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Prefetching in File Systems for MIMD Multiprocessors

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Abstract

The problem of providing file I/O to parallel programs has been largely neglected in the development of multiprocessor systems. There are two essential elements of any file system design intended for a highly parallel environment: parallel I/O and effective caching schemes. This paper concentrates on the second aspect of file system design and specifically, on the question of whether prefetching blocks of the file into the block cache can effectively reduce overall execution time of a parallel computation. MIMD multiprocessor architectures have a profound impact on the nature of the workloads they support. In particular, it is the collective behavior of the processes in a parallel computation that often determines the performance. The assumptions about file access patterns that underlie much of the work in uniprocessor file management are called into question. Results from experiments performed on the Butterfly Plus multiprocessor are presented showing the benefits that can be derived from prefetching (e.g. significant improvements in the cache miss ratio and the average time to perform an I/O operation). We explore why it is not trivial to translate these gains into much better overall performance.

This technical report, although still available on hardcopy from Duke University, has been superseded by [EK89] and later published more thoroughly as [KE90]. For yet another presentation and many more results, see also [Kot91, KE91b, KE92b, KE91a, KE92a, Kot92].

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