes misinterpretation. For example, as reported by Shin [15], Venn diagrams lack many features, such as representation of existential statements; in Euler diagrams such features as the representation of existential statements not only obscure the visual clarity but also raise serious interpretational problems, and Peirce's diagrams are characterized by arbitrariness in conventions, making them confusing.

In general, advantages of diagrams include the following:

- Explicit depiction of details represented only implicitly in the statement of problems
- Better understanding of problems, especially in the environment of learning
- New ways to consider and reflect on problems

The flow-based model, called the Flowthing Model (FM), utilized to represent philosophical works has been used in several applications (*e.g.*, [16-21]). For the sake of completeness, FM will be briefly described in the next section. The example developed there, taken from sociology to illustrate the nature of the FM representation, is a new contribution.

2. Flowthing Model

FM represents a web of interrelated flows that cross boundaries of intersecting and nested spheres. Components of a flow include

- flowthings ("things that flow," or artifacts) and
- flow systems (flowsystems) that represent the structures of flow, each with at most six stages (see Figure 2).

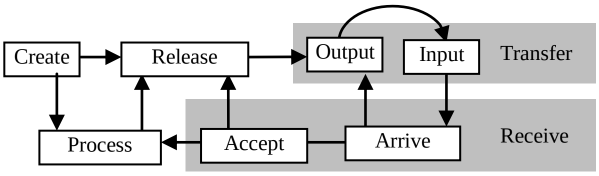

Figure 2. Flowsystem

Messages, ideas, concepts, and opinions are examples of flowthings. A *thing* is defined, in FM, as a flowthing: that which is *created, processed, arrives, is accepted, released, and transferred,* while flowing within and among spheres. It has a permanent identity but impermanent form, *e.g.*, the same news translated into different languages.

An abstract flowsystem constrains the trajectory of flow of flowthings. The flowsystem shown in Figure 2 is a generalization of the traditional input-process-output model used in many fields Figure 3. It comprises a delineation of the distinct parts and operations that represent a kind of geography of flow in a system.

Figure 3. Input-Process-Output Model

Flows connect the six stages that are exclusive for flowthings; *i.e.*, a basic flowthing can be in one and only one of these six states at a time: transfer, process, creation, release, arrival, and acceptance, analogous to water being in one of three states in Earth's atmosphere: solid, liquid, or gas. A *stage* here is a "transmigration field" of the flowthing that is created, processed, released, and transferred, arrives, and is accepted (or simply received, combining arrived and accepted into one state). In Figure 2, irreversibility of flow is assumed, *e.g.*, released flowthings flow only to Transfer.

The exclusiveness of FM stages (*i.e.*, a flowthing cannot be in two stages simultaneously) indicates synchronized change of the flowthing, *i.e.*, a flowthing cannot be changed in form and sphere simultaneously. This is a basic systematic property of flowthings.

FM also uses the notions of *spheres and subspheres*. These are the network environments and relationships of systems and subsystems. Multiple systems can exist in a sphere if needed in a structure similar to a Venn diagram. A sphere can be a mind, an organ, an entity (*e.g.*, a company, a customer), a location, a communication medium (a channel). A flowsystem is a subsphere that embodies the flow; it itself has no subspheres. FM also utilizes the notion of triggering. Triggering is the activation of a flow, denoted in FM diagrams by a dashed arrow. It is a dependency among flows and parts of flows. A flow is said to be triggered if it is created or activated by another flow (*e.g.*, a flow of electricity triggers a flow of heat), or activated by another point in the flow. Triggering can also be used to initiate events such as starting up a machine (*e.g.*, remote signal to turn on).

Example: This example from sociology illustrates the nature of the FM representation in comparison with modeling of theory in artificial intelligence.

According to Lynch [22], most visual representations of theory in sociology are primitive in nature. "They do not supply readers with puzzles, evidences, or notation systems from which to work out a sense of what the text is saying independent of its words." Later works in sociology introduced richer diagrams such as Coleman diagram [23] and networks [24] to visualize the way that a social system operates.

