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Computer and IEEE Micro Magazines Highlight Intel's Loihi, a Revolutionary Neuromorphic 'Self-Learning' Chip

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SOURCE IEEE Computer Society

LOS ALAMITOS, Calif., March 8, 2018 /PRNewswire/ -- As we approach the limits of physics and require new breakthroughs to advance future computing capabilities, the promising field of neuromorphic computing is finally delivering-by creating programmable learning chips that can mimic the human brain and replace the traditional CPU to capably implement on-chip heavy-duty machine learning algorithms. In IEEE Computer Society's *Computer* and *IEEE Micro* magazines, two articles present Intel's novel, manycore neuromorphic processor, Loihi, which features a microcode-programmable learning engine that enables on-chip training of spiking neural networks (SSNs).



In "Programming Spiking Neural Networks on Intel's Loihi," available as a special preview article and will appear in *Computer's* March 2018 issue, Intel's Chit-Kwan Lin and colleagues describe how this neuromorphic computing approach-taking cues from biology-adopts "the brain's locality, fine-grain parallelism, and event-driven operation in building highly efficient, scalable computing machines, by realizing SNNs in dedicated hardware." Loihi's toolchain, the authors describe in their article, consists of an intuitive Python-based API for specifying SNNs, and a compiler and runtime library for building and executing SNNs on this as well as other target platforms. By showcasing how to build, train, and use a SNN to classify handwritten digits from the MNIST database, the authors demonstrate this innovative microcode-based learning rule engine within each neuro core.

In "Loihi: A Neuromorphic Manycore Processor with On-Chip Learning," published in the January/February 2018 issue of *IEEE Micro* magazine, researchers from Intel present the details of this new neuromorphic processor for AI applications. This 60-mm² chip, fabricated in Intel's 14nm process, advances the state-of-the-art modeling of SNNs in silicon. Loihi integrates a wide range of novel features for the field, such as hierarchical connectivity, dendritic compartments, synaptic delays, and, most importantly, programmable synaptic rule-learning.

The Loihi research test chip includes digital circuits that mimic the brain's basic mechanics, making machine learning faster and more efficient while requiring lower compute power. Neuromorphic chip models draw inspiration from the ways human neurons communicate and learn, using spikes and plastic synapses that can be modulated based on timing. This game-changing technology could help computers self-organize and make decisions based on patterns and associations.

In the first half of 2018, the Loihi test chip will be shared with leading university and research institutions with a focus on advancing AI. It is Intel's hope that this toolchain will ease the task of programming SSNs on Loihi, and as a result, be a catalyst for greater participation in neuromorphic computing from the broader research community.

"The Loihi chip and its toolchain kit come to finally move neuromorphic computing from being a promising yet algorithm-specific concept/prototype to a fully-programmable learning architecture," said Sumi Helal, editor-in-chief of *Computer*. "Programmable neuromorphic learning will increase utility and will empower other key technologies such as the Internet-of-Things, which could eventually lead to democratizing AI for all."

"We're pleased to have the opportunity to present and support Intel's novel manycore neuromorphic processor **Loihi** and its toolchain in our leading *Computer* and *IEEE Micro* publications," said Dr. Hironori Kasahara, 2018 President of the IEEE CS, Professor of Computer Science at Waseda University in Tokyo and the Director of the campus' Advanced Multicore Research Institute. "At the IEEE CS we look forward to the advancements this will create for AI and computing potential overall."

The entire *Computer* issue will be available later in March.

Computer, IEEE Computer Society's flagship magazine, explores new cutting-edge technologies, discoveries, and innovations. With readership that

includes over 53,000 technology professionals, it covers all aspects of computer science, computer engineering, computing technology, and applications. For more than 40 years, developers, researchers, and managers have relied on *Computer* for timely, peer-reviewed information about research, trends, best practices, and changes in the profession.

IEEE Micro, a bimonthly publication of the IEEE Computer Society, addresses users and designers of microprocessors and microprocessor systems, including managers, engineers, consultants, educators, and students involved with computers and peripherals, components and subassemblies, communications, instrumentation and control equipment, and guidance systems. Topic areas include architecture, communications, data acquisition, control, hardware and software design/implementation, algorithms (including program listings), digital signal processing, microprocessor support hardware, operating systems, computer aided design, languages, application software, and development systems.

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