A New Direction in AI--Toward a Computational Theory of Perceptions

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Humans have a remarkable capability to perform a wide variety of physical and mental tasks without any measurements and any computations. Familiar examples are: parking a car, driving in city traffic, playing golf, cooking a meal, and summarizing a story. In performing such tasks, humans employ perceptions of time, direction, speed, shape, possibility, likelihood, truth, and other attributes of physical and mental objects. Reflecting the bounded ability of the human brain to resolve detail, perceptions are intrinsically imprecise. In more concrete terms, perceptions are f-granular, meaning that (a) the boundaries of perceived classes are unsharp; and (b) the values of attributes are granulated, with a granule being a clump of values (points, objects) drawn together by indistinguishability, similarity, proximity, and functionality. For example, the granules of age might be labeled very young, young, middle-age, old, very old, etc.

F-granularity of perceptions puts them well beyond the reach of traditional methods of analysis based on predicate logic and/or probability theory. The computational theory of perceptions (CTP) that is outlined here adds to the armamentarium of AI a capability to compute and reason with perception-based information. The point of departure in CTP is the assumption that perceptions are described by propositions drawn from a natural language, e.g., it it is very unlikely that there will be a significant increase in the price of oil in the near future.

In CTP, a proposition, *p*, is viewed as an answer to a question and the meaning of *p* is represented as a generalized constraint. To compute with perceptions, their descriptors are translated into what is called the Generalized Constraint Language (GCL). Then, a goal-directed constraint propagation is employed to answer a give query. A concept that plays a key role in CTP is that of precisiated natural language (PNL).

The computational theory of perceptions suggests a new direction in AI--a direction that may enhance the ability of AI to deal with real-world problems in which decision-relevant information is a mixture of measurements and perceptions. What is not widely recognized is that many important problems in AI fall into this category.

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