A sample diagram of a theory that illustrates the "social structure of a society," in which an artificial society is related to sociology and to organizational theory, is given by [25]. The environment denoted by S is a set of external states, and an agent is described as a 7-tuple (D, T, A, perceive, infer, select, act) where D is a database that contains the agent's acquired knowledge, a set T of partitions of the environment S which constitute the possible perceptions of the agent, and a set A of possible actions of the agent. Figure 4 shows a partial view of the resultant diagram that portrays this model (from [25]). Figure 5 expresses the same ideas in FM.

First, a "state" of the environment is perceived by the agent through created data (circle 1) that flows (2) to the agent. In the agent sphere, the data are processed (3) to trigger generation of the so-called partitions of the environment (4). These along with inferences in the database (5) are processed (6) to trigger the creation of inferences (8) that:

- are stored in the database (9)
- trigger the creation of actions (10)

Actions flow to be received by the environment (11).

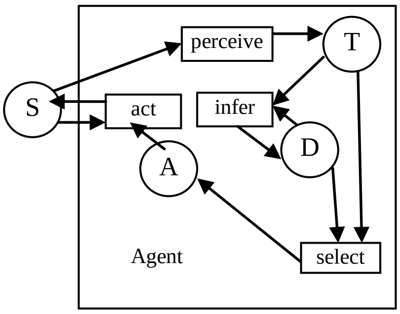

Figure 4. The 7-Tuple (D, T, A, Perceive, Infer, Select, Act)

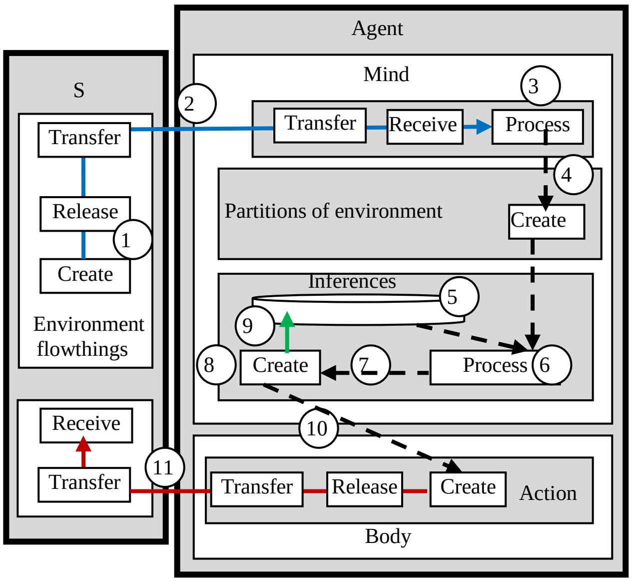

Figure 5. FM Representation of the 7-Tuple (D, T, A, Perceive, Infer, Select, Act)

Note that the FM representation almost "forces" closing of gaps in the conceptual picture, *e.g.*, spheres are included such as mind and body (reasoning and action units in artificial agents) that are implicit or unstated in other representations. A potentially infinite list of English verbs such as conceive, infer, act, and select are represented by the five stages in FM; *e.g.*, conceive is represented by processing of data received from the environment. Additionally, the original diagram conceptually mixes heterogeneous terms, representing all of them as circles: A is a sphere (set-like notion) as well as an action (verb), D is storage, and T is a partition. The *arrow* linking *infer* to D indicates *movement* (flow) of inferences to storage, while the arrow from D to infer indicates *generating* (triggering) of an inference. Both *moving* and *creating* of a thing are represented by the same type of arrow.

Lind [25] applies this model to artificial agents (no diagrams are presented).

Consider an automated container terminal where a robot has the task to unload incoming containers from trucks and to store them on shelves in the storage area. Using the abstract description scheme given above, the scenario is modeled as follows.

This study can be represented in FM as an application of the general model. Because of space limitation, this example of a robot process is limited to that of moving containers from source location to target location. As shown in Figure 6, the state of container storage (1) in the target location is monitored (processed – circle 2) and triggers creating data (3) that flow to the robot (4). For simplicity's sake, the flowsystem in the target location is not contained in a box. Data are processed (5) to create a difference in current level of containers (6) and a threshold used to create possible action, limited in the diagram to supplying containers to the target location (7 and 8). This triggers the supplying action (9) that releases containers from the source location to the target location (10).

