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Artificial Intelligence: Bringing expert knowledge to computers

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General Note
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ABSTRACT

This paper discusses what artificial intelligence (AI) exactly means, what is the need of AI, applications of AI and its advantages and disadvantages; and evaluates the future aspects of artificial intelligence. AI is the study and design of intelligent agents. The original goal of artificial intelligence was the construction of "thinking machines".. Artificial Intelligence is the key technology in many of today's novel applications. Although there are some fairly pure applications of AI -- such as industrial robots, for the most part, AI does not produce stand-alone systems, but instead adds knowledge and reasoning to existing applications, databases, and environments, to make them friendlier, smarter, and more sensitive to user behavior and changes in their environments. AI began as an attempt to answer some of the most fundamental questions about human existence by understanding the nature of intelligence, but it has grown into a scientific and technological field affecting many aspects of commerce and society.

Keywords: Intelligent Agents, Expert System, Robots, Back propagation.

Abbreviations: AI - Artificial Intelligence, IA - Intelligent Agents, ES - Expert System.

1. INTRODUCTION

1.1 What is AI?

Artificial intelligence (AI) is the intelligence of machines and the branch of computer science that aims to create it. In other words, AI is the branch of computer science concerned with making computers behave like humans (Russell and Norvig, 2011; Eric Tatro, 2004; Weyand, 1986; Bonn, 1986). The term was coined in 1956 by John McCarthy at the Massachusetts Institute of Technology. Artificial intelligence includes games playing, expert systems, natural language, neural networks, robotics etc.

Definitions of artificial intelligence are organized into four categories:

- SYSTEMS THAT THINK LIKE HUMANS

"The exciting new effort to make computers think…machines with their minds, in the full and literal sense"

- SYSTEMS THAT ACT LIKE HUMANS

"The art of creating machines that performs functions that require intelligence when performed by people"

- SYSTEMS THAT THINK RATIONALLY

"The study of the computations that makes it possible to perceive reason and act"

- SYSTEMS THAT ACT RATIONALLY

"The branch of computer science that is concerned with the automation of intelligent behaviour",

1.2 Why AI?

Artificial Intelligence attempts to build intelligent entities as well as understand them. AI addresses one of the ultimate puzzles: How is it possible for a slow, tiny brain, whether biological or electronic, to perceive, understand and manipulate a world far larger and more complicated than itself? How do we go about making something with those properties? These are hard questions but AI has solid evidence that the quest is possible. AI currently encompasses a huge variety of subfields, from general-purpose areas such as perception and logical reasoning, to such as specific tasks such as playing chess, providing mathematic theorems, writing poetry, and diagnosis diseases. AI is truly a universal field.

2. INTELLIGENT AGENTS

2.1. What are intelligent agents?

In artificial intelligence, an intelligent agent (IA) is an autonomous entity which observes and acts upon an environment (i.e. it is an agent) and directs its activity towards achieving goals (i.e. it is rational) Intelligent agents may also learn or use knowledge to achieve their goals. They may be very simple or very complex: a reflex machine such as a thermostat is an intelligent agent as is a human being, as is a community of human beings working together towards a goal. Intelligent agents are often described schematically as an abstract functional system similar to a computer program. For this reason, intelligent agents are sometimes called abstract intelligent agents (AIA).

2.2. How agents should act?

A rational agent is one that does the right thing. The right action is the one that will cause the agent to be most successful. That leaves us with the problem of deciding how and when to evaluate the agent's success. We use the term performance measure for the how—the criteria that determine how successful an agent is. Obviously, there is not one fixed measure suitable for all agents. We as outside observers establish a standard of what it means to be successful in an environment and use it to measure the performance of agents.For each possible percept sequence, an ideal rational agent should do whatever action is expected to maximize its performance measure, on the basis of the evidence provided by the percept sequence and whatever built-in knowledge the agent has.

