Unity in Diversity: Co-operative Embedded Heterogeneous Computing

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Abstract. Heterogeneous computing, materialized in the form of multiprocessor system-on-chips comprising of various processing elements such as general-purpose cores with differing power-performance characteristics, GPUs, DSPs, non-programmable accelerators (e.g., AI accelerators), and reconfigurable computing, are expected to dominate the current and the future embedded platform landscape. The heterogeneity enables a computational kernel with specific requirements to be paired with the processing element(s) ideally suited to perform that computation, leading to substantially improved performance and energy-efficiency. While heterogeneous computing is an attractive proposition in theory, considerable architectural and software support at all levels are essential to fully realize its promises. The architecture should include compute elements that can accommodate and accelerate diverse application domains through runtime adaptations. The systems software (compiler and operating systems) needs to orchestrate the different on-chip compute resources in a synergistic manner with minimal engagement from the application developers. I will present architectural and software perspective of co-operative embedded heterogeneous computing, especially in the context mobile and wearable devices. I will introduce the technology trends driving heterogeneous computing and elaborate our research efforts in architecture, compiler, and runtime approaches to fully realize the potential of heterogeneity towards high-performance, energy-efficient embedded computing.

Biography

Tulika Mitra is a Professor of Computer Science at School of Computing, National University of Singapore (NUS). Her research interests span various aspects of the design automation of embedded real-time systems, cyber-physical systems (CPS), and Internet of Things (IoT) with particular emphasis on energy-efficient computing, heterogeneous computing, application-specific processors, and software timing analysis/optimizations. She has authored over hundred scientific publications in leading international journals and conferences in this domain. Her research has been recognized by best paper award at FPT 2012 and best paper nominations at DAC (2016, 2012, 2009), VLSI Design, CODES+ISSS, FPL, ECRTS, CASES. Her research has been supported by Ministry of Education Singapore, National Research Foundation Singapore, A*STAR Science & Engineering Research Council, Cambridge Silicon Radio, and Huawei. Prof. Mitra currently serves as Senior Associate Editor of the ACM Transactions on Embedded Computing Systems, Deputy Editor-in-Chief of IEEE Embedded Systems Letters, Associate Editor of IEEE Design & Test Magazine and EURASIP Journal on Embedded Systems. She has served as Associate Editor of IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems and IET Computers & Digital Techniques in the past. She has served in the organizing and program committees of several major conferences in embedded systems, real-time systems, and electronic design automation.