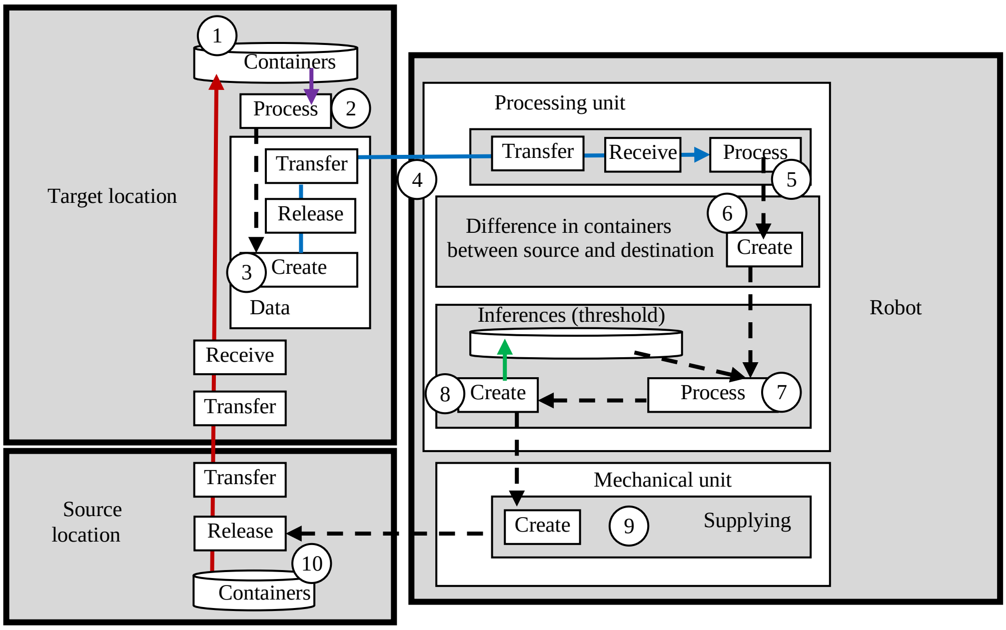

Figure 6. FM Representation of the Robot Example

3. Theory of Knowledge

Understanding the positions of Hume and Kant on philosophical issues is "crucial for a proper understanding of modern philosophy more generally" [26]. Hume is "probably the most influential philosopher of modem times" [27]. In regard to Kant, "Never has a system of thought so dominated an epoch as the philosophy of Immanuel Kant dominated the thought of the nineteenth century" [28].

On the notion of causality, Kant attempted to "answer" what he took to be Hume's skeptical view, and this "answer" has been subject to intense controversy over whether the two conceptions actually differ significantly [26]. Also, the relationship between the two philosophers is significant. According to Kant, "I freely admit that it was the remembrance of David Hume which, many years ago, first interrupted my dogmatic slumber and gave my investigations in the field of speculative philosophy a completely different direction." Accordingly, it is appropriate to demonstrate the FM representation applied to works of Hume and Kant. The aim, as mentioned earlier, is not to contrast their philosophical stands; rather, it is to explore the capability of FM to express some of their well-known thoughts.

3.1. Hume

Morris and Brown [4] are here used as the main source of Hume's work, and that text will be interwoven with FM terminology to align the textual and diagrammatic languages. Figure 7 will be used to model Hume's ideas from different sources. Hume portrays the study of human nature as a kind of mental geography or anatomy of the mind [4], the type that will be re-portrayed, in this paper, using flow machines and spheres.

Hume aims to explain how the mind works by discovering its "springs" [4], called Create stages in FM terminology. The mind's contents—perceptions [flowthings], as Hume calls them—come and go (flow) in the mind, and simple perceptions combine [trigger] to form complex perceptions [flowthings] in ways that explain human thought [flowthing], belief [flowthing], feeling [flowthing], and action [flowthing].

Accordingly, Figure 7 shows (see quote in [4]) the following notions:

- *Perception* (circle 1) designates any mental content whatsoever, and perceptions are divided into two categories, *impressions* (2) and *ideas* (3)

- *Impressions* (2) include *sensations* (4) as well as *desires, passions, and emotions* (5).

- *Ideas* are "faint images of these in thinking and reasoning" [4]. Accordingly, we interpret this definition as shown in the figure, that is, sensations (4) as well as desires, passions, and emotions (5) trigger ideas in the thinking and reasoning sphere.

