

Chapter 12

Artificial Intelligence in Business Processes: The Mechanism of Interaction in Process Neurons

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ABSTRACT

The aim of this chapter is to establish that the principles used by neural networks can be applied to business process management. The similarity between artificial neurons and business processes, and hence between neural networks and process landscapes, will be demonstrated. This novel approach leads to an emphasis on process interactions and their effect on actions as a major governing factor in controlling process outputs. Stigmergic interaction in biological systems is explored in the context of business processes, and its potential to understand process interaction is investigated. In order to verify the use of stigmergy in business environments, a pilot study is described in which shop floor business processes in a retailing environment are observed and described using a stigmergic framework. Establishing the viability of using stigmergic interaction to control process actions and outputs is the first step towards designing neural process networks.

INTRODUCTION

It is not often easy to identify the transforming potential of a new technology. Just as people in the 19th century could not fully appreciate the potential of talking to someone they did not know in another country (which was made possible by the invention of the telephone), or many did not recognise the potential uses of a machine which could play Pong on a TV screen in the eighties, today's technologies will increasingly reveal their potential, as their environment is transformed by them. This chapter con-

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siders an innovative use of neural networks, which have been developed and applied over the last half a century with increasing success in enabling digital transformation, and explores how the developments and knowledge gained could be used to transform the, until now, unrelated field of business process management.

In the early years of computer programming, flowcharts were often used to depict an unambiguous, ordered sequence of computational instructions. However, this algorithmic approach reached its limits when trying to solve certain types of artificial intelligence (AI) problems, such as face recognition or human language (Brooks, 1990). Over the past few decades the field of artificial intelligence has profited greatly from the intuition of early researchers like McCulloch and Pitts (1943), Rosenblatt (1958) and Hebb (1949), who realised that the limitations of the prevailing artificial intelligence paradigm could be overcome by looking more closely at the way nature solves the problem. Understanding the way the brain works led to the creation of artificial neurons and artificial neural networks. Since then, there have been great advances in the application of these artificial neural networks to solve problems in many areas. While AI can be seen as “a field of computer science that studies how machines can be made to act intelligently” (Gil et al., 2020, p.4), this chapter will demonstrate that the principles of AI can also be applied to make business processes act “intelligently.” As with computer programmes, process management techniques can be developed beyond the flow chart paradigm.

In this chapter, the concept of the process neuron is introduced, derived from its biological counterpart, and guided by the insights of artificial neural networks. This will reveal similarities between the structures of neural networks and process landscapes, which suggest that the techniques used by computer scientists to create intelligent computer applications, based on neural networks, could also be used by process managers to create and manage processes with an inherent intelligence (i.e. an ability to adapt to an environment and optimise complex systems). However, in order to apply these techniques, it is necessary to understand how processes interact with each other as well as with their environment. One such mechanism, stigmergy, is described in its original biological application, and how it could be used in a business environment is outlined. A study to demonstrate the viability of the stigmergic model to observe and analyse real life business process interactions is discussed. Having shown that processes can be modelled as neural networks, and that stigmergy is a viable concept for identifying and classifying interactions, the final section considers some areas for further research.

LITERATURE REVIEW AND CONCEPT DEVELOPMENT

The Biological Neuron

When Ramon y Cajal and Camillo Golgi (as cited in De Carlos and Borrell, 2007) identified the neuron as the elementary unit of the nervous system, they started a chain of discoveries which have led to an understanding of the way the brain is structured and some of the underlying mechanisms involved in learning and memory. The seemingly simple network of neurons, which make up the brain, are somehow able to organise themselves in such a way as to perform extremely complex tasks, such as facial recognition and mastering human language. Early researchers in the field, like Hebb (1949), recognised the mechanism involved. Although the physiological and chemical mechanisms of neuron interaction are quite intricate, the basic principle is simple. Figure 1 shows the structure of the most common type of neuron, the multipolar neuron. The many dendrites are responsible for collecting the inputs of many other neurons and passing them on to the cell body as an electrical signal. As well as creating the chemical

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