A Brain-inspired Information Processing Framework: Applications and Accelerations

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Bio

Qinru Qiu received her M.S. and Ph.D. degrees from the department of Electrical Engineering at University of Southern California in 1998 and 2001 respectively. She received her B.S. degree from the department of Information Science and Electronic Engineering at Zhejiang University, China in 1994. Dr. Qiu is currently a professor and the program director of Computer Engineering at Department of Electrical Engineering and Computer Science in Syracuse University. Before joining Syracuse University, she has been an assistant professor and then an associate professor at the Department of Electrical and Computer Engineering in State University of New York, Binghamton. Her research areas are high performance energy efficient computing systems, and neuromorphic computing. She is the TPC member of DATE, DAC, ISLPED, ISQED, VLSI-SoC, and ICCAD. She is the associate editor of TODAES.

Abstract

It is known that humans are naturally superior to machines in image recognition, natural language understanding, and situation awareness. With an estimated computing speed at 100 TFLOPs (Trillion Instructions Per Second) and power consumption of 20 Watt, the neocortex system also outperforms existing supercomputer systems in both energy efficiency and size to computation ratio. Existing research suggests that the neocortex has massively parallel architecture based on unified building blocks (i.e. neurons or cortical columns), closely coupled memory and computation, distributed (instead of central) storage, and its operation largely relies on pattern matching and probabilistic inference instead of numerical computation. In this talk, a hierarchical information processing model is presented that emulates these key features of neocortex system and was applied in many applications for cognition and detection. The proposed information processing is based on a cortical processing model. To imitate human cognition process, a hierarchical structure is adopted: the lower level is designated to pattern detection of the raw external input, while the upper level is dedicated for probabilistic inference. The model is successfully used for context aware document image recognition, traffic monitoring, network anomaly detection, etc. Our experimental results show that compared to conventional approaches, the brain-inspired information processing gives better recall accuracy, higher detection rate and lower false alarm.