Hume distinguishes two kinds of impressions: impressions of sensation [we assume that it is sensation (4)], or original impressions, and impressions of reflection, or secondary impressions [we assume it is desires, passions, and emotions (5)].

- Impressions of sensation include the feelings we get from our five senses as well as pain and pleasure, all of which arise in us "originally, from unknown causes."

Accordingly, we assume in the FM representation that data are created by Things-in-themselves (6 - Stimulus) that flow (7) to the five senses (8) and trigger (8 - original impressions, unknown causes) the creation of sensation in the mind (4).

Note again, how the FM picture "forces" adding of missing pieces of the description.

- Impressions of reflection include desires, emotions, passions, and sentiments. [We assume that this is what is previously called desires, passions, and emotions (5)]. They are essentially reactions or responses to ideas, which is why the author calls them secondary.

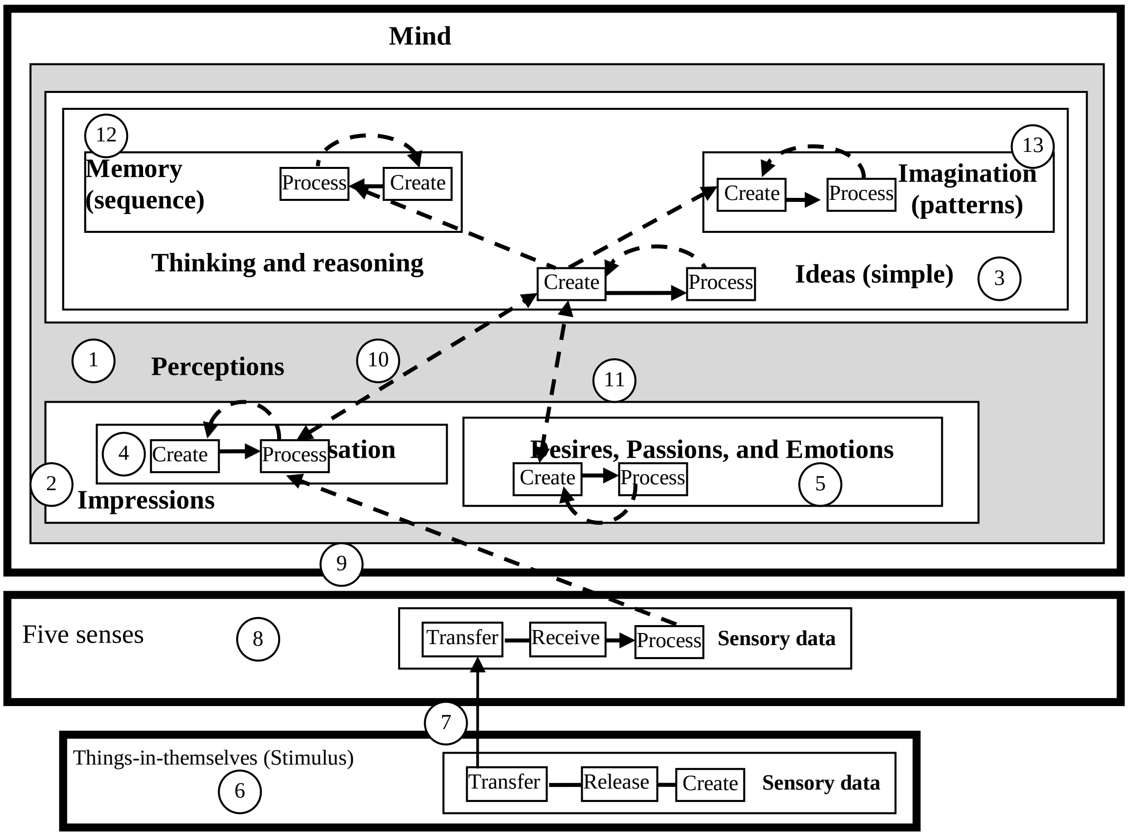

Figure 7. FM Representation of Some of Hume's Concepts

This description by Morris and Brown [4] seems unclear to this author. Previously, the authors [4] stated, "Impressions (2) include sensations (4) as well as desires, passions, and emotions" (5). Ideas are "the faint images of these in thinking and reasoning." Accordingly, we interpret this as shown in the figure, that is, sensations (4) as well as desires, passions, and emotions (5) trigger ideas in the in thinking and reasoning sphere.

