



Optimization for an Array Computer

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APPLIED DATA RESEARCH

ABSTRACT

The unconventional design of the ILLIAC-IV requires unconventional optimization techniques. Conventional techniques focus on the program. Since conventional hardware executes one instruction at a time, greater efficiency is obtained by reducing the number of instructions executed. Elimination of common subexpressions and literal computations, removal of locally invariant computations, reduction of operator strength, etc. are all methods of restructuring a program to allow greater efficiency. This focus on the program is not sufficient for the ILLIAC-IV. Efficient use of an array of processors depends upon the data being stored so as to permit parallel execution on many data streams. Further, the inability of each processor to access more than 2K of memory requires the use of routing commands for inter-processor communication. Hence, optimization on an array computer requires restructuring of the data as the primary area of effort. Such restructuring includes, for example, an extension to the skewed storage method which permits any slice of any array to be accessed in parallel and, further, to be aligned with an other slice by a uniform route. (A slice of an n -dimensional array A is the vector $\{A(c_1, \dots, c_{i-1}, j, c_{i+1}, \dots, c_n : m_i \leq j \leq M_i, c_k \text{ constant})\}$.)