Designing Efficient Heterogeneous Computer Systems Across Computing Scales

Abstract: Computer systems at all scales, from server-class systems for datacenters to embedded systems on IoT devices, are embracing extreme heterogeneity in hardware and software. While heterogeneity offers immense computational promise, it also poses programmability and performance/energy challenges. In this talk, I will show how we can leverage decades of research on traditional general-purpose CPUs to improve the programmability and efficiency of two classes of emerging heterogeneous systems. In one example, we will improve the programmability and performance of server-class GPGPUs using virtual memory techniques developed over decades for traditional CPUs. In the second example, I will co-opt server-class hardware traditionally designed for branch prediction in servers to instead manage energy in brain implants with a completely different power/performance profile. At a high-level, these two examples represent two types of heterogeneity -- intra- and inter-device -- and our work shows how we can reap the benefits of specialization using modest hardware enhancements of these systems.

Bio: Abhishek Bhattacharjee is an Associate Professor of Computer Science at Rutgers University. His research spans systems architectures and software for the cloud, brain-machine interfaces, and brain modeling applications. His group’s research has influenced the design of real-world systems. Most notably, their work on coalesced TLBs is now implemented in AMD’s Zen architecture, their work on superpage migration is now implemented in the Linux 4.14 kernel series, and their POSIX-compliant GPU system call interface is hosted under the Radeon Open Compute platform for ultrascale computing. Abhishek is a recipient of the Chancellor's Award for Faculty Excellence in Research at Rutgers and the CV Starr Fellowship at Princeton Neuroscience. He obtained his PhD from Princeton, where he was awarded the Gordon Wu Prize, and BEng from McGill, where he received the British Association Medal for Great Distinction.