Morris and Brown [4] then state, "They [impressions] are essentially reactions or responses to ideas." We interpret this to mean that ideas also trigger sensation and desires, emotions, passions, and sentiments. Accordingly, we draw bi-directional arrows indicating triggering (10 and 11).

This confusion (on the part of the present author) can be viewed as a motivation for philosophers to support this engineering-drawing type of description.

In the current case, if our interpretation of Hume through Morris and Brown [4] is wrong, then it is easy to modify the FM diagram to correct the meaning. The FM depiction promotes a type of description that is suitable for non-philosophers; hence, it facilitates discussion and communication.

In conclusion, as the diagram clearly reflects, Hume's works pointed out that simple impressions always precede the simple ideas which resemble them in our experience amounts, and includes the "denial that there are any innate ideas" [27]. Also, in the following, Boniecki [27] describes Hume's concepts:

- There are simple impressions and ideas, and complex ones. The difference is that the simple ones 'admit of no distinction or separation'

- We have two different faculties, one called *memory* (circle 12 in Figure 7), in which we have present in the mind a series of ideas in a fixed order or sequence.

- The other faculty is called imagination (13) by which we can arrange our ideas in any order we like. But, in spite of this freedom of imagination, we find that our ideas come in *patterns*.

It is hoped these insights will serve to raise appreciation for the conceptual map shown in Figure 7 as a tool for discussion and clarification of Hume's thought. To enhance such a response, the following subsection focuses on the specific problem of causation, with descriptive text taken, almost literally, from Boniecki [27].

3.2. Hume's Analysis of Causation

According to Hume, patterns, mentioned at the end of the previous subsection, are the associations of ideas, and there "is a kind of attraction among ideas," *i.e.*, a tendency for ideas to become linked with one another, as in the case where ideas are contiguous in time, or ideas that are causally related to each other. These patterns are the associations of ideas.

How do we discover that two or more ideas are causally related? When we examine a situation like that of a rock striking a window [27], we find that the elements, window and rock, are contiguous and form a succession of events. Figure 8 represents this case. For simplicity's sake, the stages of the physical window are not shown in a box. The conceptual window includes the flowsystems of the physical window and the rock that flows into it. At time t (circle 1), a rock flows to the window (2) and makes its effect (a type of process – 3). At the next slot of time, t+1, the window is in the broken state (4).

Now, consider the following situation that is represented in Figure 9. At time t, two children are traveling on a train with their mother. The mother gives each of them a banana (1). Note that such details as where the banana comes from (*e.g.*, child's pocket) are not related to the description of the situation. As the first child bites into the banana (2), in the next time slot t+1 (3), the train rushes (4) into a tunnel, resulting in darkness (5). "Don't eat that banana!" he cries out in panic to his brother, "It makes you go blind." The contiguity and the succession are there [27]; why, then, do we not accept causality in this situation?

