Information Aggregation in Intelligent Systems

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Abstract

In intelligent systems, like fuzzy control systems, decision support and expert systems, the problem of information aggregation of is one of the key issues. Since the pioneering work of Prof. Lotfi Zadeh dated to 1965 a great number of fuzzy connectives, aggregation operators have been introduced, and the problem of aggregating information represented by membership functions in a meaningful way has been of central interest since the late 1970s. In most cases, the aggregation operators are defined on a pure axiomatic basis and are interpreted either as logical connectives (such as t-norms and t-conorms) or as averaging operators allowing a compensation effect (such as the arithmetic mean).

On the other hand, it can be recognized by some empirical tests that the above-mentioned classes of operators differ from those ones that people use in practice and do not follow always the real phenomena and do not provide optimal performance. The requirement to develop more sophisticated intelligent systems demands to find new operator families

One can also discern that people are inclined to use standard classes of aggregation operators also as a matter of routine. For example, when one works with binary conjunctions and there is no need to extend them for three or more arguments, as it happens e.g. in the inference pattern called generalized modus ponens, associativity of the conjunction is an unnecessarily restrictive condition. The same is valid for the commutativity property if the two arguments have different semantical backgrounds and it has no sense to interchange one with the other.

These observations advocate the study of enlarged classes of operations for information aggregation and have urged us to revise their definitions and study further properties.

This lecture summarizes some new approaches to information aggregation from the literature and the research results of the authors and his colleagues that have been carried out in recent years on generalization of conventional operators. This includes, but is not limited to, the class of uninorms and nullnorms, absorbing norms, distance- and entropy-based operators, quasi-conjunctions and nonstrict means.