

Adaptive Cache-Oblivious All-to-All Operation

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Abstract—Modern processors rely on cache memories to reduce the latency of data accesses. Extensive cache misses would thus compromise the usefulness of the scheme. Cache-aware algorithms make use of the knowledge about the cache, such as the cache line size, L , and cache size, Z , to be cache efficient. However, careful tuning of these parameters for these algorithms is needed for different hardware platforms. Cache-oblivious (*CO*) algorithms were first introduced by Leiserson to work without the knowledge of the cache parameters mentioned earlier, but still achieve optimal work complexity and optimal cache complexity. Here we present *CO* algorithms for *all-to-all operations* (analogous to the cross-product operation). Its applications include *Convolution, Polynomial Arithmetic, Multiple Sequence Alignment, N-Body Simulation*, etc. Given two lists each with n elements, a *naive* implementation of all-to-all operation incurs $O(n^2/L)$ cache misses. Our *CO* version incurs only $O(n^2/L^2 \sqrt{Z})$ cache misses. Preliminary experiments on *Opteron 1.4GHz* and *MIPS 250MHz* show that the *CO* implementation achieves two times faster. The profiling tool further confirms that the amount of cache misses is significantly lower. We also consider various situations where (a) the elements have non-uniform sizes, (b) an element cannot fit into the cache, (c) the lengths of the lists vary, and (d) an element is linked list. In addition, we study the extension to *K-lists All-to-All Operation* and its application. Finally, we will present the empirical results and compare with cache-aware algorithms.

[Full Text Not Available]