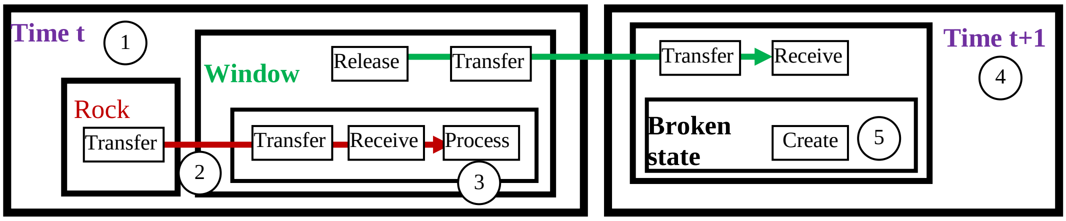

Figure 8. FM Representation of the Rock/Window Situations

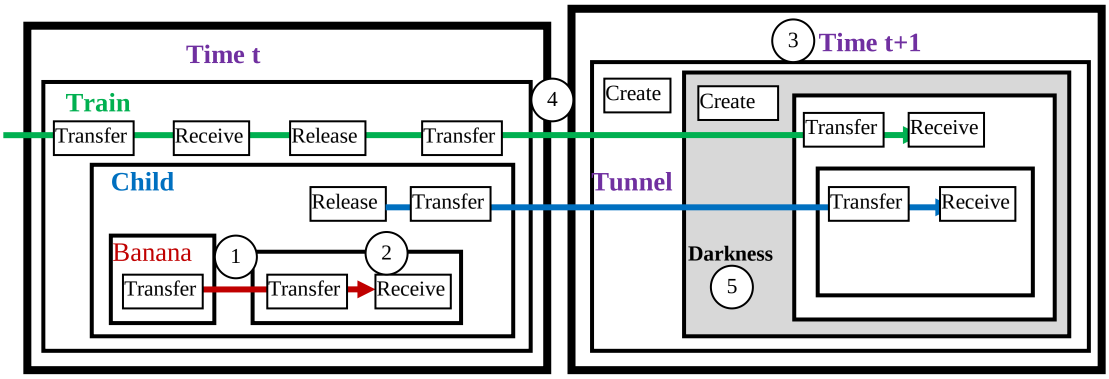

Figure 9. FM Representation of the Eventless Banana/Darkness Situation

Hume concluded, "Since it is not from knowledge or any scientific reasoning, that we derive the opinion of the necessity of a cause to every new production, that opinion must necessarily arise from observation and experience." (Hume as quoted by [27]).

For our analysis, the important issue is how well the two figures reflect the two situations. This will be discussed after Kant's analysis of casualty is introduced.

3.3. Kant

Figure 10 will be used to model Kant's ideas from different sources. Kant (*Critique of Pure Reason*) distinguished between phenomena and *things-in-themselves* (circle 1 in the figure). Phenomena are how it is that objects appear in conscious minds (2). Conscious experience imposes certain conditions on phenomenal appearance such as abstract forms of connections between events and objects. Things-in-themselves are the way that reality exists apart from experience consciousness, and minds.

Perception (3) results in *sensation* (4) which gives rise to *Experience* (5). A sensation is merely the *awareness* (6) of a stimulus, such as a taste on the tongue, pressure on the hand, or flash of light in the eye. The *mind* (2) molds and coordinates *sensations* into *ideas* (7). Since ideas are used by Boniecki [27] to refer to concepts, mental things are used in the diagram to refer to what the *mind* molds and coordinates *sensations* (4) into *it*.

