Small Guide to Writing Fast Code

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Guideline for writing fast Code (I)

- **Avoid obvious mistakes**
  - Know the available algorithms: use good algorithms
  - Precompute once were possible (e.g., constants)
  - Give the compiler a chance: write simple code, avoid complicated data structures
  - Understand were the runtime is wasted
    - code profiling
    - optimize only code parts that matter
  - Compiler
    - Use vendor compiler if possible
    - Try different flags, -O3 is not always best

- **Optimization for caches**
  - Recursive is better then iterative
  - Understand your code in terms of cache behavior and try to improve
  - Know your cache size and maybe other parameter
Guideline for writing fast Code (II)

- **Basic block optimization**
  - For the innermost kernels use unrolled code: no loops, recursive calls or other control structures
  - Order instructions for register locality and/or instruction parallelism; scalar replacement for variables being reused; other optimizations
  - Maybe: check assembly code

- **Adaptivity through search over alternatives**
  - Accept that you can't know the right answers for all choices
  - Search over a relevant subset of possible algorithms and/or implementation options

- After optimization check whether you still use the right algorithm
How to Write Good SIMD Vector Code

- Take the “right” algorithm and the “right” data structures
  - Fine grain parallelism
  - Correct alignment in memory
  - Contiguous arrays

- Use a good compiler (e.g., vendor compiler)

- First: Try compiler vectorization
  - Right options, pragmas and dynamic memory functions
    (Inform compiler about data alignment, loop independence,…)
  - Check generated assembly code and runtime

- If necessary: Write vector code yourself
  - Most expensive subroutine first
  - Use intrinsics, no (inline) assembly
  - Important: Understand the ISA
Further Reading

- Check out the Proceedings of the IEEE special issue on “Program Generation, Optimization, and Platform Adaptation,” Feb. 2005, 93(2) and the references therein.