

Invited Presentation

The Next Generation Software (NGS) Program

Frederica Darema

National Science Foundation

Abstract

In this talk I will discuss the research and technology trusts fostered by the NSF Next Generation Software (NGS) Program. The program focuses in two systems software areas: One is on the development of Performance Engineering Technology for the Design, Management and Control of Computing Systems. The other seeks to create a new system software architecture and technology for the development and runtime support of complex applications executing on complex computing platforms, such as Computational Grids Platforms encompassing heterogeneous networked platforms including petaflop (Grids-in-a-Box) platforms and embedded sensor systems.

A computing system consists of several architectural layers – the application layer, the system software, processing nodes, grid platform architecture, and interconnect layers; the ideas presented here are aimed to lead to software systems that take into account the interrelation among these layers in affecting the behavior of a system.

The performance engineering thrust of the program pertains development of novel multilevel methods and tools, and performance frameworks for combing such methods and tools for a particular analysis or view of the system, it's components and layers. The power of these new methods will enable ability to analyze behavior of existing systems, as well as enable prediction of the behavior of future systems, thus affecting their design cycle.

The thrust for a new system software technology includes new directions in compiling technology and application composition technology. In the integrated compiling system technology fostered by the Program, part of the compiler is embedded into the run-time and dynamically interacts with: 1) the underlying (distributed) operating systems' resource managers to determine and request resources; 2) the performance modeling frameworks to optimize the mapping and partition of the application; and 3) the application library components and knowledge-based systems to dynamically select the appropriate application components (algorithms) depending on problem size and on the underlying complex computing platforms' architecture.

The talk will also provide examples of research funded under the NGS Program.

Bio: Dr. Darema is the Senior Science and Technology Advisor at EIA and CISE, and Director of the Next Generation Software (NGS) Program and the Biological Information Technology & Systems (BITS) Program. Dr. Darema's interests and technical contributions span the development of parallel applications, parallel algorithms, programming models, environments, and performance methods and tools for the design of applications and of software for parallel and distributed systems. Dr. Darema

received her BS degree from the School of Physics and Mathematics of the University of Athens - Greece, and MS and Ph. D. degrees in Theoretical Nuclear Physics from the Illinois Institute of Technology and the University of California at Davis Respectively, where she attended as a Fulbright Scholar and a Distinguished Scholar. After Physics Research Associate positions at the University of Pittsburgh and Brookhaven National Lab, she received an APS Industrial Fellowship and became a Technical Staff Member in the Nuclear Sciences Department at Schlumberger-Doll Research. Subsequently, in 1982, she joined the IBM T. J. Watson Research Center as a Research Staff Member in the Computer Sciences Department and later on she established and became the manager of a research group at IBM Research on parallel applications. While at IBM she also served in the IBM Corporate Strategy Group examining and helping set corporate-wide strategies. In 1984 Dr. Darema proposed the SPMD (Single-Program-Multiple-Data) computational model that has become the popular model for programming today's parallel and distributed computers. Dr. Darema has been at NSF since 1994, where she has developed initiatives for new software capabilities, a new paradigm for applications (DDDAS), and pushing for research in the interface of neurobiology and computing. The NGS, the BITS, and the Scalable Enterprise Systems programs foster such ideas. She is also managing the Dynamic Data Driven Application Systems (DDDAS; an ITR component), and involved in the Nanotechnology Science and Engineering, and the Scalable Enterprise Systems (cross-Directorate programs). During 1996-1998 she completed a two-year assignment at DARPA where she initiated a new thrust for research on methods and technology for performance engineered systems.