Coarse Grained Parallel Algorithms Yield Better Parallel I/O Complexity

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Abstract

Block-wise access to data is a central theme in the design of efficient External Memory Algorithms. A similar requirement arises in the transmission of data between processors in certain parallel computation models such as BSP and CGM. Previous papers have shown a useful mapping from coarse grained parallel algorithms to external memory algorithms. In this paper, we explore the I/O complexity of a number of external memory algorithms obtained via this mapping. In particular we show that algorithms known for the Coarse Grained Multicomputer(CGM) Model can be used to obtain external memory algorithms that seem to have better I/O complexity than the well known lower bounds for various problems, including sorting, permutation, matrix transpose, geometric and GIS algorithms including Voronoi diagrams, and graph algorithms. We explain how a similar phenomenon can also occur with BSP algorithms. We explain this contradiction by examining the parameter values which permit the $log_{\frac{M}{B}}\frac{N}{B}$ term in the I/O complexity to become a constant. We show that such a parameter constellation arises naturally in coarse grained parallel algorithms such as CGM and that it is not unusual for the external memory domain.