Chapter IV
The Pattern at the Root of It All

The world came out of a single spark, the creator is in the creation and the creation is in the creator

- Kabir Das, a 15th-century poet-philosopher from India

ABSTRACT

This chapter describes the concept of a Pattern, and describes why patterns are the basis of knowledge. It establishes the semantics of Pattern, and describes the concept of "information space," an abstract arena in which patterns of information create meanings. It shows how the concept of measurability is the basis of all meaning and how meanings are structured by patterns in information space. It also distinguishes a meaning from its physical representation and establishes the identity between objects and patterns. It shows how joining and constraining meanings creates new patterns of information, which lead to new meanings and hence the ability to configure meanings from other meanings. This is the basis on which components of knowledge are derived in this book and also in its companions in the series.

The concept of Pattern and Information Space is where our journey begins. Meanings are abstract patterns of information. We conceive of these patterns of information as patterns in an abstract place called Information Space. We cannot physically see, hear, touch, or sense information space or the abstract meanings that swirl and twist though Information Space. This makes it difficult for most of us to visualize these patterns and to understand how they are assembled from other patterns, which may also be meanings and are always components of meanings.

Pattern is the fundamental object from which all meanings are born. The metamodel of Pattern is also the metamodel of *Object*[1]. In this chapter, we summarize the key characteristics of Pattern.

A pattern is a pattern of objects. A pattern cannot be a pattern unless the arrangement of its constituent objects follows some kind of law. In order to be considered a pattern, the information conveyed by the law cannot exceed the information

conveyed by the ensemble of objects that constitute the pattern in the absence of the law (that is, the law must not make things more unpredictable; see Appendix II on Shannon's information theory). A pattern exists in state space. State Space is also a pattern of information. Fundamental to the concept of a pattern are the criteria that its constituents must satisfy to be considered parts of the pattern. These criteria compose the law that defines the identity and shape of the pattern. Since it is a pattern in state space, its constituents are located in state space. For this reason, we consider that its Law of Location defines a pattern.

The following example will illustrate this concept. Cars have properties such as weight and color. Its weight and color contain information about the car; hence, the pattern of information that defines the car includes the dimensions of weight and color. The physical location of a car at a particular time is also information about the car, and hence an aspect of its state. Its physical location is therefore also a property of the car. Physical space and time may also be facets of the state space of cars. State space extends and subsumes the concept of physical space by extending physical space into additional dimensions to account for the all the information conveyed by an object. This leads to the concept of information space.

Concepts and meanings need not have a physical presence. They could be abstractions. For instance, the concept of enumeration is an abstraction. Information content of objects like these, which are actually meanings, may not involve physical space, time, or properties like color and texture related to our senses. These objects exist in information space as pure concepts, which are abstract patterns of information. As stated earlier, information space can extend into physical space to accommodate physical objects with physical and temporal locations. Hence, the concept of information space subsumes and extends the physical concepts of space, time, and physical properties of objects.

Information space contains all the information conveyed by an object, which could be a physical object or an abstract concept. Indeed, it may be argued that objects that convey exactly the same information in every way are mutually indistinguishable and are therefore identical to each other because they possess exactly the same footprint in information space. The concept of object class conveys information that is common to all object instances in the class. Reusable information flows from the concept of Class. On the other hand, the instance identifier of an object is a symbol for all the unshared information in information space that makes an individual object different from the other individuals in its class, and thereby lends the object instance its very identity. To create a pattern, we must have a measure of similarity, which will serve as the basis for the arrangement of objects in the pattern: i.e., concepts of similarity and contrast are at the heart of every pattern.

MEASURE OF SIMILARITY: THE PROXIMITY METRIC

Similarity and contrast between the constituents of a pattern are the basis for including or excluding an item from the pattern. The proximity of items in state space is a measure of their mutual similarity. The closer they are, the greater their similarity. For this reason, we call a measure of similarity between a pair of objects a *Proximity Metric*. The Proximity Metric is an integral part of the Law of Location and is derived from it. Other things being the same, two blue cars will be considered closer in information space than a blue and red car. Similarly, other things being the same, if two cars are physically close to each other, their states are considered to be closer, and in that aspect, they are considered more similar than a pair of cars separated by a larger physical distance. Any measure may be considered to be a proximity metric, provided it satisfies the following common-sense criteria:

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