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The Platform Competence Centre team just published a new report comparing software technologies for vectorization and parallelization. The report is available through the publications' section of this website and thanks to the link below.

Executive summary of the report:

This paper demonstrates how modern software development methodologies can be used to give an existing sequential application a considerable performance speed-up on modern x86 server systems. Whereas, in the past, speed-up was directly linked to the increase in clock frequency when moving to a more modern system, current x86 servers present a plethora of performance dimensions that need to be harnessed with great care. The application we used is a real-life data analysis example in C++ analyzing High Energy Physics data. The key software methods used are OpenMP, Intel Threading Building Blocks (TBB), Intel Cilk Plus, and the auto-vectorization capability of the Intel compiler (Composer XE). Somewhat surprisingly, the Message Passing Interface (MPI) is successfully added, although our focus is on single-node rather than multi-node performance optimization. The paper underlines the importance of algorithmic redesign in order to optimize each performance dimension and links this to close control of the memory layout in a thread-safe environment. The data fitting algorithm at the heart of the application is very floating-point intensive so the paper also discusses how to ensure optimal performance of mathematical functions (in our case, the exponential function) as well as numerical correctness and reproducibility. The test runs on single-, dual-, and quad-socket servers show first of all that vectorization of the algorithm (with either auto-vectorization by the compiler or the use of Intel Cilk Plus Array Notation) gives more than a factor 2 in speed-up when the data layout in memory is properly optimized. Using coarse-grained parallelism all three approaches (OpenMP, Cilk Plus, and TBB) showed good parallel speed-up on the available CPU cores. The best one was obtained with OpenMP, but by combining Cilk Plus and TBB with MPI in order to tie processes to sockets, these two software methods nicely closed the gap and TBB came out with a slight advantage in the end. Overall, we conclude that the best implementation in terms of both ease

of implementation and the resulting performance is a combination of the Intel Cilk Plus Array Notation for vectorization and a hybrid TBB and MPI approach for parallelization.

Comparison of Software Technologies for Vectorization and Parallelization [2]

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