Parallel Computing

Series of three Lectures by
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Abstract

Computational science and engineering (CSE) is an interdisziplinary field that applies the techniques of computer science and mathematics to solving physical and engineering problems. CSE emerged as a discipline with the advent of supercomputers in the 1970s. Today, the methods of CSE can also be used with cost-effecive PCs and workstations making them available to a large number of scientists and engineers studying complex events such as car crashes, formation of galaxies, 3D-studies in fluid and rigid body mechanics and so on.

Recent developments in networking have turned computer networks into attractive platforms for parallel computing bringing in a new concept of network computing when a network is viewed as a multi-processor parallel computer. Numerous programming environments have been developed to support parallel execution of programs on computer networks. In the first talk we present a survey and analysis of existing frameworks for network computing with a particular focus on computing systems for Networks of Workstations. A classification and assessment scheme for such systems is proposed. Analysis of systems advantages and drawbacks is given and future perspectives are discussed.

The second part of the course will deal with communication issues of distributed memory machines. Processors in a distributed memory machine need to communicate to overcome the fact that there is no global common shared storage and that all the information is scattered among processors' local memories. First we survey interconnection topologies and communication technologies, their structural and computational properties, embeddings and simulations among them. All this will form a framework for studying interprocessor communication algorithms, both point-to-point and collective communication operations. We will concentrate mainly on orthogonal topologies, such as hypercubes, meshes, and tori, and will study basic routing algorithms, permutation routing, and one-to-all as well as all-to-all communication operation algorithms. We conclude with some more realistic abstract models for distributed memory parallel computations.

The third part is devoted to the case studies of parallel algorithms. We will study several families of distributed memory parallel algorithms, in which the communication algorithms explained above are heavily used. Finally, we discuss important instances of efficient parallel algorithms on dense matrix, namely basic matrix operations and algorithms for solving systems of linear equations.

We show few examples which are solved on parallel clusters on our clusters.