Errorless Compute For Scalable AI

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The Age of Low-Precision

AI companies are scaling models and compute because of scaling laws, which suggest that model error decreases as one increases data, parameters, and compute (measured in floating-point operations per second, or FLOPS). AI Compute scales by getting more FLOPS out of GPUs. Since 2012, the greatest source of GPU FLOPS growth has been number representation for lower-precision. Indeed, NVIDIA offers GPUs that do 8-bit or even 4-bit floating-point arithmetic. This is necessary due to the floating-point tradeoff between precision and speed.

Low-Precision Won't Continue to Scale

Looking forward, it seems unlikely that low-precision compute will continue to scale AI. The benefits are diminishing, and the risks are raised as precision is lowered. Epoch AI forecasts only a 2× FLOP increase by 2030 from 8-bit floating point adoption, a rather marginal advancement. On the other hand, as precision is decreased further, the risks become serious, requiring either complicated workarounds or limits on lowering precision. These include fewer effective parameters, reduced with weight accuracy, and unstable training due to gradient biases.

Beyond Floating-Point

The way to increase operations per second is not to go after FLOPS at all; floating-point is a poor format for representing numbers and doing arithmetic. SciSci has a number representation scheme of its own, based not on floating-point arithmetic, but on exact p-adic arithmetic. SciSci is building the first fast and errorless AI accelerator chip, the exact processing unit (EPU), to perform exact arithmetic without any rounding error, and faster than floating-point, using this alternative number representation. The EPU will give perfect-precision results and 15× speed gains *per operation per ALU*. SciSci aims to end the tradeoff between precision and speed for more scalable AI.