Practical Parallel Computer Model for Parallel Computers and Facility Location for Parallel and Distributed Computer Networks

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Abstract

Many parallel computers have been investigated and developed, and these parallel computers are one of the alternatives to the vector computers because parallel computers can achieve the high-performance and low-cost by advanced VLSI technology. In this thesis, we address the practical parallel computer model and the efficient facility location method by taking account of the performance and cost for massively parallel and distributed computer networks.

For the practical parallel computer model, we point out the buffering behavior of communication lines and the message contention on the computer networks. Then, we propose the LogPQ model which includes three message queues for buffering, and eight parameters to decide the physical restriction of parallel computers. Some parameters, the communication latency L, the overhead o, the gap g and the number of processors P are as almost same as the LogP model proposed by Culler et. al., and the others, the queue limits SQ, TQ, RQ and the extra overhead n, are our originals. We investigate on the constructions of LogPQ model from the view of computer architecture. As a result, the LogPQ model can describe the parallel algorithms with more detail for various parallel machines. Then, we show the efficiency of LogPQ model to develop the parallel algorithms through the execution of experiment on the parallel computer CM5. The LogPQ model can accurately estimate the parallel execution time for an application than the LogP model.

For efficient facility locations on the parallel and distributed computer networks, we investigate facility location algorithms on the tree-shaped computer networks by taking account of the cost-performance. First, we formulate the facility location problem on the tree-shaped computer networks which the facility consists of small subfacilities with equal size. The execution time of proposed facility location algorithm is analyzed in detail. Next, we investigate the facilities location problem which the facilities consist of the equal size facility.

To discuss the communication cost in the high-performance communication facility, we propose the all-pair distancesum which shows the average distance of any two nodes in the network. Then we formulate the facility location problem and prove that the optimal location algorithm can be achieved in $O(n)$, where n is the number of nodes in the tree-shaped computer network. Next, we investigate the facility location problem for the tree-shaped computer networks which the facility decreases the edge cost from d to $f(d)$. And we show that the facility location, in

which $f(d)$ is proportional to d, is equivalent to the facility location problem using the all-pair distancesum. Finally, the facility location problem is formulated for the general tree-shaped networks in which the length of edge is a_i and the cost of each edge is c_i. The optimal facility location algorithm for the tree-shaped computer networks is proposed.

Keywords: **parallel and distributed computer systems, LogP model, computer network system, tree-shaped facility, facility location**