

Topic 21:

Compiler Challenges for High-Performance Architectures

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The past two decades have been exciting ones for high-performance computing. Besides technological improvements were also very important enhancements in computer architecture. For example, it is clear that parallelism is now essential in terms of performance, but there are also other techniques. On the other hand, as architectures have grown more complex, they have become more difficult to program. Therefore the compiler must play a special role because of its responsibility for translating source programs to the suitably efficient target programs.

This presentation introduces the basic problems of compiling high-level languages to code that achieves acceptable performance on high-performance computer systems. We will show important architectural features, including pipelining, vector parallelism, VLIW and superscalar processing, asynchronous parallelism, and memory hierarchy. For each of these we will introduce optimizations that are helpful in improving performance. These strategies include instruction scheduling, automatic vectorization, automatic parallelization, and loop transformations to improve reuse in the memory hierarchy.