



سخنرانی علمی

پژوهشگاه دانش‌های بنیادی
پژوهشکده علوم کامپیوتر

Energy-Efficient Convolutional Neural Networks Using Stochastic Computing

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Abstract

Stochastic computing (SC), a low-cost and noise-tolerant computing paradigm first introduced in the 1960s, has received considerable attention in recent years for efficient design of machine learning systems, particularly convolutional neural networks (CNNs). Data is converted from traditional weighted binary format to uniform bit-stream representation and processed using extremely simple logic gates. Multiplication, as a common but costly operation in conventional design of CNNs can be implemented using simple standard AND gates in stochastic domain. The paradigm achieves orders of magnitude saving in hardware cost compared to the conventional fixed-point binary designs. Long latency and high energy consumption, however, have been the main challenges in SC-based design of CNNs. Often long random bit-streams must be processed to produce acceptable results. Recent developments in the area of SC has revolutionized the paradigm. Low-cost, high-performance, and energy efficient CNNs are being developed by processing low-discrepancy deterministic bit-streams. In this talk, we will review the current state-of-the-art SC-based designs of CNNs. From conventional random bit-stream-based to developing low-discrepancy SC designs, we will discuss the potentials and challenges in designing SC-based CNNs.

Biography

Dr. M. Hassan Najafi received the B.Sc. degree in Computer Engineering from the University of Isfahan, Isfahan, Iran, the M.Sc. degree in Computer Architecture from the University of Tehran, Tehran, Iran, and the Ph.D. degree in Electrical Engineering from the University of Minnesota, Twin Cities, USA, in 2011, 2014, and 2018, respectively. He is currently an Assistant Professor with the School of Computing and Informatics, University of Louisiana at Lafayette, Louisiana, USA. His research interests include stochastic and approximate computing, unary processing, processing in memory, and energy-efficient VLSI design.

Dr. Najafi's research establishes some counterintuitive, yet fundamental, new design methodologies for designing digital stochastic systems. Conceptually, his works challenge the limitations of bit-stream-based computing; practically, they provide a means for designing significantly smaller, faster, and energy-efficient embedded systems.

Dr. Najafi was a recipient of the 2018 EDAA Outstanding Dissertation Award, the Doctoral Dissertation Fellowship from the University of Minnesota, the Best Poster Award at the 2019 DAC PhD Forum, and the Best Paper Award at the 35th IEEE International Conference on Computer Design (ICCD'17). His work on Polysynchronous Clocking was selected as the Feature Paper of the Month in the Oct. 2017 Issue of the IEEE Transactions on Computers.

زمان: پنج‌شنبه ۹۸/۰۹/۲۸ - ساعت ۱۵

مکان: فرمانیه - خیابان شهید لواسانی - جنب برج کوه نور - نبش خیابان فربین - پژوهشگاه دانش‌های بنیادی - طبقه سوم

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