

Dissecting artificial intelligence to better understand the human brain

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In the natural world, intelligence takes many forms. It could be a bat using echolocation to expertly navigate in the dark, or an octopus quickly adapting its behavior to survive in the deep ocean. Likewise, in the computer science world, multiple forms of artificial intelligence are emerging - different networks each trained to excel in a different task. And as will be presented today at the 25th annual meeting of the Cognitive Neuroscience Society (CNS), cognitive neuroscientists increasingly are using those emerging artificial networks to enhance their understanding of one of the most elusive intelligence systems, the human brain.

"The fundamental questions cognitive neuroscientists and computer scientists seek to answer are similar," says Aude Oliva of MIT. "They have a complex system made of components - for one, it's called [neurons](#) and for the other, it's called units - and we are doing experiments to try to determine what those components calculate."

In Oliva's work, which she is presenting at the CNS symposium, neuroscientists are learning much about the role of contextual clues in human image recognition. By using "artificial neurons" - essentially lines of code, software - with neural [network](#) models, they can parse out the various elements that go into recognizing a specific place or object.

"The brain is a deep and complex neural network," says Nikolaus Kriegeskorte of Columbia University, who is chairing the symposium. "Neural network models are brain-inspired models that are now state-of-

the-art in many artificial intelligence applications, such as computer vision."

In one recent study of more than 10 million images, Oliva and colleagues taught an artificial network to recognize 350 different places, such as a kitchen, bedroom, park, living room, etc. They expected the network to learn objects such as a bed associated with a bedroom. What they didn't expect was that the network would learn to recognize people and animals, for example dogs at parks and cats in living rooms.

The machine [intelligence](#) programs learn very quickly when given lots of data, which is what enables them to parse contextual learning at such a fine level, Oliva says. While it is not possible to dissect human neurons at such a level, the computer [model](#) performing a similar task is entirely transparent. The [artificial neural networks](#) serve as "mini-brains that can be studied, changed, evaluated, compared against responses given by human neural networks, so the cognitive neuroscientists have some sort of sketch of how a real brain may function."

Indeed, Kriegeskorte says that these models have helped neuroscientists understand how people can recognize the objects around them in the blink of an eye. "This involves millions of signals emanating from the retina, that sweep through a sequence of layers of neurons, extracting semantic information, for example that we're looking at a street scene with several people and a dog," he says. "Current neural network models can perform this kind of task using only computations that biological neurons can perform. Moreover, these neural network models can predict to some extent how a neuron deep in the brain will respond to any image."

Using computer science to understand the human brain is a relatively new field that is expanding rapidly thanks to advancements in computing speed and power, along with neuroscience imaging tools. The artificial

networks cannot yet replicate human visual abilities, Kriegeskorte says, but by modeling the human brain, they are furthering understanding of both cognition and [artificial intelligence](#). "It's a uniquely exciting time to be working at the intersection of neuroscience, cognitive science, and AI," he says.

Indeed, Oliva says; "Human cognitive and computational neuroscience is a fast-growing area of research, and knowledge about how the [human brain](#) is able to see, hear, feel, think, remember, and predict is mandatory to develop better diagnostic tools, to repair the [brain](#), and to make sure it develops well."

More information: Oliva and Kriegeskorte are presenting in the symposium "[Human and machine cognition: The deep learning challenge](#)" at the CNS annual meeting in Boston. More than 1,500 scientists are attending the meeting from March 24-27, 2018.

Provided by Cognitive Neuroscience Society

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