Preface

Parallel computing aims at reducing the solution time of computer applications by using a number of processors to solve the same problem. As the technology of parallel hardware and software matures, parallel computing is entering the mainstream of computing. On the one hand, parallel processing is an approach for achieving high performance to solve the so-called "Grand Challenge" problems which demand a computing power beyond the teraflops. On the other hand, parallel processing provides a way to by-pass the fundamental limitations on the speed of a single processor and to scale up the performance using existing off-the-shelf technology. This trend can be clearly observed from the fact that not only the traditional supercomputers are using parallel processors, but also powerful servers and workstations are equipped with parallel processors. There are now PCs with multiple processors. Another trend is the use of cluster of simple PCs and workstations to form powerful parallel&distributed computing systems which are capable of delivering hundreds folds or more computing speed than a single processor computer.

The use of parallel computers introduces a number of new problems which are not present or not important in the traditional use of sequential computers. 1) The increase of the number of design choices in a parallel architecture introduces extra complexity in designing parallel computers; 2) The issues in designing parallel algorithms differ strongly from the sequential counterparts in that communication and load-balancing have great influences on the performance of a parallel algorithm; 3) System software and application software are dramatically affected by the architectural characteristics of the hardware. Developing efficient and portable parallel programs is still a non-trivial task and many problems in parallel software development still need to be solved.

This course intends to give an introduction to the aforementioned three major issues in parallel computing. Both theoretical and practical aspects concerning these three issues are discussed. The emphasis is on the fundamental aspects of parallel computing rather than specific computer systems and specific applications. Examples of parallel computers and algorithms are used to discuss the general and fundamental issues. This course aims at giving a general overview on the various aspects in parallel computing, describing some basic techniques for the design and analysis of parallel algorithms, and last but not least providing some experiences with developing parallel programs for practical applications. This last goal is realized by a practical exercise in solving a problem on parallel computers.

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