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A methodology approach to compare performance of parallel programming models for shared-memory architectures. (English) Zbl 1468.68035

Summary: The majority of current HPC applications are composed of complex and irregular data structures that involve techniques such as linear algebra, graph algorithms, and resource management, for which new platforms with varying computation-unit capacity and features are required. Platforms using several cores with different performance characteristics make a challenge the selection of the best programming model, based on the corresponding executing algorithm. To make this study, there are approaches in the literature, that go from comparing in isolation the corresponding programming models’ primitives to the evaluation of a complete set of benchmarks. Our study shows that none of them may provide enough information for a HPC application to make a programming model selection. In addition, modern platforms are modifying the memory hierarchy, evolving to larger shared and private caches or NUMA regions making the memory wall an issue to consider depending on the memory access patterns of applications. In this work, we propose a methodology based on parallel programming patterns to consider intra and inter socket communication. In this sense, we analyze MPI, OpenMP and the hybrid solution MPI/OpenMP in shared-memory environments. We demonstrate that the proposed comparison methodology may give more accurate predictions in performance for given HPC applications and consequently a useful tool to select the appropriate parallel programming model.

For the entire collection see [Zbl 1435.65016].

MSC:
68M20 Performance evaluation, queueing, and scheduling in the context of computer systems
68N19 Other programming paradigms (object-oriented, sequential, concurrent, automatic, etc.)

Keywords:
MPI; OpenMP; HPC; parallel programming patterns

Software:
MPI

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