Domain-Specific Metacomputing for Computational Science

Achieving Specificity Through Abstraction

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A domain-specific language (DSL) is a computer language specialized to a particular application domain. This is in contrast to a general-purpose language (GPL), which is broadly applicable across domains. There are a wide variety of DSLs, ranging from widely used languages for common domains, such as HTML for web pages, down to languages used by only one or a few pieces of software, such as MUSH soft code. DSLs can be further subdivided by the kind of language, and include domain-specific markup. Historically, computational science has largely been confined to the realm of research scientists and doctoral candidates. However, over the years...
perhaps unbeknownst to the larger software community us scientific computing eggheads have been quietly compiling collaborative open-source libraries that handle the vast majority of the heavy lifting. The result is that it is now easier than ever to implement mathematical models, and while the field may not yet be ready for mass-consumption, the bar to successful implementation has been drastically lowered. Since the purpose of scientific computing is to provide scientific insight into real systems that exist in nature, the discipline represents the cutting edge in making computer software approach reality. Innovations in supercomputing have led to new hybrid node designs, mixing conventional multi-core hardware and accelerators such as graphics processing units (GPUs). One of the first atmospheric models that has been fully ported to these architectures is the COSMO (Consortium for Small-scale Modeling) model. In a consistency test using the new solver, the specific concentration constancy is preserved up to machine roundoff, whereas a typical formulation can have errors many orders of magnitude larger. In addition to mass conservation and consistency, CSLAM-SW also ensures shape preservation by combining the new scheme with existing shape-preserving filters.