

## Research news reading report

Source article: <https://news.yale.edu/2017/11/28/new-research-creates-computer-chip-emulates-human-cognition>

The article introduces a new research field that's emerging and growing---neuromorphic chip. It was inspired by how human brain works. The field started to rise after 1980s, when tasks performed by computers get more and more complex and require more powerful chips. This kind of chip works in an asynchronous way and runs faster than other chips in most of today's digital devices. Along with its advantageous speed and structure, it appears to be exceptionally proficient at works related to pattern recognition and able to solve such tasks efficiently in terms of energy.

First, it is important to understand the difference between synchronous system and asynchronous system. Imagine being in a classroom where, after finishing an assignment, you have to wait until everyone else in the classroom finishes the assignment before you can move on to the next one. That's how devices in synchronous system works. There is a built-in clock that allows the same amount of time for the completion of each computational function. As a result, the system can only run as fast as the slowest function in the chain. (1) However, in asynchronous system, every function runs in its own speed in parallel and moves on individually after finishing its task. In this case, no time is wasted because of disparity among tasks, allowing for faster processing of complex task and less energy consumption.

Despite its many advantages over synchronous system, asynchronous system had been forgotten for years after its advent. In the blueprint of the first modern computer, the machine was in fact designed in an asynchronous way. But computer architecture soon grew in complexity and included a lot more wires. Ensuring that a signal was sent and received correctly within the machine got trickier. An internal timekeeper was needed to make sure that things ran properly, and synchronous circuits became the law of the land. (1) The drawbacks of synchronous system didn't draw enough attention until in 1980s, when chips get more complicated and takes more and more energy to run its internal clock.

In TrueNorth, there are 5.4 billion transistors, and 1 million neurons that communicate via 256 million "synapses. Designed very similar to a brain, TrueNorth has a parallel, distributed, modular, scalable, fault-tolerant, flexible architecture that integrates computation, communication, and memory and has no clock. It is fair to say that TrueNorth completely redefines what is now possible in the field of brain-inspired computers, in terms of size, architecture, efficiency, scalability, and chip design techniques. (2)

After tested by IBM teams, TrueNorth turns out to be extremely adept at at inference work for deep neural networks. Under the trend of emerging artificial intelligence methods using data processing, this chip makes the tasks of pattern recognizing, such as image recognition, speech recognition, that is, to learn from data and identify objects and words from images and sentences. Such technologies can be used in live in numerous ways from game consoles, automatic driving cars, intelligent personal assistant, and many other fields.

Sources:

1. <https://news.yale.edu/2017/11/28/new-research-creates-computer-chip-emulates-human-cognition>
2. <http://www.research.ibm.com/articles/brain-chip.shtml>