

Computational Science for Application Domains

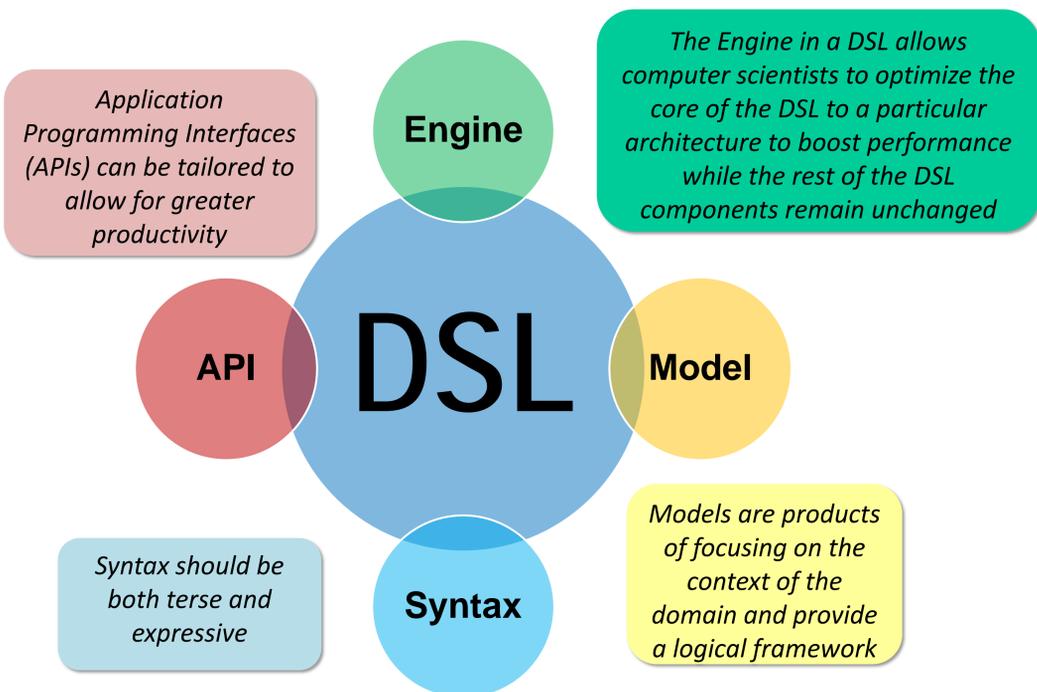


S&T Campaign: Computational Sciences
Computing Sciences

Dale Shires, (410) 278-5006
dale.r.shires.civ@mail.mil
Patrick Hanrahan, (650) 723-8530
hanrahan@cs.stanford.edu

Research Objective

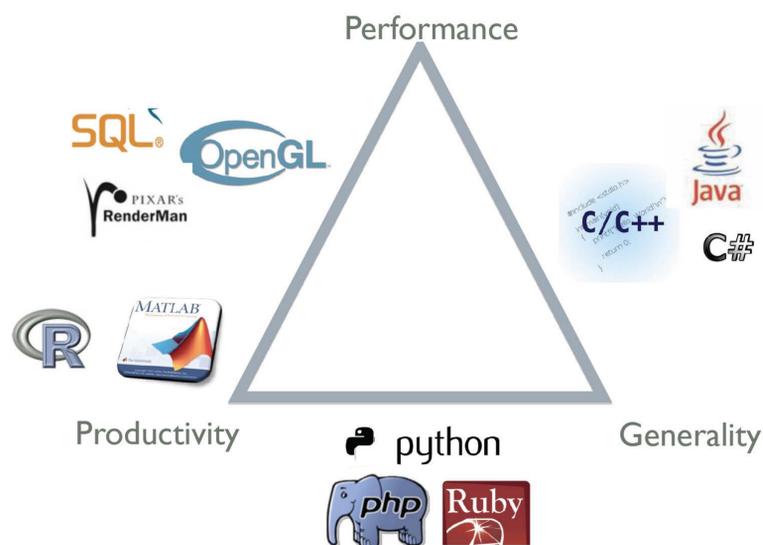
- Develop novel methods to facilitate High Performance Computing algorithm development
- Discover innovative ways to speed software delivery and ensure efficient execution on heterogeneous emerging systems using Domain Specific Languages (DSLs)



Domain Specific Languages (DSLs) give computational scientists a programming language dedicated to their particular problem domain

Challenges

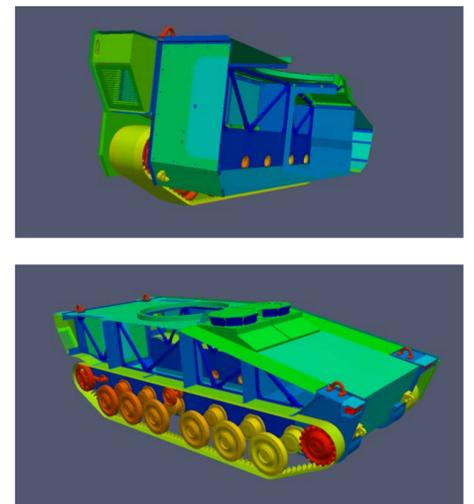
- Determining an appropriate balance to the four components of a DSL
- Efficient mapping to complex heterogeneous architectures
- Achieving scalability to emerging memory-hierarchy dependent processors



DSLs can be designed to allow for a balance of productivity, generality, and performance

ARL Facilities and Capabilities Available to Support Collaborative Research

- Joint research being conducted with the Army High Performance Computing Research Center (AHPCRC) with Stanford University
- Primary initial targets are Finite Element Mesh (FEM)-based codes (LisztFEM)
- New DSL Engine developments for complex heterogeneous architectures
- ARL facilities include large-scale heterogeneous systems and small-scale emerging binary processor testbeds



Domain Specific Languages can target numerous possible domains. Finite Element Mesh (FEM)-based codes are a good preliminary candidate

Complementary Expertise/ Facilities/ Capabilities Sought in Collaboration

- Expanded sets of applications to facilitate greater understanding of cross-cutting impacts in syntax, model, engine, and API DSL components.
- Compiler expertise is needed for additional components (such as power-aware computing) to be factored into engine developments
- Evolving trends toward exascale computing need to be addressed at this critical stage