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Towards a human centric analysis of processes and systems using fuzzy
logic, computing with words, and natural language processing

Abstract

We consider systems in a general sense as an interdependent set of entities. We concentrate on systems that involve human (individuals, groups or organizations) and inanimate agents (e.g. software agents, robots), and we follow a systems approach that advocates a more general perspective than just a simplistic "cause events –to – effect events" view. We concentrate on more general, structural properties by basically considering some patterns of behavior which characterize the problem or system considered in terms of its structural properties and dynamics. These are meant as how the variables of relevance (sales, prices, share prices, interest rates, etc.) are interconnected, and how they change over time. We adopt the systems thinking perspective which shows that similar patterns of behavior occur in various problems and systems so that the insight gained may be more general.

We advocate the use of natural language to describe various patterns of behavior, both in their static and dynamic perspective, by using linguistic summaries of sets of numeric data, i.e. we follow the "numbers – to - words" approach. More specifically, we employ the linguistic summaries which are based on Zadeh's computing with words in which linguistic terms are represented semantically by fuzzy sets to be able to represent imprecise meaning, with some modalities, an schemes of approximate reasoning derived.

We show how to use our approach to linguistic data summarization (Kacprzyk and Zadrożny, 2001 – 2010) to capture relevant patterns of behavior, first in its static aspect, in particular using the concept of a protoform. Then, by proceeding to the dynamic case, we use our (Kacprzyk, Wilbik and Zadrożny, 2006 – 2009; Kacprzyk and Wilbik, 2008 – 2010) approach to the linguistic summarization of time series representing the behavior of variables of interest using dynamic type protoforms too. We illustrate our consideration on data on the Web server logs, quotations of mutual funds, preference updating in consensus reaching, etc. We mention the role of process specific and problem specific ontologies.

Finally, we show that the approach proposed can be implemented using tools and techniques developed in computational linguistics, notably natural language generation (NLG) and Halliday's Systemic Functional Linguistics as proposed by Kacprzyk and Zadrożny (2010).