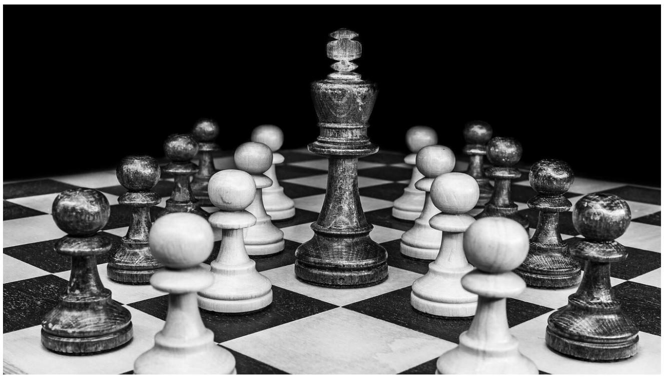
How learning more about neuroscience might influence development of improved AI systems

15 February 2019, by Bob Yirka



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Deep-learning neural networks have come a long way in the past several years—we now have systems that are capable of beating people at complex games such as shogi, Go and chess. But is the progress of such systems limited by their basic architecture? Shimon Ullman, with the Weizmann Institute of Science, addresses this question in a Perspectives piece in the journal *Science* and suggests some ways computer scientists might reach beyond simple AI systems to create artificial general intelligence (AGI) systems.

Deep learning networks are able to learn because they have been programmed to create artificial neurons and the connections between them. As they encounter new data, new neurons and communication paths between them are formed—very much like the way the human brain operates. But such systems require extensive training (and a feedback system) before they are able to do anything useful, which stands in stark contrast to the way that humans learn. We do not need to watch thousands of people in action to learn to follow someone's gaze, for example, or to figure out that a smile is something positive.

Ullman suggests this is because humans are born with what he describes as preexisting network structures that are encoded into our neural circuitry. Such structures, he explains, provide growing infants with an understanding of the physical world in which they exist—a base upon which they can build more complex structures that lead to general intelligence. If computers had similar structures, they, too, might develop physical and social skills without the need for thousands of examples.

But there is a problem—neuroscientists do not know how or where these structures exist in the brain. That makes it difficult to create artificial versions for use in computers. Ullman suggests that the path to building more sophisticated AI systems lies with learning more about the human brain and how it learns—and how it uses what it learns to make decisions regarding day-to-day existence. He also notes that there is actually an alternative approach—building computational learning methods from "scratch." But doing so, he acknowledges, could be just as difficult as figuring out how our own brains actually work.

More information: Shimon Ullman. Using neuroscience to develop artificial intelligence, *Science* (2019). DOI: 10.1126/science.aau6595

Abstract
Since the early days of artificial intelligence (AI), scientists have turned to neuroscience as a source of guidance. However, even the AI systems of today reflect a highly simplified version of the complex biological neural networks of the human brain, particularly when it comes to human-like learning and perception. In a Perspective, Shimon Ullman discusses the ways in which neuroscience might continue to inform AI technology. One of the

biggest challenges in AI development is the ability to achieve human-like learning and perception. However, given our limited understanding of these aspects within our own brains, it is unclear how they could be used to produce artificial human-like cognitive abilities. According to Ullman, this is an area where network systems and the brain differ fundamentally. Human cognitive systems contain innate cognitive structures – evolution-equipped information innate to humans – that help to facilitate the growth of our cognitive skills with very little prior knowledge or experience. Network systems, on the other hand, rely on extended training using large sets of data. However, Ullman suggests that combining artificial deep learning with brain-like innate structures may help guide network models toward more human-like cognitive abilities.

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