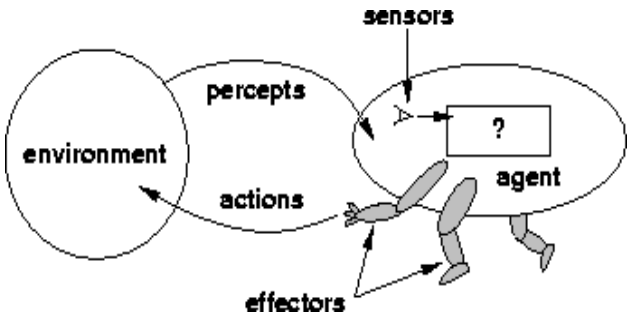

Figure 1

Intelligent Agent

2.3. Structure of Intelligent Agent

A simple agent program can be defined mathematically as an agent function which maps every possible percepts sequence to a possible action the agent can perform or to a coefficient, feedback element, function or constant that affects eventual action

$$f : P^* \rightarrow A$$

3. NEED OF ARTIFICIAL INTELLIGENCE

3.1. A word about paradigms

AI will force a dualistic view of life to change because the environment will be inseparable from it. Axiological shifts will occur in defining life, causing society to expand current definitions of life (e.g. requirement of a body). On the other hand, most scientists would be happy to view the brain as a vast but complex machine. As such it should then be possible to purely replicate the brain using artificial neurons. This has already been done for very simple life forms such as insects which only have a few thousand neurons in their brains. In principle, it would not be necessary to have a full scientific understanding of how the brain works. One would just build a copy of one using artificial materials and see how it behaves.

3.2. The need for artificial intelligence as an aid in controlling a manufacturing operation

AI applications to industrial production and planning are discussed and illustrated with diagrams and drawings. Applications examined include flexible automation of manufacturing processes (robots with open manual control, robots programmable to meet product specifications, self-regulated robots, and robots capable of learning), flexible fault detection and diagnostics, production control, and overall planning and management. For the case of robots, problems in the design and operation of a state-of-the-art machine-tool cell (for hole boring, milling, and joining) are analyzed in detail.

3.3. Why the computer industry needs artificial intelligence

From the dawn of the personal computer until very recently, computers have required more powerful processors to keep up with our day-to-day needs. First it was office software, then graphics design, then video editing and so on, each more and more processor-intensive. These days, however, even the most basic, inexpensive computers possess more than enough raw power for most, which are primarily using them to access the Web –a task where very little power is needed. Hence the latest developments in notebook PCs, where most growth is taking place, don't emphasize sheer power and speed, but rather focus on improving battery life and reducing weight. While manufacturers like Intel and AMD can certainly continue to develop low-cost processors that draw as little power as possible, they'll also need a reason to develop ultra-powerful (and expensive!) high-end chips. Enter artificial intelligence. Applications using AI would actually be able to take advantage

of the power offered by the latest and greatest processors and give consumers incentive to purchase them, which in turn gives manufacturers the economic push to design and create them. In the end, consumer demand for the capabilities made possible by AI will drive the adoption of faster processors, which will enable further developments in AI that will use that power, and so on. The circle continues.

4. APPLICATIONS OF AI

Artificial Intelligence in the form of expert systems and neural networks has applications in every field of human endeavor. They combine precision and computational power with pure logic, to solve problems and reduce error in operation. Already, robot expert systems are taking over many jobs in industries that are dangerous for or beyond human ability. Some of the applications divided by domains are as follows:

4.1. Heavy Industries and Space

Robotics and cybernetics have taken a leap combined with artificially intelligent expert systems. An entire manufacturing process is now totally automated, controlled and maintained by a computer system in car manufacture, machine tool production, computer chip production and almost every high-tech process. They carry out dangerous tasks like handling hazardous radioactive materials.

4.2. Finance

Banks use intelligent software applications to screen and analyze financial data. Software programs that can predict trends in the stock market have been created which have been known to beat humans in predictive power.

4.3. Computer Science

Researchers in quest of artificial intelligence have created spin offs like dynamic programming, object oriented programming, symbolic programming, intelligent storage management systems and many more such tools.

4.4. Aviation

Air lines use expert systems in planes to monitor atmospheric conditions and system status. The plane can be put on auto pilot once a course is set for the destination.

4.5. Weather Forecast

Neural networks are used for predicting weather conditions.

4.6. Swarm Intelligence

Here, programmers study how intelligence emerges in natural systems like swarms of bees even though on an individual level, a bee just follows simple rules. They study relationships in nature like the prey-predator relationships that give an insight into how intelligence emerges in a swarm or collection from simple rules at an individual level. They develop intelligent systems by creating agent programs that mimic the behavior of these natural systems.

4.7. Game Playing

You can buy machines that can play master level chess for a few hundred dollars. There is some AI in them, but they play well against people mainly through brute force computation--looking at hundreds of thousands of positions.

4.8. Understanding Natural Language

Just getting a sequence of words into a computer is not enough. Parsing sentences is not enough either. The computer has to be provided with an understanding of the domain the text is about, and this is presently possible only for very limited domains.