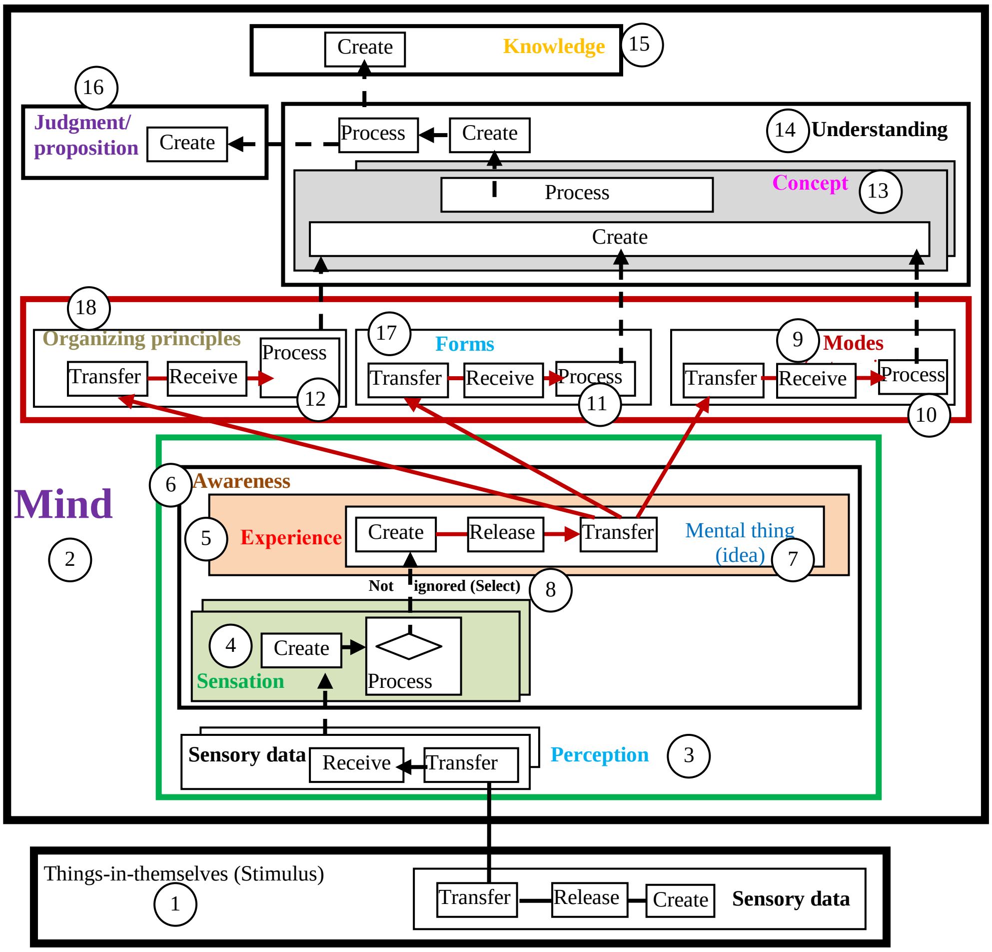

Figure 10. Kant's Thought Regarding Some Portions of Theory of Knowledge

The mind is an organ that transforms the chaotic multiplicity of experience (5) into the ordered unity of thought (7). The mind groups the various sensations about an object, such as an apple. The sensations of odor, pressure, light, and taste are united to constitute a "thing", which we call an apple. There is now an awareness not so much of a stimulus as of a specific object. This is what Kant means by a perception. Not all sensations are accepted; most are ignored (8).

The mind then arranges perceptions about certain basic ideas. Ideas are processed into different “spheres” of mind. *Space* and *time* are not things perceived but modes of perception, ways of putting sense into sensation. According to Kant, these modes are unity, plurality, totality, reality, negation, limitation, substance-and-accident, cause-and-effect, reciprocity, possibility, necessity, and contingency. These are Kant's famous twelve categories.

They are subjective in the same sense in which space and time are subjective; *i.e.*, they are applicable to whatever we experience, or they are the means by which we *process* our experience (see process stages 10, 11, and 12 in Figure 10). The categories are the pre-existing structures in the mind into which perceptions are received, and by which they are classified and molded into the ordered *concepts* of thought (13). The categories are the bridge to our ideas [concepts!] of the world. All our *understanding* (14), all theory, is mediated by them. “Conception is organized perception, *i.e.*, *knowledge* (15)” “Categories, further conditions which are imposed upon the data of our sensations, are those which are needed in order for us to be able to make any judgments (16) at all. Every *judgment* is a synthesizing of two concepts into a connected proposition” [3].

While contacts with the experiential world supply the content of our knowledge, our faculties supply the *form* (17: form of intuition - pattern**),** in which we know the content [26]. Since we are capable of attaining organized and intelligible information about the world, we must have within ourselves *the organizing principles* (18).

“Besides the forms of intuition, Kant believed, there must also be principles or concepts by which we organize the general content of any possible experience in order to recognize it as a coherent datum. Our minds structure and interpret the observations of our senses” [3]. Accordingly, the theory is that the world of our experience, the so-called phenomenal world, is the product both of what we are presented with (2), and the *a priori* conditions supplied by the mind (9, 17, 18) [3].

3.4. Kant’s Analysis of Causation

According to Kant, Hume is the one who attempted to derive the pure concepts of the understanding of cause “from a subjective necessity arising from frequent association in experience” (see [26]). Kant does not endorse Hume’s solution to the problem of causality and believes the concept of causality to be *a priori*. He illustrates this with his own example of the sun warming a stone:

If I say that experience teaches me something, I always mean only the perception that lies within it, *e.g.*, that heat always follows the illumination of the stone by the sun. That this heating results necessarily from the illumination by the sun is in fact contained in the judgment of experience (in virtue of the concept of cause); but I do not learn this from experience, rather, conversely, experience is first generated through this addition of the concept of the understanding (of cause) to the perception. [26]

The perception of an illuminated stone is constantly followed by the perception of heat; we then convert this perception into an objective law according to which the very same relationship is now viewed as “necessary and universally valid.” This transformation is effected by the addition of the a priori concept of causality: “through its light, the sun is the cause of heat.” In this way, pure concepts of the understanding relate to experience: “not in such a way that they are derived from experience, but that experience is derived from them, a completely reversed kind of connection which never occurred to Hume" (see [26]). Figure 11, shows the FM representation of this situation.

