The Intelligent Systems Revolution: Is it Real?

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Abstract

Machine intelligence has been an object of fascination, discussion and controversy for decades and more. When Artificial Intelligence (AI) was christened in 1956, it became the standard bearer of efforts to devise and build machines that could exhibit human-like intelligence in performing various tasks. For some time thereafter, the AI scene was one of unbridled enthusiasm and, as we now realize, unrealistic expectations. In judging that period, however, what should be remembered is that -- as Jules Verne astutely observed at the turn of the century -- scientific progress is driven by exaggerated expectations.

It took forty years for a computer to challenge and beat a chess champion. Why did it take so long to achieve some of AI's objectives? In the first place, the basic difficulty of approximating to what humans can do so easily without any measurements and any computations, e.g., understand speech, read handwriting, summarize a story and park a car, was greatly underestimated. More important, however, is the fact that the needed technologies and methodologies were not in place. In particular, we did not have the highly capable sensors and computers which we have today, and we did not employ such recently developed methodologies as neurocomputing, evolutionary computing, probabilistic computing and fuzzy logic.

AI's progress has been seriously impeded by its dominant commitment to classical

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logic and symbolic computing, and its aversion to methodologies in which numerical computing lies at the center. More specifically, the principle of the excluded middle in classical Aristotelian logic asserts that every proposition is either true or false, with no shades of gray allowed. But in the real world, as perceived by humans, it is partiality rather than categoricity that is ubiquitous. Generally, we have partial knowledge, partial certainty, partial belief, partial understanding and deal with partial causality and partial truth. The concept of partiality, and especially that of partiality of truth, plays a central role in fuzzy logic. The essentiality of the role of partiality in human cognition has been very slow in gaining acceptance in AI.

In the past, what were called intelligent systems were for the most part symbol-manipulation oriented, e.g., machine translation systems, text understanding systems and game ploying systems, among others. Today, what we see is the rapidly growing visibility of systems which are sensor-based and have imbedded intelligence, e.g., smart washing machines, smart air conditioners, smart rice cookers and smart automobile transmissions. The counterpart of the concept of IQ in such systems is what might be called Machine IQ, or simply MIQ. However, what is important to recognize is that MIQ is product specific and does not necessarily involve the same dimensions as human IQ.

Viewed in this perspective, the focus of activity in applications of machine intelligence is shifting from writing computer programs that can prove difficult theorems, understand text, provide expert advice and beat a chess champion, to more mundane tasks devolving on the conception, design and construction of products and systems that have a high MIQ, making them reliable, capable, affordable and user-friendly. Among recent examples of systems of this kind are programs which can detect the presence of known or new viruses in computer programs; checkout scanners which can identify fruit and vegetables through the use of scent sensors; car navigation

systems which can guide a driver to a desired destination; and molecular breathanalyzers which are capable of diagnosing lung cancer, stomach ulcers and other diseases.

Given the rapidly growing number and visibility of products and systems which have a high MIQ, to describe what we see today as the intelligent systems revolution is not an exaggeration. In essence, the intelligent systems revolution has been brought about by major advances in sensors and computers, and the addition to AI's armanentarium of the methodologies of neurocomputing, evolutionary computing, probabilistic computing and fuzzy logic. To give an idea of the magnitude of these advances, if a cellular phone were made of vacuum tubes, it would have the size of the Washington monument.

In conclusion, the answer to the question posed in the title of this article is emphatically in the affirmative but with the understanding that we are still in the initial stages of the intelligent systems revolution, and that there will always be tasks that human can perform with ease and that no machine, now or in the foreseeable future, could perform as well. The more we learn about the human mind, the more impressed we become by its remarkable capabilities.