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Data-Centric Models for Multilevel Algorithms

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Today, computational scientists must contend with a diverse set of supercomputer architectures that are capable of exposing unprecedented levels of parallelism and complexity. Effectively placing, moving, and operating on data residing in complex distributed memory hierarchies is quickly becoming an intractable problem for developers of parallel scientific software. Because of this, there is an increased desire to explore data-centric task-based programming models because of their ability to assist in performing complex, error-prone tasks required for application correctness, performance, and scalability.

In this talk we will present our data- and task-parallel implementation of the High Performance Conjugate Gradient (HPCG) benchmark targeting the Legion runtime. HPCG implements a multigrid preconditioned conjugate gradient method that comprises several computational kernels commonly found in many scientific applications. We will discuss how we are using this infrastructure as a vehicle for investigating how design and abstractions choices impact the performance and programmability of multilevel methods expressed in this model. We will conclude our talk by discussing our current efforts porting the High Performance Geometric Multigrid (HPGMG) benchmark to Legion.