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Tolle, Donald M. (1981)
"Coordination of Computation in a Binary Tree of Processors: An Architectural Proposal"
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A design is proposed for a cellular computer consisting of many processors, of two kinds, connected in the form of a binary tree. The design is inspired by and closely related to one recently presented by Mago. Both machines are intended for the highly parallel execution of the Formal Functional Programming (FFP) languages of Backus. These are high-level, general-purpose languages especially well suited for expressing parallel algorithms. Both machines, storage permitting, take advantage of all the parallelism expressed in a single program and can execute many programs simultaneously. Both machines, furthermore, decompose each primitive FFP operator into more elementary operations, many of which may be executable concurrently.
In comparison to Mago's machine, the computer described here offers the possibility of a higher degree of concurrency below the FFP language level, has more powerful basic operations, and often requires less storage for the same computation. The individual processors of the computer are more complex than Mago's, but are still well suited for implementation in VLSI.
The machine proposed here uses the syntactic structure of an FFP expression to guide the embedding of a syntactic network of nodes in the binary tree of machine cells. Execution of the FFP program is accomplished through operations performed by the embedded network of nodes. As new FFP expressions are produced during execution of the FFP program, corresponding new syntactic networks are automatically and dynamically embedded and used for further execution.
A "Syntax Tree Language" (STL) for programming the embedded syntactic networks is specified in some detail. Several examples of the computational potential of the machine are presented, including primitive operators for sorting, for matrix multiplication, and for solving simultaneous linear equations.