

Neural network CLIP mirrors human brain neurons in image recognition

March 9 2021, by Sarah Katz

BIOLOGICAL NEURON

Probed via depth electrodes

Halle Berry



Responds to photos of Halle Berry and Halle Berry in costume



CLIP NEURON

Neuron 244 from pen-ultimate layer in CLIP RN50x4

Spider-Man



Responds to photos of Spider-Man in costume and spiders



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PREVIOUS ARTIFICIAL NEURON

Neuron 483, generic person detector from Inception v1

human face



Responds to photos of human faces



Photorealistic images



Responds to sketches of Halle Berry



Responds to comics or drawings of Spider-Man and spider-themed icons



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Does not respond significantly to drawings of faces



Conceptual drawings



Responds to the text "Halle Berry"



Responds to the text "spider" and others



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Does not respond significantly to text



Images of text

Credit: Open AI

Open AI, the research company founded by Elon Musk, has just discovered that their artificial neural network CLIP shows behavior

strikingly similar to a human brain. This find has scientists hopeful for the future of AI networks' ability to identify images in a symbolic, conceptual and literal capacity.

While the human [brain](#) processes [visual imagery](#) by correlating a series of abstract concepts to an overarching theme, the first biological neuron recorded to operate in a similar fashion was the "Halle Berry" neuron. This neuron proved capable of recognizing photographs and sketches of the actress and connecting those images with the name "Halle Berry."

Now, OpenAI's multimodal vision system continues to outperform existing systems, namely with traits such as the "Spider-Man" neuron, an artificial neuron which can identify not only the image of the text "spider" but also the comic book character in both illustrated and live action form. This ability to recognize a single concept represented in various contexts demonstrates CLIP's abstraction capabilities. Similar to a human brain, the capacity for abstraction allows a vision system to tie a series of images and text to a central theme.

However, a difference between biological and artificial [neurons](#) lies in semantics versus visual stimuli. Whereas neurons in the brain connect a cluster of visual input to a single [concept](#), AI neurons respond to a cluster of ideas. Indeed, by examining exactly how systems such as CLIP identify, researchers can potentially learn more about how human neurons recognize a vast array of common concepts, such as facial expressions, famous people, geographical regions and religious iconography, among others. Likewise, by studying how CLIP forms its lexicon, scientists hope to uncover more similarities to the [human brain](#).



Credit: Open AI

Research teams examine CLIP along two lines: 1) Feature visualization, which looks at how strongly a neuron fires in response to the amount of visual input, and 2) dataset examples, which assesses the distribution of activating dataset images to which a neuron responds. Thus far, the teams have discovered that CLIP neurons seem to be immensely multi-faceted, meaning that they respond to many unique concepts at a high level of abstraction.

As a recognition system, CLIP also exhibits various forms of bias. For example, the system's "Middle East" neuron has been associated with terrorism, alongside an "immigration" neuron that responds to input involving Latin America.

In terms of limitations to these findings and room for further research, scientists acknowledge that, despite CLIP's finesse in locating

[geographical regions](#), individual cities and even landmarks, the system does not appear to exhibit a distinct "San Francisco" neuron that ties a landmark such as Twin Peaks to the identifier San Francisco.

More information: Goh, G., et al. "Multimodal Neurons in Artificial Neural Networks." OpenAI, OpenAI, 4 Mar. 2021, openai.com/blog/multimodal-neurons/

Goh, G., et al. "Multimodal Neurons in Artificial Neural Networks." Distill, Distill, 4 Mar. 2021, distill.pub/2021/multimodal-neurons/

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