

Vector Parallelism on Multi-Core Processors

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All modern CPUs boost their performance through vector processing units (VPUs). VPUs are activated through special SIMD instructions that load multiple numbers into extra-wide registers and operate on them simultaneously. Intel's latest processors feature a plethora of 512-bit vector registers, as well as 1 or 2 VPUs per core, each of which can operate on 16 floats or 8 doubles in every cycle. Typically these SIMD gains are achieved not by the programmer directly, but by (a) the compiler through automatic vectorization of simple loops in the source code, or (b) function calls to highly vectorized performance libraries. Either way, vectorization is a significant component of parallel performance on CPUs, and to maximize performance, it is important to consider how well one's code is vectorized. We will take a look at vector hardware, then turn to simple code examples that illustrate how compiler-generated vectorization works.

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