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A Parallel Programming Tutorial

by

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Course Description

High Performance Computers require Parallel Programming. To solve the largest scientific problems it is necessary to attach many processors to a single computational task. In this tutorial, programming techniques to harness the power of the largest computers to solve scientific problems will be discussed.

Scientists and Engineers who program parallel computers in Fortran or C are invited to attend.

There are several steps on the way to a parallel program. First of all, the mathematical algorithm that is used to obtain the solution must allow for independent computations. It is expected that participants will have the knowledge of their specific discipline and its algorithms. The second step, implementation of the algorithm on a parallel machine, is not a trivial task, as here mistakes frequently lead to programs not scaling in performance or giving incorrect results as multiple processors attack the task. In this tutorial we will look at some issues regarding program implementation. The information in this tutorial will be based on the practical application of techniques and methods used at SGI on a daily basis.

We will discuss the various Parallel Programming Models. Best known are the Message Passing (MP) and Shared Memory Programming (SMP) and how they map to the different Computer Architectures. Examples will be given of the MPI and OpenMP programming model on the SGI CC-NUMA machine and on Clusters of small SMP machines. The CC-NUMA machine supports all programming paradigms; it is a valuable tool for looking at the various Parallel Programming Models. Tools used by SGI's engineers to detect hot spots in users' codes along with a description of the compiler and its process in producing optimized code will be looked at.

At the completion of this tutorial, participants will be able to understand how programs map to different Computer Architectures and how to optimize for performance. A comparison of the different Programming Models (MPI and SMP) techniques will give attendees the ability to use these techniques in practical applications.