

Modeling Resource Management in Concurrent Computing Systems

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Abstract

After over 50 years of intense research in Parallel Processing, we still have no real popular and successful system with the promised performance of the technology. A review of the evolution of parallel processing research is presented and a solution advocated: the generation of true parallel operating systems.

A novel operating systems paradigm for massively parallel computers is introduced. The paradigm incorporates concepts such as virtualization of processors and time-sharing of parallel machine resources. It assumes the SPMD (Single-Program Multiple-Data) model of execution, which is simple, powerful and popular.

Open theoretical problems in the design of operating systems for parallel computers are identified and a key problem is addressed in particular: Scheduling. A mathematical framework for scheduling, both in time and across processors, is proposed. In this general framework, the problem of finding the best schedule based on the metrics of response time and throughput is considered. Preliminary results show that it suffices to limit the search for the best schedule to a finite, well-behaved class called periodic schedules.