

Quo vadis, computational intelligence?

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Abstract. What are the most important problems of computational intelligence? A sketch of the road to intelligent systems is presented. Several experts have made interesting comments on the most challenging problems.

1 Introduction.

In the introduction to the “MIT Encyclopedia of Cognitive Sciences” M. Jordan and S. Russell [33] used the term “computational intelligence” to cover two views of artificial intelligence (AI): engineering and empirical science. Traditional AI started as an engineering discipline concerned with the creation of intelligent machines. Computational modeling of human intelligence is an empirical science. Both are based on computations.

Artificial Intelligence (AI) has established its identity quite early, during the Dartmouth conference in 1956 [6]. It had clearly defined goals, exemplified by great early projects, such as the General Problem Solver of Simon and Newell. There are many definitions of AI [48,64], for example: “... the science of making machines do things that would require intelligence if done by humans” (Marvin Minsky), “The study of how to make computers do things at which, at the moment, people are better” [48]. In essence AI tries to solve problems for which effective algorithms do not exist, using knowledge-based methods.

In the 1970-ties AI has contributed to the development of cognitive science and to the goal of creating “unified theories of cognition”, as Allen Newell called it. Ambitious theories of high cognitive functions were formalized by John Anderson in his Act* theory [3], and by Newell and his collaborators in the Soar theory [43]. Both were very successful and led to many practical (and commercial) applications. In the last decade intelligent agents become the focus of AI, entities that can perceive and act in a rational goal directed way to achieve some objectives.

Machine learning has been important from the beginning in AI. Samuel’s checker-playing system (1959) learned to play far superior checkers than its creator. Although initially research on perceptions has developed as a part of AI in the late 1950-ties machine learning became preoccupied with inductive, rule based knowledge [50]. AI development has always been predominately concerned with high-level cognition, where symbolic models are appropriate.

Quo Vadis Computational Intelligence

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