On the relation between Artificial Intelligence and Pattern Recognition

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The idea of artificial intelligence (AI) has been fascinating mankind for hundreds of years. The ancient myth of Talos (Greek: Τάλως), a giant automaton made of bronze to protect the Greek island Crete from enemy ships, is one of the first known mentions of intelligent artificial beings. In the late 18^{th} century, the world was impressed by an automaton that was apparently able to play chess. This machine is nowadays known as the *Mechanical Turk* and its intelligence was actually fake, since it was controlled by a hidden human operator. About 200 years later, in 1997, a chess-playing computer named *Deep Blue* defeated the reigning world champion Garry Kasparov without human intervention. Since then, the benchmarks for AI have continuously been changing: For winning a chess game, sufficient compute power for simulating the consequences of all possible decisions is all that is needed. Thus, one might argue that this is not intelligence, but just number crunching. The game Go has then been considered the last bastion of human intelligence regarding board games for a long time, until the world No. 1 ranked player was beaten by a machine learning approach called *Alpha Go*. Shortly after that, the psychologist Gary Marcus argued that Alpha Go did not learn the game completely on its own, but benefits from a considerable amount of prior knowledge about the game hard-wired into the system by humans. Moreover, though it is capable of playing usual Go games with impressive performance, it could not generalize what it has learned to boards of different size, in contrast to humans.

These examples illustrate the usual shift of requirements imposed on AI: There are problems which are generally considered requiring intelligence for being solved appropriately, but once done by machines, the mechanisms solving the problem are considered as being engineered and not that intelligent after all. AI is hence a moving target without exact definition. Wikipedia defines AI as "intelligence demonstrated by machines". However, what is intelligence?

According to a thought experiment by the philosopher John Searle known as *the Chinese Room*, a computer could simulate intelligence, generating plausible outputs for given inputs, without actually *understanding* any of them. Imagine a lookup table of all possible sequences of sentences in a certain language and corresponding responses for each sentence. A machine could have a conversation in that language with a human just by looking up the responses, but actually understanding nothing.

This is similar to what contemporary AI systems do, leveraging advanced pattern recognition (PR) techniques: Digital "smart" assistants recognize spoken language and map it onto a set of request types with manually engineered algorithms for producing adequate responses. Driving assistance systems recognize patterns in sensor data, such as traffic signs and weather conditions in images. The reaction on these events is, again, hard-wired and not actually learned. Of course, these typical responses are also patterns and could, in theory, be learned from data. However, learning and recognizing patterns is only one component of intelligence. The associations machine learning algorithms currently try to learn have their origin in human intelligence itself: language, complex categorizations of the entities of the world, the rules of traffic etc. Real intelligence is less about solving a certain task or learning to recognize set of patterns, but more about learning how to learn (the part of pattern recognition that is currently done by humans) and abstracting. Intelligence is not only about recognizing concepts, but also inventing them in the first place. It is about curiosity, innovation, and creativity. A contemporary AI system may be able to recognize the writing style of different authors and even to generate new books, but the results will always be an imitation of the existing. Such a machine cannot create its own style. Similarly, machine learning techniques can recognize the patterns underlying chess and Go and learn how to play them, but could they have invented these games and their rules in the first place?

The drivers behind such innovations are often biological needs of humans: The hunger of ancient people led to the invention of weapons for hunting. Language was necessary to overcome loneliness and for solving tasks that cannot be accomplished alone. The creation of art, culture, music, and literature is the result of the human search for joy. Thus, intelligence also involves emotions. Machines, on the contrary, have no motivation to learn beyond what they are told to learn. Moreover, they might be able to recognize the patterns in human behavior, but they will not be able to *understand* how humans feel and why they act the way they do. However, a machine will only be perceived as intelligent by humans if it can understand them the same way other humans do.

Because PR is a fundamental component of and a prerequisite for intelligence, it is currently often used to *pretend* intelligent machines, but true intelligence goes far beyond this. Whether machines can achieve this at all, is questionable.