Short Presentations 3: Performance Issues

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In this session seven papers are presented, concerning problems typical in parallel processing and their impact on the performance of the overall system. In “Alpha-Linux Cluster vs. Cray T3E - A Case Study in Numerical Field Theory”, the recent problem of achieving a powerful computational capability by joining together several workstations is dealt. A 64 466 MHz Alpha workstation cluster with a Myrinet communication link was compared with a Cray T3E supercomputer based on 600 MHz processors, by executing QCD simulations. The cluster outperforms the Cray, so confirming that this research direction, adopted by several groups, is promising for the future.

Another challenge strictly related to workstation clusters is the implementation of Distributed Memory System architectures. Although different protocols have been proposed for software DSM, their performance is application-dependent. Thus, it is interesting to build a system selecting different protocols based on the access patterns it observes. In “Working-set Based Adaptive Protocol (WAP) for Software Distributed Shared Memory”, a new protocol is presented which tries to exploit spatial locality, by assuming that a process localizes its references to a rarely changing working-set: WAP was compared with the popular Lazy Hybrid protocol by running six applications on eight nodes of an IBM SP2. The results showed an improvement in performance depending on the size of the temporal window containing the last referenced set of pages.

Both in clusters and in supercomputers, performance is dramatically affected by communications: moreover, in wide area computing, remote job executions should be decided very accurately, since long communications can affect the overall execution times depending on the moment they happen. In “Prediction of Communication Performance for Wide Area Computing Systems”, a predictive model is presented, based on the analysis of the human life rhythm and able to balance the communication vs. computation requirements. The model has been implemented in Java on a hypercomputer architecture at the University of Rostock and predicts latency and bandwidth several weeks beforehand, enabling a better scheduling and balancing of the jobs. Another predictive model, based on the isoefficiency concept, is presented in “Predictability of Cellular Programs Implemented with CAMELot” which is a problem solving environment, permitting simulation and modeling of complex dynamic phenomena through cellular automata. Two cellular programs have been run on a 24 CPU Meiko-CS2 machine and their scalability has been analysed with CAMELot: a good adherence between predictions and experiments was found.

Instead of predictive models, one can choose a better communication strategy for each application. In “Communication Policies Performance: A Case Study” five typical strategies are investigated, to provide the best approach for high volume, long range communications while implementing a multi-dimensional FFT on an IBM SP2 parallel system. The results were analysed and modelled by using Medea a tool for workload characterisation developed at the University of Pavia, with the unexpected conclusion that not always sophisticated strategies are also the best working.

Parallel processing can affect also the industrial world when real time applications are implemented on parallel systems. In large distributed systems performances are mainly due to the response times of data storage devices: not only the optimal system but also the location of the data is essential to achieve high throughput. In “Towards a Cost Model for Distributed and Replicated Data Stores”, large data stores containing mostly read-only data are analysed through models implementing two different philosophies: centralised or distributed and fully replicated data store. By implementing data migration or application migration approaches, influence and costs of data stores on WANs can be estimated, which are not addressed in database research.

Finally in “Adding Flexibility and Real Time Performance by Adapting a Single Processor ...” issues concerning the transformation of a single application into a multiprocessor application and the change of a single platform (SARA) into a flexible multiprocessor real time system are dealt. Considerations about cooling, power consumption, scalability, use of standard technologies, networks, configuration flexibility are useful for industrial application designers, to upgrade their systems by exploiting capabilities of the parallelism instead of changing too often their hardware.