4.9. Computer Vision

The world is composed of three-dimensional objects, but the inputs to the human eye and computers' TV cameras are two dimensional. Some useful programs can work solely in two dimensions, but full computer vision requires partial three-dimensional information that is not just a set of two-dimensional views. At present there are only limited ways of representing three-dimensional information directly, and they are not as good as what humans evidently use.

4.10. Expert Systems

A ``knowledge engineer'' interviews experts in a certain domain and tries to embody their knowledge in a computer program for carrying out some task. How well this works depends on whether the intellectual mechanisms required for the task are within the present state of AI. When this turned out not to be so, there were many disappointing results. One of the first expert systems was MYCIN in 1974, which diagnosed bacterial infections of the blood and suggested treatments. It did better than medical students or practicing doctors, provided its limitations were observed. The usefulness of current expert systems depends on their users having common sense.

4.11. Heuristic Classification

One of the most feasible kinds of expert system given the present knowledge of AI is to put some information in one of a fixed set of categories using several sources of information. An example is advising whether to accept a proposed credit card purchase. Information is available about the owner of the credit card, his record of payment and also about the item he is buying and about the establishment from which he is buying it.

5. ADVANTAGES OF AI

Artificial intelligence use information technology to gain and use human expertise. Obviously, this can be very beneficial to organizations. Artificial intelligence can:

1. Provide answers for decisions, processes and tasks that are repetitive.
2. Hold huge amounts of information.
3. Minimize employee training costs.
4. Centralize the decision making process.
5. Make things more efficient by reducing the time needed to solve problems.
6. Combine various human expert intelligences.
7. Reduce the number of human errors.
8. Machines can be used to take on complex and stressful work that would be otherwise performed by humans.
9. Use of robotics to discover unexplored landscape, outer space and also be useful in our home activities.
10. Less danger, injury and stress to humans as the work is done by a artificially intelligent machine.
11. Understanding complex software can be made in to easy-to-understand types with the aid of artificial intelligence.
12. Minimized time and resources.

6. DISADVANTAGES OF AI

However, there are also disadvantages to artificial intelligence, such as:

1. No common sense used in making decisions.
2. Lack of creative responses that human experts are capable of.
3. Not capable of explaining the logic and reasoning behind a decision.
4. It is not easy to automate complex processes.
5. Not able to recognize when there is no answer.
6. Human capabilities can be replaced using a machine and therefore can foster feelings of inferiority among workers and staff.
7. Artificial Intelligence can malfunction and do the opposite of what they are programmed to do.
8. There is no filtering of information.
9. This type of technology can be misused to cause mass scale destruction.

If robots start replacing human resources in every field, we will have to deal with serious issues like unemployment in turn leading to mental depression, poverty and crime in the society. Human beings deprived of their work life may not find any means to channelize their energies and harness their expertise. Human beings will be left with empty time. Secondly, replacing human beings with robots in every field may not be a right

decision to make. There are many jobs that require the human touch. Intelligent machines will surely not be able to substitute for the caring behavior of hospital nurses or the promising voice of a doctor. Intelligent machines may not be the right choice for customer service. One of the major disadvantages of intelligent machines is that they cannot be 'human'. We might be able to make them think. But we will not be able to make them feel. Intelligent machines will definitely be able to work for long hours. But they will not do it with dedication and devotion.

7. CONCLUSION

AI can have two purposes. One is to use the power of computers to augment human thinking, just as we use motors to augment human or horse power. Robotics and expert systems are major branches of that. The other is to use a computer's artificial intelligence to understand how humans think.

SUMMARY OF RESEARCH

1. AI is the study and design of intelligent agents. The aim of artificial intelligence was the construction of "thinking machines".
2. AI began as an attempt to answer some of the most fundamental questions about human existence by understanding the nature of intelligence, but it has grown into a scientific and technological field affecting many aspects of commerce and society.
3. Replacing human beings with robots in every field may not be a right decision to make. There are many jobs that require the human touch. Intelligent machines will surely not be able to substitute for the caring behavior of hospital nurses or the promising voice of a doctor.

FUTURE ISSUES

In the next 10 years technologies in narrow fields such as speech recognition will continue to improve and will reach human levels. In 10 years AI will be able to communicate with humans in unstructured English using text or voice, navigate (not perfectly) in an unprepared environment and will have some rudimentary common sense (and domain-specific intelligence). We will recreate some parts of the human (animal) brain in silicon. There will be an increasing number of practical applications based on digitally recreated aspects human intelligence, such as cognition, perception, rehearsal learning, or learning by repetitive practice.

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