

A New Brain-on-a-Chip May Usher in the Beginning of the Singularity

A self-learning memristor is our closest step yet to recreating synapses in the human brain.

Here's what you'll learn when you read this story:

- Memristors, or “memory resistors,” are the leading candidate for replacing synapses in a neuromorphic (brain-like) computer.
- Earlier this year, Korea Advanced Institute of Science and Technology, or KAIST, announced the development of a self-learning memristor that's even better at replicating the synapses in our brain.
- This could allow AI computing to occur locally while also being more energy efficient and capable of improving at tasks over time.

In 1971, American electrical engineer and computer scientist Leon Chua reasoned that there must exist a fourth fundamental element of computing. There's the resistor, capacitor, and inductor, but Chua believed there also existed a “[memristor](#)”—a portmanteau of “memory” and “resistor” that described a simple, non-volatile memory component that could store information even when turned off.

This sounds like a simple function, but it provides the technological foundation of neuromorphic (a.k.a. brain-like) computing—an effective memristor would essentially act as an artificial synapse in an [AI](#) neural net, as it can achieve both data storage and computation at the same time (which is something our brain does). Since researchers “discovered” memristors [back in 2008](#), scientists and engineers around the world have been slowly improving their capabilities in the hopes of bringing about computers that are as efficient and powerful as human brains.

At the forefront of this research is the Korea Advanced Institute of Science and Technology, or KAIST. In January of this year, KAIST president Kwang Hyung Lee announced that his institute had successfully developed a memristor that can correct errors and learn from mistakes, meaning it could solve problems that were previously difficult for [neuromorphic systems](#). The researchers say, for example, that this chip could separate a moving image from a background during video processing, and actually improve its ability to do this task over time. The results were published in the [journal *Nature Electronics*](#).

This breakthrough means that AI tasks could be performed locally (instead of relying on cloud-computing servers) while also improving privacy and [energy efficiency](#).

“This system is like a smart workspace where everything is within arm’s reach instead of having to go back and forth between desks and file cabinets,” Hakcheon Jeong and Seungjae Han, both researchers from KAIST, [said in a press statement](#). “This is similar to the way our [brain](#) processes information, where everything is processed efficiently at once at one spot.”

In the same vein, KAIST also developed the first AI superconductor chip that runs at ultra-high speeds with minimal power consumption—just like the brain. In terms of computing, the human brain can perform a billion-billion [mathematical operations](#) per second with *just 20 watts* of power. If you want to make an AI neuromorphic brain, then you also need it to make it hyper-efficient.

Developing better and better memristors brings us incremental steps closer to creating a true brain-on-a-chip, essentially supercharging AI and (possibly) pushing us ever closer toward the singularity—the moment when AI surpasses human intelligence. However, “intelligence” is [a notoriously complicated subject](#), and just because an AI can perform certain calculations like the human brain, that doesn’t mean it is capable of all of the brain’s functions.

Of course, some scientists argue that such a capability means these machines could simply be “[alien minds](#)”—neural constructions unlike our own but undeniably intelligent in their own unique way. But for now, the human brain remains king in terms of hyper-efficient computing. With the help of improved memristors, however, AI could one day claim that neural crown for its own.