Accordingly, a similar a priori concept of causality can be added to Hume's situation of the banana/darkness, as shown in Figure 12.

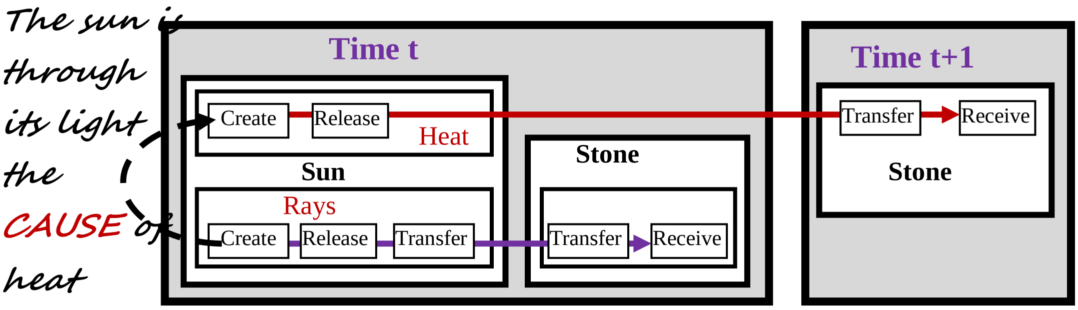

Figure 11. FM Representation of Kant's Example

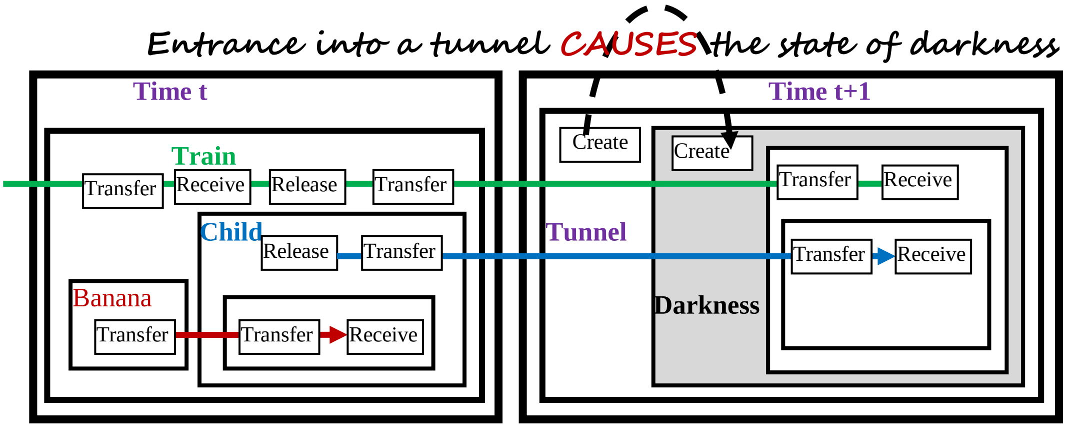

Figure 12. Modification of Hume's Example

4. Conclusion

This paper has introduced an engineering-like philosophical schemata to represent theories in philosophical works as espoused by Hume and Kant. The claim is that, for computer scientists and engineers, such an effort is worth pursuing, especially since it gives them a familiar tool to help in understanding of philosophical works. The proposed diagrammatic language is introduced through examples from the two philosophers.

The resultant diagrammatic description seems to achieve the described aim. Further refinement in representing the thoughts of Hume and Kant will clarify the extent of the potential of the diagrammatic description. Also, experimenting with the works of other philosophers will enable further evaluation of the significance of such an approach.

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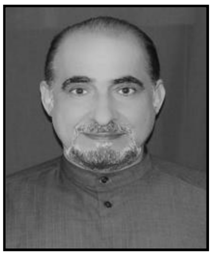

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