Usable assembly language for GPUs

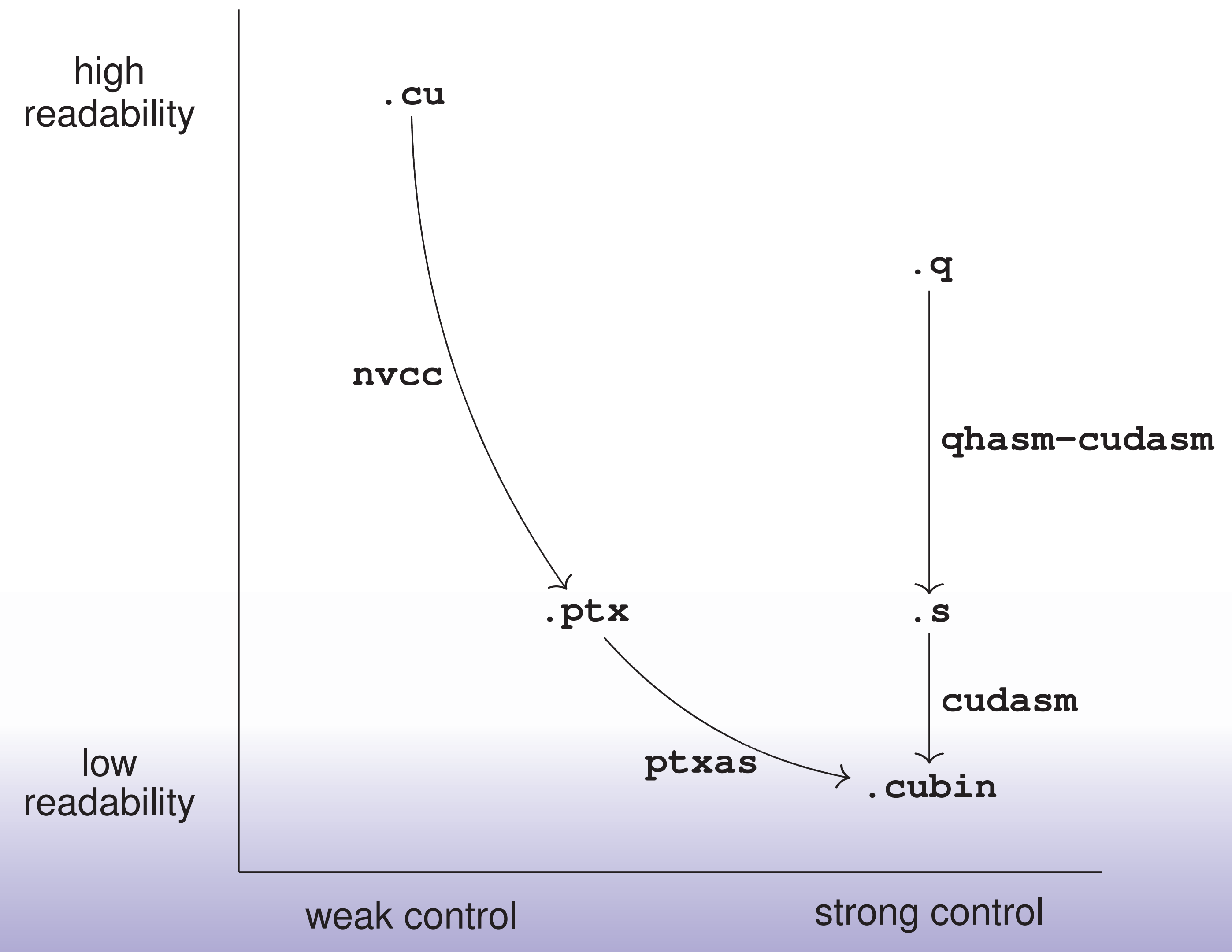
NCF

The NVIDIA compilers `nvcc` and `ptxas` leave the programmer with only very limited control over register allocation, register spills, instruction selection, and instruction scheduling. In theory a programmer can gain control by writing an entire kernel in W.J. van der Laan's `cudasm`, but this requires tedious, error-prone tracking of register assignments. We have built a higher-level assembly language that allows much faster programming while providing the same amount of control over the GPU.

Decades of advances in the design of optimizing compilers have *reduced*, but have not *eliminated*, the need for some performance-critical functions to be written in assembly language. We have built a new assembly language `qhasm-cudasm` for programming on NVIDIA's Tesla-architecture GPUs.

We have used `qhasm-cudasm` successfully to produce highly optimized code for a major cryptanalytic computation, the "ECC2K-130" computation, an order of magnitude larger than the recently announced RSA-768 factorization. This computation has already kept thousands of CPU cores busy for several months; the addition of several GPU clusters running our code has drastically reduced the overall expected time for the computation.

We use G200b GPUs in low-cost GTX 295 graphics cards for development. We have also run our software without trouble on the T10 GPUs (in Tesla S1070-500 units) in TeraGrid's Lincoln cluster, similar GPUs in the NCF/SARA cluster, and the FX 5800 GPUs in TeraGrid's Longhorn cluster.



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