Chapter 38
Wild Architecture:
Explaining Cognition via Self-Sustaining Systems

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ABSTRACT

In this chapter, the authors focus on cognitive architectures that are developed with the intent to explain human cognition. The authors first describe the mission of cybernetics and early cognitive architectures and recount the popular criticism that these perspectives fail to provide genuine explanations of cognition. Moving forward, the authors propose that there are three pervasive problems that modern cognitive architectures must address: the problem of consciousness, the problem of embodiment, and the problem of representation. Wild Systems Theory (Jordan, 2013) conceptualizes biological cognition as a feature of self-sustaining embodied context that manifests itself at multiple, nested, time-scales. In this manner, Wild Systems Theory is presented as a particularly useful framework for coherently addressing the problems of consciousness, embodiment, and representation.

INTRODUCTION

For some time now, one of the leading assumptions in the development of cognitive architectures has been Marr's (1982) tri-level theory of explanation; the idea that the proper approach in developing a cognitive architecture (and thus explaining cognition) is to

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1. Determine the computations necessary to completing a cognitive task (e.g., sorting a list of numbers from lowest to highest),
2. Generate a representation of the inputs, outputs, and algorithms an information-processing system would need to complete the task, and
3. Actually build (i.e., implement) a system capable of executing the algorithms.

The purpose of the present paper is to examine issues that have proven challenging to Marr's implementation approach to explaining cognition. Three particular challenges are the issues of consciousness, embodiment, and representation. After examining these challenges, we will present an approach to describing cognitive architectures (Wild Systems Theory—WST, Jordan, 20213) that addresses each challenge, while simultaneously shifting the focus of modeling from looking to biology for inspiration, to looking at a more fundamental property that biological systems share with many other types of systems, including chemical, psychological, and cultural—specifically, the ability of certain far from equilibrium systems to generate catalysts that feedback into and sustain the processes that produced them; what Kauffman (1995) refers to as 'autocatalytic' systems, and what Jordan (2013) refers to as self-sustaining, or *wild* systems.

PROBLEMS WITH "IMPLENTATION AS EXPLANATION"

While Marr's (1982) approach to developing cognitive architectures has inspired research that has given rise to a host of new technologies, there are those who have expressed doubts regarding his assertion that implementation constitutes explanation. In his seminal paper, *Quantitative analysis of purposive systems: Some spadework at the foundation of scientific psychology*, William T. Powers (1973) expressed his belief that psychologists were working under the confused assumption that control-theoretic concepts had been developed to explain the behavior of organisms. According to Powers, control-theoretic concepts were developed so that engineers could develop systems capable of doing what organisms do; namely, maintain ordered states with their environment by offsetting environmental disturbances to those ordered states. Powers referred to this ability to maintain ordered states as *input control*, and he further stated that in order for engineers to be able to build input control systems, they had to develop a conceptual scheme that captured the dynamics of organismic input control in a way that allowed the dynamics to be transformed into functioning, artificial, input-control systems, what have come to be known as servomechanisms. Thus, the conceptual scheme created by engineers includes phrases such as reference signal, which represents the state the system is to sustain. For example, when one dials in a room temperature on a thermostat, one is basically specifying the reference signal for the system. Or, said another way, one is setting the input level the system should keep constant. In order to keep its input at a pre-specified level, the system must be able to counteract environmental events that move the input (i.e., sensed temperature) away from the value of the reference signal. For example, when one opens a window and allows cold air into the room, the air temperature will change. If it varies from the pre-specified level, the system must be able to offset such disturbance. The system's ability to generate disturbance-offsetting events is referred to as output. In the case of the thermostat, the system's output is the turning on of the furnace. As the system continues to generate output (e.g., the furnace stays on) the difference between the input and the reference signal decreases. From the perspective of an engineer, who is actually trying to build such a system, this means the system has to be able to compare its current

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