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"Hardware opportunities for Deep Neural Networks and Artificial Intelligence"

For more than 50 years, the capabilities of Von Neumann-style information processing systems improved tremendously, mostly thanks to Dennard's Law: the amazing realization that each generation of scaled-down transistors could in fact be consistently better, in terms of power and speed, than the previous generation. But now that we find ourselves in the post-Dennard's Law era, attention is turning to computing approaches that are not as dependent on engineering billions of devices that have to work absolutely perfectly. One such approach is to move towards Non-Von Neumann algorithms, and in particular, to Deep Neural Networks (DNNs) and other Artificial Intelligence (AI) architectures motivated by the human brain.

In this tutorial, I will discuss the challenges and review recent progress towards hardware implementation and acceleration of such brain-inspired computing architectures. This progress ranges from systems that combine conventional CMOS devices in different and unconventional ways, to systems built around emerging NVM (Non-Volatile Memory) devices; and from systems designed to accelerate conventional DNNs through hardware innovation, to systems that seek to transcend the known limitations of current DNN algorithms (such as the requirement for batch-based learning using vast datasets of static and labeled data).

Geoffrey W. Burr received his Ph.D. in Electrical Engineering from the California Institute of Technology in 1996. Since that time, Dr. Burr has worked at IBM Research--Almaden in San Jose, California, where he is currently a Principal Research Staff Member. He has worked in a number of diverse areas, including holographic data storage, photon echoes, computational electromagnetics, nanophotonics, computational lithography, phase-change memory, storage class memory, and novel access devices based on Mixed-Ionic-Electronic-Conduction (MIEC) materials. Dr. Burr's current research interests include non-volatile memory and cognitive computing. An IEEE Senior Member, Geoff is also a member of MRS, SPIE, OSA, Tau Beta Pi, Eta Kappa Nu, and the Institute of Physics (IOP).