Chapter IV
Rationale for Cognitive Machines

INTRODUCTION

This chapter outlines rationale for cognitive machines. It connects theories of bounded rationality of Herbert Simon with theories of fuzzy systems of Lotfi Zadeh in order to justify advantages of the participation of cognitive machines in organizations. The connections are derived by explaining why cognitive machines can extend limits of knowledge (lack of information) and limits of information processing and management (lack of cognition and computational capacity) of humans when participating in organizations.

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The Herbert Simon and Lotfi Zadeh’s Theories

This book was influenced by the scientific work of Herbert A. Simon and Lotfi A. Zadeh developed in the period between the middle and the end of the 20th century. Despite having no direct relation to each other, they provided the literature with theories which under the perspective of this research complement each other by contributing important results to the fields of artificial intelligence, cognition, organizations and systems theory. Such a background may be regarded as the first...
contribution of this investigation – i.e. to connect theories and results of these two brilliant researchers.

**Bounded Rationality Theory**

Simon was awarded in 1978 with the Nobel Prize in Economics. He received his PhD in Political Science from The University of Chicago in 1943 and among his prominent scientific contributions is the theory of administrative behaviour which comprises the concept of bounded rationality (Simon, 1982a, 1982b, 1997a and 1997b).

The theory of bounded rationality as proposed by Simon represents an important framework for the analysis of human behaviour, cognition and decision processes in organizations. It can also be viewed as a model of cognition and economic decision-making processes which considers the limits of knowledge and computational capacity of humans. However, Simon’s theory of bounded rationality was missing alternative mathematical and computational tools which could be used to encapsulate the particularities of his model of human cognition and decision processes in a proper way. This was an important requirement for the development of the field of artificial intelligence – i.e. the need of alternative mathematical and computational approaches for the analysis, design and engineering of systems (machines) whose processes and behaviour are metaphors for, and models of, human cognition and intelligence.

Despite having important advancements since its inception in the early fifties, artificial intelligence has found serious limitations to progress in those areas where problems require approximate (fuzzy) rather than precise (crisp) formulation (Zadeh, 2001). Such areas need alternative methodologies for the representation and manipulation of natural concepts which are characterized by fuzzy boundaries (Nobre, 2005).

**Fuzzy Systems Theory**

Zadeh received his PhD in Electrical Engineering from The University of Columbia in 1949 and among his prominent scientific contributions are the theories of fuzzy systems (Zadeh, 1965 and 1973), computing with words (Zadeh, 1996a) and computation of perceptions (Zadeh, 1999).

The theory of fuzzy systems represents an important framework with mathematical and computational background for the analysis of complex systems and decision processes – where complex systems is synonymous with systems (such as organizations) whose behaviour is preponderantly influenced by human emotion, cognition and social networks. The theories of computing with words and computa-
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