

Pattern Recognition Principle as a Solution to Ambiguous Cognitive Definitions

Proposal of a Pattern Recognition Principle Set to Solve the Problem of Ambiguity in Definitions of Cognitive Concepts in Cognitive Science and Philosophy of Mind

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Abstract—this work proposes one solution to the problem of ambiguous definitions of many difficult cognitive functions like consciousness. The cognitive functions definitions are constructed over simple Pattern Recognition mechanisms and properties. First a physical definition of the Pattern Recognition concept is given to relate the primitive cognitive functions as physical quantities variations. It is proposed also a model on how any cognitive function can be described from simple physical Pattern Recognition systems to arguably more complex cognitive Pattern Recognition systems (neurological or computational). From describing some basic cognitive functions like instincts and learning, the model proposes unambiguous definitions of any cognitive function.

Keywords—*Pattern Recognition; Ambiguous Definitions; Cognitive Functions; Consciousness;*

I. INTRODUCTION

The cognitive science lacks one standard formulation to address the core philosophy of mind issues, despite been founded on the connectionist and computational models. The concepts of processing, memory and learning consists the basic cognitive functions both in neural and computational models, but they are not clearly accepted as a set of primitive cognitive principles or functions. This article proposes the primitive concept of pattern recognition to solve this gap by identifying it's equivalency to proposed concepts as pattern processing and learning, building a complete explanatory model of the mind functioning.

II. THEORETICAL PROPOSALS

A. Pattern Recognition is an Established Cognitive Science Technique but not a Key Theoretical Principle

Pattern Recognition is already an important concept to understand cognitive functions, generally related to detection, perception or sensing. Research on pattern recognition processing in neuroscience and artificial intelligence is one front end of science and technology. In contrast, no model in cognitive science takes the pattern recognition concept as a key cognitive principle. This may be a theoretical gap since pattern recognition processing is arguably the mechanism of mind

functioning most strictly related to experimental observation, with rigorous mathematical formalism, and applied to possibly all scientific fields.

Despite it is generically accepted that the pattern recognition concept is used to model most sensorial and perceptual cognitive functions, it is not the same for more controversial cognitive functions like consciousness. This paper argues that the same pattern recognition mechanisms used to model sensorial functions can model instinctive, processing and learning functions, as well as thinking, and conscious-unconscious functions.

B. Physical and Cognitive Science Concept of Pattern Recognition

The concept of pattern recognition is widely used in the scientific literature, particularly in cognitive science related areas. It is generically defined in Math, Computer Science, Design, and few other areas as a method or technique of classification, regularity search, decision making, etc. But the formal overall concept of pattern recognition from physical to algorithmic basis is not clearly defined in the scientific literature [1][2].

This article proposes one definition of pattern recognition first as a strict physical phenomenon. This is important because pattern recognition is often viewed as an artificial technique rather than a basic natural phenomenon. Then is derived the concept of cognitive pattern recognition, and its difference from the basic physical pattern recognition. Also is proposed the not usual concepts of pattern processing and pattern learning as playing key cognitive functions.

C. Physical and Cognitive Pattern Recognition

Many different definitions of Pattern Recognition as a physical phenomenon can be discussed. The proposal here is that any natural phenomenon is a set of physical interactions, and any physical interaction is measured or detected by a pattern recognition mechanism. So, one assumption we can take is that any physical interaction is isomorphic to a pattern recognition process. As physical interactions are described by

the variation of physical quantities, we can propose a definition of Physical Pattern Recognition.

Then some questions arise. How can we relate or differ this Physical Pattern Recognition description to the cognitive description of living systems pattern recognition? For example, the immune system can recognize a great number of organic molecules and cells. It can also learn and memorize to recognize new antigen patterns. Can it be defined as an intermediary pattern recognition system between the basic physical pattern recognition proposed above and a neurological cognitive pattern recognition definition? What are the key functions of cognitive pattern recognition systems, and do they have any advantage from the more basic physical pattern recognition systems?

Many different definitions for a cognitive pattern recognition concept can be proposed. This paper presents one that includes the combinatorial properties of connectionist and computational systems and the basic cognitive functions of processing and learning.

D. Pattern Processing and Pattern Learning

In the cognitive science literature, the terms pattern processing and pattern learning generally refers to any method, function or algorithm for doing pattern recognition instead of basic physical phenomena that can be central to the foundations of cognitive science.

This article proposes the definitions of pattern processing and pattern learning consistent to the previous definitions of Physical and Cognitive Pattern Recognition.

The conceptual emphasis proposed here is that the same functional mechanism that performs pattern recognition can perform pattern processing. Cognitive Pattern Recognition systems can implement pattern processing by sequential activation among its subsystems. By the above discussion, any processing function is in fact a pattern recognition event of composition of sequential pattern recognition events.

III. PATTERN RECOGNITION DEFINITIONS AND EXPLANATION OF COGNITIVE PHENOMENA

The above physical to cognitive definitions and discussions are a formal basis to propose a general theory for cognitive science in the following steps:

- Describing instincts as a pattern recognition functional mechanism.
- Proposing an unsupervised instinct conditioned pattern learning model.
- Pattern recognition definitions and mechanisms of any higher order cognitive concepts.

The definitions are constructed from the basic cognitive concept of instinct, proposed here to be isomorphic to the concept of Pattern Recognition. The same for the basic cognitive concept of learning, constructed over the concept of Pattern Learning, and also proposed here to be isomorphic concepts.

A brief description is given on how to apply these definitions to a simplified case of a baby learning motor movements and associated visual learning.

Then it is possible to construct definitions of more ambiguous cognitive concepts of self, thinking, and consciousness. The Pattern Recognition definition to the concept of self is simply the set of patterns related to the physical limits of a system body, time and interactions. It is useful to the construction of the concept of self consciousness.

The concept of thinking is defined directly to the concepts of Pattern Processing and Pattern Learning, the same for the concept of consciousness.

A. Relevant Developments from this Theoretical Proposal

With the above theoretical proposal, this work achieved the following results:

- The postulation of an unambiguous and understandable definition of the concept of consciousness as a simple Pattern Recognition mechanism.
- A clear definition and description of self consciousness as the pattern recognition of a system own properties, metacognition (self cognitive consciousness) as the pattern recognition of a system own cognitive properties, and theory of mind as the recognition of others metacognition.
- An understandable definition of the unconsciousness concept as subsystems of no intersecting pattern recognition.
- A description of the thinking concept as the pattern learning mechanisms.
- The application of the consciousness definition to animal and AI systems.
- A general formulation for Cognitive Science and Philosophy of Mind constructed primarily with the concept of Pattern Recognition.

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