Artificial Intelligence

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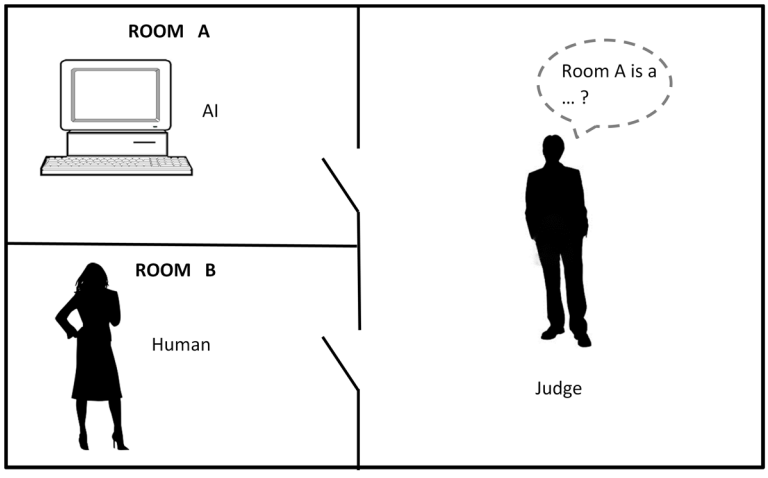
INTRODUCTION

The ENIAC computer unveiled in February 1946 is considered by many to be the first programmable digital computer. Soon after this first computer was initialized, human researchers started to dream of intelligent machines. Alan Turing (1950) proposed a means for computers to demonstrate intelligence. Thus, the science of artificial intelligence (AI) was created. The term *artificial intelligence* was first coined in August, 1955 (McCarthy et al., 2006). The goal of AI is to create computer programs, possibly embedded in sophisticated hardware such as robots, which are capable of intelligent thought, ultimately creating new knowledge. Intelligent systems should be able to perform any task normally associated with human cognition and intelligence, such as goal setting, goal seeking, path planning, and problem solving.

There are two schools of thought within AI. The first seeks to create machine intelligence by emulating the way humans think. An example of this approach is the MYCIN expert system, which utilized the problem solving processes of human experts in order to diagnose bacteriological infections (Shortliffe et al., 1975). The second is interested in creating intelligence through whatever mechanisms are available, regardless of its similarity to human thought processes. An example of this second approach is the Deep Thought (renamed Deep Blue® after IBM® purchased the program from Carnegie Mellon) chess playing program which utilized massively parallel computer architecture to achieve chess playing expertise by being able to examine game trees to a much deeper depth (Newborn & Kopec, 1989).

The Turing test (Turing, 1950), depicted in Figure 1, essentially states that if the output of an AI program cannot be distinguished by a knowledgeable human being who cannot see the respondents from responses made by another human, then the machine is intelligent. The Turing test has been

Figure 1. Turing test; judge in main room tries to determine which room has the computer AI and which room has the human by asking questions and evaluating Room A and Room B responses



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criticized that it doesn't really evaluate intelligence, just a computer's ability to imitate human conversational responses to questions. The Eliza program is an early version of what has become known as a chatbot (Weizenbaum, 1966). Eliza conversationally performed psychotherapy, but in actuality was simply using canned responses to pre-identified keywords present in the human user's responses to Eliza's statements and questions. A modern version of the Turing test is the annual Loebner Prize competition (AISB, 2016).

An interesting outcome of the Turing test is the identification that certain abilities humans may take for granted, such as speech, vision, and hearing are extremely complex for computers to perform, while complex mathematical operations are extremely easy for computers to perform. Additionally, Turing's ideal is for AI-based computers to have global knowledge, similar to humans, so that they could converse on a wide variety of topics intelligently. However, as shown by the Eliza project, early AI research was focused on solving much more narrowly defined problems within single domains. This trend of having highly specialized intelligence to outperform human experts in problem solving within a specific domain or for a specific problem with a domain is still continued today.

The field of AI has numerous disciplines:

- **Agents, Also Known as Intelligent Agents, Mobile Intelligent Agents, or Mobile Agents:** The use of atomic processing entities that collaboratively work to solve problems.
- **Artificial Life:** Systems that model natural life processes, behaviors, and evolution, both for investigating biologic and population dynamics and to be used in problems solving.
- **Artificial Neural Networks, Also Known as Neural Networks and Connectionist Systems:** Machine learning systems based on the processing of the human brain.
- **Cognitive Modeling:** Creates models of cognitive processes to explore the nature of thinking and problem solving.
- **Computer Vision:** Creating the ability to accurately interpret visual data such as pictures, animations, and movies.
- **Expert Systems, Also Known as Knowledge Based Systems:** Computer programs that simulate or surpass human expertise with a defined domain or collection of domains.
- **Evolutionary Computation:** Genetic algorithms or genetic processing.
- **Knowledge Acquisition:** Capturing human knowledge normally at an expert level.
- **Knowledge Representation:** Encapsulating acquired knowledge in a machine usable format.
- **Machine Learning:** Designing processes that enable machine intelligence to grow beyond the bounds that have been statically programmed into the AI application.
- **Natural Language Processing, Also Known as Speech Processing:** Systems that can understand and produce both written and spoken language.
- **Planning:** Development of intelligent plans for accomplishing goals, including game playing systems.
- **Robotics:** Development of automated hardware systems that can perform human-like tasks, including robots that mimic animal or human form and behavior.

The many disciplines of AI are not necessarily independent, but frequently interact with each other to try and create more comprehensive intelligence in computers. For example, a human like robot would utilize research from cognitive modeling, computer vision, knowledge acquisition, knowledge representation, machine learning, natural language processing, and planning in addition to the obvious robotics discipline. New subdisciplines are often created when an existing