Neuromorphic Processing: A New Frontier in Scaling Computer Architecture

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Abstract
The desire to build a computer that operates in the same manner as our brains is as old as the computer itself. Although computer engineering has made great strides in hardware performance as a result of Dennard scaling, and even great advances in “brain like” computation, the field still struggles to move beyond sequential, analytical computing architectures. Neuromorphic systems are being developed to transcend the barriers imposed by silicon power consumption, develop new algorithms that help machines achieve cognitive behaviors, and both exploit and enable further research in neuroscience. In this talk I will discuss a system implementing spiking neural networks. These systems hold the promise of an architecture that is event based, broad and shallow, and thus more power efficient than conventional computing solutions.

This new approach to computation based on modeling the brain and its simple but highly connected units presents a host of new challenges. Hardware faces tradeoffs such as density or lower power at the cost of high interconnection overhead. Consequently, software systems must face choices about new language design. Highly distributed hardware systems require complex place and route algorithms to distribute the execution of the neural network across a large number of highly interconnected processing units. Finally, the overall design, simulation and testing process has to be entirely reimagined. We discuss these issues in the context of the Zeroth processor and how this approach compares to other neuromorphic systems that are becoming available.

Categories and Subject Descriptors C.1.3 Neural nets, C.1.4, D.1.m Miscellaneous

Keywords neuromorphic; low power; spiking neural network, neural network; parallel computing; Zeroth

Speaker Bio
Jeff Gehlhaar is Vice President of Technology for Qualcomm Research and currently leads the engineering team developing Qualcomm’s Zeroth neuromorphic processor, pursuing fundamental research into spiking neural networks, spiking sensors and hardware and software architectures for neuromorphic computing. During his 23 years at Qualcomm, led a variety of projects encompassing software for networking and embedded system, hardware bring up, and software engineering. Jeff lead the software research team developing LTE and LTE-Advanced networking protocols, and has worked across a broad range of technologies and programs: from the integration of an on-board microprocessor into Qualcomm’s first fully integrated CDMA mobile modem (early SoC), to large-scale network management software for cellular systems. From 1999-2003 he was Vice President of Engineering and COO for Mohomine, an In-Q-Tel backed knowledge mining startup applying machine learning algorithms to text classification and information extraction applications for both government and commercial customers. He is a graduate of the Jacobs School of Engineering, UC San Diego.