Computers may soon be like brains

Stanford scientists work to develop new type of device

SAN FRANCISCO — Kwabena Boahen, a professor of bioengineering and of electrical engineering at Stanford University, has envisioned a new generation of computers to be brainlike, or neuromorphic, machines that are vastly more efficient than the conventional digital computers.

As conventional computer chips are not up to the challenges posed by next-generation autonomous drones and medical implants, "we have reached the point where we need to do something different", says Boahen, also a member of Stanford Bio-X and the Stanford Neurosciences Institute.

"Our lab's three decades of experience has put us in a position where we can do something different, something competitive."

Moore's law, an observation made by Intel Corp co-founder Gordon Moore in 1965, has held up pretty well for five decades: Roughly every two years, the number of transistors one could fit on a chip doubled, all while costs steadily declined.

However, transistors and other electronic components are so small they are beginning to bump up against fundamental physical limits on their size.

And there are needs for computing to be ever faster, cheaper and more efficient.

> **"It's complementary. It's not going to replace current computers."**
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> **Kwabena Boahen,** professor of bioengineering and of electrical engineering at Stanford University, speaking about the brainlike computers

In the latest issue of Computing in Science and Engineering, Boahen says that the future is now.

He says that while others have built brain-inspired computers, he was quoted in a news release saying that he and his collaborators have developed a five-point prospectus for how to build neuromorphic computers that directly mimic in silicon what the brain does in flesh and blood.

The first two points of the prospectus concern neurons themselves, which unlike computers operate in a mix of digital and analog modes.

In their digital mode, neurons send discrete, all-or-nothing signals in the form of electrical spikes, akin to the ones and zeroes of digital computers.

But they process incoming signals by adding them all up and firing only once a threshold is reached — more akin to a dial than a switch.

That observation led Boahen to try using transistors in a mixed digital-analog mode.

Doing so, it turns out, makes chips both more energy efficient and more robust when the components do fail, as about 4 percent of the smallest transistors are expected to do.

From there, Boahen builds on neurons' hierarchical organization, distributed computation and feedback loops to create a vision of an even more energy efficient, powerful and robust neuromorphic computer.

Over the last 30 years, Boahen's lab has implemented most of its ideas in physical devices, including Neurogrid, one of the first truly neuromorphic computers.

But, in another two or three years, Boahen says, he expects his team will have designed and built computers implementing all of the prospectus' five points.

"It's complementary," Boahen says, adding that "it's not going to replace current computers".

But as most personal computers operate nowhere near the limits of conventional chips, neuromorphic computers would be most useful in embedded systems that have extremely tight energy requirements, such as very low-power neural implants or on-board computers in autonomous drones.

XINHUA

Future stewardesses in the making

Students go through the preliminary round of selection, including height check, appearance and etiquette tests, in a stewardess recruitment by Xiamen Air on March 12 at Fuzhou University, Fujian province. Thousands of students applied, and some 1,500 new staff members are to be hired. XINHUA

China's aid boosts teacher education in Africa

KAMPALA — China's aid to the education sector in Africa is helping boost teacher training, a key component in skilling the population to fast track development, a UN official has said.

Ann Therese Ndong-Jatta, director of United Nations Educational, Scientific and Cultural Organization Regional Office for Eastern Africa, in a recent interview recognized China's contribution to Africa's education sector over the years.

"We value the initiative in teacher training in Uganda and other countries in Africa. This will revitalize the teaching profession," she says.

China through UNESCO donated equipment to three teacher-training institutions in Uganda on March 3. Figures from the Chinese embassy here show that 137 tutors were trained and 272 pieces of information communication and technology and studio equipment were donated.

Ndong-Jatta says tutors were skilled on how to integrate technology with traditional methods of training.

China through UNESCO is funding an $8 million project aimed at narrowing the educational quality gap on the continent.

The project, Enhancing Teacher Education for Bridging the Education Quality Gap in Africa, aims to accelerate progress toward the achievement of Education for All and the Sustainable Development Goal 4, which is quality education.

The four-year project that started in 2012 focused on providing a sufficient number of qualified teachers in Africa through training programs.

Eight African countries — Cote d'Ivoire, Ethiopia, Namibia, Democratic Republic of the Congo, Congo, Liberia, Tanzania, and Uganda — are benefiting from the program.

Ndong-Jatta says besides cooperation in primary education, China has been cooperating with Africa to boost higher education.

China helped set up the Capacity Building Institute of Teacher Education in Ethiopia, and the regional director says some African countries also had student and teacher exchange programs with China.

She says a conference has been scheduled in Djibouti to discuss how to boost further cooperation with China in the area of higher education.

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